BMC Nursing

RESEARCH

Open Access

The mediating effects of perceived usefulness and perceived ease of use on nurses' intentions to adopt advanced technology

Abid Hussain[1], Ma Zhiqiang[1*], Mingxing Li[1], Arif Jameel[2], Shahida Kanwel[1*], Saif Ahmad[3] and Bailin Ge[1]

Abstract

This study explored the role of technology systems in influencing nurses' intentions to adopt medical applications that enhance their performance and how technology contributes to improvements in hospital systems. The study examines the intention to use technology through the mediating effects of perceived usefulness and perceived ease of use, with technology sophistication. A random sampling method was employed to gather 687 responses from nurses. The statistical analysis was conducted using AMOS version 25.0 and SPSS. The findings indicate a significant association between technology sophistication (TS), perceived usefulness (PU), perceived ease of use (PEU), and intention to use (IU). Additionally, PU and PEU positively mediate the relationship between TS and IU. This research will benefit policymakers aiming to enhance nurses' performance by adopting modern technology. Authorities should consider introducing advanced technology systems to meet the goals of hospital administration and support nurses effectively.

Keywords Technological sophistication, Perceived usefulness, Perceived ease of use, Intention to use, Nurses, Pakistan

Introduction

Technology offers a significant advantage in enhancing processes and achieving strategic goals across various organizations, including the healthcare sector. This industry has undergone a rapid transformation as traditional manual systems have been replaced by digital healthcare technologies [1], such as personal health records, electronic prescriptions, smart health devices, wearable technologies [2], artificial intelligence-driven patient relationship management, and telemedicine [2, 3]. These advancements substantially benefit hospitals, enabling them to adopt new technologies for improved service delivery, including diagnostics and remote care for patients who may struggle to access appropriate medical treatment [4, 5]. Nurses operate in complex and demanding hospital environments, ensuring patient safety and minimizing the risk of errors, such as mistakes in drug administration that could have serious health consequences. Extended work hours, high-stress levels, and challenging circumstances, compounded by personal issues and colleagues' anxiety, significantly impact the mental well-being of medical staff, which in turn affects their performance [6]. Psychosomatic symptoms such as physical pain, extreme fatigue, anxiety, severe headaches, nausea, skin rashes, insomnia, and stomach ulcers

*Correspondence:
Ma Zhiqiang
mzq_jsu@126.com
Shahida Kanwel
shahidakanwel@yahoo.com
[1] School of Management, Jiangsu University, Zhenjiang 212013, P.R. China
[2] School of Business, Shandong Xiehe University, Jinan 250109, P.R. China
[3] Department of Public Administration, The Islamia University, Bahawalpur, Punjab 63100, Pakistan

directly diminish staff performance due to overwhelming workloads and a challenging work environment [7].

Modern technology has become essential for enhancing the performance of paramedical staff in the healthcare sector [8]. The healthcare system is widely regarded as a complex phenomenon on a global scale. The high cost of healthcare significantly impacts nearly all major economies worldwide, as national and regional governments actively participate in developing health policies. Many countries have undergone considerable transformations, both governmental and private [9], where employees have embraced information technology to improve public services, research indicates that the adoption of technology-based applications positively influences performance [10, 11]. The Health Management Information System (HMIS) is an information technology system designed to manage data related to hospital information and awareness. This system enhances patient care, encourages collaboration among service providers, and supports informed decision-making [12]. HMIS can improve online communication between patients and healthcare professionals, including doctors and nurses, reduce medication errors, increase the efficiency of healthcare delivery, and save both time and costs [13].

The Health Information Management System is a mobile app-based service that enables the general public to access various medical services easily. These services include expert evaluations, personalized self-management, tracking of health metrics, disease management, and online health promotion [14]. Rasmi, Alazzam [15] HIMS is linked to numerous positive outcomes and helps individuals embrace technology to manage their health. In the wake of the COVID-19 pandemic, many organizations, particularly in the healthcare sector, adopted this technology to provide services to the public [16]. The healthcare sector has faced significant strain, leading to numerous physical and psychological challenges for its employees. Nurses, in particular, carry the heaviest burden as they primarily work in direct patient care and are more accessible to patients. These factors affect nurses' job performance, learning approaches, and overall quality of life. To address these challenges, several countries are supporting nurses in integrating information systems and adopting new technologies to improve job performance and establish effective nursing health management systems [17, 18]. Unlike other sectors, the success of these systems largely depends on user preferences [16]. The true effectiveness of the hospital information system hinges on the staff's willingness to embrace the technology. Ultimately, the practical impact and success of these systems rely on nurses' intention to use advanced technology [19].

The Theory of Reasoned Action (TRA) was revised by Venkatesh [20] into the Technology Acceptance Model (TAM), which includes the concepts of perceived usefulness (PU) and perceived ease of use (PEU). Wadie [21] conducted a study to examine technology acceptance based on these two predictors, along with the intention to use. Venkatesh and Davis [22], later developed TAM2, an updated version of TAM1. The extended purpose of TAM2 was to investigate additional variables and explore how these factors influenced users' attitudes toward technology. Building on this, Venkatesh and Bala [23] and Venkatesh [20], along with Venkatesh, integrated TAM2 and proposed TAM3, which added new elements such as perceived enjoyment, objective usability, computer anxiety, computer playfulness, computer self-efficacy, and perceptions of external control.

The primary goal of the original Technology Acceptance Model was to investigate how individuals' psychological processes and beliefs influence their attitudes, intentions, and behaviors regarding technology. A study utilized the TAM with additional components like product factors, product innovation, subjective norms, and behavioral intention to evaluate the willingness of HIV/AIDS patients in Henan province to engage with mobile information follow-up [24]. His study aimed to identify significant variables influencing patients' willingness to accept follow-up care, investigate the underlying mechanisms of mobile services, and establish a theoretical foundation for the future development of mobile follow-up.

Kim and Park [25] enhanced the explanatory power of the Technology Acceptance Model and its relevance to health consumer intentions by incorporating additional antecedents and mediating variables. study DJ, P [26] a study utilizing TAM alongside external variables related to product characteristics was conducted to explore how perceived usefulness (PU) and perceived ease of use (PEU) of oral dialogue systems affect clinical practitioners' willingness to use these systems for recording clinical observation outcomes during endoscopy. Similarly, Wu, Wang [27] extended the Technology Acceptance Model to assess the performance of medical professionals, specifically doctors, by incorporating factors such as compatibility, self-efficacy in mobile healthcare settings, technical support, and training to gauge the intention to use mobile healthcare systems. In contrast, Fennelly, Cunningham [28] found that nurses view Electronic Health Record (EHR) systems as beneficial for improving patient care, enhancing documentation efficiency, and facilitating communication among healthcare providers. Additionally, according to Strudwick [29] noted that the TAM model effectively boosts employee performance while promoting technology acceptance. However, unlike

other medical professions, the TAM is not applied to evaluate nurses' work performance.

Holden and Karsh [30] systematically reviewed studies on the Technology Acceptance Model in healthcare and found that it consistently predicts healthcare professionals' acceptance of technology. Factors such as colleagues, supervisors, and organizational standards significantly impact nurses' willingness to adopt advanced technology. Specifically, nurses are more likely to accept technology when they receive support from their peers or superiors [31]. Kim, Lee [32] demonstrated that adequate resources, training, and technical support are essential for nurses to utilize technological advancements effectively. Furthermore, Ho, Chang [33] emphasized the importance of organizational support and sufficient training in fostering nurses' acceptance of new technologies. Previous literature indicates that the intention to use technology has been measured among healthcare professionals, administrative staff, and physicians.

While some studies examine perceived ease of use (PEU) and perceived usefulness (PU) concerning the intention to use technology, very few focus on a conceptual framework considering the complexities of technology use. Additionally, there is a lack of research addressing the mediating roles of PEU and PU within a single framework specifically for Pakistani nurses. This represents a gap in the existing literature. Based on their literature review, the researchers identified a need to investigate the impact of technology sophistication (TS) on the intention to use technology, integrating scholarly work on PEU and PU to better understand the adoption of technology among nurses. Therefore, it is essential to identify the factors that interact with technology with PEU and PU as they pertain to nurses' performance. Previous research has established a significant relationship between PEU and PU in technology use [34]. Still, no study uses both constructs as mediators within a framework incorporating technology sophistication.

This study answers the following questions:

1. In what ways does technology sophistication enhance nurses' ease of use with technology?
2. How does technology sophistication affect perceived ease of use (PEU) and perceived usefulness (PU)?
3. How do perceived ease of use (PEU) and perceived usefulness (PU) influence the intention to use technology?

Technology acceptance model studies

The Technology Acceptance Model (TAM) was initially developed to evaluate how users adopt new technologies, including computer systems, internet platforms, and software programs. The model has since been applied across various sectors, such as information technology, education, retail and e-commerce, banking and finance, transportation, telecommunications, tourism and hospitality, and healthcare [35–42]. In healthcare, TAM assesses the acceptance of technologies like wearable health devices, telemedicine, and health information systems [43]. The underlying goal of digital health is to improve the accessibility and quality of healthcare through various technological resources, including platforms, artificial intelligence, medical software, and smartphone applications. As a result, digital health has attracted the attention of numerous academic institutions, health organizations, and practitioners, aiming to broaden public access to high-quality medical care [43, 44]. Furthermore, during the COVID-19 pandemic, these technologies have been crucial in supporting paramedical staff. With technology's assistance, staff can treat patients remotely and streamline the overall medical process for patients and healthcare providers [43, 45].

Deng, Hong [46] adapted the Technology Acceptance Model (TAM) to investigate the intention to use mobile health services based on data from China. They concluded that trust, perceived usefulness, and perceived ease of use positively correlate with adopting mHealth services. They also discovered that privacy and performance risks negatively affected patients' trust and intention to adopt these services.

Similarly, Zhou, Zhao [47] applied an extended version of the TAM to assess the intention to use telemedicine systems among elderly patients in China. Their research indicated that medical service satisfaction, ease of use, and information quality significantly influenced the acceptance of telehealth among older adults. This acceptance, in turn, considerably impacted their behavioral intentions regarding telehealth. Likewise, Ahmad, Rasul [48] explored the intention of diabetic patients in Bangladesh to use digital health services. He found that all six constructs, perceived usefulness, perceived ease of use, perceived irreplaceability, perceived credibility, compatibility, and social influence, positively impacted the continued intention of elderly diabetic patients to use digital health wearables.

Tao, Chen [49] conducted studies on consumers' usage of a "personal health records system" (PHRS) and discovered that relatedness and competence were significant motivational factors influencing perceived ease of use among Chinese adults with at least six months of m-health experience. They found that task–technology fit and perceived ease of use significantly affected perceived usefulness. Ma and Luo [50] explored the extended Technology Acceptance Model (TAM) concerning the intention to use medical apps among

elderly Chinese users. Their research revealed that attitudes towards using apps significantly influence older adults' intentions to use them. They identified only two factors, perceived usefulness and facilitating conditions from the UTAUT model, that significantly predicted the intention of older adults to use apps, while other factors did not. Nonetheless, perceived usefulness, ease of use, subjective norms, and facilitating conditions significantly impacted attitudes toward using apps.

Mouloudj, Bouarar [51] integrated the Technology Acceptance Model (TAM) with the Theory of Planned Behavior (TPB) and Self-Determination Theory (SDT) to investigate the intention to use a telehealth system in Algeria. Their findings indicated that perceived usefulness, attitudes, self-efficacy, and ease of use significantly and positively predicted customers' intentions to use digital health apps. Additionally, a study conducted in Nigeria assessed healthcare workers' acceptance of digital health technologies and found that perceived usefulness, physical condition, technological anxiety, user innovativeness, and perceived availability significantly influenced their behavioral intentions [52].

Another study [53] utilized primary data from Canada to examine health providers' and administrators' perceptions of the usefulness and ease of using technology in palliative care. As an information-sharing platform, the authors argued that telehealth could enhance the coordination and collaboration among interdisciplinary providers caring for patients with palliative needs. Kowitlawakul [54] found that perceived usefulness was the most significant factor influencing nurses' intentions to use Telemedicine Technology (eICU). The key factors affecting perceived usefulness included perceived ease of use, physician support, and years of experience in the hospital.

Hung, Tsai [55] argued that the primary health information system in primary health care significantly influences service delivery. They found that compatibility positively affects the perceived usefulness and trust in the primary health information system. Alhur [56] Also, this study examined nurses' perceptions of using electronic medical records in clinical practice and identified factors that influence their acceptance of electronic medical record documentation. This study aimed to enhance understanding of nurses' perspectives on electronic medical records to promote their adoption and implementation in other health facilities across Saudi Arabia. Alhur found that perceived usefulness and usability are closely linked, contributing to nurses' acceptance of electronic medical records. A summary of previous Technology Acceptance Model studies in the healthcare sector from 2010 to 2024 can be found in Appendix 2.

Theoretical background and hypotheses development

Technology sophistication

Information technology is a method that organizations use to enhance information-processing abilities [57]. Huber [58] described, "use of advanced IT leads to more available and more quickly retrieved information, including external information, internal information, and previously encountered information, and thus leads to increased information accessibility." In 1986, Daft and Lengel emphasized technology sophistication as a key element in reducing uncertainty in organizations. Similarly, a study El Louadi, Galletta [59] confirmed that institutional technology sophistication directly impacts internally and externally. Also, Ismail and King [60] found a positive association between advanced information systems with ease of use and technology sophistication.

In their study, al-Eqab and Ismail [26] defined a significant connection between advanced technology system design (usefulness, friendly users, ease of understanding) and contingency factors. Bandura [61] discussed that self-learning technology is also linked to ease of use. The ease of use of technology directly impacts job performance learning during the task compilation; therefore, several scholars consider technology usefulness and ease of use to be essential factors for technology acceptance [62–64]. Consequently, the existing literature shows the interaction between technology sophistication and intention to use perceived usefulness and ease of use to make it successful. Therefore, we hypothesized that TS relates to the IU, PU, and PEU. The study revealed that technology sophistication helps to better performance and satisfaction in accepting and executing hospital technology systems. Thus, TS is significantly associated with IU, PU, and PEU, as we hypothesized.

H1: TS positively relates to IU.
H2: TS positively relates to PU
H3: TS positively relates to PEU

The original technology acceptance model

In 1980, Davis proposed the "Technology Acceptance Model (TAM)" to predict and explain users' intentions regarding technology Davis [65]. Building on Fishbein and Ajzen's "Theory of Reasoned Action (TRA)," [66]. Davis [67] designed TAM to identify the determinants of computer acceptance. The model aims to explain user behavior across various end-user computing technologies and populations while remaining parsimonious and theoretically sound. TAM has been extensively evaluated across various contexts and respondent groups,

establishing it as a robust and reliable framework for understanding new technology acceptance [68–71]. The model posits that perceived usefulness and perceived ease of use (PEU) are vital variables influencing individuals' acceptance of technology systems and their behaviors in actual usage scenarios [67, 72]. Since its introduction, TAM has evolved into a dependable model for forecasting user acceptance. Its initial limitations have been addressed, leading to the development of several improved theoretical models, all extending from the core constructs of perceived usefulness and ease of use [34, 57].

The "Unified Theory of Acceptance and Use of Technology (UTAUT)" [57], "TAM 2" [22, 57], and "TAM 3" [23] are advanced iterations of the technology acceptance model. Various studies have evaluated TAM in the context of the health sector [64], the model has not been empirically validated to assess nurses' acceptance of IT solutions in healthcare. This research integrates critical factors into a proposed framework to measure nurses' intentions to use technology. Perceived usefulness is defined as "the degree to which an employee believes that using technology would enhance his or her job performance," while perceived ease of use is described as "the degree to which an employee believes that using technology would be free of effort" [67].

Since 2010, the Technology Acceptance Model (TAM) has been extensively utilized in healthcare research to examine the factors influencing healthcare professionals' adoption of technology. Below are some pertinent studies demonstrating TAM's relevance and effectiveness in addressing issues related to healthcare technology adoption. TAM and its variants have been employed to evaluate various healthcare technologies, including Electronic Health Records and Clinical Decision Support Systems [30]. This review confirmed that perceived usefulness and ease of use among healthcare workers significantly influence technology acceptance, suggesting that TAM remains a strong predictor in healthcare contexts where usability and perceived patient impact are critical.

In the study by [73], TAM was applied to assess nurses' acceptance of electronic health records (EHRs). Their findings revealed that perceived usefulness and ease of use significantly correlate with nurses' willingness to adopt EHRs. TAM proved effective in elucidating healthcare professionals' acceptance of new technology, significantly when such technology impacts their daily workflows. Rahimi, Nadri [74] applied the Technology Acceptance Model (TAM) to explore the acceptance of mHealth applications among professionals in Iran. They identified two key determinants of acceptance: perceived ease of use and perceived usefulness. This study emphasized TAM's applicability across different cultural contexts and its significance in promoting mHealth adoption in resource-limited settings. An, You [75] utilized an extended TAM to investigate healthcare professionals' acceptance of telemedicine during the COVID-19 pandemic. Their findings indicated that the urgency of the pandemic required swift technology integration, making perceived ease of use and usefulness crucial for adoption. This research underscores the ongoing relevance of TAM in understanding healthcare professionals' responses to urgent technological implementations.

Alanazi [76] Employing TAM, the researchers examined healthcare providers' adoption of health information technology in Saudi Arabia. Their study confirmed that perceived usefulness, ease of use, and social influence influenced technology acceptance. The researchers further demonstrated that TAM applies and is adaptable to various cultural contexts and healthcare environments, each with unique challenges and pressures. Chen, Zhang [77] investigated physicians' acceptance of artificial intelligence (AI) diagnostic tools through an extended Technology Acceptance Model framework. They found that perceived usefulness, ease of use, and trust in AI influence physicians' willingness to adopt AI-based diagnostic technologies. This study illustrates the applicability of TAM for emerging technologies and intricate healthcare innovations, highlighting its relevance for current and future healthcare challenges.

Singh and Jaiswal [78] applied TAM to evaluate healthcare providers' adoption of wearable health devices in India. They noted that perceived usefulness and ease of use were critical factors for healthcare workers in accepting wearable devices, increasingly recognized as patient monitoring tools. This research indicates that TAM is well-suited to various healthcare contexts and underscores the importance of user-centered design in enhancing technology acceptance. TAM has proven robust and flexible in studying various healthcare technologies, such as EHRs, telemedicine, AI, and wearable devices. It identifies the key factors influencing healthcare professionals' decisions to adopt technology, focusing on perceived usefulness and ease of use. This evidence establishes TAM's relevance and widespread acceptance in addressing healthcare technology adoption challenges from 2010 to 2023.

According to Kamal, Shafiq [79] the study identified several key factors influencing the intention to use telemedicine services, including perceived usefulness, social influence, trust, ease of use, and facilitating conditions. The literature suggests that the effectiveness of nurses' services in enhancing hospital performance relies heavily on their perceptions of the technology system's usefulness and ease of use. The study found that perceived usefulness (PU) and perceived ease of use (PEU) are

critical in fostering intention to use (IU) hospital technology. Therefore, we hypothesized that PU and PEU are positively related to IU:

H4: PU positively relates to IU
H5: PEU positively relates to IU.

The effect of PU and PEU on IU

As previously established by the Technology Acceptance Model (TAM), individuals' intentions to use a system are influenced by two fundamental beliefs: perceived usefulness (PU) and perceived ease of use (PEU). These intentions, in turn, shape attitudes toward using the system, ultimately leading to its adoption. Research by Winata, Permana [80], Asiri [81], and Muslichah [82] demonstrated that both PU and PEU significantly affect behavioral intentions. Additionally, Chen and Tseng [62] found that PU is the primary factor directly influencing intention. At the same time, Mallat, Rossi [83] argued that the impact of PU on intention to use (IU) depends on specific instances of system usage. Nevertheless, PEU and PU remain the main predictors of attitudes toward usage intentions.

Furthermore, Wu and Wang [84] identified that both PU and PEU play essential roles in technology adoption. Rezvani, Heidari [85] highlighted the role of perceived ease of use as a mediator between system quality and user satisfaction. Research by Daud, Farida [86] examined satisfaction with PU as a mediator between computer anxiety, system acceptance, and satisfaction, as shown by Igbaria, Schiffman [87].

The existing literature suggests that PU and PEU mediate the relationship between technology systems and intentions to use, contributing to their overall success. Consequently, we hypothesized that PU and PEU correlate with technology systems and intentions to use. Our study found that PU and PEU significantly enhance nurses' intentions to accept and implement hospital management systems. Therefore, PU and PEU are significantly essential factors in this context.

H6: PU mediates the relationship between TS and IU
H7: PEU mediates the relationship between TS and IU

Conceptual model

Figure 1 presents the study's research model, which defines the independent variable (TS) and dependent variable (PU, PEU, and IU).

Research methods

Context selection

The adapted questionnaires were distributed to nurses using random sampling from public hospitals between February and June 2023. This survey approach, commonly used in the social sciences, was employed to gather empirical data for analyzing the research hypotheses. The study was conducted in public hospitals across five major districts: Multan, Lodhran, Bahawalpur, Bahawalnagar, and Rahimyar Khan in Punjab, Pakistan, during working days from Monday to Saturday. The questionnaire consisted of two sections: one for demographic details and the other for information on technology sophistication, perceived usefulness (PU), perceived ease of use (PEU), and intention to use (IU). We targeted 850 respondents, following the recommendations of as Saunders, Lewis [88], and Krejcie and Morgan [89] recommended.

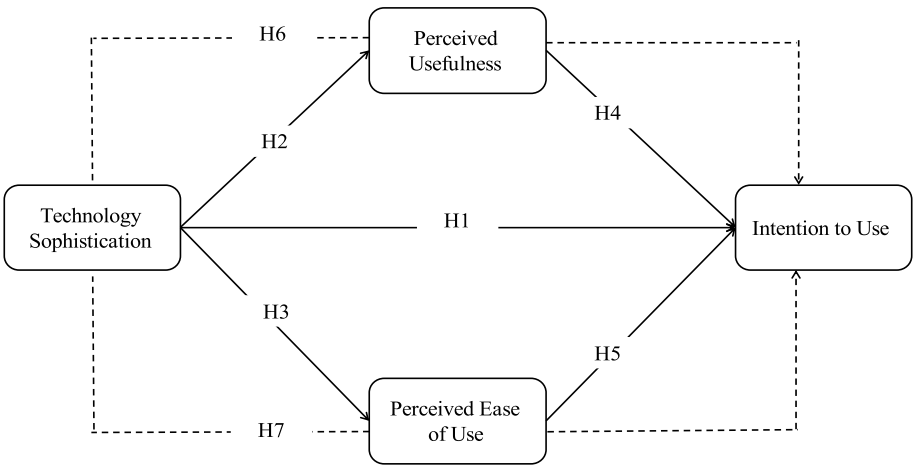

Fig. 1 Conceptual model

Ultimately, we achieved an 81% response rate, receiving 687 completed questionnaires.

Constructs development and research instruments

All items adapted from the previous studies, such as technology sophistication, perceived ease of use, perceived usefulness, and intention to use. Technology sophistication was measured through 6 items adapted from Angst and Agarwal [90] and Boadu, Lamptey [91] with the sample item "Overall, I enjoyed using the technology with sophistication". Perceived usefulness accessed by five items adapted from Davis [67], Davis, Bagozzi [92], Alfuqaha, Rabay'ah [93] with the sample item "The degree to which a nurse believes that the use of technology would enhance his or her job performance." Perceived ease of use was measured through 4 constructs adapted from the studies of Davis [67] and Davis, Bagozzi [92] with the sample item "The degree to which a nurse believes that the use of technology would be free of effort." Intention to use evaluated from 2 items developed by Taylor and Todd [68], Hung, Tsai [55] with the sample item "Given that I have access to the health information, I predict that I would use it." All constructs can be seen in Appendix 1. The respondents' demographic characteristics included gender, education, and age, as seen in Table 1. A 5-point Likert scale was used to measure all questions, with 1 representing strongly disagree, 2nd disagree Agree, 3rd neutral, 4th Agree, and 5th representing strongly agree.

Establishing the reliability of the questionnaire

A pilot study was conducted before the primary research to assess the reliability of the questionnaire. A sample of approximately 75 participants was chosen, representing about 10.91% of the total population. Internal consistency was evaluated using Cronbach's alpha (CA) test in SPSS. A Cronbach's Alpha coefficient of 0.7 is generally considered a good indicator of reliability, as supported by multiple sources [94–97] and [98]. This standard is widely accepted in social science research. The results in Table 1 demonstrate a level of reliability that meets this established criterion. Table 1 lists the constructs and their respective CA coefficients, indicating that respondents understood the items well.

The demographic details of 687 respondents can be seen in Table 2. Furthermore, the demographic description of the respondents includes 687 nurses who were only females. The 319 participants (46.43%) belong to the age of 20–29, 168 participants (24.46%) belong to the age of 30–39, 132 nurses (19.21%) belong to the age of 40–49 and 68 nurses (9.90%) above the age of 50 years. The participants' ages ranged from 20 to 29 (21.64%), 30–39 (19.84%), 40–49 (20.65%), and above 50 (37.87%). The educational level of the participants specified that 72.05% had a graduation education, while 27.95% had a master's education.

Table 1 Establishing the reliability of the study

Variables	CA coefficient
TS	0.852
PU	0.829
PEU	0.867
IU	0.873

Table 2 Demographic details

Description	No.	Percentage
Gender		
Female (Only)	687	100.00
Age		
20–29	319	46.43
30–39	168	24.46
40–49	132	19.21
≥50	68	9.90
Education		
Graduate	495	72.05
Master	192	27.95

Analysis methods

The Social Science Statistical Package (SPSS), analysis of moment structures (AMOS), and structural equation modeling were used to analyze the data for reliability, validity, correlations, and descriptive findings. We performed confirmatory factor analysis (CFA) and structural equation modeling (SEM) tests to examine our hypothesized model. The SEM was employed to validate the study hypotheses, which are widely used for the studies of healthcare [99–102]. The consistency analysis evaluated all items' reliability and authenticity [103]. Additionally, we created a measuring model that considered the relationships between the investigated factors and their items. We employed a three-stage approach to implement Qing's [26] suggested SEM approach. Firstly, the research employed a measurement model to evaluate component scores for all items. Secondly, discriminant validity was determined using CFA, and thirdly, the casual model was accessed through the SEM technique [104]. These measures were taken to ensure the causal model's validity and reliability. The analyses of mediating impact were employed through AMOS 21.0, SPSS.

Results

Descriptive statistics and correlations

The descriptive statistics included correlations, mean, and standard deviation of the variable demographic details exhibited in Table 3. TS shows a significant correlation to PU ($r=0.36$, $p<0.01$), PEU ($r=0.45$, $p<0.01$), and IU ($r=0.47$, $p<0.01$). A significant correlation was found between PU and IU ($r=0.29$, $p<0.01$) and between PEU and IU ($r=0.38$, $p<0.01$). Moreover, the measurement model factor loadings for the current research ranged from 0.713 to 0.898, which revealed a strong association between underlying items of the variable. The validity confirmed all constructs with Cronbach's alpha; all values are shown in Table 4. Furthermore, confirmatory factor analyses were run before testing the hypotheses to verify the most suitable measurement model [105]. The proposed model's result showed excellent model fit, $\chi2=941.25$, $\chi2$ /df$=1.957$, CFI$=0.97$, TLI$=0.96$, and RMSEA$=0.03$, compared to another possible model. Also, all indicators' values were greater than 0.5, and factor loadings were loaded significantly. The proposed model has adequate discriminant validity, as shown in Table 5.

Direct and mediating effect of PU

The study's findings were as per the instructions of Preacher and Hayes [106] and Baron and Kenny [107]. Table 6 describes a significant connection between the TS and IU ($\beta=0.23$, $p<0.001$). According to Baron and Kenny [107], the first mediation condition is covered. Next, TS and PU were positively significant ($\beta=0.44$, $p<0.001$).

Table 3 Descriptive statistics

	AVE	Mean	SD	Correlations						
				1	2	3	4	5	6	7
1. Age	-	3.56	1.85	-						
2. Gender	-	1.93	0.64	0.8	-					
3. Education	-	2.08	1.14	0.19*	0.21**	-				
4. TS	0.68	3.31	0.98	0.15*	0.09	0.23**	-			
5. PU	0.74	2.98	1.07	0.06	0.11	0.09	0.36**	-		
6. PEU	0.69	3.04	1.47	0.10	0.01	0.01	0.45**	0.39**	-	
7. IU	0.60	2.89	1.39	0.04	0.03	0.06	0.47**	0.29**	0.38**	-

AVE Average Variance Extracted, *TS* Technology Sophistication, *PU* Perceived Usefulness, *PEU* Perceived Ease of Use, *IU* Intention to Use

Significance level *$p < 0.05$; **$p < 0.01$

Table 4 Confirmatory factor analysis CFA

Factor	Items	Loadings	S.E.	T	C.R.	A
TS	TS1	0.732	-	-	0.88	0.91
	TS2	0.721	0.049	14.714**		
	TS3	0.850	0.056	15.179**		
	TS4	0.805	0.054	14.907**		
	TS5	0.713	0.050	14.260**		
	TS6	0.898	0.047	19.106**		
PU	PU1	0.745	-	-	0.89	0.90
	PU2	0.771	0.051	15.118**		
	PU3	0.826	0.047	17.574**		
	PU4	0.803	0.063	12.746**		
	PU5	0.840	0.052	16.154**		
PEU	PEU1	0.864	-	-	0.85	0.84
	PEU2	0.731	0.045	16.244**		
	PEU3	0.728	0.048	15.167**		
	PEU4	0.759	0.059	12.864**		
IU	IU1	0.811	-	-	0.86	0.88
	IU2	0.876	0.053	16.528**		

TS Technology Sophistication, *PU* Perceived Usefulness, *PEU* Perceived Ease of Use, *IU* Intention to Use, *CR* Composite Reliability

Significance level: **$p < 0.01$

Table 5 Measurement model

Model	χ^2	Df	χ^2 /df	CFI	TLI	RMSEA	SRMR
4-factor model (hypothesized model)	941.25	481	1.957	0.97	0.96	0.03	0.04
3-factor model (TS & PU combined)	1489.81	483	3.084	0.81	0.81	0.09	0.10
3-factor model (TS & PEU combined)	2061.75	485	4.251	0.70	0.69	0.17	0.21
1-factor model	2435.65	486	5.012	0.62	0.62	0.19	0.24

Table 6 Direct, Indirect and total B coefficients (H1- H7)

Hypotheses	Paths	β	S.E.	t	Confidence Interval (95%)
Direct effects					
H:1	TS → IU	0.23	0.062	3.710	(0.270, 0.326)
H:2	TS → PU	0.44	0.063	6.984	(0.199, 0.293)
H:3	TS → PEU	0.47	0.062	7.581	(0.135, 0.449)
H:4	PU → IU	0.31	0.065	4.769	(0.256, 0.341)
H:5	PEU → IU	0.35	0.063	5.556	(0.390, 0.582)
Indirect effects					
H:6	TS → PU → IU	0.136	0.061	2.230	(0.293, 0.392
H:7	TS → PEU → IU	0.164	0.059	2.779	(0.315, 0.537)
Total effect		0.300	0.076	3.947	(0.138, 0.253)

TS Technology Sophistication, *PU* Perceived Usefulness, *PEU* Perceived Ease of Use, *IU* Intention to Use

Hence, the result of the study supported the second condition of mediation and the (H2). Next, TS and PEU linked significantly (β = 0.47, $p < 0.001$). This relation is also supported by (H3). The PU and IU are positive (β = 0.31, $p < 0.001$). So, this study links support to (H4) and fulfills the mediation conditions. According to the directions of Preacher and Hayes [106], mediation was tested.

As suggested by Baron and Kenny [107], the authors evaluated the significant indirect impacts by bootstrapping the sampling distribution. The results demonstrated that the indirect effect of technology sophistication on intention to use is also found to be substantial (β = 0.136, $p < 0.001$), (S.E = 0.061), and (t = 2.230). The bootstrap results on a 95% level of confidence for all confidence intervals did not contain zero ("Lower levels of confidence interval" (LLCI) = 0.293, "Upper levels of confidence interval" (ULCI) = 0.392). Therefore, these findings are also supported (H6). Table 6 also defines the indirect effects values. PEU and IU also connected significantly (β = 0.35, $p < 0.001$) and also assisted the (H5). The indirect effect of TS on IU also discovers a significant association (β = 0.164, $p < 0.001$), (S.E = 0.059) and (t = 2.779). The bootstrap result on a 95% confidence level for all confidence intervals did not contain zero (LLCI = 0.315, ULCI = 0.537). Therefore, these findings are also supported (H7).

Discussion

The study findings indicate that technology sophistication positively influences perceived usefulness, perceived ease of use, and the intention to use technology among nurses in public sector hospitals. Additionally, the results reveal that perceived ease of use and perceived usefulness significantly mediate the relationship between technology sophistication and intention to use. Research by Abugabah and Sanzogni [108] and Chirchir, Aruasa [109] demonstrates that technology is positively associated with usage intention for improved performance, which aligns with our findings. Goodhue and Thompson [61] regard technology as a crucial factor for enhancing system and workforce performance. With the aid of sophisticated medical technologies and online access to patient data, nurses can now operate on par with medical professionals when addressing patient health concerns [110]. The healthcare sector, which is continually evolving to improve care quality and reduce costs through the adoption of new technologies, stands to benefit significantly from advancements in internet sophistication [111]. Jokonya [112] highlights that technological sophistication is essential for organizational success, while Isaac and Abdullah [63] illustrate a positive correlation between technology and hospital effectiveness. They also point out that institutions can engage effectively with staff and patients through technological sophistication, ultimately enhancing hospital services. Therefore, this study underscores the importance of technology in empowering nurses to navigate the challenges of modern healthcare.

Perceived ease of use positively correlates with nurses' intentions to use technology. A study by Prastiawan, Aisjah [113] on student learning and technology acceptance found that the ease of use of digital systems significantly increases respondents' intentions to adopt technology. Similarly, research indicates a strong positive relationship between perceived ease of use and citizens' intentions to utilize technology for information gathering [114]. Users' willingness to accept technology systems is greatly influenced by how easily they use them [115]. The authors of one study concluded that in China's technology sector, perceived ease of use and usefulness significantly enhance customer satisfaction, trust, and loyalty intentions [116]. According to Dalle, Raisinghani [44] the ease of use of technology directly motivates user acceptance; when

technology is user-friendly, the likelihood of adaptation increases. Several scholars have identified perceived ease of use as a crucial factor in technology adoption among healthcare professionals [117, 118]. The simplicity of medical apps has improved treatment quality, safety, time efficiency, cost reduction, and patient satisfaction. Medical apps are becoming increasingly popular among healthcare workers to support their duties [119, 120]. Stoumpos, Kitsios [121] noted that user-friendly technology enables nurses to collaborate more effectively with other medical staff, share vital patient information, and coordinate treatment. The advancement of technology enhances communication among medical professionals, fostering well-informed and coordinated healthcare teams, ultimately leading to improved patient outcomes.

This research indicates that perceived usefulness positively influences nurses' intentions to use technology. Several scholars [20, 122–124] have highlighted the strong impact of perceived usefulness on the acceptance of technology among healthcare service providers. A study by Han and Sa [125] found that a user-friendly interface in an application enhances user intention to adopt the technology system. Additionally, training in technology use is essential, particularly for senior staff who may be less familiar with these systems, leading to their reluctance to embrace technology. Characteristics of digital systems, such as being understandable, user-friendly, and valuable, gradually motivate users to adopt and accept technology, as noted by Peng, Yin [126].

Van Der Steen, Toscani [127] indicate that paramedical staff recognize the necessity and significance of technology in their practice, Saadatzi, Logsdon [128], highlight that this recognition influences job performance and the healthcare sector. The improvement of the healthcare industry is linked to technological elements such as technology sophistication, perceived usefulness, perceived ease of use, and intention to use. Research has shown that PU and PEU are crucial factors that affect system usage and mediate the relationship between technology sophistication and IU. By digitizing patient data, nurses gain immediate access to health indicators, diagnoses, and treatment plans, which empowers them to provide enhanced care [43]. With this wealth of information at their disposal, nurses can better assess patients' conditions, plan for their needs, and deliver personalized, effective care [129]. Furthermore, AlQudah et al. [65] and Rajak & Shaw [130, 131] demonstrate that technology is essential for service delivery, as many hospitals have already adopted and integrated technology into the healthcare sector. Our study shows that perceived usefulness is a crucial factor in technology acceptance and is directly associated with the intention to use.

To maximize the benefits of hospital information systems, it is essential to provide training and organizational support. This ensures that users fully understand the advantages of the technology and that the information technology systems can be easily adapted to meet their needs. However, nurses may face challenges learning about new technologies and staying current with best practices due to a shortage of continuing education and training opportunities. When nurses lack the necessary technical skills and training, their ability to deliver high-quality care is compromised, leading to feelings of intimidation or burden from technological advancements. Portable devices allow nurses to easily monitor patients, even during busy shifts, recording vital signs such as heart rate, oxygen saturation, and respiration rate [56]. These devices enable quick responses when patients require immediate care, significantly improving response times. Based on this discussion, this research suggests that an advanced health technology system can provide quality information with minimal errors and effectively address ongoing issues.

Clinical significance and implications

This study aims to connect nurses with advanced techniques to enhance their job performance. It also seeks to alleviate the routine stress that negatively affects their work, personal lives, learning ability, and even the safety of their patients. There is an urgent need for a robust system to reduce stress among nurses, improving their skills and performance while supporting their daily lives. The administration could implement a leave program lasting one to two months to increase nurses' life satisfaction and reduce their psychological distress. Pappa, Ntella [132] found that nurses experience higher levels of anxiety and depression compared to doctors, likely due to the unique demands of their profession, including more frequent face-to-face interactions with patients and extended hospital shifts.

Frontline healthcare workers are experiencing unprecedented levels of stress, burnout, and moral injury due to witnessing the pain and loss of patients and coworkers, navigating emotionally challenging interactions with patients and their families, balancing personal and professional responsibilities, and confronting tough ethical dilemmas. The COVID-19 pandemic significantly heightened rates of burnout and psychological issues among health practitioners, underscoring the need for close monitoring and prompt treatment of these conditions [133]. Pakistani nurses encountered similar challenges during and after the pandemic, prompting the government to implement counseling programs to address this issue. Additionally, educating nurses about the consequences of COVID-19 can help them develop adaptive coping strategies at both individual and institutional levels. The findings from this study on frontline nurses highlight the critical role of timely support systems during crises and demonstrate how the Technology Acceptance Model underscores the impact of external support and organizational preparedness on technology adoption

in healthcare. Notably, perceived usefulness and ease of use significantly influence users' decisions to adopt new technologies, as outlined by TAM. By establishing robust psychological support systems and crisis training, healthcare institutions can enhance nurses' perceptions of technology for crisis management and mental health support. When nurses view these tools as integral to their support system, they often find them more valuable during crises, which enables them to embrace technologies that improve productivity, communication, and stress management.

Moreover, TAM suggests that organizational readiness and external conditions affect user acceptance. This insight allows authorities and researchers to integrate digital resources, such as mobile health apps and virtual support platforms, into reformed emergency psychological support systems. These technologies can be designed to help nurses respond more effectively to unexpected crises, improving their efficiency in high-stress environments. Implementing such preparatory measures ensures that nurses perceive new technologies not as additional burdens but as beneficial resources, aligning with TAM principles by enhancing perceptions of usefulness and ease of use. Ultimately, this approach can lead to higher technology adoption rates and better preparedness for future epidemic events.

Contribution

Theoretical contribution

The theoretical contribution of examining the mediating effects of perceived usefulness and perceived ease of use of advanced technology on nurses' intention to adopt such technology is significant both in Pakistan and globally. This paper suggests that the Technology Acceptance Model can be enhanced by applying it within the nursing sector, particularly in healthcare environments characterized by resource limitations and the unique cultural context of Pakistan. As healthcare technology evolves rapidly, understanding the subtle variables influencing nurses' willingness to use this technology is increasingly vital. The findings are particularly relevant for Pakistan, where healthcare delivery often suffers due to overcrowded facilities, constrained budgets, and a shortage of specialized health professionals [134]. They underscore the importance of perceived usefulness and ease of use in promoting technology adoption. Many frontline nurses face barriers such as outdated infrastructure and low digital literacy, which can undermine the perceived value of new technologies [135]. This research illustrates how technology can mediate TAM's general applicability by emphasizing the roles of perceived usefulness and perceived ease of use in making technology appealing to nurses in resource-constrained settings.

This study enriches TAM by demonstrating its adaptability and reconfiguration for resource-sensitive organizations, such as nursing, as technology increasingly integrates into global healthcare practices. The relevance of TAM's perceived usefulness and perceived ease of use has grown even more critical in light of emerging challenges like the COVID-19 pandemic and the rising demand for remote and digital health solutions [136]. For example, there was an urgent need for telehealth and electronic health record systems during the pandemic. However, despite widespread adoption, technology was sometimes perceived as complicated or insufficiently beneficial. This study extends TAM by proposing that these mediators are crucial in promoting nurses' adoption of new healthcare technology. This suggests that the realization or perception of these mediators can be a crucial determinant of successful adoption. Concentrating on these mediators, this research provides theoretical insights on how tailored approaches within the TAM framework can bridge the gap between healthcare technology design and actual use, offering a valid roadmap for enhancing healthcare technology integration in resource-limited and developed contexts worldwide.

Practical contribution

This research provides a detailed practical contribution by highlighting that perceived usefulness and ease of use are crucial factors influencing nurses' adoption of advanced technology in healthcare settings in Pakistan and internationally. Healthcare facilities in Pakistan face challenges such as limited resources, high nurse-to-patient ratios, and inadequate technology training [98]. By recognizing perceived usefulness and ease of use as mediators in technology adoption among nurses, healthcare administrators can develop targeted interventions, including hands-on training, user-friendly interfaces, and demonstrations of technology benefits. These initiatives can enhance nurses' comfort, interest, willingness, and ability to adopt advanced tools. Implementing these strategies could reduce operational inefficiencies, streamline patient care, and improve effectiveness among nurses utilizing existing resources. The findings carry significant implications for technology deployment in the global healthcare sector and offer practical guidance for enhancing the end-user experience. Governments and administrators can boost technology adoption rates across various healthcare contexts by focusing technology efforts on features that align with nurses' needs, such as the technology's utility in clinical tasks and its compatibility with existing workflows. This approach enhances patient care and operational efficiency and facilitates a global transition to patient-centered, technology-driven healthcare systems that empower nurses as primary caregivers.

The study contributes to the field by empirically analyzing the relationships between technological sophistication, perceived usefulness, perceived ease of use, intention to use medical applications, and their effects on nurses' performance and hospital systems. This research expands the existing literature by employing well-established theoretical

frameworks such as the TAM. The significance of the study lies in its potential to provide valuable insights for implementing specific measures and making informed decisions that enhance nurses' efficiency and improve hospital systems through the strategic adoption of new technologies. The conclusions drawn have various practical implications. By highlighting the findings' relevance for healthcare policymakers, the study effectively bridges theoretical understanding and practical execution. It offers a framework for policymakers to successfully leverage advanced technology systems to achieve organizational objectives and enhance nursing performance, thereby contributing to the ongoing discourse on technology-driven healthcare innovation. Decision-makers can prioritize acquiring technologically advanced tools that demonstrate clear benefits regarding perceived usefulness and ease of use, informed by the strong connection between technology sophistication and nurses' intention to utilize medical applications.

Conclusion

The study investigated the mediating roles of Perceived Usefulness (PU) and Perceived Ease of Use (PEU) in the relationship between technology sophistication and the intention to use technology among nurses in Pakistan's healthcare sector. Consistent with previous research, the findings indicate that the intention to use technology improves when users perceive the system as more straightforward and beneficial, enhancing performance and saving time. Historical studies on technology systems' impact on users have shown that characteristics such as sophistication, usefulness, and ease of use are crucial factors influencing the benefits derived from their use. Moreover, increased technology acceptance leads to improved performance levels, more staff, reduced daily user stress, and an enhanced public image. This study adds to the literature on the nursing community's healthcare practices by providing empirical evidence that sheds light on nurses' technology use behaviors in Pakistan and how hospitals' performance can be enhanced by implementing advanced technology systems. Historically, the healthcare sector in Pakistan has received limited attention. Therefore, this study advocates for implementing more user-friendly hospital information systems for nurses, alleviating pain, ulcers, fatigue, migraines, stomach problems, skin eruptions, and insomnia. The Ministry of Information Technology should prioritize the healthcare sector as a critical area for implementing sophisticated technology systems in hospitals. These systems have become vital to the country, particularly in the pre and post-COVID era, as they are associated with improved service delivery, job performance, and patient satisfaction. Consequently, hospitals must be empowered to make decisions that facilitate the adoption of new systems for both their staff and the public.

Limitations and future research avenues

This study has several limitations. It focused on public hospitals in five districts of Southern Punjab, Pakistan: Multan, Bahawalpur, Lodhran, Bahawalnagar, and Rahim Yar Khan. Data were collected from nurses. Countries encounter various healthcare service challenges, including infrastructure and technological advancement issues. The current model could be enhanced by incorporating additional variables and applied to other sectors. Increasing the respondents would lead to a deeper and more comprehensive understanding. Furthermore, this research is limited to a single developing nation. Future studies should consider other developing low- and middle-income countries. The data were obtained using a cross-sectional study design, but a longitudinal design could yield valuable insights and clarify causal relationships. Although there has been a noticeable shift in the mood of nurses since the COVID-19 outbreak, further research is needed to evaluate their levels of depression, stress, and anxiety following the pandemic, as these findings may align with our study. Additionally, compliance with preventative public health policies is known to influence disease transmission, and this compliance is often connected to public perceptions of vulnerability to disease.

Appendix 1

Technology Sophistication [90, 91]
I have received formal training in healthcare information technology
I have a generally favorable attitude towards using electronic system
I believe it is a good idea to use technology for healthcare delivery
Using the technology system provided me with a lot of enjoyment
I expect my use of sophisticated technology to continue in the future
Overall, I enjoyed using the technology with sophistication
Perceived Usefulness [67, 92, 93]
The degree to which a nurse believes that the use of technology would enhance his or her job performance
Using technology at work would enhance my effectiveness at work
I would find technology useful in healthcare practice
Using technology gives me greater control over my work
My job would be difficult to perform without technology
Perceived Ease of Use [67, 92]
The degree to which a nurse believes that the use of technology would be free of effort
My interaction with the electronic system is clear and understandable
Interacting with the electronic system requires a lot of mental efforts
Overall, I find the electronic system easy to use
Intention to Use [55, 68]
I will always try to use Health information technologies
Given that I have access to the health information, I predict that I would use it

Appendix 2

Sr	Source	Year	Studied Technology	Sample Type	Acceptance Model	Country
1	Bennani and Oumlil [137]	2010	ICT Appropriation	Physicians and Nurses	TAM	Morocco
2	Lai and Li [138]	2010	Computer Assistance Orthopedic Surgery System	Healthcare Professionals	Integrated Model: TAM and TPB	Taiwan
3	Orruño et al. [139]	2011	Tele-Dermatology System	Physicians	Modified TAM	Spain
4	Schnall and Bakken [140]	2011	Continuity of Care Record (CCR) with Context-Specific Links	HIV Case Managers	Extended TAM	USA
5	Ketikidis et al. [141]	2012	Health Information Technology (HIT)	Healthcare Professionals: Doctors and Nurses	Modified TAM2	North Macedonia
6	Chang and Hsu [142]	2012	Online Patient-Safety Reporting System	Healthcare Professionals	Modified UTAUT	Taiwan
7	Chua et al. [143]	2012	Home-based Pill Dispensers	Patients	TAM	Singapore
8	Vanneste, Vermeulen, and Declercq [144]	2013	BelRAI Web Application: Web-Based System Enabling Person-Centered Recording and Data Sharing	Healthcare Professionals	Extended UTAUT	Belgium
9	Gajanayake, Sahama, and Iannella [145]	2013	Electronic Health Record (EHR)	Medical, Nursing, and Health Students	TAM	Australia
10	Lin [146]	2014	Knowledge Management Systems	Physicians	Technology Acceptance View of Knowledge Management Systems in Healthcare Organizations (TAV-KMSHO)	USA and Taiwan
11	Fleming et al. [147]	2014	Prescription Monitoring: Prescription Access	Emergency Physicians	TAM	USA
12	Steininger et al. [148]	2014	Electronic Health Record (EHR)	Physicians	Modified TAM	Austria
13	Ebie and Njoku [149]	2015	Performance Appraisal System	Line Managers	Extended TAM	United Kingdom
14	Steininger and Stiglbauer [150]	2015	Electronic Health Records (EHR	Physicians	TAM	Austria
15	Sezgin and Özkan-Yıldırım [151]	2016	Health Information Technology: Pharmaceutical Service Systems	Pharmacists/ Pharmaceutical Assistants	TAM	Turkey
16	Made Dhanar et al. [152]	2016	Hospital Information Systems	Hospital Staff and Doctors	TAM	Indonesia
17	Ifinedo Princely, Odette Griscti, and Judy Bailey [153]	2016	Healthcare Information Systems (HIS)	Registered Nurses	TAM	Canada
18	Ducey and Coovert [154]	2016	Tablet Computer Use	Physicians	Extended TAM	USA
19	Jayusman and Setyohadi [155]	2017	E-Learning System	Students at the School of Health Sciences	Extended TAM	Indonesia
20	Horne [156]	2017	Telemedicine	Healthcare Workers	TAM	USA
21	Beldad and Hegner [157]	2018	Fitness Apps	Users of Fitness Apps	TAM	Germany
22	Tubaishat [158]	2018	Electronic Health Records (EHR)	Nurses	TAM	Jordan
23	Özdemir-Güngör and Camgöz-Akda ˘g [159]	2018	Electronic Health Records (EHR)	Healthcare Professionals and Administrative Staff	TAM	Turkey
24	Boon-itt	2019	Health Websites	Internet Consumers	Extended TAM	Thailand
25	Francis [160]	2019	Self-Monitoring Devices	Healthcare Providers	Extended TAM	USA

Sr	Source	Year	Studied Technology	Sample Type	Acceptance Model	Country
26	Tao et al. [161]	2020	Health Information Portal	Adults	TAM	China
27	Ebnehoseini, et al [162]	2020	HER Adoptation	Registered Users	TAM3	Iran
28	Kataria, et al [163]	2021	Adoption of e-Health	Patients	TAM	India
29	Alexandra et al [164]	2021	Hospital Teleconsultation Applications	Patients	TAM	Indonesia
30	Walczak et al [165]	2022	Telemedicine Technology Acceptance	General Practitioners	TAM	Poland
31	Edo, et al [52]	2023	Technology Acceptance	Healthcare Professionals	TAM	Nigeria
32	Bouarar, et al [166]	2023	Intention to Engage in Digital Health	Physicians	TAM	Algeria
33	Chen, et al [167]	2024	Integration of Sports and Medicine	Medical Professionals	Extended TAM	China

Acknowledgements
We would like to thank all nurses who participated in this study.

Authors' contributions
Conceptualization: Abid Hussain, Zhiqiang Ma; Methodology: Shahida Kanwel, Arif Jameel, Mingxing Li; Formal analysis and investigation: Saif Ahmed, Bailin Ge, Abid Hussain; Writing—original draft: Abid Hussain, Saif Ahmed; Writing—review and editing: Shahida Kanwel, Bailin Ge and Mingxing Li; Supervision: Zhiqiang Ma, Revised and Review: Abid Hussain, Arif Jameel and Shahida Kanwel. All authors read and approved the final manuscript.

Funding
This study acknowledges the support of Jiangsu Province Outstanding Postdoctoral Program (2022ZB644, 2024ZB890) and the National Foreign Expert Project (Foreign Youth Talent Program) (QN2023014006).

Data availability
The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Islamia University, Bahawalpur, Pakistan (No: 871 HREC/2023), following the principles outlined in the Helsinki Declaration. Participants were informed about the study's objectives and were free to withdraw at any time. All collected data were anonymized and handled with strict confidentiality, adhering to ethical guidelines. Informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 29 May 2024 Accepted: 19 December 2024
Published online: 09 January 2025

References

1. Alolayyan MN, et al. Health information technology and hospital performance the role of health information quality in teaching hospitals. Heliyon. 2020;6(10):e05040.
2. Kumar P. Market-focused flexibility and innovative performance in public healthcare: evidence from India. J Public Affairs. 2022;22:e2809.
3. Young Z, Steele R. Empirical evaluation of performance degradation of machine learning-based predictive models–A case study in healthcare information systems. Int J Inform Manage Data Insights. 2022;2(1):100070.
4. Ahsan MM, Siddique Z. Industry 4.0 in Healthcare: a systematic review. Int J Inform Manage Data Insights. 2022;2(1):100079.
5. Akwaowo CD, et al. Adoption of electronic medical records in developing countries—A multi-state study of the Nigerian healthcare system. Front Digit Health. 2022;4:1017231.
6. Ko Y, Lee E, Lee Y. Effects of perceived nursing delivery type, errors in handover, and missed nursing care on the nursing performance of hospital nurses. 2024. https://doi.org/10.21203/rs.3.rs-3875244/v1
7. Liu J, et al. Prevalence and influencing factors of severe depression in nurses during and after the COVID-19 pandemic: a large-scale multicenter study. Depression and Anxiety. 2024(1):p. 5727506. https://doi.org/10.1155/da/5727506
8. Chang C-Y, et al. Facilitating nursing and health education by incorporating ChatGPT into learning designs. Educational Technol Soc. 2024;27(1):215–30.
9. Chunara R, et al. Telemedicine and healthcare disparities: a cohort study in a large healthcare system in New York City during COVID-19. J Am Med Inform Assoc. 2021;28(1):33–41.
10. Chan YE, Sabherwal R, Thatcher JB. Antecedents and outcomes of strategic IS alignment: an empirical investigation. IEEE Trans Eng Manage. 2006;53(1):27–47.
11. Raymond L, Pare G, Bergeron F. Matching information technology and organizational structure: an empirical study with implications for performance. Eur J Inform Syst. 1995;4:3–16.
12. Chen P-T, Lin C-L, Wu W-N. Big data management in healthcare: adoption challenges and implications. Int J Inf Manag. 2020;53:102078.
13. Singh RP, et al. Significance of Health Information Technology (HIT) in context to COVID-19 pandemic: potential roles and challenges. J Industrial Integr Manage. 2020;5(04):427–40.
14. Issadeen SR, et al. Nursing officers attitudes toward the implementation of hospital health information management system in hospitals in Kalmunai RDHS. 2024;24(2). https://doi.org/10.4038/sljma.v24i2.5422.
15. Rasmi M, et al. Healthcare professionals' acceptance Electronic Health Records system: critical literature review (Jordan case study). International Journal of Healthcare Management; 2018.
16. Ågerfalk PJ, Conboy K, Myers MD. Information systems in the age of pandemics: COVID-19 and beyond. Taylor & Francis; 2020. pp. 203–7.
17. Yang Z, Huang H, Li G. Status and influencing factors of work stress among nurse managers in western China: a cross-sectional survey study. BMC Nurs. 2024;23(1):68.
18. Molina-Gil MJ, Guerra-Martín MD, Diego-Cordero RD. Primary Health Care Case-Management nurses during the COVID-19 pandemic: a qualitative study. Nurs Rep. 2024;14(2):1119–28.
19. Wager KA, Lee FW, Glaser JP. Health care information systems: a practical approach for health care management. Wiley; 2021.

20. Venkatesh V. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. Inform Syst Res. 2000;11(4):342–65.
21. Wadie N. An exploration of facebook.com adoption in Tunisia using technology acceptance model (TAM) and theory of reasoned action (TRA). Institute of Interdisciplinary Business Research; 2012;4(5).
22. Venkatesh V, Davis FD. A theoretical extension of the technology acceptance model: four longitudinal field studies. Manage Sci. 2000;46(2):186–204.
23. Venkatesh V, Bala H. Technology acceptance model 3 and a research agenda on interventions. Decis Sci. 2008;39(2):273–315.
24. Li C, et al. Analysis of intention and influencing factors on mobile information follow-up service in HIV/AIDS in a city in China. Front Public Health. 2022;10:997681.
25. Kim J, Park H-A. Development of a health information technology acceptance model using consumers' health behavior intention. J Med Internet Res. 2012;14(5):e2143.
26. DJ B, et al. Evaluating a spoken dialogue system for recording clinical observations during an endoscopic examination. Med Inf Internet Med. 2003;28(2):85–97.
27. Wu J-H, Wang S-C, Lin L-M. Mobile computing acceptance factors in the healthcare industry: a structural equation model. Int J Med Informatics. 2007;76(1):66–77.
28. Fennelly O, et al. Successfully implementing a national electronic health record: a rapid umbrella review. Int J Med Informatics. 2020;144:104281.
29. Strudwick G. Predicting nurses' use of healthcare technology using the technology acceptance model: an integrative review. CIN: Computers Inf Nurs. 2015;33(5):189–98.
30. Holden RJ, Karsh B-T. The technology acceptance model: its past and its future in health care. J Biomed Inform. 2010;43(1):159–72.
31. Cimperman M, Brenčič MM, Trkman P. Analyzing older users' home telehealth services acceptance behavior—applying an extended UTAUT model. Int J Med Informatics. 2016;90:22–31.
32. Kim S, et al. Analysis of the factors influencing healthcare professionals' adoption of mobile electronic medical record (EMR) using the unified theory of acceptance and use of technology (UTAUT) in a tertiary hospital. BMC Med Inf Decis Mak. 2015;16(1):1–12.
33. Ho K-F, et al. Determining factors affecting nurses' acceptance of a care plan system using a modified technology acceptance model 3: structural equation model with cross-sectional data. JMIR Med Inf. 2020;8(5):e15686.
34. Islami MM, Asdar M, Baumassepe AN. Analysis of Perceived Usefulness and Perceived Ease of Use to the actual system usage through attitude using Online Guidance Application. Hasanuddin J Bus Strategy. 2021;3(1):52–64.
35. Alsamydai MJ. Adaptation of the technology acceptance model (TAM) to the use of mobile banking services. Int Rev Manage Bus Res. 2014;3(4):2039.
36. BOUAOULOU M, LAKSSOUMI F. Factors affecting intention, adoption and use of mobile banking services in Morocco based on TAM Model. Volume 5. Revue Française d'Economie et de Gestion; 2024. 2.
37. Indrayanto A, et al. Evaluation of E-Commerce Organic Coconut Sugar: Technology Acceptance Model (TAM) and end-user Computing satisfaction (EUCS) model. Volume 25. Quality-Access to Success; 2024. 199.
38. Almulla M. Technology Acceptance Model (TAM) and e-learning system use for education sustainability. Acad Strategic Manage J. 2021;20(4):1–13.
39. Gholami R, et al. Information technology/systems adoption in the public sector: evidence from the Illinois Department of Transportation. J Global Inform Manage (JGIM). 2021;29(4):172–94.
40. AL-Nawafleh EA, et al. Review of the impact of service quality and subjective norms in TAM among telecommunication customers in Jordan. Int J Ethics Syst. 2019;35(1):148–58.
41. Alkhatib G, Bayouq ST. A TAM-Based Model of Technological factors affecting use of E-Tourism. Int J Tourism Hospitality Manage Digit Age (IJTHMDA). 2021;5(2):50–67.
42. Senthilrajah T, Ahangama S. An analysis of the use of health information systems in public healthcare in Sri Lanka using the technology acceptance model. in 2024 4th International Conference on Advanced Research in Computing (ICARC). 2024. IEEE. https://doi.org/10.1109/ICARC61713.2024.10499764.
43. Alsyouf A, et al. The use of a Technology Acceptance Model (TAM) to predict patients' usage of a personal health record system: the role of security, privacy, and usability. Int J Environ Res Public Health. 2023;20(2):1347.
44. Dalle J, et al. A technology acceptance case of Indonesian senior school teachers: Effect of facilitating learning environment and learning through experimentation. Int J Online Pedagogy Course Des (IJOPCD). 2021;11(4):45–60.
45. Conway R, et al. SARS–CoV-2 infection and COVID-19 outcomes in rheumatic diseases: a systematic literature review and meta-analysis. Volume 74. Arthritis & Rheumatology; 2022. pp. 766–75. 5.
46. Deng Z, et al. What predicts patients' adoption intention toward mHealth services in China: empirical study. JMIR mHealth uHealth. 2018;6(8):e9316.
47. Zhou M, et al. Factors influencing behavior intentions to telehealth by Chinese elderly: an extended TAM model. Int J Med Informatics. 2019;126:118–27.
48. Ahmad A, et al. Understanding factors influencing elderly diabetic patients' continuance intention to use digital health wearables: extending the technology acceptance model (TAM). J Open Innovation: Technol Market Complex. 2020;6(3):81.
49. Tao D, et al. Modeling consumer acceptance and usage behaviors of m-Health: an integrated model of self-determination theory, task–technology fit, and the technology acceptance model. In Healthcare. MDPI; 2023.
50. Ma Y, Luo M. Older people's intention to use medical apps during the COVID-19 pandemic in China: an application of the Unified Theory of Acceptance and Use of Technology (UTAUT) model and the Technology of Acceptance Model (TAM). Ageing & Society; 2022. pp. 1–18.
51. Mouloudj K, et al. Factors influencing the adoption of digital health apps: An Extended Technology Acceptance Model (TAM), in Integrating Digital Health Strategies for Effective Administration. IGI global. 2023;116–32. https://doi.org/10.4018/978-1-6684-8337-4.ch007.
52. Edo OC, et al. Why do healthcare workers adopt digital health technologies-A cross-sectional study integrating the TAM and UTAUT model in a developing economy. Int J Inform Manage Data Insights. 2023;3(2):100186.
53. Nguyen M, et al. Using the technology acceptance model to explore health provider and administrator perceptions of the usefulness and ease of using technology in palliative care. BMC Palliat care. 2020;19:1–9.
54. Kowitlawakul Y. The technology acceptance model: predicting nurses' intention to use telemedicine technology (eICU). CIN: Computers Inf Nurs. 2011;29(7):411–8.
55. Hung S-Y, Tsai JC-A, Chuang C-C. Investigating primary health care nurses' intention to use information technology: an empirical study in Taiwan. Decis Support Syst. 2014;57:331–42.
56. Alhur A. An investigation of nurses' perceptions of the usefulness and Easiness of Using Electronic Medical Records in Saudi Arabia: A Technology Acceptance Model: Technology Acceptance Model. Indonesian J Inform Syst. 2023;5(2):30–42.
57. Venkatesh V, et al. User acceptance of information technology: toward a unified view. MIS Q. 2003;27(3):425–78.
58. Huber JH. Software reviews: JMP. Social Sci Comput Rev. 1990;8(3):468–9.
59. El Louadi M, Galletta DF, Sampler JL. An empirical validation of a contingency model for information require-ments determination. ACM SIGMIS database: the DATABASE for advances in Information systems. 1998;29(3):31–51.
60. Ismail NA, King M. Factors influencing the alignment of accounting information systems in small and medium sized Malaysian manufacturing firms. J Inform Syst Small Bus. 2007;1(1–2):1–20.
61. Bandura A. Social cognitive theory: an agentic perspective. Ann Rev Psychol. 2001;52(1):1–26.
62. Chen H-R, Tseng H-F. Factors that influence acceptance of web-based e-learning systems for the in-service education of junior high school teachers in Taiwan. Eval Program Plan. 2012;35(3):398–406.
63. Hernández B, Jiménez J, Martín MJ. Customer behavior in electronic commerce: the moderating effect of e-purchasing experience. J Bus Res. 2010;63(9–10):964–71.

64. Fussell SG, Truong D. Using virtual reality for dynamic learning: an extended technology acceptance model. Virtual Reality. 2022;26(1):249–67.
65. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 1989;13(3):319–40.
66. Fishbein M, Ajzen I. Misconceptions about the Fishbein model: reflections on a study by Songer-Nocks. J Exp Soc Psychol. 1976;12(6):579–84.
67. Davis FD. User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. Int J Man Mach Stud. 1993;38(3):475–87.
68. Taylor S, Todd P. Decomposition and crossover effects in the theory of planned behavior: a study of consumer adoption intentions. Int J Res Mark. 1995;12(2):137–55.
69. Adams DA, Nelson RR, Todd PA. Perceived usefulness, ease of use, and usage of information technology: a replication. MIS Q. 1992;16(2):227–47.
70. Granić A, Marangunić N. Technology acceptance model in educational context: a systematic literature review. Br J Edu Technol. 2019;50(5):2572–93.
71. Al-Emran M, Granić A. Is it still valid or outdated? A bibliometric analysis of the technology acceptance model and its applications from 2010 to 2020, in recent advances in technology acceptance models and theories. Springer; 2021. pp. 1–12.
72. Gumbo LC, Halimani D, Diza M. Perceived usefulness (PU) and perceived ease of use (PEOU) as key drivers of mobile banking adoption: a case of Zimbabwe. JCGIRM. 2017;4(5).
73. Escobar-Rodríguez T, Romero-Alonso M. The acceptance of information technology innovations in hospitals: differences between early and late adopters. Behav Inform Technol. 2014;33(11):1231–43.
74. Rahimi B, et al. A systematic review of the technology acceptance model in health informatics. Appl Clin Inf. 2018;9(03):604–34.
75. An MH, et al. Using an extended technology acceptance model to understand the factors influencing telehealth utilization after flattening the COVID-19 curve in South Korea: cross-sectional survey study. JMIR Med Inf. 2021;9(1):e25435.
76. Alanazi B. Evaluating the healthcare professionals' perceptions about the adoption of electronic health records in primary care centres in Riyadh City, Saudi Arabia. University of Tasmania. 2020. https://doi.org/10.25959/23237864.v1
77. Chen M, et al. Acceptance of clinical artificial intelligence among physicians and medical students: a systematic review with cross-sectional survey. Front Med. 2022;9:990604.
78. Singh RK, Jaiswal SK. Adoption challenges for wearable devices by the Indian healthcare providers: a case study on healthcare providers using wearables in India. Linnaeus University. 2023.
79. Kamal SA, Shafiq M, Kakria P. Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM). Technol Soc. 2020;60:p101212.
80. Winata LFA, et al. The effect of electronic coupon value to perceived usefulness and perceived ease-of-use and its implication to behavioral intention to use server-based electronic money. Int J Innovative Sci Res Technol. 2020;5(1):147–58.
81. Asiri MJ. Do teachers attitudes, perception of usefulness, and perceived social influences predict their behavioral intentions to use gamification in EFL classrooms? Evidence from the Middle East. Int J Educ Pract. 2019;7(3):112–22.
82. Muslichah M. The effect of self efficacy and information quality on behavioral intention with perceived usefulness as intervening variable. J Acc Bus Manage (JABM). 2018;25(1):21–34.
83. Mallat N et al. The impact of use situation and mobility on the acceptance of mobile ticketing services. in Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06). 2006;2:pp. 42b-42b.IEEE.
84. Wu J-H, Wang S-C. What drives mobile commerce? An empirical evaluation of the revised technology acceptance model. Inf Manag. 2005;42(5):719–29.
85. Rezvani S et al. The effectiveness of system quality, habit, and effort expectation on library application use intention: the mediating role of perceived usefulness, perceived ease of use, and user satisfaction. Int J Bus Inform Syst. 2022;1(1):1–18.
86. Daud A, et al. Impact of customer trust toward loyalty: the mediating role of perceived usefulness and satisfaction. J Od Bus Retail Manage Res (JBRMR). 2018;13(2):235–42.
87. Igbaria M, Schiffman SJ, Wieckowski TJ. The respective roles of perceived usefulness and perceived fun in the acceptance of microcomputer technology. Behav Inform Technol. 1994;13(6):349–61.
88. Saunders M, Lewis P, Thornhill A. Research methods for business students. Pearson education; 2009.
89. Krejcie RV, Morgan DW. Determining sample size for research activities. Educ Psychol Meas. 1970;30(3):607–10.
90. Angst CM, Agarwal R. Getting personal about electronic health records: modeling the beliefs of personal health record users and non-users. Robert H. Smith School Research Paper No. RHS-06-007; 2006.
91. Boadu RO, et al. Healthcare providers' intention to use technology to attend to clients in Cape Coast Teaching Hospital, Ghana. BioMed Research International. 2021;1:5547544.
92. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: a comparison of two theoretical models. Manage Sci. 1989;35(8):982–1003.
93. Alfuqaha O, Rabay'ah M, Alsalaht M. Technology acceptance model among nurses and other healthcare providers during the 2019 Coronavirus pandemic: a comparative cross-sectional study. Cent Eur J Nurs Midwifery. 2022;13(4):775–82.
94. Rafique H, et al. Investigating the acceptance of mobile library applications with an extended technology acceptance model (TAM). Comput Educ. 2020;145:103732.
95. Hussain A, et al. Exploring Sustainable Healthcare: innovations in Health Economics, Social Policy, and management. Heliyon; 2024.
96. Khan AU et al. Beyond bookshelves, how 5/6G technology will reshape libraries: two-stage SEM and SF-AHP analysis. Technology in Society. 2024;p.102629. https://doi.org/10.1016/j.techsoc.2024.102629
97. Khan AU, et al. Based on the S–O–R theory adoption intention of blockchain technology in libraries: a two-stage analysis SEM–PLS and ANN. Library Hi Tech; 2024.
98. Kanwel S, et al. The influence of hospital services on patient satisfaction in OPDs: evidence from the transition to a digital system in South Punjab, Pakistan. Volume 22. Health Research Policy and Systems; 2024. p. 93. 1.
99. Al Mansoori SANA, et al. Strategic Management Planning and the development of Healthcare Sector in Abu Dhabi: structural equation modeling (SEM) Approach. European Journal of Social Sciences Studies; 2018.
100. Singh S, et al. Determinants of health system efficiency in middle-east countries-DEA and PLS-SEM model approach. Int J Syst Assur Eng Manage. 2024;15(5):1815–27.
101. Vrontis D, et al. Managerial innovative capabilities, competitive advantage and performance of healthcare sector during Covid-19 pandemic period. Foresight. 2022;24(3/4):504–26.
102. Miao R, et al. Using structural equation modeling to analyze patient value, satisfaction, and loyalty: a case study of healthcare in China. Int J Prod Res. 2020;58(2):577–96.
103. Nunnally J, Bernstein I. *Psychometric theory, 3rd edn., internat. stud. ed.,* McGraw-Hill Series in Psychology. Tata McGraw-Hill Ed, New Delhi. 2010.
104. Shaheen F, et al. Structural equation modeling (SEM) in social sciences & medical research: a guide for improved analysis. Int J Acad Res Bus Social Sci. 2017;7(5):132–43.
105. Anderson JC, Gerbing DW. Structural equation modeling in practice: a review and recommended two-step approach. Psychol Bull. 1988;103(3):411.
106. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods. 2008;40(3):879–91.
107. Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. J Personal Soc Psychol. 1986;51(6):1173.
108. Abugabah A, Sanzogni L. Enterprise resource planning (ERP) system in higher education: a literature review and implications. Int J Hum Social Sci. 2010;5(6):395–9.

109. Chirchir LK, Aruasa WK, Chebon SK. Perceived usefulness ease use as mediators effect health inform syst user perform. European Journal of Computer Science and Information Technology, 2019.7(1), 22-37.
110. Lira ALBdC, et al. Nursing education: challenges and perspectives in times of the COVID-19 pandemic. Revista brasileira de enfermagem. 2020;73(suppl 2):e20200683.
111. Al-rawashdeha M et al. Effective factors for the adoption of IoT applications in nursing care: a theoretical framework for smart healthcare. J Building Eng. 2024;89:109012.
112. Jokonya O. Validating technology acceptance model (TAM) during IT adoption in organizations. In 2015 IEEE 7th International Conference on Cloud Computing Technology and Science (CloudCom). 2015. IEEE. https://doi.org/10.1109/CloudCom.2015.56
113. Prastiawan DI, Aisjah S, Rofiaty R. The effect of perceived usefulness, perceived ease of use, and social influence on the use of mobile banking through the mediation of attitude toward use. APMBA (Asia Pac Manage Bus Application). 2021;9(3):243–60.
114. Chen L, Aklikokou AK. Determinants of E-government adoption: testing the mediating effects of perceived usefulness and perceived ease of use. Int J Public Adm. 2020;43(10):850–65.
115. Al-Rahmi AM, et al. Acceptance of mobile technologies and M-learning by university students: an empirical investigation in higher education. Educ Inform Technol. 2022;27(6):7805–26.
116. Wilson N, Keni K, Tan PHP. The role of perceived usefulness and perceived ease-of-use toward satisfaction and trust which influence computer consumers' loyalty in China. Gadjah Mada Int J Bus. 2021;23(3):262–94.
117. Khan I et al. Effect of barrier related factors on perceived usefulness and ease of use of social media applications in the Australian healthcare sector. Australasian J Inform Syst. 2021;25. https://doi.org/10.3127/ajis.v25i0.2625.
118. Prayoga T, Abraham J. Behavioral intention to use IoT health device: the role of perceived usefulness, facilitated appropriation, big five personality traits, and cultural value orientations. Int J Electr Comput Eng. 2016;6(4):1751–65.
119. Dhingra M, Mudgal RK. Applications of Perceived Usefulness and Perceived Ease of Use: A Review. in 2019 8th International Conference System Modeling and Advancement in Research Trends (SMART). 2019. IEEE. https://doi.org/10.1109/SMART46866.2019.9117404.
120. Lee J-W. B.-Y. Kim. The effect of service influence factors on perceived usefulness and use satisfaction in digital healthcare sector. Int J Manage. 2021;12(9):43–54.
121. Stoumpos AI, Kitsios F, Talias MA. Digital transformation in healthcare: technology acceptance and its applications. Int J Environ Res Public Health. 2023;20(4):3407.
122. Malik ANA, Annuar SNS. The effect of perceived usefulness, perceived ease of use, reward, and perceived risk toward e-wallet usage intention. Eurasian Business and Economics perspectives. Springer; 2021. pp. 115–30.
123. Prasetyo YT, et al. Determining factors affecting acceptance of e-learning platforms during the COVID-19 pandemic: integrating extended technology Acceptance model and DeLone. Sustainability. 2021;13(15):8365. & Mclean is success model
124. Izuagbe R, et al. Effect of perceived ease of use on librarians'e-skills: Basis for library technology acceptance intention. Volume 41. Library & Information Science Research; 2019. p. 100969. 3.
125. Han J-H, Sa HJ. Acceptance of and satisfaction with online educational classes through the technology acceptance model (TAM): the COVID-19 situation in Korea. Asia Pac Educ Rev. 2022;23(3):403–15.
126. Peng Y, et al. Patient–Physician Interaction and Trust in Online Health Community: the role of perceived usefulness of health information and services. Int J Environ Res Public Health. 2020;17(1):139.
127. Van Der Steen JT, et al. Physicians' and nurses' perceived usefulness and acceptability of a family information booklet about comfort care in advanced dementia. J Palliat Med. 2011;14(5):614–22.
128. Saadatzi MN, et al. Acceptability of using a robotic nursing assistant in health care environments: experimental pilot study. J Med Internet Res. 2020;22(11):e17509.
129. Pendet NMDP, Pramartha C, Wirawan I. Nurse's perception toward management information system: a systematic literature review. In International conference on WorldS4. 2024. Springer. https://doi.org/10.1007/978-981-99-7569-3_26.
130. AlQudah AA, Al-Emran M, Shaalan K. Technology acceptance in healthcare: a systematic review. Appl Sci. 2021;11(22):10537.
131. Rajak M, Shaw K. An extension of technology acceptance model for mHealth user adoption. Technol Soc. 2021;67:101800.
132. Pappa S, et al. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. Brain Behav Immun. 2020;88:901–7.
133. Giusti EM, et al. The psychological impact of the COVID-19 outbreak on health professionals: a cross-sectional study. Front Psychol. 2020;11:1684.
134. Shaheen R, et al. Addressing Financial and Administrative Challenges in Public Sector Health Programs: a review of Pakistan's Health care system. J Hum Dynamics. 2023;1(2):45–52.
135. Conte G et al. Embracing digital and technological solutions in nursing: a scoping review and conceptual framework. Int J Med Informatics. 2023;177:p. 105148.
136. Zin KSLT, et al. A study on technology acceptance of digital healthcare among older Korean adults using extended tam (extended technology acceptance model). Administrative Sciences. 2023;13(2):42. https://doi.org/10.3390/admsci13020042.
137. Bennani A-E, Oumlil R. Do constructs of technology acceptance model predict the ICT appropriation by physicians and nurses in healthcare public centres in Agadir, South of Morocco? in International Conference on Health Informatics. 2010. SCITEPRESS. https://doi.org/10.5220/0002714502410249.
138. Lai D-W, Li Y-P. Examining the technology acceptance model of the computer assistance orthopedic surgery system. in 20107th International Conference on Service Systems and Service Management. 2010. IEEE.
139. Orruño E, et al. Evaluation of teledermatology adoption by healthcare professionals using a modified Technology Acceptance Model. J Telemed Telecare. 2011;17(6):303–7.
140. Schnall R, Bakken S. Testing the Technology Acceptance Model: HIV case managers' intention to use a continuity of care record with context-specific links. Inform Health Soc Care. 2011;36(3):161–72.
141. Ketikidis P, et al. Acceptance of health information technology in health professionals: an application of the revised technology acceptance model. Health Inf J. 2012;18(2):124–34.
142. Chang I-C, Hsu H-M. Predicting medical staff intention to use an online reporting system with modified unified theory of acceptance and use of technology. Telemedicine e-Health. 2012;18(1):67–73.
143. Chua JC et al. Using paper prototyping to assess the perceived acceptance of MedMate: A home-based pill dispenser. in 2012 Southeast Asian Network of Ergonomics Societies Conference (SEANES). 2012. IEEE.
144. Vanneste D, Vermeulen B, Declercq A. Healthcare professionals' acceptance of BelRAI, a web-based system enabling person-centred recording and data sharing across care settings with interRAI instruments: a UTAUT analysis. BMC Med Inf Decis Mak. 2013;13:1–14.
145. Gajanayake R, Sahama T, Iannella R. The role of perceived usefulness and attitude on electronic health record acceptance. in 2013 IEEE 15th International Conference on e-Health Networking, Applications and Services (Healthcom 2013). 2013. IEEE.
146. Lin H-C. An investigation of the effects of cultural differences on physicians' perceptions of information technology acceptance as they relate to knowledge management systems. Comput Hum Behav. 2014;38:368–80.
147. Fleming ML, et al. Exploratory study of emergency physicians' use of a prescription monitoring program using a framework of technology acceptance. J Pain Palliat Care Pharm. 2014;28(1):19–27.
148. Steininger K et al. Factors explaining physicians' acceptance of electronic health records in 2014 47th Hawaii international conference on system sciences. 2014. IEEE.
149. Ebie S, Njoku E. Extension of the technology acceptance model (TAM) to the adoption of the electronic knowledge and skills framework (E-KSF) in the national health service (NHS). J Appl Sci Dev. 2015;6:19–50.
150. Steininger K, Stiglbauer B. EHR acceptance among Austrian resident doctors. Health Policy Technol. 2015;4(2):121–30.
151. Sezgin E, Özkan-Yıldırım S. A cross-sectional investigation of acceptance of health information technology: a nationwide survey of community pharmacists in Turkey. Res Social Administrative Pharm. 2016;12(6):949–65.

152. IY MD et al. Acceptance of HIS usage level in hospital with SEM-PLS as analysis methodology: case study of a private hospital in Indonesia. in. 2016 International Conference on Information Management and Technology (ICIMTech). 2016. IEEE.
153. Ifinedo P, et al. Nova Scotia nurses' acceptance of healthcare information systems: focus on technology characteristics and related factors. Can J Nurs Inf. 2016;11(2):1–13.
154. Ducey AJ, Coovert MD. Predicting tablet computer use: an extended Technology Acceptance Model for physicians. Health Policy Technol. 2016;5(3):268–84.
155. Jayusman H, Setyohadi DB. An empirical investigations of user acceptance of Scalsa e-learning in stikes Harapan Bangsa Purwokerto. in 2017 5th International Conference on Cyber and IT Service Management (CITSM). 2017. IEEE.
156. Horne MEP. The technology acceptance model and telemedicine: Predicting health care providers' intention to use telemedicine. University of Phoenix; 2017.
157. Beldad AD, Hegner SM. Expanding the technology acceptance model with the inclusion of trust, social influence, and health valuation to determine the predictors of German users' willingness to continue using a fitness app: a structural equation modeling approach. Int J Human–Computer Interact. 2018;34(9):882–93.
158. Tubaishat A. Perceived usefulness and perceived ease of use of electronic health records among nurses: application of Technology Acceptance Model. Volume 43. Informatics for Health and Social Care; 2018. pp. 379–89. 4.
159. Özdemir-Güngör D, Camgöz-Akdağ H. Examining the effects of technology anxiety and resistance to change on the acceptance of breast tumor registry system: evidence from Turkey. Technol Soc. 2018;54:66–73.
160. Francis RP. Examining healthcare providers' acceptance of data from patient self-monitoring devices using structural equation modeling with the UTAUT2 model. Int J Healthc Inform Syst Inf (IJHISI). 2019;14(1):44–60.
161. Tao D, et al. Integrating usability and social cognitive theories with the technology acceptance model to understand young users' acceptance of a health information portal. Health Inf J. 2020;26(2):1347–62.
162. Ebnehoseini Z, et al. Understanding key factors affecting on hospital electronic health record (EHR) adoption. J Family Med Prim care. 2020;9(8):4348–52.
163. Kataria P, et al. TAM model for e-health implementation in rural areas of Uttarakhand, post covid-19 pandemic. Asia Pac J Health Manage. 2021;16(3):67–74.
164. Alexandra S, Handayani PW, Azzahro F. Indonesian Hosp Telemedicine Acceptance Model: Influence user Behav Technological Dimensions Heliyon, 2021. 7(12).
165. Walczak R, Kludacz-Alessandri M, Hawrysz L. Use of telemedicine technology among general practitioners during COVID-19: a modified technology acceptance model study in Poland. Int J Environ Res Public Health. 2022;19(17):10937.
166. Bouarar AC, et al. Antecedents of physicians' intentions to engage in digital volunteering work: an extended technology acceptance model (TAM) approach. J Integr Care. 2023;31(4):285–99.
167. Chen B et al. Technology acceptance model perspective on the intention to participate in medical talents training in China. Heliyon, 2024.

Publisher's Note