

Intention to use picture archiving and communication system and its predictors among physicians and nurses at specialized teaching hospitals in Amhara region, Northwest Ethiopia

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Abstract

Background: Picture archiving and communication system is an innovation system in the health information that reduces costs, facilitates access to medical image, and improves workflow in radiology department. However, studies indicated that intention and usage of picture archiving and communication system is limited in middle-income and developing countries.

Objective: This study aimed to assess the intention to use picture archiving and communication system and its predictors among physicians and nurses at specialized teaching hospitals in Amhara region, Northwest Ethiopia.

Method: Institution-based cross-sectional study design was conducted from October 11 to November 12, 2023. Proportional allocation and a simple random sampling were used to select participants of the study. A self-administered structured English questionnaire was used, and a 5% pretest was performed. Data were entered into Epi data 4.6 and exported to SPSS 26 and AMOS 23. Descriptive and structural equation modeling analysis was performed. The hypothesis was tested using a path coefficient and a p -value <0.05 .

Results: About 54.7% (95% CI: 50.9–58.4) of the participant intended to use picture archive and communication system with a 90.38% of response rate. Performance expectancy ($\beta=0.146$, p -value <0.05), perceived enjoyment ($\beta=0.397$, p -value <0.001), and computer literacy ($\beta=0.191$, p -value <0.001) had positive influence on intention to use picture archiving and communication system.

Conclusions: Overall, more than half of physicians' and nurses' intention to use picture archiving and communication system were at hopeful stage for future. Performance expectancy, perceived enjoyment and computer literacy had direct positive effect on intention to use picture archiving and communication system among physicians and nurses. The designers, developers, and managers of the picture archiving and communication system should consider these variables. Furthermore, using this system can improve quality of health service through change workflow in to digital image, clinicians evaluate image more quickly and saving resources.

Keywords

Intention to use, picture archiving and communication system, UTAUT, physicians and nurses, Ethiopia

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Introduction

Nowadays, the use of information technology in the health-care system has increasingly enhanced and has the potential to improve healthcare service.¹ Among the most widely used systems in the healthcare service has been Picture Archiving and Communication System (PACS). PACS is growing into a hospital-integrated system that stores diagnostic imaging data that frequently goes much outside the radiology department.² PACS was initially created as a tool to help clinicians evaluate

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images more quickly.³ It has various modalities such as cross-sectional tomography, Magnetic Resonance Imaging, ultrasound, radiography, and digital radiation.

PACS is a cutting-edge health evidence system that creates medical picture access easier and enhances radiology department workflow. Additionally, it is a crucial tool in medical imaging centers, aiding in diagnosis, managing, retrieving, and transmitting medical images for professionals.⁴ Currently, in Ethiopia Ministry of Health, PACS is one of an essential component of data hub pillars that changes the workflow to advance performance.⁵

Notwithstanding, the studies have indicated that global implementation of PACS is low because of challenges factors including price, the need for the capacity to handle the required computer infrastructure, the necessity of changing the workflow of healthcare staff members, and a shortage of user acceptance, as healthcare professionals do not easily accept new information technologies.^{1,3,6} Consequently, the services' quality is not at its highest possible standard, and patients confront many problems during their treatment process which makes them unsatisfied with the healthcare system.⁷ According to WHO reports, 70% of donated equipment in some regions is nonfunctional because of service and support problems.⁸ PACS intention and acceptability have grown significantly worldwide during the last few decades.⁶

Studies have shown that PACS can increase radiologist efficiency by more than 40% and 69% due to the implementation in the workflow.⁹ However, the proven benefits of these systems in improving the quality of healthcare delivery in worldwide, many developing countries still depend on the traditional healthcare setups associated with problems such as duplication of patient records and wastage of time.^{10,11} Researches indicated that intention and usage of PACS is limited in middle-income and developing countries. Studies done in Iran,¹² Saudi Arabia,¹³ Nigeria,¹⁴ and South Africa¹⁵ had low proportion of PACS adoption. In Ethiopia, study done on intention to use electronic medical record is low.¹⁶

Studies show using of PACS services in the health sector has the potential to increment health service access, quality, adherence, and efficiency.^{13,17} Nevertheless, the technological benefit obtained depends on the rate of use and adherence of users. Human activities mainly depend on their behavioral intention, and the intention to use digital tools is a determinant factor of actual user behavior. Therefore, determining the behavioral intention to use and its predictors before the adoption of technology is important and prevents implementation failure.¹⁸ To rise accepting of factors affecting behavioral intention, adaptation of the original Unified Theory of Acceptance and Use of Technology (UTAUT) had been carried out by different scholars.^{3,13,19} In this regard, growing an understanding of the predictors that influence the behavioral intention of healthcare providers to use PACS by modifying UTAUT is important. However, in Ethiopia, there is lack of information on how PACS is adopted and used in healthcare by physician and nurse in resource limited settings.

Several factors affect physicians' and nurses' intention to use PACS. Poor technological infrastructure, physicians' and nurses' resistance to use PACS, low motivation, and lack of digital literacy are common sectors that affect the use of PACS in healthcare facilities.²⁰ Low- and middle-income countries have limited resource, low technical support, and low attitude to use innovative technology, low digital literacy, and experience, which prevents applying PACS.²¹ The main issue initiating this research is the lack of a basis to predict behavioral intention to use PACS among physicians and nurses. To facilitate the future implementation of PACS, UTAUT model is the most vital tool to establishing and evaluate users behavioral intent to use new technology.²² The objectives of this study were to:

- (a) Determine behavioral intention to use PACS that introduces a adapted UTAUT model
- (b) Analyze relationships between important predictors on behavioral intention to use PACS among physicians and nurses

Theoretical background of the model and hypothesis

Hypothetical models have been applied in the past few decades to evaluate and interpret the behavioral intentions of PACS users. UTAUT is one of the accepted theoretical models that are implemented in many ICT applications on a large and practical scale.²³ Developed as a framework to examine users' behavioral intentions for ICT applications, UTAUT combines elements of activity theory and technology acceptance models (TAMs).²⁴

The UTAUT model, a modification of previous models, is better able to describe users' behavioral intents than other single models.²⁵ The UTAUT approach incorporates major components like performance expectancy (PE), effort expectancy (EE), social influence (SI), and enabling variables that have a direct impact on users' behavioral intentions.²² To reflect the intention to use PACS, we added perceived enjoyment (PEen) and computer literacy (CL) to the UTAUT model. Given that users who are more familiar with IT are more likely to accept and stay with new developments in PACS than users who are less familiar with IT.²⁶ Moreover, subjective enjoyment also influences behavioral intentions to use PACS.²⁷ This concept was therefore incorporated into the model.

Moderating effect of age

A study done in Turkey,¹⁹ age had moderating effect on PE and SI with behavioral intention to use PACS. Similarly, a study done in Iran age group has moderating effect on PE to adoption of electronic patient records.²⁸ On the other side, a study done in Saudi Arabia age had no moderating effect on PE, EE, SI and Facilitating condition (FC) with behavioral intention to use PACS.¹³ Moderation effect of age, with

younger respondents are indicating greater to accept healthcare technology.²⁹

Moderating effect of gender

As study done in Iran showed that gender had difference to adopt healthcare technology.¹² Another study conducted in Taiwan indicated that gender had moderating effects on SI to behavioral intention to use the PACS.¹² Another study done in China using the TAM indicated that gender was a positive influence on SI to behavioral intention to use smart wearable technology.³⁰ The following hypothesis was developed using the actual UTAUT model mentioned above as a basis.

Performance expectancy

PE is the degree to which a person believes that employing the system will support him or her in improving job performance.^{22,31} Studies conducted in Iran,³ and Saudi Arabia³² are positively associated with behavioral intention to use picture archive and communication system. Additionally, studies conducted in South Africa³³ on intention to use e-Prescribing and in Ethiopia on intention to use electronic medical record among healthcare professionals are positively associated with behavioral intention.¹⁶ On the other hand, studies conducted in India on acceptance of healthcare technology among medical doctors are not positively significant predictor.²⁰

To test the effect of PE on intention to use PACS, the following hypotheses were proposed:

H1: PE has positively influenced physicians and nurses toward intention to use PACS.

H2: The influence of PE on physicians' and nurses' behavioral intention to use PACS is moderated by gender.

H3: The influence of PE on physicians' and nurses' behavioral intention to use PACS is moderated by age.

Effort expectancy

EE the degree to which someone perceives a system to be simple to use.²² A study conducted in Iran indicated that PE is positively associated with behavioral intention to use PACS.³ Another study done in Saudi Arabia indicated that perceived ease of use is positively associated with behavioral intention to use PACS.¹³ To test the effect of EE on intention to use PACS, the following hypotheses were proposed:

H4: EE has positively influenced physicians and nurses toward intention to use PACS.

H5: The influence of EE on physicians' and nurses' intention to use PACS is moderated by gender.

H6: The influence of EE on physicians' and nurses' intention to use PACS is moderated with age.

Social influence

SI is the extent to which a person believes significant people believe they should utilize a particular technology. Studies conducted in China³⁴ and Nigeria³⁵ on intention to use digital health and in Ethiopia³⁶ on intention to use mobile phone for mental support are positively associated with behavioral intention. To test the effect of SI on intention to use PACS, the following hypotheses were proposed:

H7: SI has positively influenced physicians and nurses toward intention to use PACS.

H8: The influence of SI on physicians' and nurses' intention to use PACS has moderated by gender.

H9: The influence of SI on physicians' and nurses' intention to use PACS has moderated with age.

Facilitating condition

FC is the degree to which a person believes that the system's organizational and technical infrastructure is enough to support the use of the system.²² A study conducted in Canada on intention to use electronic decision among elders,³⁷ Iran,^{3,38} Saudi Arabia,¹³ in South Africa on the intention to use e-prescribing³³ and Ethiopia on intention to use electronic medical record are positively associated with behavioral intention to use healthcare technology.^{16,39} To test the effect of FCs on intention to use PACS, the following hypotheses were proposed:

H10: FC has positively influenced physicians' and nurses' intention to use PACS.

H11: The influence of FC on physicians' and nurses' intention to use PACS has moderated by gender.

H12: The influence of FC on physicians' and nurses' intention to use PACS has moderated with age.

Perceived enjoyment

PEn determines how much pleasure can be obtained from using an e-learning system and is a basic intrinsic motivation.⁴⁰⁻⁴² In addition to any performance implications resulting from system use, PEn is the degree to which the action of utilizing a particular system can be considered to be enjoyable.⁴³ A study done in Saudi Arabia¹³ PACS is positively supported with pleasant or enjoyment, and a study done in South Korea on adoptions of smart health service is positively associated with PEn.⁴¹ Studies conducted in China on adoption of internet healthcare technology using VAM,⁴⁴ United States⁴⁵ and

United Kingdom on extension of UTAUT model on healthcare,⁴⁶ and in Ethiopia⁴⁷ on intention to use eLearning among health sciences students are positively associated with PEn. To test the effect of PEn on intention to use PACS, the following hypotheses were proposed:

H13: PEn has positive influence on physicians' and nurses' intention to use PACS.

H14: The influence of PEn on physicians' and nurses' intention to use PACS is moderated by gender.

H15: The influence of PEn on physicians' and nurses' intention to use PACS is moderated with age.

Computer literacy

CL is defined as the ability to understand the association with digital technology and its uses, possibilities, and significances. Studies conducted in Canada⁴⁸ and Nigeria on use of e-Medicine,⁴⁹ South Africa on acceptance of e-prescribing technology,³³ and Ethiopia on intention of electronic medical records are positively associated with CL.¹⁶ To test the effect of CL on intention to use PACS, the following hypotheses were proposed:

H16: CL has positive influence on physicians' and nurses' intention to use PACS.

H17: The influence of CL on physicians' and nurses' intention to use PACS is moderated by gender.

H18: The influence of CL on physicians' and nurses' intention to use PACS is moderated with age.

In this study, one dependent and six independent components were examined. The suggested technology is a predicted technology that has not until now been implemented in Ethiopia, and there is currently no actual usage of PACS in these two specialized teaching hospitals. User behavior, which was considered a dependent variable in the original UTAUT, was not examined in this study. The study's real modified UTAUT model framework is shown in Figure 1.

Methods

Study design and setting

An institutional based cross-sectional study was conducted from October 11 to November 12, 2023 at specialized teaching hospitals in Amhara regional state. The Amhara region is one of the twelve regional states in Ethiopia that found in the Northern part of the country. The study was conducted at two specialized teaching hospitals in the Amhara region, namely University of Gondar and Tibebe Ghion specialized teaching hospitals. The Amhara regional state, consisting 13 administrative zones, 181 woredas, and its capital city, Bahir Dar. According to the data obtained from each hospital's human

resource administrative office, the total number of physicians and nurses is 1214; among them, 457 nurses and physicians and 757 nurses and physicians were from Tibebe Ghion and University of Gondar specialized teaching hospitals, respectively.

Source and study population

The source population consisted of every physician and nurse employed by the University of Gondar specialized teaching hospital and Tibebe Ghion specialized teaching hospital. However, our study's populations included all physicians and nurses who were employed by specialized teaching hospitals and available during the data collection period.

Inclusion and exclusion

The study included physicians and nurses who had been employed by specialized teaching hospitals as well as those who volunteered to take part. Physicians and nurses with less than 6 months of work experience and those who were employed during data collection were not included in our study.

Sample size determination and sampling procedures

In this study, the minimum sample size was determined based on the number of free parameters in the hypothetical model; a 1:10 ratio of respondents to free parameters to be estimated has been recommended.⁵⁰ Therefore, taking consideration of the 69 parameters that need to be estimated based on the proposed model using Figure 1 and taking participants to a free parameter's ratio of 10, the minimum sample needed is 690. This is because structural equation modeling estimation of free parameters includes 31 variance of independent variables, 15 covariance of between independent variables, 17 load factors, and 6 regression coefficients of between unobserved variables. The ultimate sample size is 759 since the computed sample size takes the 10% non-response rate into consideration.

Study participants were chosen from the teaching specialized hospitals in the Amhara regional state of Ethiopia. Simple random sampling was used to choose all of the study participants from the specialized teaching hospitals, allocating a proportionate amount to each healthcare facility. Lastly, each participant was selected from the administrative human resource records of each specialized institution using openEpi random software V.3. Seven hundred and fifty-nine professionals were enlisted for the study.

Variables of the study

The endogenous variable was intention to use PACS, and exogenous variables were PE, EE, SI, FCs, PEn, and CL and socio-demographic characteristics (age, gender, marital status, profession, educational level, and work experience).

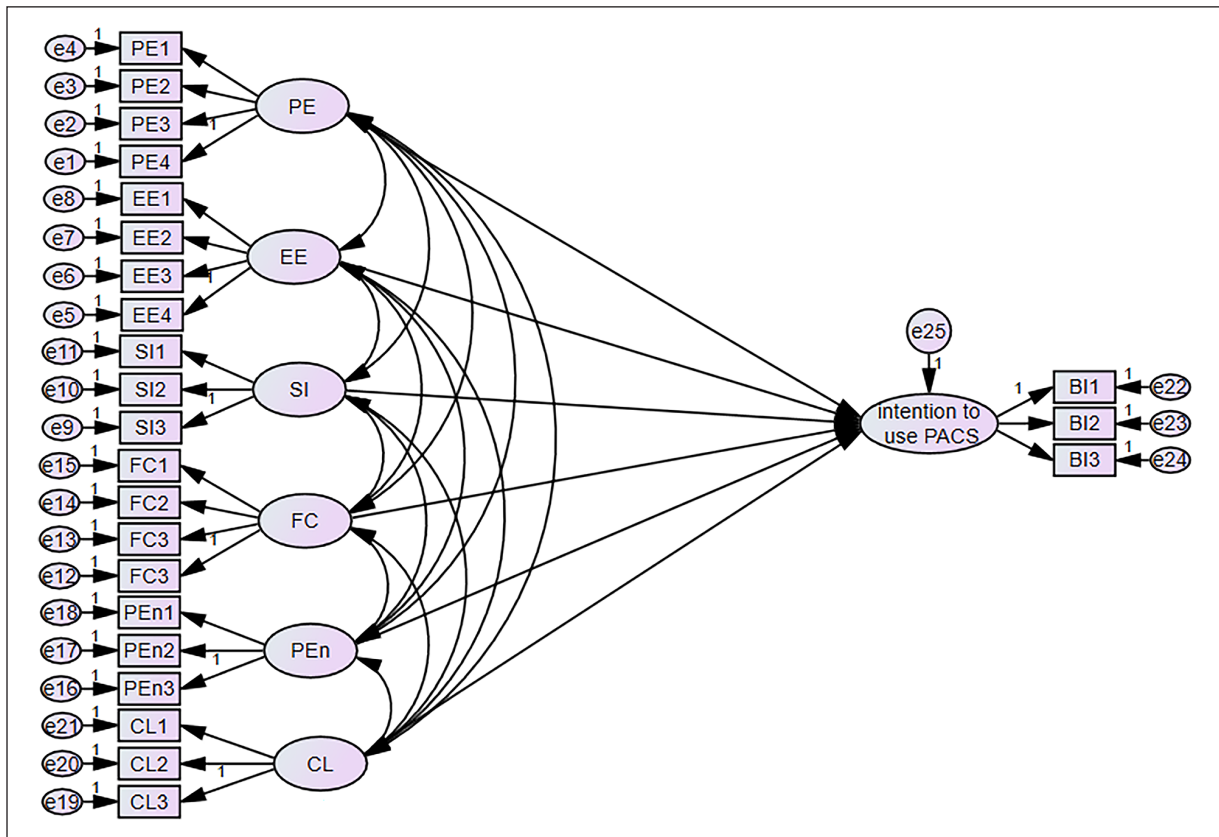


Figure 1. Modified UTAUT model.

Operational definition

Intention to use: the extent to which a physician and nurses have made intentional plans to conduct or refrain from using a PACS to diagnosis radiological images.^{13,16} Intended to use a PACS to interpret medical images when a physician’s and nurse’s rates intention to use a PACS measurement and scores mean and above the mean is intended to use the PACS, otherwise not intended to use it, with a 5-point Likert scale of three items questions.

Data collection tools and procedures

Data were gathered using a Standard English questionnaire that was self-administered. The questionnaire was modified to take into consideration for the latent variable based on different sources of literature.^{22,39,47} The questionnaire was modified to better fit the study’s purpose. The structured questionnaire had two parts, the first part includes the socio-demographic characteristics of the nurses and physicians healthcare providers, and the second part includes behavioral intention to use PACS. The construct in the modified UTAUT model was measured using multiple items. PEn, CL, SI and intention to use each were measured with three items. However, the PE, EE, and FCs, each were measured with

four items. A total of 24 items were used in this study to test the proposed hypothesis. A Likert scale ranging from strongly disagree (1) to strongly agree (5) was used to rate the level of participant agreement toward the prepared close-ended questions.^{22,32}

Data quality control

Prior to actual data collection, a pretest among physicians and nurses working at Debarik general hospitals was conducted on 5% of the sample size to ensure the quality of the data. The Cronbach’s alpha result value of the pretest on the PEn, CL, SI, intention to use, PE, EE, and FCs were above 0.7, and the internal consistency of the construct was achieved. However, minimal adjustment of the questionnaire for wording was done.

Following that, four data collectors and two supervisors received one entire day of training on the study’s purpose, data collection techniques, data confidentiality, and respondents’ rights. Two medical doctors and two nurses with BSc degrees were among the data collectors. Throughout the data collection process, supervision was provided by the principle investigator and supervisors to ensure that the study protocol was carried out. Following gathering data, accurateness was confirmed.

Data processing and analysis

Prior to analysis, the data collected had been exported to AMOS version 23 for structural model assessment and analysis of the measurement model, and SPSS version 26 for descriptive data analysis. Using SPSS, a descriptive analysis was conducted on the socio-demographic data. The results are displayed in a frequency table. Physicians' and nurses' intention to use PACS was calculated descriptively, and the results were displayed in a pie chart.

The structural equation modeling (SEM) assumption was checked and the maximum likelihood estimate approach was applied before the measurement and structural model assessment.⁵¹ Kurtosis and the critical ratio were used to verify multivariate normality.⁵² The results of these analyses showed that the data were normally distributed.

Using the variance inflation factor (VIF) at a cut-off point of less than 10, the presence of multicollinearity among independent variables was assessed.⁵³ In addition to examining for 21 instances of multicollinearity between external observable variables using the correlation coefficient approach, the VIF in this study ranged from 1.42 to 2.26. All Pearson's correlations in this study's results are less than 0.8 this which is the suggested value for ruling out multicollinearity.⁵⁴ There was no multicollinearity among the independent variables, according to the results. Three or more observable variables have to be utilized in order to measure each latent variable in the structural equation model, according to the multiple items assumption.

Measurement model

Confirmatory factor analysis (CFA) was done before hypothesis testing. In the evaluation of the measurement model, the items' reliability, validity, and discriminant validity were evaluated through the utilization of Cronbach's alpha (α), standardized factor loading, composite reliability (CR), average variance extracted (AVE), the square root of the AVE, and the cross-loading matrix.⁵⁵ AMOS version 23 was utilized to verify the constructs' reliability, validity, and discriminant validity. To assess the internal consistency of the variables, Cronbach's alpha and CR values are normally accepted for values of 0.7 or above (96). An AVE of at least 0.50 was used to determine convergent validity, and factor loading is much higher than 0.50 (56, 97). The square root of the AVE and the cross-loading matrix were measured to determine discriminant validity and according to the cross loading results, the measurement items have higher loading under their latent constructs than with other constructs.^{56,57} The models' overall goodness of fit was measured and assessed based on standards from previous studies⁶⁴ using Chi-25 square ratio (χ^2/df) (0.9), the goodness of fit index (GFI > 0.8), adjusted goodness of fit index (AGFI > 0.8), comparative fit index (CFI > 0.9), root mean square of standardized residual (RMSR < 0.08).^{56,58,59}

Structural model

In order to construct a structural equation model for influencing factors related to physicians' and nurses' behavioral intention to utilize PACS to interpret medical pictures, the measurement model evaluation was followed by the structural model assessment. The method of maximum likelihood estimation was applied. The standardized regression weights that show the degree of connection between the constructs as well as path analysis and the *p*-value with a cutoff point were taken into consideration in order to test the proposed hypothesis.⁶⁰

Results

Most of participants (46.2%) were in the age groups of 31–40 and two-thirds (66.3%) of respondents were males. Majority 56.3% of respondents were orthodox and 56.0% of participants were married. In terms profession and educational level, 56.3% and 82.9% of respondents were nurses and first degree, respectively, and 59.2% of respondents were less than 5 years' experience (Table 1).

Intention to use PACS

In this study, 375 (54.7%) (95%: CI: 50.9–58.4) of respondents were intended to use PACS. Behavioral intention to use PACS was measured using three-point Likert scale. The mean score of intention to use PACS was 9.5, and the maximum and minimum scores were 15 and 3, respectively (Figure 2).

Measurement model assessment

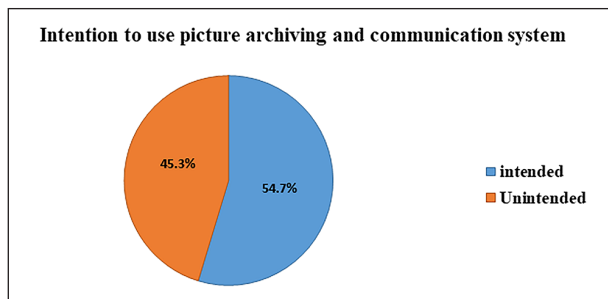
Assessment of the measurement model involves checking the model validity (discriminate and convergent), internal consistency and the model fit using CFA. We used covariate error terms with high modification indices to improve model fit. Consequently, depend on their highest modification indices, we covariate e2 with e3 and e6 with e8 (Figure 3).

The goodness of model fit. The result in CFA indicated that chi-square divided by degrees of freedom ($\chi^2/df=2.586$), standardized root mean squared residual (RMR=0.041), the goodness of the fit index (GFI=0.932), adjusted goodness of fit index (AGFI=0.911), normed fit index (NFI=0.944), comparative fit index (CFI=0.965), and root mean square error of approximation (RMSEA=0.048). The goodness of model fit values met the requests.

Reliability and validity of the construct. The result indicates that the square root of the AVE of the constructs refers to the significant correlation between constructs. The values in bold (diagonal values) are higher than other values in its column and the raw (Table 2).

Table 1. Socio-demographic characteristics of physicians and nurses at specialized teaching hospitals in Amhara region Ethiopia, 2023 ($n=686$).

Variable	Category	Frequency (n)	Percent (%)
Age (years)	21–30	313	45.6
	31–40	317	46.2
	>40	56	8.2
Gender	Male	455	66.3
	Female	231	33.7
Marital status	Unmarried	302	44.0
	Married	384	56.0
Religion	Orthodox	437	63.7
	Muslim	156	22.7
	Protestant	39	7.1
	Catholic	44	6.4
Profession	Nurses	386	56.3
	General practitioner	217	31.6
	Specialist	83	12.1
Educational level	Diploma	34	5
	First degree	569	82.9
	Second degree and above	83	12.1
Work experience (years)	<5	423	61.7
	5–10	194	28.3
	>10	69	10.1

**Figure 2.** Proportion of intention to use PACS among physicians and nurses at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Hence, the discriminant validity of the measurement model is done well. The above table shows that all of the construct HTMT ratios are less than 0.9, indicating that all constructs are acceptable and useful for further analysis.

Convergent validity of the construct. Based on the illustrated results in Table 3 Cronbach's alpha and CR have values above for all constructs.

Structural equation model assessment. A structural model was developed in order to determine the relationships between the components in the study model. Accordingly, we assessed the theoretical hypothesis and the relationships between the latent constructs in the structural model (Figure 4). Collinearity can also impact interpretation. When the VIF and

tolerance are over 10 and below 0.1, respectively, it suggests that multicollinearity may exist. Proving that multicollinearity was nonexistent in this finding (Table 4).

The study result shows that PE, Pen, and CL had a direct positive influence on physicians' and nurses' intention to PACS to improve radiological health service. H1, H5, and H6 were accepted; on the other hand, H2, H3, and H4 were rejected.

According to SEM analysis, the result of the study finding showed that PEN had the most significant effect on the physicians' and nurses' intention to use PACS, which was higher than the effects of other predictors (Figure 4). Having PE ($\beta=0.146$, 95% CI: [0.008, 0.298], p -value < 0.05), PEN ($\beta=0.397$, 95% CI: [0.248, 0.544], p -value < 0.001), and CL ($\beta=0.191$, 95% CI: [0.102, 0.281], p -value < 0.001) had a direct positive effect on the intention to use PACS.

On the other hand, EE ($\beta=0.076$, 95% CI: [-0.100, 0.258], p -value=0.382), SI ($\beta=0.117$, 95% CI: [-0.064, 0.297], p -value=0.205) and FCs ($\beta=-0.129$, 95% CI: [-0.231, 0.032], p -value=0.110) had no direct on the intention to use PACS.

Testing potential moderators

In this study, we investigated the moderator effect of age and gender of physicians and nurses on the relationship between PE, EE, SI, FCs, PEN, and CL with intention to use PACS.

Moderating effect of gender. Based on the results, the effects of PE, EE, SI, FCs, PEN, and CL on the intention to use

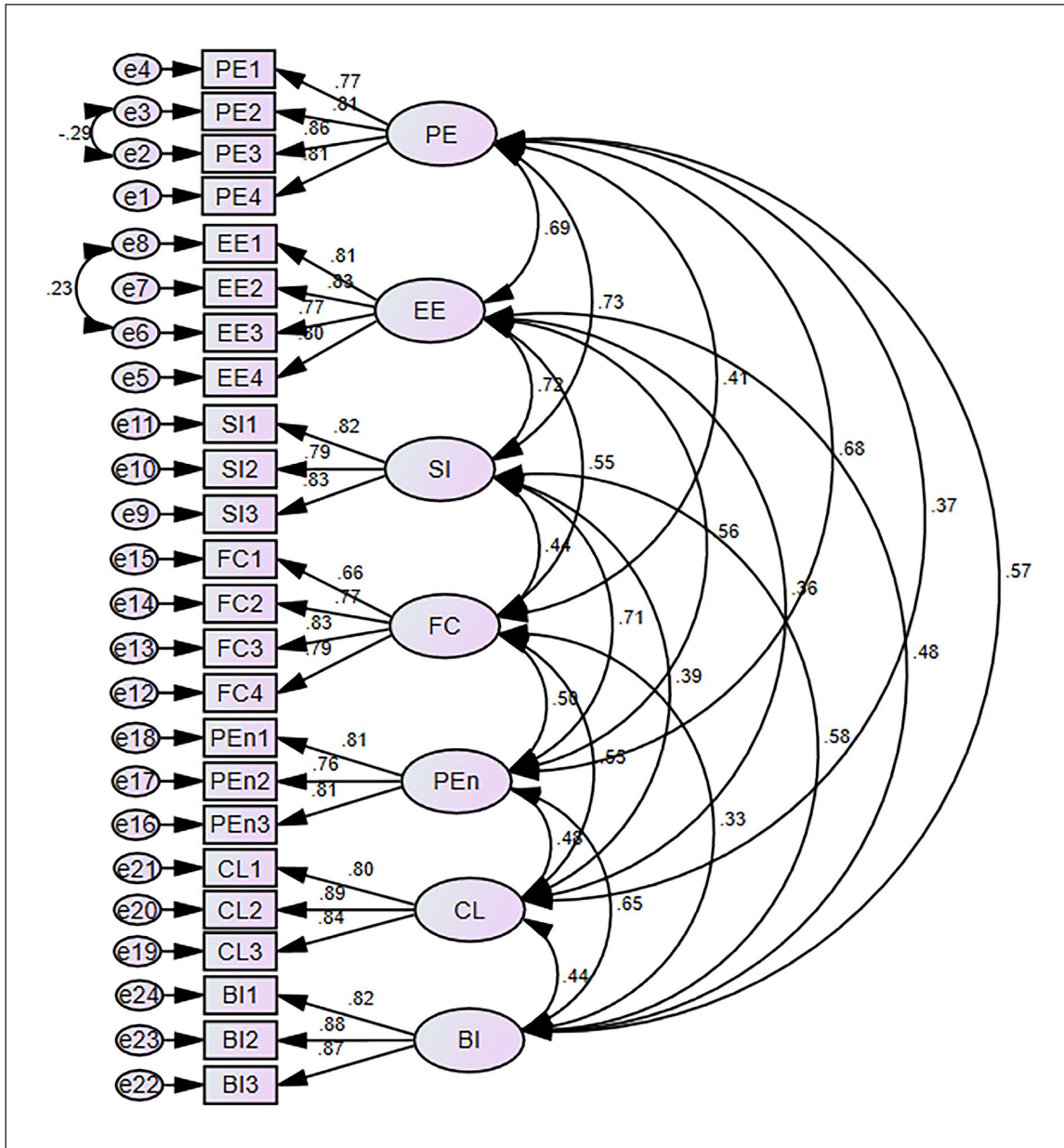


Figure 3. CFA of behavioral intention to use PACS among physicians and nurses at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Table 2. Discriminate validity between constructs of intention to use PACS among physicians’ and nurses’ at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Constructs	PE	EE	SI	FC	Pen	CL	BI
PE	0.812						
EE	0.691	0.801					
SI	0.733	0.725	0.812				
FC	0.406	0.555	0.445	0.763			
Pen	0.678	0.561	0.715	0.504	0.794		
CL	0.372	0.363	0.394	0.549	0.484	0.840	
BI	0.572	0.483	0.582	0.330	0.650	0.440	0.857

Table 3. Convergent validity between constructs of intention to use PACS among physicians at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Construct	Indicators	Factor loading	CR	Cronbach's alpha	AVE
PE	PE1	0.769	0.885	0.876	0.659
	PE2	0.810			
	PE3	0.860			
	PE4	0.805			
EE	EE1	0.807	0.878	0.883	0.642
	EE2	0.835			
	EE3	0.766			
	EE4	0.796			
SI	SI1	0.818	0.853	0.852	0.659
	SI2	0.792			
	SI3	0.825			
FC	FC1	0.660	0.847	0.844	0.847
	FC2	0.766			
	FC3	0.826			
	FC4	0.790			
CL	CL1	0.769	0.878	0.876	0.706
	CL2	0.887			
	CL3	0.835			
Pen	PEn1	0.807	0.836	0.836	0.630
	PEn2	0.760			
	PEn3	0.814			
BI	BI1	0.822	0.893	0.891	0.735
	BI2	0.877			
	BI3	0.872			

AVE: average variance extracted; CR: critical ratio.

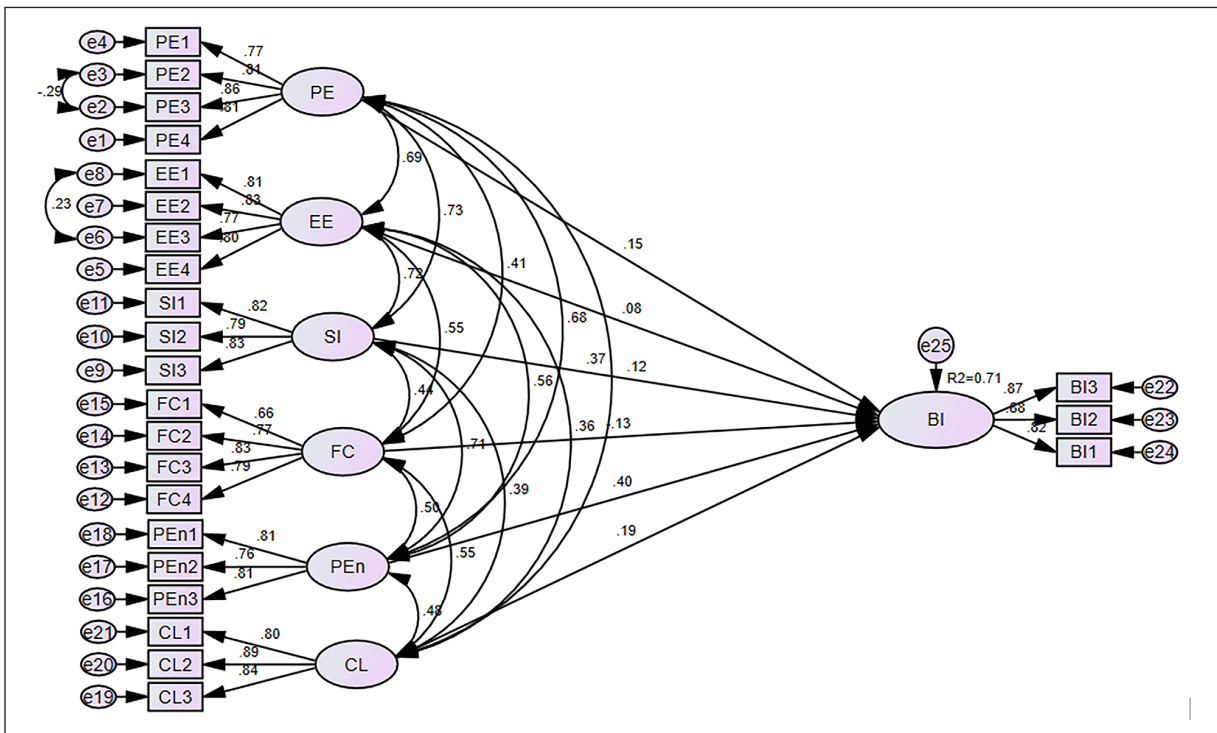


Figure 4. SEM analysis of behavioral intention to use PACS among physicians and nurses at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Table 4. SEM analysis of behavioral intention to use PACS among physicians and nurses at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Hypothesis	Path	VIF	Estimate	p -Value	95% Confidence interval		Result
					Lower	Upper	
H1	PEBI	2.17	0.146	0.045	0.008	0.298	Supported
H2	EEBI	2.09	0.076	0.382	-0.100	0.258	Not supported
H3	SI BI	2.26	0.117	0.205	-0.064	0.297	Not supported
H4	FCBI	1.58	-0.129	0.110	-0.231	0.032	Not supported
H5	PEnBI	1.92	0.397	***	0.248	0.544	Supported
H6	CLBI	1.42	0.191	***	0.102	0.281	Supported

*** $p < 0.001$.

Table 5. Moderating effect of gender for intention to use PACS among physicians at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Hypothesis	Moderator	Path coefficient	p -value	Model test (unconstrained & constrained model)		Result
				ΔX^2	p -value	
PE→BI	Male	0.095	0.385	0.326	0.568	Not supported
	Female	0.174	0.038			
EE→BI	Male	0.189	0.049	1.830	0.176	Not supported
	Female	-0.033	0.800			
SI→BI	Male	0.022	0.837	2.537	0.111	Not supported
	Female	0.303	0.031			
FC→BI	Male	-0.169	0.019	0.248	0.618	Not supported
	Female	-0.110	0.226			
PEn→BI	Male	0.521	***	0.965	0.405	Not supported
	Female	0.382	0.004**			
CL→BI	Male	0.205	***	0.226	0.635	Not supported
	Female	0.160	0.026			

** $p < 0.01$. *** $p < 0.001$.

PACS are not significantly different between individuals by gender (Table 5).

Moderating effect of age. Based on the findings, the effects of PE, EE, SI, FCs, PEn, and CL on the intention to use PACS were not significantly different between individuals by age (Table 6).

Discussion

This study investigates the intention to use PACS and its predictors among physicians and nurses. The result revealed that physicians' and nurses' intention to use PACS was 375 (54.7% [95%: CI: 50.9–58.4]). And, the result of this study showed that PEn and PE have the most and the least association with intention to use PACS. Although, in developing countries challenge by lack of technologies and socio-economic status, in sub-Saharan African region is still in its infancy of PACS deployment, this result indicated that physicians' and nurses' intend to use PACS is a promising stage.

This finding is greater than a study done in Ethiopia among healthcare providers on intention to use electronic medical records.¹⁶ This discrepancy might be the technology cutting-edge quickly, and the sample size ($n=420$) was lower in previous study. However, this finding is lower than a study done in Iran (67.86%).⁶¹ This discrepancy may be due to the presence of high internet penetration in Iran (78.6%) and variations in awareness about the use of advanced healthcare technology. Moreover, shortage of digital health literacy, barriers to regarding the use PACS and low level of innovative technology progress in Ethiopia.⁶²

The present study model explains a 71% variance in the intention of physicians and nurses to use PACS. This indicate that all predictors were strongly explained the intention to use PACS. Also this study's findings clearly showed that using UTAUT is a suitable approach for examining how physicians and nurses adopt new technology, like PACS, since it has a great deal of potential for explaining and identifying the key variables that influence end users' perceptions of using PACS. Furthermore, the graph (Figure 4) showed that

Table 6. Moderating effect of age for intention to use PACS among physicians at specialized teaching hospitals in Amhara region, Ethiopia, 2023.

Hypothesis	Moderator	Path coefficient	<i>p</i> -value	Model test (unconstrained and constrained model)		Result
	Age (year)			ΔX^2	<i>p</i> -value	
PE→BI	≤ 30	0.083	0.341	1.581	0.209	Not accepted
	> 30	0.254	0.014			
EE→BI	≤ 30	0.123	0.187	0.408	0.523	Not accepted
	> 30	0.042	0.716			
SI→BI	≤ 30	0.042	0.711	0.925	0.336	Not accepted
	> 30	0.208	0.105			
FC→BI	≤ 30	-0.005	0.945	4.294	0.121	Not accepted
	> 30	-0.270	0.065			
PEn→BI	≤ 30	0.511	0.213	0.350	0.554	Not accepted
	> 30	0.415	0.123			
CL→BI	≤ 30	0.156	0.015	0.764	0.382	Not accepted
	> 30	0.237	0.231			

PE, PEn, and CL controlled 71% of the behavior intention of physicians and nurses.

PE, PEn and CL were significantly directly associated with intention to use PACS. Hence, H1, H5, and H6 are accepted. The following insights are described, based on the findings, to enhance intention to use PACS by physicians and nurses in Amhara region at teaching specialized hospitals Ethiopia.

According to our findings, PE had a direct effect on physicians' and nurses' intention to use PACS ($\beta=0.146$, $p<0.05$). This indicates that physicians and nurses are more likely to intend to use PACS when they perceive them to be very useful and to access digital images rapidly. The findings of this study are consistent with previous study in Iran on acceptance of evidence-based medicine database,^{3,38} Saudi Arabia,¹³ in South Africa on the intention to use e-prescribing³³ and Ethiopia on intention to use electronic medical record and eLearning based continuing professional development among healthcare professionals.^{16,26,31} The study result indicates that physicians' and nurses' perception of PACSs are valuable predictors of behavioral intention to use. The possible reason might be the more PACS improve image productivity, performance, and decrease waiting time of patient the more likely they will be intended to use it. This result is contrary on technology acceptance among medical doctors in India.²⁰ The reason might be small sample size ($n=100$) in previous study.

A motivating finding of this study is that PEn was the most significant predictors of physicians' and nurses' intention to use PACS ($\beta=0.397$, p -value <0.001). This indicates that desirability, pleasure and interests of PACS had positive influence on the physicians' and nurses' intention to use. This finding is supported by prior studies conducted in China on adoption of internet healthcare technology using VAM,⁴⁴ United States,⁴⁵ United Kingdom on extension of UTAUT model on healthcare,⁴⁶ Saudi Arabia on intention to PACS,¹³

and Ethiopia on intention to use eLearning among health sciences students.⁴⁷ This suggests the physicians and nurses plan to utilize PACS to enhance patient experience by making diagnosis and interpretation of radiological images more enjoyable. However, this study is contrary to a study done in India on technology acceptance among medical doctors.⁶³ The possible reason might be the prior research used small sample size (427) and conducted in small area.

Finally, this findings revealed that there was a strong association between CL and intention to use PACS ($\beta=0.191$, p -value <0.001). This finding is supported by a study conducted in Canada,⁴⁸ Nigeria on use of e-Medicine,⁴⁹ South Africa on acceptance of e-prescribing technology,³³ and Ethiopia on intention of electronic medical records.¹⁶ This may be due to those who are familiar with computers believed they will not have any difficulties if the PACS will be implemented in the organization.

This study demonstrated how digital knowledge and participant pleasure about using PACS are substantially associated. This implies that, if managers and active authorities supported the adoption of PACS, user happiness and digital knowledge may connect with implementation success, in line with other study findings.

In this study, we found that age and gender have no significance difference on the relationship between intention to use PACS and predictors. This findings is supported with previous studies conducted in Belgium.^{64,65} Although studies indicate age and gender play a significant role in IT, but there is no strong evidence for their influence on healthcare.

Finally, this study offers practical and theoretical implications based on findings.

Limitations of the study

This investigation was limited by quantitative methods and do not include UTAUT2 predictors like habit and price

value, the volunteer participation may be selection bias and was not incorporated power analysis for sample size calculation are some of the limitations of this study that need to be addressed in future studies. Lastly, future studies may use a mixed-method approaches, in addition to including extraneous elements that could influence physicians' and nurses' behavioral intention to utilize PACS in order to improve perception and provide a greater generalization of the findings.

Conclusion

Over all more than half of physicians' and nurses' intention to use PACS were at hopeful stage for imminent. PE, PEn, and CL had direct positive effect on intention to use PACS among physicians and nurses. Among the three findings PEn had the most significant predictors of physicians' and nurses' intention to use PACS. The designers, developers, and managers of the PACS should consider these variables. Furthermore, using this system can improve quality of health service through change workflow in to digital image, clinicians evaluate image more quickly and saving resources. In the future studies testing adoption of PACS by means of another model, such as UTAUT2.

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Authors' contributions

JMK was responsible for contributing significantly to the conceptualization, study selection, data collection, formal analysis, funding acquisition, investigation, methodology, and original draft preparation. Project administration, resources, software, supervision, validation, visualization, and reviewing are all handled by HMB, ABT, RAM, AAN, and HDW. JMK, ABT and HDW wrote the final draft of the manuscript, and the final draft of the work was read, edited, and approved by all the writers.

Availability of data and materials

The corresponding author can request reasonable access to the datasets created and/or analyzed during the current work.

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study was used human participants. Additionally, this study was conducted according to the Helsinki Declaration. Written informed consent was obtained from the study participants after being informed of the objective of the study. They have also been informed of the benefits of the study. If they feel discomfort, they were informed that they can stop at any time. To keep the confidentiality of any information provided by study participants, the dataset did not include personal identifiers.

Ethics approval

Ethical clearance was obtained from the Ethical Review Board (IRB), University of Gondar College of Medicine and Health Sciences (Ethical reference number SOM 0049/2016).

Consent for publication

Not applicable.

Informed consent


Written informed consent was obtained from all subjects before the study.

Trial registration

Not applicable.

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Supplemental material

Supplemental material for this article is available online.

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