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Health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting: Applying UTAUT model

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Abstract

Objective: This study aimed to assess healthcare providers' intentions and its associated factors to use mobile phone short message services to support adherence and care of TB patients in the Oromia region of southwest Ethiopia.

Study design: An institutional-based cross-sectional study was conducted from October to November 2022.

Participants: A total of 625 (54.9% male and 45.1% female) health professionals participated in the study. The study participants were selected using a simple random sampling technique. All health professionals permanently working in Ilu Aba Bor and Buno Bedelle zones were included in this study. However, Health professionals with less than six months of experience and those who were not present during the data collection period were excluded from this study.

Setting: Public hospitals which includes Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.in Ilu Aba Bor and Buno Bedelle zones

Outcome measure: The main outcome measure was intention to use mobile based short message service to support TB patients

Result: Effort expectancy had a significant direct effect on attitude (β =0.162, P<0.01) and intention towards using mobile phone SMS (β =0.329, P<0.001). The behavioral intention to use mobile phone SMS was directly and significantly affected by facilitating conditions (β= 0.104, P< 0.01) and attitude (β= 0.26, P < 0.001). The relationship between effort expectation and intention to use a mobile phone SMS was mediated by attitude (β= 0.043, p-value < 0.01).

Conclusion: Effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy had a more significant prediction power than intention to use mobile phone SMS. As a result, system forms that are easily interactive and applicable should be implemented to improve capacity building and support the adherence and care of TB patients.

Keywords: mobile health, short message service, tuberculosis, UTAUT

Strength and limitation of the study

- This is the first study in Ethiopia assessing the intentions of health care professionals to use a mobile phone-based SMS health service for TB patients.
- The study implications for upcoming researchers, practice and health care policy
- The study may be tilted in favor of social desirability because it is a cross-sectional survey.
- The study was not supported by qualitative findings
- The study was not included private hospitals

Introduction

Globally, it is crucial to cure tuberculosis (TB) to reduce morbidity, mortality, and the risk of continued transmission, but it can be difficult to support and monitor patients during the entirety of treatment (1, 2). The consequences of patients' noncompliance with TB therapy include drug resistance, recurrence, and death (2-4). The World Health Organization (WHO) recommends in-person, directly observed therapy, either at home or in a medical facility, to increase TB adherence (5). However, directly observed therapy is frequently difficult and impractical to implement in most areas with a high TB burden; TB programs frequently struggle to provide the human resources to guarantee regular face-to-face interactions over a long period, and directly observed therapy is extremely time-consuming, can seriously interfere with work, family obligations, and other daily activities from the perspective of people with TB, and may be perceived as patronizing and intrusive(6).

According to studies carried out in northwest Ethiopia, 34% of patients' arguments for not adhering to TB treatment were forgetfulness (7, 8). Patients in the continuation phase, as opposed to those in the intensive phase, are in charge of returning their prescriptions once a week to the neighboring clinic and taking their medications at home while being observed by neighbors. However, community members may be too preoccupied with their daily tasks to remember and monitor patients for such a long time. Thus, the introduction of digital health technologies by the healthcare professional may improve patient adherence to TB therapy.

Digital technology adoption is viewed by health professionals as a key method for improving the efficacy, efficiency, and quality of healthcare delivery because it can improve patient care quality and service delivery efficiency while minimizing errors (9, 10). Particularly, there is an increase in the usage of mobile technology in healthcare, For instance, mobile technology's Short Message Service (SMS) feature can be used to track upcoming appointments, preventative immunizations, and long-term self-management treatments (9).To encourage the development of digital health innovations in worldwide efforts to improve TB care and prevention, the WHO has already formed its global task force on digital health, such as mobile health (11, 12).

With extensive adoption in low- and middle-income countries (LMIC), especially those with lower socioeconomic standing, the number of mobile phone subscriptions now outnumbers the number

of people worldwide (13). With their ability to facilitate direct communication between health care providers and people with TB thanks to their short message service (SMS) and mobile voice call features, mobile phones have the potential to help overcome the difficulties associated with directing observed therapy-based TB care. Mobile calls that allow for audio communication are second most common to SMS, which includes basic text messaging and other app-based messaging options. Additionally, more individuals now own smartphones, making it possible in some locations with a strong internet connection to conduct video conversations.

The study may have effects on practice, policy, and upcoming researchers. The main beneficiaries of this study's useful information for normal practices are patients, health professionals, RHBs, and NGOs. According to our search of the literature, little research has been done on the subject of health care professionals' intentions to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting using the UTAUT model. As a result, this study investigates, introduces, and empirically tests a modified theoretical model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model to identify the main factors influencing healthcare professionals' intention to adopt and use a mobile phone SMS system.

Theoretical background and hypothesis development

Different types of models have been used to identify factors associated with the acceptance and use of health information system technologies (14, 15). A unified theory of acceptance and use of technology (UTAUT) model is currently regarded as the most accurate and up-to-date technology acceptance model used to evaluate intention to use and actual use of technology. After looking at eight models, including the theory of reasoned action, the technology acceptance model, the theory of planned behavior, the social cognitive theory, the motivational model, the combined technology acceptance model, and the innovation diffusion theory, the UTAUT model was developed to put forth a unified theory of technology acceptance (14, 16).

The acceptance and utilization of mobile-based SMS for TB treatment monitoring depend on the particular patients, healthcare providers, and facilities that serve TB patients. If adopted, our suggested approach will be implemented in resource-constrained settings, and healthcare professionals will play a crucial role in its adoption and continued use. The UTAUT model is

suitable for this study due to its robustness and broad use in analyzing technology adoption at the individual level.

This model proposes four predictive elements, including performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) (16). After we used the fundamental elements of the UTAUT model we modified it in the context of a comprehensive review of the literature employing UTAUT in healthcare technology (14, 17-19). In addition to the four fundamental constructs (PE, EE, SI, and FC), attitude toward using technology (ATT) may have a substantial impact on the intention to use information technology (BI) in developing nations. Actual use is another factor in the UTAUT model that is important when the solution is frequently accessible. This variable was not included in our study because the solution is still not accessible for continuous use (Figure 1). The definitions of the constructs used and the associations that were hypothesized and tested in this study are provided below.

Behavioral Intention to Use (BI)

Behavioral intention is the degree to which a person has made deliberate plans to engage in or refrain from engaging in a particular future action (16). It essentially assesses the healthcare professional's intent to utilize the solution. In this study, healthcare professionals are questioned about their intentions to employ the proposed solution when it becomes accessible in the future.

Performance Expectancy (PE)

Performance expectancy is described as the extent to which a person believes that implementing the solution will enable him or her to boost their level of productivity at work (16). Respondents were questioned about the solution's value and how it influenced their task effectiveness, productivity, job effectiveness, quality of work, and the TB monitoring process. Health professionals' views toward the solution and their intention to adopt it may be positively influenced by the improved work output and improved health outcomes that this digital solution may enable. Thus, healthcare professionals are more likely to use mobile phone-based SMS, if they think that PE is high (9, 20-24). Based on the above-mentioned literature, the following hypotheses were investigated in this study:

H1-PE has a positive influence on the intention to use mobile phone SMS technology.

H2-PE has a positive influence on attitudes toward using mobile phone SMS technology.

Effort Expectancy (EE)

Effort Expectancy is the degree of ease with which a system is used (16). Items in this design have to do with how simple it is to use, learn and build new skills, and comprehend how the suggested solution interacts with the user. In the treatment value chain, healthcare professionals are expected to enter information, read it, and engage with communication technology like mobile phones. Because of this, the system must be simple to use when it comes to entering patient data throughout therapy and retrieving it to confirm and send the data to patients. According to studies, users' intention to utilize technology is influenced by their effort expectations (9, 21, 22, 24). Based on these, the following hypotheses were investigated in this study:

H3. EE has a positive influence on the intention to use mobile phone SMS technology

H4. EE has a positive influence on attitude to use mobile phone SMS technology

Social Influence (SI)

Social influence is the extent to which the user believes that significant others think he or she should use the system (16). SI is thought to be significant, particularly outside of the workplace. SI may play a significant role in the adoption and continued use of the solution given the experience of inconsistent adherence to reporting guidelines and treatment regimens by patients, medical professionals, allied healthcare professionals, and their organizations (clinic/hospital management). Intention to use the mobile phone for SMS may therefore be strong if SI is positive (9, 20, 21, 24). In the context of this, the following hypotheses were investigated in this study:

H5: SI has a positive influence on the intention to use mobile phone SMS technology.

H6: SI has a positive influence on attitudes toward using mobile phone SMS technology.

Facilitating Condition (FC)

A facilitating Condition is an extent to which a person believes that an institutional and technological framework exists to enable the use of the system (16). Conditions in the context of TB treatment monitoring include having the knowledge and tools required to utilize the system as

well as the proposed solution's compatibility with existing systems (9, 20, 23, 24). On account of these empirical findings, our study makes the following hypothesis:

H7.FC has a positive influence on the intention to use mobile phone SMS technology.

H8. FC has a positive influence on attitudes toward using mobile phone SMS technology.

Attitude (ATT)

The concept of attitude describes how social opinions regarding new technologies influence people's feelings and conduct (25). In a context with low resources, health professionals have little knowledge about access to technology, which makes changing their attitude about using a new technology extremely difficult (14). We reasoned that including attitude as a category could seem pertinent to studying behavioral intentions to use new technology in certain contexts (14, 20, 22, 26-29). On account of those findings, our study makes the following hypothesis:

H9: ATT has a positive influence on the intention to use mobile phone SMS technology.
H10: Attitude mediates the relationship between PE and intention to use mobile phone SMS technology.
H11: Attitude mediates the relationship between EE and intention to use mobile phone SMS technology.
H12: Attitude mediates the relationship between SI and intention to use mobile phone SMS technology.
H13: Attitude mediates the relationship between FC and intention to use mobile phone SMS technology.

Methods and materials

Study design and setting

The institutional-based cross-sectional study design was conducted from October to November 2022 at public hospitals in Ilu Aba Bor and Buno Bedelle zones, Oromia Regional State, southwest Ethiopia. Illu Aba Bor Zone comprises one town administration and fourteen rural districts with a total population of 1,606,502, according to the 2019 district finance and economic development

office annual data report. Among those zones, five hospitals exist, namely: Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.

Study Population

All healthcare professionals working in the southwest Oromia region of public hospitals in the two zones were used as study populations. All health professionals working at public health hospitals in the Ilu Aba Bor and Buno Bedelle zones who were available during data collection time were included in the study. Health professionals with less than six months of working experience in the two zones were excluded from the study

Sample size determination

The sample size was estimated based on structural equation modeling assumptions of determining model-free parameters using the modified model (Figure 1) by considering 25 variances of the independent variables, 6 covariances between independent variables, 16 load factors between latent and latent indicators, and 8 direct effects. 4 indirect effects of regression coefficients and between observed or latent variables were estimated, yielding a total of 59 free parameters. But the variances of dependent variables, the covariance between dependent variables, and the covariance between dependent and independent variables are never parameters (as would be explained by other parameters), and for each latent variable, its metric must be set: Set its variance to a constant (typically 1) and fix a load factor between latent and its indicator for independent latent (68). Accordingly, A 1: 10 ratio of responders to free parameters to be estimated was suggested to estimate the sample size based on the number of free parameters in the hypothetical model(30). As a result, the minimum sample size necessary was 590, taking into account the 59 parameters that needed to be estimated and taking participants by a free parameter ratio of 10. The final sample size was 649 since the computed sample size considers the 10% non-response rate.

Sampling Procedure

Participants for the study were chosen from five hospitals in southwest Ethiopia. Using population proportion allocation, the study subjects were chosen from the following hospitals: Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital. The

number of healthcare professionals from the five hospitals in southwest Ethiopia was calculated using population proportional allocation and simple random sampling.

Data collection tools, data quality control, and procedures

To investigate the hypotheses provided by this study, a structured questionnaire was used from earlier investigations (14, 26-29). There are two sections to the questionnaire. In a multiple-choice format, Section A focuses on user demographic data, including gender, age, education, and years of experience. Various professions. 18 encouraging statements make up Section B, which represents the constructions that are part of the UTAUT as well as the one newly introduced construct, ATT. A five-point Likert scale, with 1 denoting strongly disagree and 5 denoting strongly agree, was used to measure the constructs.

To control the quality of the data, two days of training were given to data collectors and supervisors on the objective of the study, data collection procedures, data collection tools, respondents' approaches, data confidentiality, and respondents right before the data collection date. Before the actual data collection, pretesting of the questionnaire was conducted by about 10% of the study participants outside of the study in Jimma Hospital. After obtaining feedback from the respondents, language experts modified the wording of the questions

Verify the internal consistency of the items using the Cronbach alpha coefficient (Cα), and composite reliability (CR). The results showed that all of the items' scores were above 0.7. The assumptions were examined for outliers, multi-collinearity, and independent error factors before running the structural equation model. The results showed that there was no existing multi-collinearity, with the overall variance inflation factor (VIF) value being less than 2 and the tolerance being greater than 0.5.

Patient and public involvement

The research question, outcome measures, design, recruitment, analysis and interpretation of the results and study execution were all developed without the involvement of any patients. Additionally, there are no plans to share the findings with the patients and the study's design did not directly engage the general public.

Data processing and analysis

Data from respondents were entered into Epi-Data version 4.6 and exported to SPSS version 25 for descriptive data analysis. Additionally, model constructs were evaluated using structural equation modeling (SEM) analysis via Analysis of Moment Structure (AMOS) version 26 software. On the test measurement model, confirmatory factor analysis (CFA) using standardized data was used. As part of confirmatory factor analysis, a correlation between constructs less than 0.8 and factor loadings greater than 0.6 for each item was examined (31). The chi-square ratio ($\leq$5), the tucker-lewis index (TLI>0.9), the comparative fit index (CFI>0.9), the goodness of fit index (GFI > 0.9), the adjusted goodness of fit index (AGFI > 0.8), the root means square error approximation (RMSEA<0.08), and the root mean square of the standardized residual (RMSR<0.08) were all used to evaluate the goodness of fit (25, 32, 33).

Data normality was evaluated using multivariate kurtosis < 5 and the critical ratio between -1.96 and +1.96. Multicollinearity was also tested using VIF < 10 and tolerance > 0.1, as well as the correlation between exogenous constructs of <0.8, and there were no problems. In the measurement model, Cronbach's alpha test was used to assess construct reliability; each construct in the study met the required threshold of >0.70, and the composite reliability was above 0.70 (34). The Average Variance Extracted (AVE) approach, with values above 0.5, was used to assess the converging validity, while the square root of AVE in Furnell Larcker criterion, with values below 0.9, was used to assess the diverging validity (25, 35, 36).

To evaluate a structural model, the critical ratio (CR) and the path coefficient were used to analyze the relationship between exogenous and endogenous variables. A p-value of less than 0.05 and 95% confidence intervals was used to assess the predictors' statistical significance. The influence and level of significance of each of the four possible mediation paths in the model were explored, partial mediation occurs when a construct's direct, indirect, and total effects are all statistically significant, and full mediation occurs when the direct and indirect effects are both statistically significant but the total effect is not. To confirm mediation, we typically looked for a substantial indirect effect with a p-value < 0.05

Results

Socio-demographic characteristics of healthcare professionals

A total of 625 study participants have included in the study with a response rate of 96.3% of them who gave their consent and responded to the questions. Of the total of (n=625) respondents, 343(54.9%) of them were males, 293(46.9%) respondents were in the age group of <30 years and the mean age of the respondents was 32±6.01 years About more than half of the respondents 451 (72.2%) had less than or equal to 3 years of work experience. In addition, about 228(36.5%) of the respondents were medical doctor professionals (Table 1).

Table 1: Socio demographic characteristics of health care professionals in a resource-limited setting, 2022 (n=625)

Sociodemographic Characteristics	Category	Frequency(N)	Percentage (%)
Gender	Male	343	54.9
	Female	282	45.1
Age (year)	<30	293	46.9
	30-39	254	40.6
	>40	78	12.5
Profession	Medical doctor	228	36.5
	Nurse	165	26.4
	Midwifery	117	18.6
	Health officer	46	7.4
	Others	115	11
Work experience	1-3	451	72.2
	3-5	62	9.9
	>5	112	17.9

Others: Anesthesia, Radiology, Psychiatry and Pharmacy

Measurement model

Reliability and validity of the construct

All of the constructs had Cronbach's alpha scores between 0.77 and 0.91 and composite reliability scores between 0.78 and 0.92, factor loadings of the items ranged between 0.64 and 0.89, and the value of AVE varied between 0.61 and 0.71. Therefore, all of the constructs had strong convergent validity (Table 2).

Table 2: Convergent validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Construct	Indicators / Items	Standard loading	Composite Reliability	Cronbach alpha	AVE	Convergent Validity
Performance Expectancy	PE1	0.85	0.88	0.85	0.65	Established
	PE2	0.84				
	PE3	0.67				
	PE4	0.74				
Effort Expectancy	EE1	0.87	0.91	0.87	0.69	Established
	EE2	0.89				
	EE3	0.69				
	EE4	0.73				
Social Influence	SI1	0.78	0.90	0.90	0.68	Established
	SI2	0.97				
	SI3	0.88				
Facilitating Condition	FC1	0.81	0.92	0.91	0.72	Established
	FC2	0.84				
	FC3	0.83				
	FC4	0.82				
Attitude	ATT1	0.67	0.78	0.77	0.61	Established
	ATT2	0.71				

	ATT3	0.68				
	ATT4	0.66				
Behavioral Intention	BI1	0.80	0.79	0.79	0.64	Established
	BI2	0.64				
	BI3	0.82				

Note; AVE: Average Variance Extracted

According to the findings, the bolded values (diagonal values) or the square root of the AVE of the construct were higher than the other values in that column, and the raw. As a result, the model's constructs' discriminant validity has been proven (Table 3).

Table 3: Discriminant validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Construct	PE	EE	SI	FC	ATT	BI	Divergent Validity
Performance Expectancy (PE)	**0.806**						Established
Effort Expectancy (EE)	0.143	**0.831**					Established
Social Influence (SI)	0.436	0.516	**0.825**				Established
Facilitating Condition (FC)	0.533	0.178	0.543	**0.848**			Established
Attitude (ATT)	0.366	0.601	0.383	0.511	**0.781**		Established
Behavioral Intention to use (BI)	0.325	0.556	-0.112	0.362	0.603	**0.800**	Established

Goodness of fit

The results in confirmatory factor analysis showed that model fit indices with respective values were chi squire difference(x^2/df=2.76), Goodness-of-fit-index (GFI=0.93), Adjusted goodness-of-fit-index (AGFI=0.91), Comparative fit index (CFI=0.94), Tucker-Lewis's index (TLI=0.93), Root means the square error of approximation (RMSEA=0.05) and standardized root mean squared residual (SRMR=0.03). Accordingly, the goodness of fit model's values met the requirements.

Structural equation model

The result showed that effort expectancy had a significant direct effect on health care professionals' attitude to using mobile phone short message service (β =0.162, 95% CI: [0.061,0.270], P<0.01) and intention towards using mobile phone SMS (β =0.329, 95% CI: [0.233, 0.433], P<0.001). The facilitating condition had a direct significant effect on healthcare provider's intention towards using mobile phone SMS (β =0.104, 95% CI: [0.025, 0.191], P<0.01), and also healthcare professionals' attitude towards the system had a direct significant effect on behavioral intention to use mobile phone SMS (β =0.268, 95% CI: [0.163, 0.373], P<0.001). whereas the relationship between performance expectancy (β =0.268, 95% CI: [-0.017,0.170], P=0.109), social influence (β =0.015, 95% CI: [-0.044, 0.075], P=0.610) and facilitating conditions (β =0.055, 95% CI: [-0.026, 0.140], P=0.184) were not significant effect on health care professionals' attitude towards using mobile phone SMS, and the path relationship of performance expectancy(β =0.002, 95% CI: [-0.088, 0.094], P=0.980) and social influence(β =-0.030, 95% CI: [-0.086,0.028], P=0.318) to use mobile phone SMS were not statistically significant (Table 4).

Table 4: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	B	S. E	C.R	P-Value	95% CI		Decision
						Lower	Upper	
PE → BI	H1	0.002	0.041	0.055	0.980	-0.088	0.094	Not Supported
PE→ ATT	H2	0.076	0.044	1.70	0.109	-0.017	0.170	Not Supported
EE → BI	H3	0.329	0.048	6.583	0.000***	0.233	0.433	Supported
EE→ ATT	H4	0.162	0.050	3.229	0.001**	0.061	0.270	Supported
SI → BI	H5	-0.030	0.030	-1.002	0.318	-0.086	0.028	Not supported
SI→ ATT	H6	0.015	0.032	0.475	0.610	-0.044	0.075	Not Supported
FC → BI	H7	0.104	0.039	2.649	0.011**	0.025	0.191	Supported
FC→ ATT	H8	0.055	0.041	1.317	0.184	-0.026	0.140	Not Supported
ATT → BI	H9	0.268	0.054	4.956	0.001**	0.163	0.373	Supported

Note: ** p value <0.01, ***p value is <0.001 C, R: critical ratio S.E: standard error, CI: confidence interval, β: estimate

According to the finding, performance expectancy, effort expectancy, social influence, and facilitating conditions accounted for 68% and 74% of the variance (R^2) in attitude and intention to use mobile phone short message services, respectively (Figure 2).

Mediation effects

The results revealed that attitude played a mediating role in the relationship between health care professionals' effort expectations and their intention to use mobile phone short message service to support TB patients, as opposed to the relationship between performance expectancy, social influence, and facilitating conditions. Both the relationship between attitude and intention to use the system, as well as the regression coefficient between attitude and effort expectancy, were statistically significant. The indirect effect of the standardized estimation value was 0.043 and P< 0.01. In the context of this, the relationship between effort expectancy and an intention to use mobile-based SMS was statistically significant through attitude (Table 5).

Table 5: Mediating effects of Attitude and health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	Effect	β	P-value	Result	Decision
PE→AT→ BI	H10	Total effect	0.025	0.643	No relationship	Not Support
		Indirect effect	0.023	0.090		
		Direct effect	0.003	0.982		
EE→AT→ BI	H11	Total effect	0.365	0.000***	Partial Mediation	Support
		Indirect effect	0.043	0.001**		
		Direct effect	0.323	0.000***		
SI→AT→ BI	H12	Total effect	-0.038	0.390	No relationship	Not Support
		Indirect effect	0.006	0.587		
		Direct effect	-0.323	0.311		
FC→AT→ BI	H13	Total effect	0.136	0.005 **	Direct relationship	Not Support
		Indirect effect	0.017	0.158		
		Direct effect	0.119	0.012*		

*Significance at P< 0.05, **significance at P< 0.01, ***significance at P< 0.001, β: estimate

Discussion

This research used the UTAUT model for determining the predictors that may influence the use of mobile phone short message service systems to support adherence and care of patients with tuberculosis. The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectation and intention to use the system. Thus, H3, H4, H7, H9, and H11 were supported and thus can be used as effective measures of mobile phone SMS adoption in resource-limited settings.

According to the findings, healthcare professional effort expectancy had a positive direct effect on attitude and both direct and indirect effects on the intention to use mobile phone SMS. This suggested that when healthcare professionals perceived the system's simplicity or lack of effort in use, their perceptions of its usefulness, attitude, and intention to use mobile phone SMS were significantly improved. This finding is consistent with findings from other studies in different countries (9, 22, 37-40). This could be because an individual's attitude and acceptance of the use of mobile phone SMS systems are greatly affected by the work required to manipulate the system. If the system is expected to manipulate people's intentions to use mobile phone SMS systems with less effort, the system's performance will improve. As a result, when implementing the use of mobile phone SMS technologies, the system should be simple for healthcare providers to understand and use to ensure long-term system adoption.

Facilitating conditions also positively influenced the intention to use mobile phone short message services to support adherence and care of patients with tuberculosis. This showed the significance of creating the organizational and IT requirements for this example, including the resources, technical support, and training that are necessary for the adoption and ongoing use of mobile-based SMS-enabled solutions by healthcare providers in the public health system This finding is consistent with findings from other studies in different countries (9, 23, 24, 41). This could be because health professionals think that as mobile phone use has increased, more people have access to them and are familiar with using devices to communicate with their intended recipients. As a result, they are convinced and have no trouble supporting patient care and adherence.

Health professionals' attitudes positively influenced their intention to use mobile phone SMS systems. Medical experts supported the usage of mobile phone SMS as a tool for bettering their health and the standard of tuberculosis treatment as they observed it being done. This finding is in line with findings from other studies done in different settings (9, 20, 42-44). This might be because new technologies will deeply irritate medical professionals who have a fixed, favorable opinion of the usage of SMS systems on mobile phones. Therefore, it is important to give priority to initiatives that change attitudes, such as providing mobile devices at work, providing ongoing training and assistance, and fostering knowledge exchange about eHealth technologies such as mobile SMS for the remainder of the patient's care.

Conclusion

Overall, the UTAUT model was the most suitable model for determining the predictors that may influence the use of mobile phone short message service systems to support adherence and care of patients with tuberculosis in Ethiopia. The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectations and the intention to use the system. Among the five influencing predictors, effort expectancy had a more significant prediction power for healthcare providers' intention to use mobile phone SMS systems. Therefore, easily interactive and applicable forms of the system should be implemented for health care professionals, as well as improving capacity and building on the simplicity of technology to support adherence and the care of TB patients.

Abbreviations and acronyms

AMOS: Analysis of Moment and Structure; **ATT**: Attitude; **BI**: Behavioral Intention; **CI**: Confidence Intervals; **EE**: Effort Expectancy; **FC**: Facilitating Condition; **PE**: Performance Expectancy; **SEM**: Structural Equation Modeling: **SI**: Social Influence; **SMS**: Short Message Service; **SPSS:** Statistical Package for Social Science; **UTAUT**: Unified Theory of Acceptance and Use of Technology; **WHO**: World Health Organization

Ethics approval and consent to participate

The study participants gave their informed consent after the study protocol was evaluated and approved by Mettu University's ethical review board with approval number MeU/RAC/1036/15. Each hospital provided a letter of permission. Each participant in the study gave their written and oral consent after being informed of the study's goal. Furthermore, all data collectors and investigators strictly adhered to the law's requirements for data privacy and confidentiality. Only the study was conducted using the data that was retrieved. As a result, the data-gathering tool did not contain participant's names or any other personal information about them. Furthermore, study was done according to the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

Upon reasonable request from the corresponding author, the datasets created and/or analyzed during the current work will be made available.

Competing interests

The authors declare that we have no competing interests.

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Authors' contributions

The authors contributed equally to the conceptualization, study design, data collection, analysis, and interpretation of the study and agreed to be held accountable for all aspects of the work. Furthermore, they contributed to the paper's formulation or critical revision of its core intellectual ideas

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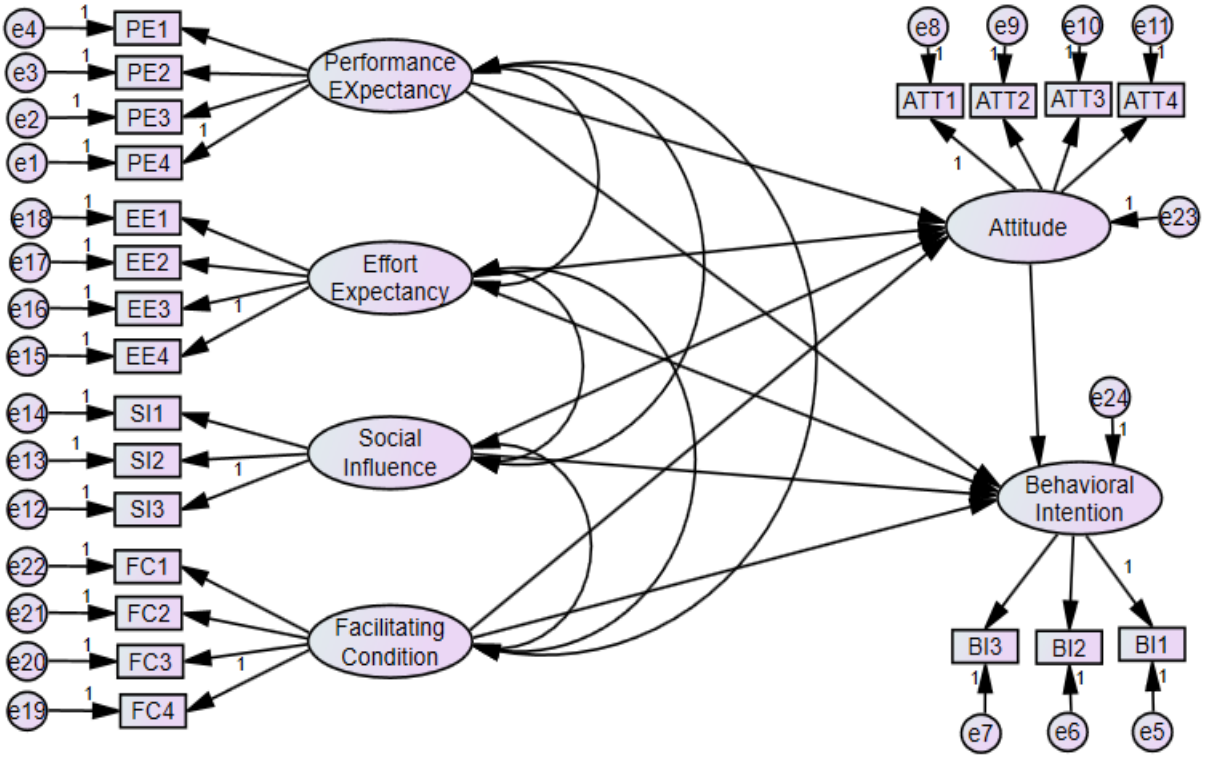
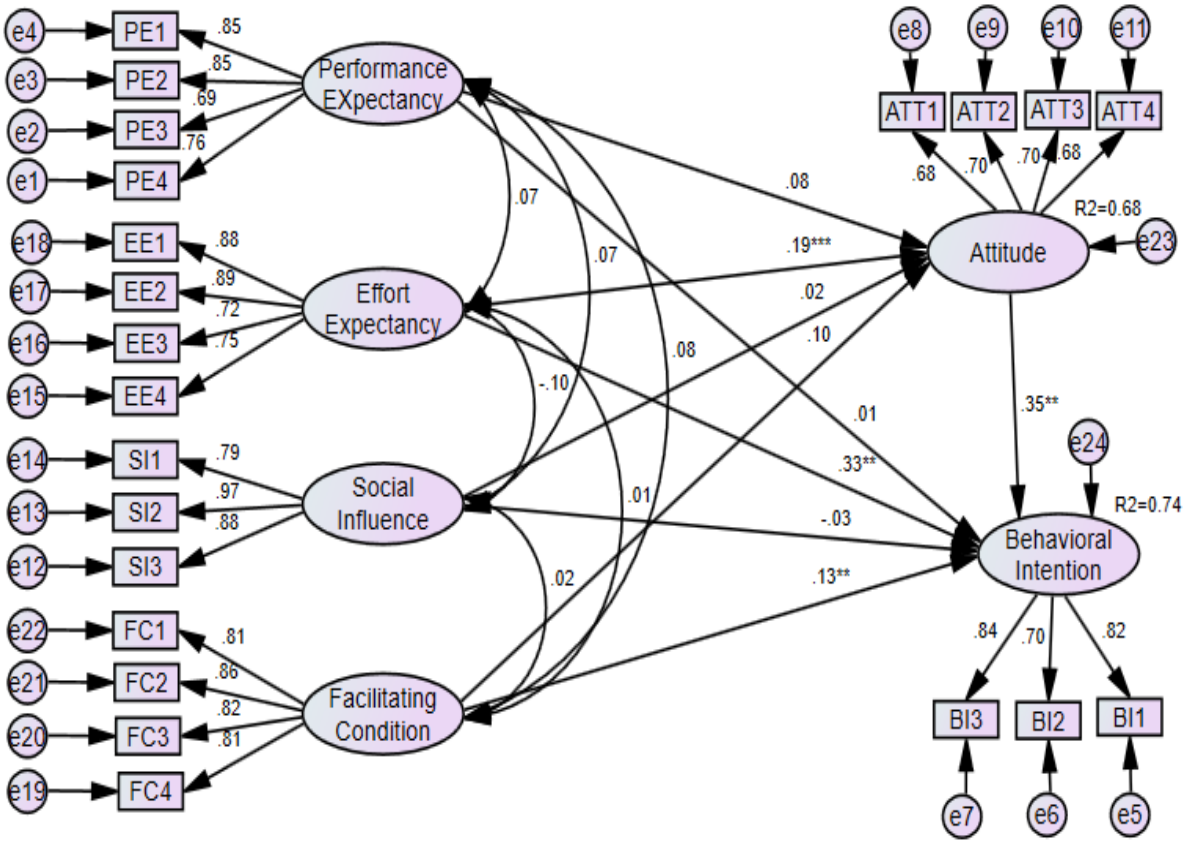
Figures

Figure 1: Modified UTAUT models of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Figure 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022





STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-9
Methods			
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*11-12*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11-12
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14-15
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	15,16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	

		(*b*) Report category boundaries when continuous variables were categorized	15-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Healthcare professionals' intention to use mobile phone-based SMS and its predictors for adherence support and care of TB patients in a resource-limited setting: A structural equation modeling analysis

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Abstract

Objective: To assess healthcare providers' intentions and its associated factors to use mobile phone-based SMS to support adherence and care of TB patients in the Oromia region of southwest Ethiopia.

Study design: An institutional-based cross-sectional study was conducted from October to November 2022.

Setting: Public hospitals which include Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.in Ilu Aba Bor and Buno Bedelle zones.

Participants: A total of 625 (54.9% male and 45.1% female) health professionals participated in the study. The study participants were selected using a simple random sampling technique. All health professionals permanently working in Ilu Aba Bor and Buno Bedelle zone hospitals were included in this study. However, health professionals with less than six months of experience and those who were not present during the data collection period were excluded from this study.

Outcome measure: The intention to use mobile phone-based short message service to support TB patients.

Results: Healthcare professionals' intention to use mobile SMS was 54.4%. Effort expectancy had a significant direct effect on attitude (β =0.162, P<0.01) and intention towards using mobile phone SMS (β =0.329, P<0.001). The intention to use mobile phone SMS was directly influenced by facilitating conditions (β= 0.104, P< 0.01) and attitude (β= 0.26, P < 0.001). The relationship between effort expectancy and intention to use SMS was mediated by attitude (β= 0.043, p-value < 0.01).

Conclusions: Overall, intention to use of mobile-based SMS was high. Effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy had a more significant prediction power than others. As a result, system forms that are easily interactive and

applicable should be implemented to improve capacity building and support the adherence and care of TB patients.

Keywords: mobile health, short message service, tuberculosis, UTAUT

Strengths and limitations of the study

- This study used the unified theory of acceptance and use of technology, which is the most accurate and recent model to identify important factors to influence mobile health technologies.
- The study covers public hospitals with a large sample size, which improved its generalizability.
- This study may be tilted in favor of social desirability because it is a cross-sectional survey.
- The study was not supported by qualitative findings
- The study was not included private hospitals

Introduction

Globally, it is crucial to cure tuberculosis (TB) to reduce morbidity, mortality, and the risk of continued transmission, but it can be difficult to support and monitor patients during the entirety of treatment (1, 2). The consequences of patients who experience treatment interruptions with TB therapy include drug resistance, recurrence, and death (2-4). The World Health Organization (WHO) recommends in-person, directly observed therapy, either at home or in a medical facility, to increase TB adherence (5). However, directly observed therapy is frequently difficult and impractical to implement in most areas with a high TB burden; TB programs frequently struggle to provide the human resources to guarantee regular face-to-face interactions over a long period, and directly observed therapy is extremely time-consuming, can seriously interfere with work, family obligations, and other daily activities from the perspective of people with TB, and may be perceived as patronizing and intrusive(6).

According to studies carried out in northwest Ethiopia, 34% of patients' arguments for not adhering to TB treatment were forgetfulness (7, 8). Patients in the continuation phase, as opposed to those in the intensive phase, are in charge of returning their prescriptions once a week to the neighboring clinic and taking their medications at home while being observed by neighbors. However, community members may be too preoccupied with their daily tasks to remember and monitor patients for such a long time. Thus, the introduction of digital health technologies by healthcare professional may improve patient adherence to TB therapy.

Digital technology adoption is viewed by health professionals as a key method for improving the efficacy, efficiency, and quality of healthcare delivery because it can improve patient care quality and service delivery efficiency while minimizing medical errors (9, 10). Particularly, there is an increase in the usage of mobile technology in healthcare, For instance, mobile technology's Short Message Service (SMS) feature can be used to track upcoming appointments, preventative immunizations, and long-term self-management treatments (9).To encourage the development of digital health innovations in worldwide efforts to improve TB care and prevention, the WHO has already formed its global task force on digital health, such as mobile health (11, 12).

With extensive adoption in low- and middle-income countries (LMIC), especially those with lower socioeconomic standing, the number of mobile phone subscriptions now outnumbers the number

of people worldwide (13). With their ability to facilitate direct communication between health care providers and people with TB thanks to their short message service (SMS) and mobile voice call features, mobile phones have the potential to help overcome the difficulties associated with directing observed therapy-based TB care. Mobile calls that allow for audio communication are second most common to SMS, which includes basic text messaging and other app-based messaging options. Additionally, more individuals now own smartphones, making it possible in some locations with a strong internet connection to conduct video conversations. However, in comparison to other developed regions, the use of mobile technology in the healthcare system in developing countries is too often limited to certain roles for health interventions. The evidence done in Ethiopia showed that mobile-phone messaging revealed a positive effect in improving healthcare services (2, 14, 15), but the intention level of healthcare providers to use mobile health with SMS to support patients in the resource-limited setting is uncertain.

Theoretical background and hypothesis development

Different types of models have been used to identify factors associated with the acceptance and use of health information system technologies (16, 17). A unified theory of acceptance and use of technology (UTAUT) model is currently regarded as the most accurate and up-to-date technology acceptance model used to evaluate intention to use and actual use of technology. After looking at eight models, including the theory of reasoned action, the technology acceptance model, the theory of planned behavior, the social cognitive theory, the motivational model, the combined technology acceptance model, and the innovation diffusion theory, the UTAUT model was developed to put forth a unified theory of technology acceptance (16, 18).

The acceptance and utilization of mobile-based SMS for TB treatment monitoring depend on the particular patients, healthcare providers, and facilities that serve TB patients. The UTAUT model is suitable for this study due to its robustness and broad use in analyzing technology adoption at the individual level. Since the UTAUT model is an extension of other models and therefore has a strong capability to clarify the behavioral intentions of users as compared with other single models (19, 20). Accordingly, we used the model through adapt or modify the constructs in our study setting

This model proposes four predictive elements, including performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) (18). After we used the fundamental elements of the UTAUT model we modified it in the context of a comprehensive review of the literature employing UTAUT in healthcare technology (16, 21-23). In addition to the four fundamental constructs (PE, EE, SI, and FC), attitude toward using technology (ATT) may have a substantial impact on the intention to use information technology (BI) in developing nations. Actual use is another factor in the UTAUT model that is important when the solution is frequently accessible. This variable was not included in our study because the solution is still not accessible for continuous use (Figure 1). The constructs used and the associations that were hypothesized and tested in this study are provided below.

Behavioral Intention to Use (BI)

Behavioral intention is the degree to which a person has made deliberate plans to engage in or refrain from engaging in a particular future action (18). It essentially assesses the healthcare professional's intent to utilize the solution. In this study, healthcare professionals are questioned about their intentions to employ the proposed solution when it becomes accessible in the future.

Performance Expectancy (PE)

Respondents were questioned about the solution's value and how it influenced their task effectiveness, productivity, job effectiveness, quality of work, and the TB monitoring process. Health professionals' views toward the solution and their intention to adopt it may be positively influenced by the improved work output and improved health outcomes that this digital solution may enable. Thus, healthcare professionals are more likely to use mobile phone-based SMS, if they think that PE is high (9, 24-28). Based on the above-mentioned literature, the following hypotheses were investigated in this study:

H1-PE has a positive influence on the intention to use mobile phone SMS technology.

H2-PE has a positive influence on attitudes toward using mobile phone SMS technology.

Effort Expectancy (EE)

In system design has to do with how simple it is to use, learn and build new skills, and comprehend how the suggested solution interacts with the user. In the treatment value chain, healthcare professionals are expected to enter information, read it, and engage with communication technology like mobile phones. Because of this, the system must be simple to use when it comes to entering patient data throughout therapy and retrieving it to confirm and send the data to patients. According to studies, users' intention to utilize technology is influenced by their effort expectations (9, 25, 26, 28). Based on these, the following hypotheses were investigated in this study:

H3. EE has a positive influence on the intention to use mobile phone SMS technology

H4. EE has a positive influence on attitude to use mobile phone SMS technology

Social Influence (SI)

Social influence is thought to be significant, particularly outside of the workplace. SI may play a significant role in the adoption and continued use of the solution given the experience of inconsistent adherence to reporting guidelines and treatment regimens by patients, medical professionals, allied healthcare professionals, and their organizations (clinic/hospital management). Intention to use the mobile phone for SMS may therefore be strong if SI is positive (9, 24, 25, 28). In the context of this, the following hypotheses were investigated in this study:

H5: SI has a positive influence on the intention to use mobile phone SMS technology.

H6: SI has a positive influence on attitudes toward using mobile phone SMS technology.

Facilitating Condition (FC)

Conditions in the context of TB treatment monitoring include having the knowledge and tools required to utilize the system as well as the proposed solution's compatibility with existing systems (9, 24, 27, 28). On account of these empirical findings, our study makes the following hypothesis:

H7.FC has a positive influence on the intention to use mobile phone SMS technology.

H8. FC has a positive influence on attitudes toward using mobile phone SMS technology.

Attitude (ATT)

In a context with low resources, health professionals have little knowledge about access to technology, which makes changing their attitude about using a new technology extremely difficult (16). We reasoned that including attitude as a category could seem pertinent to studying behavioral intentions to use new technology in certain contexts (16, 24, 26, 29-32). On account of those findings, our study makes the following hypothesis:

H9: ATT has a positive influence on the intention to use mobile phone SMS technology.

H10: Attitude mediates the relationship between PE and intention to use mobile phone SMS technology.

H11: Attitude mediates the relationship between EE and intention to use mobile phone SMS technology.

H12: Attitude mediates the relationship between SI and intention to use mobile phone SMS technology.

H13: Attitude mediates the relationship between FC and intention to use mobile phone SMS technology.

The main beneficiaries of this study will be patients, health professionals, Regional Health Bureaus (RHBs), and health organizations for health system practices. According to our search of the literature, little research has been done on the subject of healthcare professionals' intentions to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting using the Unified Theory of Acceptance and Use of Technology (UTAUT)model. As a result, this study investigates, introduces, and empirically tests a modified theoretical model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model to identify the main factors influencing healthcare professionals' intention to adopt and use a mobile phone SMS system.

Methods and materials

Study design and setting

The institutional-based cross-sectional study design was conducted from October to November 2022 at public hospitals in Ilu Aba Bor and Buno Bedelle zones, Oromia Regional State, southwest Ethiopia. Illu Aba Bor Zone comprises one town administration and fourteen rural districts with a total population of 1,606,502, according to the 2019 district finance and economic development

office annual data report. Among those zones, five hospitals exist, namely: Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.

Study Population

All healthcare professionals working in the southwest Oromia region of public hospitals in the two zones were used as study populations. All health professionals, working at public health hospitals, who were available during data collection time were included in the study. However, Health professionals with less than six months of working experience and who were on maternal or annual leave or those who were seriously ill during the study period were excluded from the study.

Operational definition

The outcome variable was the intention to use mobile-based SMS among healthcare professionals. Intention to use means the extent to which a person has made intentional plans to use new technology (33, 34). When a healthcare professional rates intention to use a technology measurement and scores median, and above the median was considered as intended to use mobile phone-based SMS, else not intended to use it, with a five-point Likert scale of three questions (33).

Sample size determination

The sample size was estimated based on structural equation modeling assumptions of determining model-free parameters using the modified model (33, 34) (Figure 1), by considering 25 variances of the independent variables, 6 covariance between independent variables, 16 load factors between latent and latent indicators, and 8 direct effects and4 indirect effects of regression coefficients between observed or latent variables were estimated Finally a total of 59 free parameters was estimated. But the variances of dependent variables, the covariance between dependent variables, and the covariance between dependent and independent variables are never parameters (as would be explained by other parameters), and for each latent variable, its metric must be set: Set its variance to a constant (typically 1) and fix a load factor between latent and its indicator for independent latent (68). Accordingly, A 1: 10 ratios of responders to free parameters to be estimated was suggested to estimate the sample size based on the number of free parameters in the hypothetical model (33-35). As a result, the minimum sample size necessary was 590, taking into

account the 59 parameters that needed to be estimated and taking participants by a free parameter ratio of 10. Since the computed sample size considers the 10% non-response rate. Thus, the final sample size of 649 study participants was calculated.

Sampling Procedure

The participants of this study were health professionals across all five study hospitals in southwest Ethiopia. The number of healthcare professionals from the five hospitals was calculated using population proportional allocation and a simple random sampling technique. Finally, consecutive healthcare professionals who full fill the inclusion criterion were included in the study until the allocated size was obtained in each of the five hospitals.

Data collection tools, data quality control, and procedures

To investigate the hypotheses provided by this study, a structured questionnaire was used from earlier investigations (16, 29-32). There are two sections to the questionnaire. In a multiple-choice format, Section A focuses on user demographic data, including gender, age, education, and years of experience. Section B contains 18 positive statements that symbolize the constructs, which represents the constructions that are part of the UTAUT as well as the one newly introduced construct, ATT. A five-point Likert scale, with 1 denoting strongly disagree and 5 denoting strongly agree, was used to measure the constructs.

To control the quality of the data, two days of training were given to data collectors and supervisors on the objective of the study, data collection procedures, data collection tools, respondents' approaches, data confidentiality, and respondents right before the data collection date. Before the actual data collection, pretesting of the questionnaire was conducted by about 10% of the study participants outside of the study in Jimma Hospital. After obtaining feedback from the respondents, language experts modified the wording of the questions

We calculated the internal consistency of the items using the Cronbach alpha coefficient (Cα), and composite reliability (CR). The results showed that all of the items' scores were above 0.7. The assumptions were examined for outliers, multi-collinearity, and independent error factors before running the structural equation model. The results showed that there was no existing multi-

collinearity, with the overall variance inflation factor (VIF) value being less than 2 and the tolerance being greater than 0.5.

Patient and public involvement

The research question, outcome measures, design, recruitment, analysis, and interpretation of the results and study execution were all developed without the involvement of any patients. Additionally, there are no plans to share the findings with the patients and the study's design did not directly engage the general public.

Data processing and analysis

Data from respondents were entered into Epi-Data version 4.6 and exported to SPSS version 25 for descriptive data analysis. Additionally, model constructs were evaluated using structural equation modeling (SEM) analysis via Analysis of Moment Structure (AMOS) version 26 software. On the test measurement model, confirmatory factor analysis (CFA) using standardized data was used. As part of confirmatory factor analysis, a correlation between constructs less than 0.8 and factor loadings greater than 0.6 for each item was examined (36). The chi-square ratio ($\leq$5), the tucker-lewis index (TLI>0.9), the comparative fit index (CFI>0.9), the goodness of fit index (GFI > 0.9), the adjusted goodness of fit index (AGFI > 0.8), the root means square error approximation (RMSEA<0.08), and the root mean square of the standardized residual (RMSR<0.08) were all used to evaluate the goodness of fit (37-39).

Data normality was evaluated using multivariate kurtosis < 5 and the critical ratio between -1.96 and +1.96. Multicollinearity was also tested using VIF < 10 and tolerance > 0.1, as well as the correlation between exogenous constructs of <0.8, and there were no problems. In the measurement model, Cronbach's alpha test was used to assess construct reliability; each construct in the study met the required threshold of >0.70, and the composite reliability was above 0.70 (40). The Average Variance Extracted (AVE) approach, with values above 0.5, was used to assess the converging validity, while the square root of AVE in Fornell Larcker criterion, with values below 0.9, and the correlations with other latent constructs should have a lower value than the square root of AVE in each constructs was used to assess the diverging validity (33, 38, 41, 42).

To evaluate a structural model, the critical ratio (CR) and the path coefficient were used to analyze the relationship between exogenous and endogenous variables. A p-value of less than 0.05 and 95% confidence intervals were used to assess the predictors' statistical significance. The influence and level of significance of each of the four possible mediation paths in the model were explored, partial mediation occurs when a construct's direct, indirect, and total effects are all statistically significant, and full mediation occurs when the direct and indirect effects are both statistically significant but the total effect is not. To confirm mediation, we typically looked for a substantial indirect effect with a p-value < 0.05

Results

Socio-demographic characteristics of healthcare professionals

A total of 625 study participants have included in the study with a response rate of 96.3% of them who gave their consent and responded to the questions. Of the total of (n=625) respondents, 343(54.9%) of them were males, 293(46.9%) respondents were in the age group of <30 years and the mean age of the respondents was 32±6.01 years About more than half of the respondents 451 (72.2%) had less than or equal to 3 years of work experience. In addition, 228(36.5%) of the respondents were medical doctor professionals (Table 1).

Table 1: Socio-demographic characteristics of health care professionals in a resource-limited setting, 2022 (n=625)

Sociodemographic Characteristics	Category	Frequency(N)	Percentage (%)
Gender	Male	343	54.9
	Female	282	45.1
Age (year)	<30	293	46.9
	30-39	254	40.6
	>40	78	12.5
Profession	Medical doctor	228	36.5
	Nurse	165	26.4
	Midwifery	117	18.6
	Health officer	46	7.4
	Others	115	11
Work experience	1-3	451	72.2
	3-5	62	9.9
	>5	112	17.9

Others: Anesthesia, Radiology, Psychiatry, and Pharmacy

Intention to use mobile-based SMS

Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) healthcare professionals were intended to use mobile phone-based SMS in southwest Ethiopia. The median score of intention to use mobile phone-based SMS was 10.1, with a standard deviation of 3.3. The minimum and maximum scores were 3 and 15, respectively.

Measurement model

Reliability and validity of the construct

All of the constructs had Cronbach's alpha scores between 0.77 and 0.91 and composite reliability scores between 0.78 and 0.92, factor loadings of the items ranged between 0.64 and 0.89, and the value of AVE varied between 0.61 and 0.71. Therefore, all of the constructs had strong convergent validity (Table 2).

Table 2: Convergent validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Construct	Indicators /Items	Standard loading	Composite Reliability	AVE	Convergent Validity
Performance Expectancy	PE1 PE2 PE3 PE4	0.85 0.84 0.67 0.74	0.88	0.65	Established
Effort Expectancy	EE1 EE2 EE3 EE4	0.87 0.89 0.69 0.73	0.91	0.69	Established
Social Influence	SI1 SI2 SI3	0.78 0.97 0.88	0.90	0.68	Established

Facilitating Condition	FC1 FC2 FC3 FC4	0.81 0.84 0.83 0.82	0.92	0.72	Established
Attitude	ATT1 ATT2 ATT3 ATT4	0.67 0.71 0.68 0.66	0.78	0.61	Established
Behavioral Intention	BI1 BI2 BI3	0.80 0.64 0.82	0.79	0.64	Established

Note; AVE: Average Variance Extracted

According to the findings, the bolded values (diagonal values) or the square root of the AVE of the construct were higher than the other values in that column, and the raw. As a result, the model's constructs' discriminant validity has been proven (Table 3).

Table 3: Discriminant validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Construct	PE	EE	SI	FC	ATT	BI	Divergent Validity
Performance Expectancy (PE)	**0.806**						Established
Effort Expectancy (EE)	0.143	**0.831**					Established
Social Influence (SI)	0.436	0.516	**0.825**				Established
Facilitating Condition (FC)	0.533	0.178	0.543	**0.848**			Established

Attitude (ATT)	0.366	0.601	0.383	0.511	**0.781**		Established
Behavioral Intention to use (BI)	0.325	0.556	-0.112	0.362	0.603	**0.800**	Established

Goodness of fit

The results in confirmatory factor analysis showed that model fit indices with respective values were chi squire difference(x^2/df=2.76), Goodness-of-fit-index (GFI=0.93), Adjusted goodness-of-fit-index (AGFI=0.91), Comparative fit index (CFI=0.94), Tucker-Lewis's index (TLI=0.93), Root means the square error of approximation (RMSEA=0.05) and standardized root mean squared residual (SRMR=0.03). Accordingly, the goodness of fit model's values met the requirements.

Structural equation model

The result showed that effort expectancy had a significant direct effect on health care professionals' attitude to using mobile phone short message service (β =0.162, 95% CI: [0.061,0.270], P<0.01) and intention towards using mobile phone SMS (β =0.329, 95% CI: [0.233, 0.433], P<0.001). The facilitating condition had a direct significant effect on healthcare provider's intention towards using mobile phone SMS (β =0.104, 95% CI: [0.025, 0.191], P<0.01), and also healthcare professionals' attitude towards the system had a direct significant effect on behavioral intention to use mobile phone SMS (β =0.268, 95% CI: [0.163, 0.373], P<0.001). whereas the relationship between performance expectancy (β =0.268, 95% CI: [-0.017,0.170], P=0.109), social influence (β =0.015, 95% CI: [-0.044, 0.075], P=0.610) and facilitating conditions (β =0.055, 95% CI: [-0.026, 0.140], P=0.184) were not significant effect on health care professionals' attitude towards using mobile phone SMS, and the path relationship of performance expectancy(β =0.002, 95% CI: [-0.088, 0.094], P=0.980) and social influence(β =-0.030, 95% CI: [-0.086,0.028], P=0.318) to use mobile phone SMS were not statistically significant (Table 4).

Table 4: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	B	S. E	C.R	P-Value	95% CI		Decision
						Lower	Upper	
PE → BI	H1	0.002	0.041	0.055	0.980	-0.088	0.094	Not Supported
PE→ ATT	H2	0.076	0.044	1.70	0.109	-0.017	0.170	Not Supported
EE → BI	H3	0.329	0.048	6.583	0.000***	0.233	0.433	Supported
EE→ ATT	H4	0.162	0.050	3.229	0.001**	0.061	0.270	Supported
SI → BI	H5	-0.030	0.030	-1.002	0.318	-0.086	0.028	Not supported
SI→ ATT	H6	0.015	0.032	0.475	0.610	-0.044	0.075	Not Supported
FC → BI	H7	0.104	0.039	2.649	0.011**	0.025	0.191	Supported
FC→ ATT	H8	0.055	0.041	1.317	0.184	-0.026	0.140	Not Supported
ATT → BI	H9	0.268	0.054	4.956	0.001**	0.163	0.373	Supported

Note: ** p value <0.01, ***p value is <0.001 C, R: critical ratio S.E: standard error, CI: confidence interval, β: estimate

According to the finding, performance expectancy, effort expectancy, social influence, and facilitating conditions accounted for 68% and 74% of the variance (R^2) in attitude and intention to use mobile phone short message services, respectively (Figure 2).

Mediation effects

The results revealed that attitude played a mediating role in the relationship between health care professionals' effort expectations and their intention to use mobile phone short message service to support TB patients, as opposed to the relationship between performance expectancy, social influence, and facilitating conditions. Both the relationship between attitude and intention to use the system, as well as the regression coefficient between attitude and effort expectancy, were statistically significant. The indirect effect of the standardized estimation value was 0.043 and P< 0.01. In the context of this, the relationship between effort expectancy and an intention to use mobile-based SMS was statistically significant through attitude (Table 5).

Table 5: Mediating effects of Attitude and health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	Effect	β	P-value	Result	Decision
PE→AT→ BI	H10	Total effect	0.025	0.643	No relationship	Not Support
		Indirect effect	0.023	0.090		
		Direct effect	0.003	0.982		
EE→AT→ BI	H11	Total effect	0.365	0.000***	Partial Mediation	Support
		Indirect effect	0.043	0.001**		
		Direct effect	0.323	0.000***		
SI→AT→ BI	H12	Total effect	-0.038	0.390	No relationship	Not Support
		Indirect effect	0.006	0.587		
		Direct effect	-0.323	0.311		
FC→AT→ BI	H13	Total effect	0.136	0.005 **	Direct relationship	Not Support
		Indirect effect	0.017	0.158		
		Direct effect	0.119	0.012*		

*Significance at P< 0.05, **significance at P< 0.01, ***significance at P< 0.001, β: estimate

Discussion

This research used the UTAUT model for determining the level of intention and its predictors that may influence the use of mobile phone short message service systems to support adherence and care of patients with tuberculosis. Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) of healthcare professionals was intended to use mobile phone-based SMS to support TB patients in southwest Ethiopia. This finding was higher than study done on intention of health providers electronic medical record in Amhara regional state of Ethiopia (39.8%) (43). This discrepancy could be due to study period and use small sample size. Similarly, willingness of healthcare professionals to use mobile based health services in Ethiopia was 44% (44).This possible difference could be due to study participants only obstetric health providers and they used smaller sample size.

The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectation and intention to use the system. Thus, H3, H4, H7, H9, and H11 were supported and thus can be used as effective measures of mobile phone SMS adoption in resource-limited settings.

According to the findings, healthcare professional effort expectancy had a positive direct effect on attitude and both direct and indirect effects on the intention to use mobile phone SMS. This suggested that when healthcare professionals perceived the system's simplicity or lack of effort in use, their perceptions of its usefulness, attitude, and intention to use mobile phone SMS were significantly improved. This finding is consistent with findings from other studies in different countries (9, 26, 45-48). This could be because an individual's attitude and acceptance of the use of mobile phone SMS systems are greatly affected by the work required to manipulate the system. If the system is expected to manipulate people's intentions to use mobile phone SMS systems with less effort, the system's performance will improve. As a result, when implementing the use of mobile phone SMS technologies, the system should be simple for healthcare providers to understand and use to ensure long-term system adoption.

Facilitating conditions also positively influenced the intention to use mobile phone short message services to support adherence and care of patients with tuberculosis. This showed the significance

of creating the organizational and IT requirements for this example, including the resources, technical support, and training that are necessary for the adoption and ongoing use of mobile-based SMS-enabled solutions by healthcare providers in the public health system This finding is consistent with findings from other studies in different countries (9, 27, 28, 49). This could be because health professionals think that as mobile phone use has increased, more people have access to them and are familiar with using devices to communicate with their intended recipients. As a result, they are convinced and have no trouble supporting patient care and adherence.

Health professionals' attitudes positively influenced their intention to use mobile phone SMS systems. Medical experts supported the usage of mobile phone SMS as a tool for bettering their health and the standard of tuberculosis treatment as they observed it being done. This finding is in line with findings from other studies done in different settings (9, 24, 50-52). Therefore, it is important to give priority to initiatives that change attitudes, such as providing mobile devices at work, providing ongoing training and assistance, and fostering knowledge exchange about eHealth technologies such as mobile SMS for the remainder of the patient's care. This study provides theoretical and practical implications based on the findings. The findings might alleviate any concerns regarding mobile-based SMS and its acceptability in resource-constrained environments. MHealth and other digital communication technologies have a positive impact on healthcare. The need to support further innovative mHealth initiatives from all stakeholders. Policymakers, healthcare providers, and planners should be concerned about improving the ability of users regarding mobile health technologies in addition to resources, technical support, and training of all health professionals, as well as improving the attitude to adopt mobile-based SMS in Ethiopia.

Conclusions

Overall, healthcare professionals' intention to use mobile-based SMS was high. The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectations and the intention to use the system. Among the five influencing predictors, effort expectancy had a more significant prediction power for healthcare providers' intention to use mobile phone SMS systems. Therefore, easily interactive

and applicable forms of the system should be implemented for health care professionals, as well as improving capacity and building on the simplicity of technology to support adherence and the care of TB patients. Finally, we recommend that upcoming investigators include external variables, and all health institutions, similarly, support it with a qualitative study.

Abbreviations and acronyms

AMOS: Analysis of Moment and Structure; **ATT**: Attitude; **BI**: Behavioral Intention; **CI**: Confidence Intervals; **EE**: Effort Expectancy; **FC**: Facilitating Condition; **PE**: Performance Expectancy; **SEM**: Structural Equation Modeling: **SI**: Social Influence; **SMS**: Short Message Service; **SPSS:** Statistical Package for Social Science; **UTAUT**: Unified Theory of Acceptance and Use of Technology; **WHO**: World Health Organization

Ethics approval and consent to participate

The study participants gave their informed consent after the study protocol was evaluated and approved by Mettu University's ethical review board with approval number MeU/RAC/1036/15. Each hospital provided a letter of permission. Each participant in the study gave their written and oral consent after being informed of the study's goal. Furthermore, all data collectors and investigators strictly adhered to the law's requirements for data privacy and confidentiality. Only the study was conducted using the data that was retrieved. As a result, the data-gathering tool did not contain participants' names or any other personal information about them. Furthermore, the study was done according to the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

Upon reasonable request from the corresponding author, the datasets created and/or analyzed during the current work will be made available.

Competing interests

The authors declare that we have no competing interests.

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Authors' contributions

ADW was contributed in conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing -original draft, **AWD** also done the conception and design, acquisition of data or analysis and interpretation of data, and **MKH** contributed the funding acquisition, investigation, methodology and resources. **ADW** and **AWD** wrote the final draft of the manuscript, and the final draft of the manuscript was read, edited and approved by all authors.

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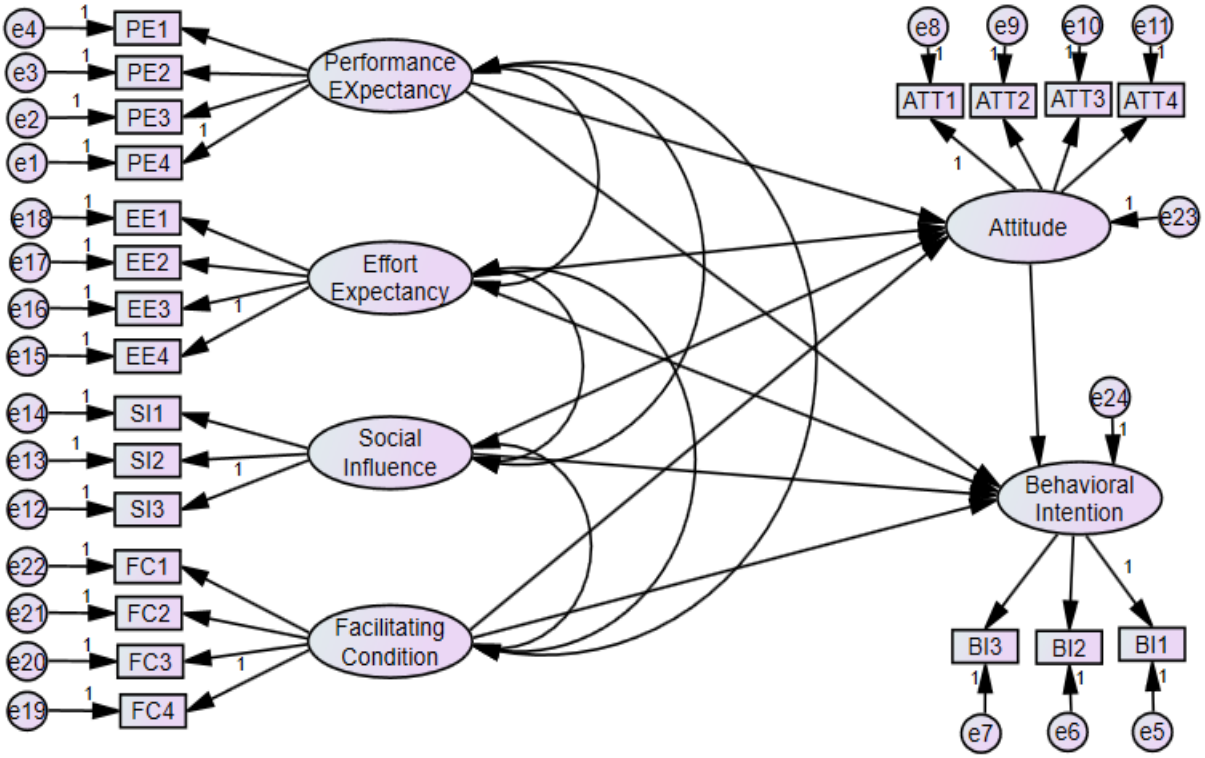
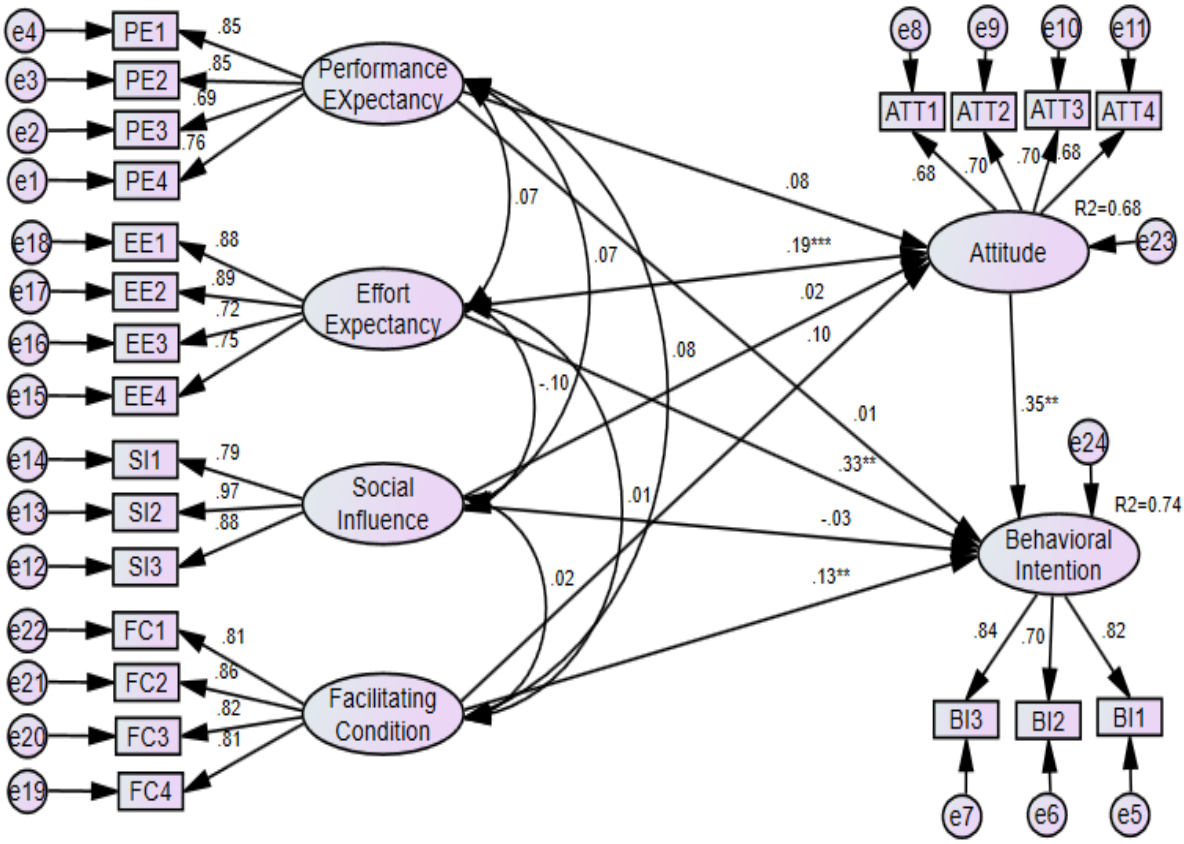
Figures

Figure 1: Modified UTAUT models of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Figure 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022





STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-9
Methods			
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*11-12*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11-12
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14-15
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	15,16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	

		(*b*) Report category boundaries when continuous variables were categorized	15-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Healthcare professionals' intention to use mobile phone-based SMS and its predictors for adherence support and care of TB patients in a resource-limited setting: A structural equation modeling analysis

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Abstract

Objective: To assess healthcare providers' intentions and its associated factors to use mobile phone-based SMS to support adherence and care of TB patients in the Oromia region of southwest Ethiopia.

Study design: An institutional-based cross-sectional study was conducted from October to November 2022.

Setting: Public hospitals which include Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.in Ilu Aba Bor and Buno Bedelle zones.

Participants: A total of 625 (54.9% male and 45.1% female) health professionals participated in the study. The study participants were selected using a simple random sampling technique. All health professionals permanently working in Ilu Aba Bor and Buno Bedelle zone hospitals were included in this study. However, health professionals with less than six months of experience and those who were not present during the data collection period were excluded from this study.

Outcome measure: The intention to use mobile phone-based short message service to support TB patients.

Results: Healthcare professionals' intention to use mobile SMS was 54.4%. Effort expectancy had a significant direct effect on attitude (β =0.162, P<0.01) and intention towards using mobile phone SMS (β =0.329, P<0.001). The intention to use mobile phone SMS was directly influenced by facilitating conditions (β= 0.104, P< 0.01) and attitude (β= 0.26, P < 0.001). The relationship between effort expectancy and intention to use SMS was mediated by attitude (β= 0.043, p-value < 0.01).

Conclusions: Overall, intention to use of mobile-based SMS was high. Effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy had a more significant prediction power than others. As a result, system forms that are easily interactive and

applicable should be implemented to improve capacity building and support the adherence and care of TB patients.

Keywords: mobile health, short message service, tuberculosis, UTAUT

Strengths and limitations of the study

- This study used the unified theory of acceptance and use of technology, which is the most accurate and recent model to identify important factors to influence mobile health technologies.
- The study covers public hospitals with a large sample size, which improved its generalizability.
- This study may be tilted in favor of social desirability because it was a cross-sectional survey.
- The study was not supported by qualitative findings
- The study was not included private hospitals

Introduction

Globally, it is crucial to cure tuberculosis (TB) to reduce morbidity, mortality, and the risk of continued transmission, but it can be difficult to support and monitor patients during the entirety of treatment (1, 2). The consequences of patients who experience treatment interruptions with TB therapy include drug resistance, recurrence, and death (2-4). The World Health Organization (WHO) recommends in-person, directly observed therapy, either at home or in a medical facility, to increase TB adherence (5). However, directly observed therapy is frequently difficult and impractical to implement in most areas with a high TB burden; TB programs frequently struggle to provide the human resources to guarantee regular face-to-face interactions over a long period, and directly observed therapy is extremely time-consuming, can seriously interfere with work, family obligations, and other daily activities from the perspective of people with TB, and may be perceived as patronizing and intrusive (6).

According to studies carried out in northwest Ethiopia, 34% of patients' arguments for not adhering to TB treatment were forgetfulness (7, 8). Patients in the continuation phase, as opposed to those in the intensive phase, are in charge of returning their prescriptions once a week to the neighboring clinic and taking their medications at home while being observed by neighbors. Thus, the introduction of digital health technologies by healthcare professional may improve patient adherence to TB therapy.

Digital technology adoption is viewed by health professionals as a key method for improving the efficacy, efficiency, and quality of healthcare delivery because it can improve patient care quality and service delivery efficiency while minimizing medical errors (9, 10). Particularly, there is an increase in the usage of mobile technology in healthcare, For instance, mobile technology's Short Message Service (SMS) feature can be used to track upcoming appointments, preventative immunizations, and long-term self-management treatments (9).To encourage the development of digital health innovations in worldwide efforts to improve TB care and prevention, the WHO has already formed its global task force on digital health, such as mobile health (11, 12).

With extensive adoption in low- and middle-income countries (LMIC), especially those with lower socioeconomic standing, the number of mobile phone subscriptions now outnumbers the number of people worldwide (13). The evidence done in Ethiopia showed that mobile-phone messaging

revealed a positive effect in improving healthcare services (2, 14, 15), but the intention level of healthcare providers to use mobile health with SMS to support patients in the resource-limited setting is uncertain.

Theoretical background and hypothesis development

Different types of models have been used to identify factors associated with the acceptance and use of health information system technologies (16, 17). A unified theory of acceptance and use of technology (UTAUT) model is currently regarded as the most accurate and up-to-date technology acceptance model used to evaluate intention to use and actual use of technology.

The UTAUT model is suitable for this study due to its robustness and broad use in analyzing technology adoption at the individual level. Since the UTAUT model is an extension of other models and therefore has a strong capability to clarify the behavioral intentions of users as compared with other single models (18, 19). Accordingly, we used the model through adapt or modify the constructs in our study setting

This model proposes four predictive elements, including performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) (20). After we used the fundamental elements of the UTAUT model we modified it in the context of a comprehensive review of the literature employing UTAUT in healthcare technology (16, 21-23). In addition to the four fundamental constructs (PE, EE, SI, and FC), attitude toward using technology (ATT) may have a substantial impact on the intention to use information technology (BI) in developing nations. Actual use is another factor in the UTAUT model that is important when the solution is frequently accessible. This variable was not included in our study because the solution is still not accessible for continuous use (Figure 1).

Behavioral Intention to Use (BI)

Behavioral intention is the degree to which a person has made deliberate plans to engage in or refrain from engaging in a particular future action (20).

Performance Expectancy (PE)

Health professionals' views toward the solution and their intention to adopt it may be positively influenced by the improved work output and improved health outcomes. Thus, healthcare

professionals are more likely to use mobile phone-based SMS, if they think that PE is high (9, 24-28). Based on the above-mentioned literature, the following hypotheses were investigated in this study:

H1-PE has a positive influence on the intention to use mobile phone SMS technology.

H2-PE has a positive influence on attitudes toward using mobile phone SMS technology.

Effort Expectancy (EE)

In the treatment value chain, healthcare professionals are expected to enter information, read it, and engage with communication technology like mobile phones. Because of this, the system must be simple to use when it comes to entering patient data throughout therapy and retrieving it to confirm and send the data to patients. According to studies, users' intention to utilize technology is influenced by their effort expectations (9, 25, 26, 28). Based on these, the following hypotheses were investigated in this study:

H3. EE has a positive influence on the intention to use mobile phone SMS technology

H4. EE has a positive influence on attitude to use mobile phone SMS technology

Social Influence (SI)

Social influence may play a significant role in the adoption and continued use of the digital solution given the experience of inconsistent adherence to reporting guidelines and treatment regimens by patients, medical professionals, allied healthcare professionals, and their organizations (clinic/hospital management). Intention to use the mobile phone for SMS may therefore be strong if SI is positive (9, 24, 25, 28). In the context of this, the following hypotheses were investigated in this study:

H5: SI has a positive influence on the intention to use mobile phone SMS technology.

H6: SI has a positive influence on attitudes toward using mobile phone SMS technology.

Facilitating Condition (FC)

Conditions in the context of TB treatment monitoring include having the knowledge and tools required to utilize the system as well as the proposed solution's compatibility with existing systems (9, 24, 27, 28). On account of these empirical findings, our study makes the following hypothesis:

H7.FC has a positive influence on the intention to use mobile phone SMS technology.

H8. FC has a positive influence on attitudes toward using mobile phone SMS technology.

Attitude (ATT)

In a context with low resources, health professionals have little knowledge about access to technology, which makes changing their attitude about using a new technology extremely difficult (16). We reasoned that including attitude as a category could seem pertinent to studying behavioral intentions to use new technology in certain contexts (16, 24, 26, 29-32). On account of those findings, our study makes the following hypothesis:

H9: ATT has a positive influence on the intention to use mobile phone SMS technology.

H10: Attitude mediates the relationship between PE and intention to use mobile phone SMS technology.

H11: Attitude mediates the relationship between EE and intention to use mobile phone SMS technology.

H12: Attitude mediates the relationship between SI and intention to use mobile phone SMS technology.

H13: Attitude mediates the relationship between FC and intention to use mobile phone SMS technology.

According to our search of the literature, little research has been done about this study. As a result, this study investigates, introduces, and empirically tests a modified theoretical model based on theUTAUT model to identify the main factors influencing healthcare professionals' intention to adopt and use a mobile phone SMS system.

Methods and materials

Study design and setting

The institutional-based cross-sectional study design was conducted from October to November 2022 at public hospitals in Ilu Aba Bor and Buno Bedelle zones, Oromia Regional State, southwest Ethiopia. Illu Aba Bor Zone comprises one town administration and fourteen rural districts with a total population of 1,606,502, according to the 2019 district finance and economic development office annual data report. Among those zones, five hospitals exist, namely: Mettu Karl referral hospital, Dembi hospital, Bedelle hospital, Darimu hospital, and Chora hospital.

Study Population

All healthcare professionals working in the southwest Oromia region of public hospitals in the two zones were used as study populations. All health professionals, working at public health hospitals, who were available during data collection time were included in the study. However, Health professionals with less than six months of working experience and who were on annual leave or those who were seriously ill during the study period were excluded from the study.

Operational definition

The outcome variable was the intention to use mobile-based SMS among healthcare professionals. Intention to use means the extent to which a person has made intentional plans to use new technology (33, 34). When a healthcare professional rates intention to use a technology measurement and scores median, and above the median was considered as intended to use mobile phone-based SMS, else not intended to use it, with a five-point Likert scale of three questions (33).

Sample size determination

The sample size was estimated based on structural equation modeling assumptions of determining model-free parameters using the modified model (33, 34) (Figure 1), by considering 25 variances of the independent variables, 6 covariance between independent variables, 16 load factors between latent and latent indicators, and 8 direct effects and 4 indirect effects of regression coefficients between observed or latent variables were estimated Finally a total of 59 free parameters was estimated. But the variances of dependent variables, the covariance between dependent variables,

and the covariance between dependent and independent variables are never parameters (as would be explained by other parameters), and for each latent variable, its metric must be set: Set its variance to a constant (typically 1) and fix a load factor between latent and its indicator for independent latent (68). Accordingly, A 1: 10 ratios of responders to free parameters to be estimated was suggested to estimate the sample size based on the number of free parameters in the hypothetical model (33-35). As a result, the minimum sample size necessary was 590, taking into account the 59 parameters that needed to be estimated and taking participants by a free parameter ratio of 10. Since the computed sample size considers the 10% non-response rate. Thus, the final sample size of 649 study participants was estimated.

Sampling Procedure

The participants of this study were health professionals across all five study hospitals in southwest Ethiopia. The number of healthcare professionals from the five hospitals was calculated using population proportional allocation and a simple random sampling technique. Finally, consecutive healthcare professionals who full fill the inclusion criterion were included in the study until the allocated size was obtained.

Data collection tools, data quality control, and procedures

To investigate the hypotheses provided by this study, a structured questionnaire was used from earlier investigations (16, 29-32). There are two sections to the questionnaire. Section A focuses on user demographic data, including gender, age, education, and years of experience. Section B contains 18 positive statements that symbolize the constructs, which represents the constructions that are part of the UTAUT and newly introduced construct, ATT. A five-point Likert scale, with 1 denoting strongly disagree and 5 denoting strongly agree, was used to measure the constructs.

To control the quality of the data, two days of training were given to data collectors and supervisors on the objective of the study, data collection procedures, data collection tools, respondents' approaches, data confidentiality, and respondents right before the data collection date. Before the actual data collection, pretesting of the questionnaire was conducted by about 10% of the study participants outside of the study in Jimma Hospital. After obtaining feedback from the respondents, language experts modified the wording of the questions.

We estimated the internal consistency of the items using the Cronbach alpha coefficient (Cα), and composite reliability (CR). The results showed that all of the items' scores were above 0.7. The assumptions were examined for outliers, multi-collinearity, and independent error factors before running the structural equation model. The results showed that there was no existing multi-collinearity, with the overall variance inflation factor (VIF) value being less than 2 and the tolerance being greater than 0.5.

Patient and public involvement

No patient and public were involved

Data processing and analysis

Data from respondents were entered into Epi-Data version 4.6 and exported to SPSS version 25 for descriptive data analysis. Additionally, model constructs were evaluated using structural equation modeling (SEM) analysis via Analysis of Moment Structure (AMOS) version 26 software. This analysis technique is multivariate types of analysis, which is important to examine the relationship between multiple independent variables, making clear comparison, discard unwanted information, predict future outcome, correct errors , get new insights address the confounders' issue and more accurate, realistic and closer to the real life situation than bivariate and univariate types of statistical technique (36). To test measurement model, confirmatory factor analysis (CFA) using standardized data was used. As part of confirmatory factor analysis, a correlation between constructs less than 0.8 and factor loadings greater than 0.6 for each item was examined (37). The chi-square ratio (≤5), the tucker-lewis index (TLI>0.9), the comparative fit index (CFI>0.9), the goodness of fit index (GFI > 0.9), the adjusted goodness of fit index (AGFI > 0.8), the root means square error approximation (RMSEA<0.08), and the root mean square of the standardized residual (RMSR<0.08) were all used to evaluate the goodness of fit (38-40).

Data normality was evaluated using multivariate kurtosis < 5 and the critical ratio between -1.96 and +1.96. Multicollinearity was also tested using VIF < 10 and tolerance > 0.1, as well as the correlation between exogenous constructs of <0.8, and there were no problems. Cronbach's alpha test was used to assess construct reliability; each construct in the study met the required threshold of >0.70, and the composite reliability was above 0.70 (41). The Average Variance Extracted (AVE) approach, with values above 0.5, was used to assess the converging validity, while the square root of AVE in Fornell Larcker criterion, with values below 0.9, and the correlations with other latent constructs should have a lower value than the square root of AVE in each constructs was used to assess the divergent validity (33, 39, 42, 43).

To evaluate a structural model, the critical ratio (CR) and the path coefficient were used to analyze the relationship between exogenous and endogenous variables. A p-value of less than 0.05 and 95% confidence intervals were used to assess the predictors' statistical significance. In mediation analysis, partial mediation occurs when a construct's direct, indirect, and total effects are all statistically significant, and full mediation occurs when the direct and indirect effects are both

statistically significant but the total effect is not. To confirm mediation, we typically looked for a substantial indirect effect with a p-value < 0.05

Results

Socio-demographic characteristics of healthcare professionals

A total of 625 study participants have included in the study with a response rate of 96.3% of them who gave their consent and responded to the questions. Of the total of (n=625) respondents, 343(54.9%) of them were males, 293(46.9%) respondents were in the age group of <30 years and the mean age of the respondents was 32±6.01 years About more than half of the respondents 451 (72.2%) had less than or equal to 3 years of work experience. In addition, 228(36.5%) of the respondents were medical doctor professionals (Table 1).

Table 1: Socio-demographic characteristics of health care professionals in a resource-limited setting, 2022 (n=625)

Sociodemographic Characteristics	Category	Frequency(N)	Percentage (%)
Gender	Male	343	54.9
	Female	282	45.1
Age (year)	<30	293	46.9
	30-39	254	40.6
	>40	78	12.5
Profession	Medical doctor	228	36.5
	Nurse	165	26.4
	Midwifery	117	18.6
	Health officer	46	7.4
	Others	115	11
Work experience	1-3	451	72.2
	3-5	62	9.9
	>5	112	17.9

Others: Anesthesia, Radiology, Psychiatry, and Pharmacy

Intention to use mobile-based SMS

Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) healthcare professionals were intended to use mobile phone-based SMS in southwest Ethiopia. The median score of intention to use mobile phone-based SMS was 10.1, with a standard deviation of 3.3. The minimum and maximum scores were 3 and 15, respectively.

Measurement model

Reliability and validity of the construct

All of the constructs had Cronbach's alpha scores between 0.77 and 0.91 and composite reliability scores between 0.78 and 0.92, factor loadings of the items ranged between 0.64 and 0.89, and the value of AVE varied between 0.61 and 0.71. Therefore, all of the constructs had strong convergent validity (Supplemental Table 1).

According to the findings, the bolded values (diagonal values) or the square root of the AVE of the construct were higher than the other values in that column, and the raw. As a result, the model's constructs' discriminant validity has been proven (Supplemental Table 2).

Goodness of fit

The model fit results in confirmatory factor analysis showed that chi squire difference(x^2/df=2.76), Goodness-of-fit-index (GFI=0.93), Adjusted goodness-of-fit-index (AGFI=0.91), Comparative fit index (CFI=0.94), Tucker-Lewis's index (TLI=0.93), Root means the square error of approximation (RMSEA=0.05) and standardized root mean squared residual (SRMR=0.03). Accordingly, the goodness of fit model's values met the requirements.

Structural equation model

The result showed that effort expectancy had a significant direct effect on health care professionals' attitude (β =0.162, 95% CI: [0.061, 0.270], P<0.01) and intention towards using

mobile phone SMS (β =0.329, 95% CI: [0.233, 0.433], P<0.001). The facilitating condition had a direct significant effect on healthcare provider's intention (β =0.104, 95% CI: [0.025, 0.191], P<0.01), and also healthcare professionals' attitude towards the system had a direct significant effect on behavioral intention to use mobile phone SMS (β =0.268, 95% CI: [0.163, 0.373], P<0.001). whereas the relationship between performance expectancy (β =0.268, 95% CI: [-0.017,0.170], P=0.109), social influence (β =0.015, 95% CI: [-0.044, 0.075], P=0.610) and facilitating conditions (β =0.055, 95% CI: [-0.026, 0.140], P=0.184) were not significant effect on health care professionals' attitude, and the path relationship of performance expectancy(β =0.002, 95% CI: [-0.088, 0.094], P=0.980) and social influence(β =-0.030, 95% CI: [-0.086,0.028], P=0.318) to use mobile phone SMS were not statistically significant (Table 2).

Table 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	B	S. E	C.R	P-Value	95% CI		Decision
						Lower	Upper	
PE → BI	H1	0.002	0.041	0.055	0.980	-0.088	0.094	Not Supported
PE→ ATT	H2	0.076	0.044	1.70	0.109	-0.017	0.170	Not Supported
EE → BI	H3	0.329	0.048	6.583	0.000***	0.233	0.433	Supported
EE→ ATT	H4	0.162	0.050	3.229	0.001**	0.061	0.270	Supported
SI → BI	H5	-0.030	0.030	-1.002	0.318	-0.086	0.028	Not supported
SI→ ATT	H6	0.015	0.032	0.475	0.610	-0.044	0.075	Not Supported
FC → BI	H7	0.104	0.039	2.649	0.011**	0.025	0.191	Supported
FC→ ATT	H8	0.055	0.041	1.317	0.184	-0.026	0.140	Not Supported

ATT → BI	H9	0.268	0.054	4.956	0.001**	0.163	0.373	Supported

Note: ** p value <0.01, ***p value is <0.001 C, R: critical ratio S.E: standard error, CI: confidence interval, β: estimate

According to the finding, performance expectancy, effort expectancy, social influence, and facilitating conditions accounted for 68% and 74% of the variance (R^2) in attitude and intention to use mobile phone short message services, respectively (Figure 2).

Mediation effects

The results revealed that attitude played a mediating role in the relationship between health care professionals' effort expectations and their intention to use mobile phone short message service to support TB patients, as opposed to the relationship between performance expectancy, social influence, and facilitating conditions. Both the relationship between attitude and intention to use the system, as well as the regression coefficient between attitude and effort expectancy, were statistically significant. The indirect effect of the standardized estimation value was 0.043 and P< 0.01. In the context of this, the relationship between effort expectancy and an intention to use mobile-based SMS was statistically significant through attitude (Table 3).

Table 3: Mediating effects of Attitude and health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	Effect	β	P-value	Result	Decision
PE→AT→ BI	H10	Total effect	0.025	0.643	No relationship	Not Support
		Indirect effect	0.023	0.090		
		Direct effect	0.003	0.982		
EE→AT→ BI	H11	Total effect	0.365	0.000***	Partial Mediation	Support
		Indirect effect	0.043	0.001**		
		Direct effect	0.323	0.000***		
SI→AT→ BI	H12	Total effect	-0.038	0.390	No relationship	Not Support
		Indirect effect	0.006	0.587		
		Direct effect	-0.323	0.311		
FC→AT→ BI	H13	Total effect	0.136	0.005 **	Direct relationship	Not Support
		Indirect effect	0.017	0.158		
		Direct effect	0.119	0.012*		

*Significance at P< 0.05, **significance at P< 0.01, ***significance at P< 0.001, β: estimate

Discussion

This study was used the UTAUT model for determining the level of intention and its predictors that may influence the use of mobile phone short message service systems to support adherence and care of patients with tuberculosis. Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) of healthcare professionals was intended to use mobile phone-based SMS to support TB patients in southwest Ethiopia. This finding was higher than study done on intention of health providers electronic medical record in Amhara regional state of Ethiopia (39.8%) (44). This discrepancy could be due to study period and use small sample size. Similarly, willingness of healthcare professionals to use mobile based health services in Ethiopia was 44% (45).This possible difference could be due to study participants only obstetric health providers and they used smaller sample size. Similarly, the study done in Ethiopia proved that 85.9% of the healthcare professionals were willing to use the EMR system in their assigned clinic and committed to advance patient data management system (46). This consistency in the high percentages of persons who were eager to use the EMR system could be explained by global contextual technology advancement (automation of medical systems for advancement in healthcare practice) (47).

The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectation and intention to use the system. Thus, H3, H4, H7, H9, and H11 were supported and thus can be used as effective measures of mobile phone SMS adoption in resource-limited settings.

According to the findings, healthcare professional effort expectancy had a positive direct effect on attitude and both direct and indirect effects on the intention to use mobile phone SMS. This suggested that when healthcare professionals perceived the system's simplicity or lack of effort in use, their perceptions of its usefulness, attitude, and intention to use mobile phone SMS were significantly improved. This finding is consistent with findings from other studies in different countries (9, 26, 48-51). This could be because an individual's attitude and acceptance of the use of mobile phone SMS systems are greatly affected by the work required to manipulate the system. If the system is expected to manipulate people's intentions to use mobile phone SMS systems with less effort, the system's performance will improve (46). As a result, when implementing the use of

mobile phone SMS technologies, the system should be simple for healthcare providers to understand and use to ensure long-term system adoption.

Facilitating conditions also positively influenced the intention to use mobile phone short message services to support adherence and care of patients with tuberculosis. This showed the significance of creating the organizational and IT requirements for this example, including the resources, technical support, and training that are necessary for the adoption and ongoing use of mobile-based SMS-enabled solutions by healthcare providers in the public health system This finding is consistent with findings from other studies in different countries (9, 27, 28, 52). This could be because health professionals think that as mobile phone use has increased, more people have access to them and are familiar with using devices to communicate with their intended recipients. As a result, they are convinced and have no trouble supporting patient care and adherence.

Health professionals' attitudes positively influenced their intention to use mobile phone SMS systems. Medical experts supported the usage of mobile phone SMS as a tool for bettering their health and the standard of tuberculosis treatment as they observed it being done. This finding is in line with findings from other studies done in different settings (9, 24, 53-55). Therefore, it is important to give priority to initiatives that change attitudes, such as providing mobile devices at work, providing ongoing training and assistance, and fostering knowledge exchange about eHealth technologies such as mobile SMS for the remainder of the patient's care.

This study provides theoretical and practical implications based on the findings. The findings might alleviate any concerns regarding mobile-based SMS and its acceptability in resource-constrained environments. MHealth and other digital communication technologies have a positive impact on healthcare. The need to support further innovative mHealth initiatives from all stakeholders. Policymakers, healthcare providers, and planners should be concerned about improving the ability of users regarding mobile health technologies in addition to resources, technical support, and training of all health professionals, as well as improving the attitude to adopt mobile-based SMS in Ethiopia.

Conclusions

Overall, healthcare professionals' intention to use mobile-based SMS was high. The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined

healthcare professionals' behavioral intention to use mobile phone SMS. Among the five influencing predictors, effort expectancy had a more significant prediction power for healthcare providers' intention to use mobile phone SMS systems. Therefore, easily interactive and applicable forms of the system should be implemented for health care professionals, as well as improving capacity and building on the simplicity of technology to support adherence and the care of TB patients. Finally, we recommend that upcoming investigators include external variables, and wide range of study area, similarly, support it with a qualitative study.

Declarations

Abbreviations and acronyms

AMOS: Analysis of Moment and Structure; **ATT**: Attitude; **BI**: Behavioral Intention; **CI**: Confidence Intervals; **EE**: Effort Expectancy; **FC**: Facilitating Condition; **PE**: Performance Expectancy; **SEM**: Structural Equation Modeling: **SI**: Social Influence; **SMS**: Short Message Service; **SPSS:** Statistical Package for Social Science; **UTAUT**: Unified Theory of Acceptance and Use of Technology; **WHO**: World Health Organization

Ethics approval and consent to participate

The study participants gave their informed consent after the study protocol was evaluated and approved by Mettu University's ethical review board with approval number MeU/RAC/1036/15. Each hospital provided a letter of permission. Each participant in the study gave their written and oral consent after being informed of the study's goal. Furthermore, all data collectors and investigators strictly adhered to the law's requirements for data privacy and confidentiality. Only the study was conducted using the data that was retrieved. As a result, the data-gathering tool did not contain participants' names or any other personal information about them. Furthermore, the study was done according to the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

Upon reasonable request from the corresponding author, the datasets created and/or analyzed during the current work will be made available.

Competing interests

The authors declare that we have no competing interests.

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Authors' contributions

ADW was contributed in conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing -original draft, **AWD** also done the conception and design, acquisition of data or analysis and interpretation of data, and **MKH** contributed the funding acquisition, investigation, methodology and resources. **ADW** and **AWD** wrote the final draft of the manuscript, and the final draft of the manuscript was read, edited and approved by all authors.

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Figures

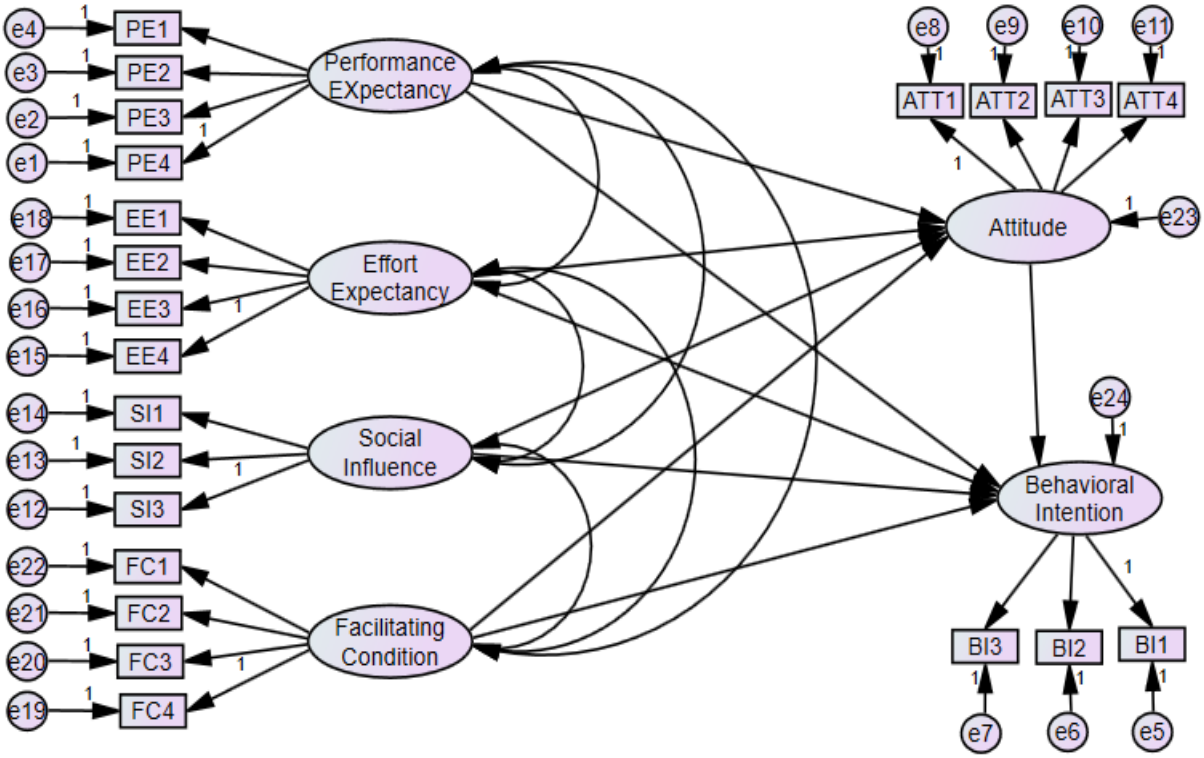
Figure 1: Modified UTAUT models of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

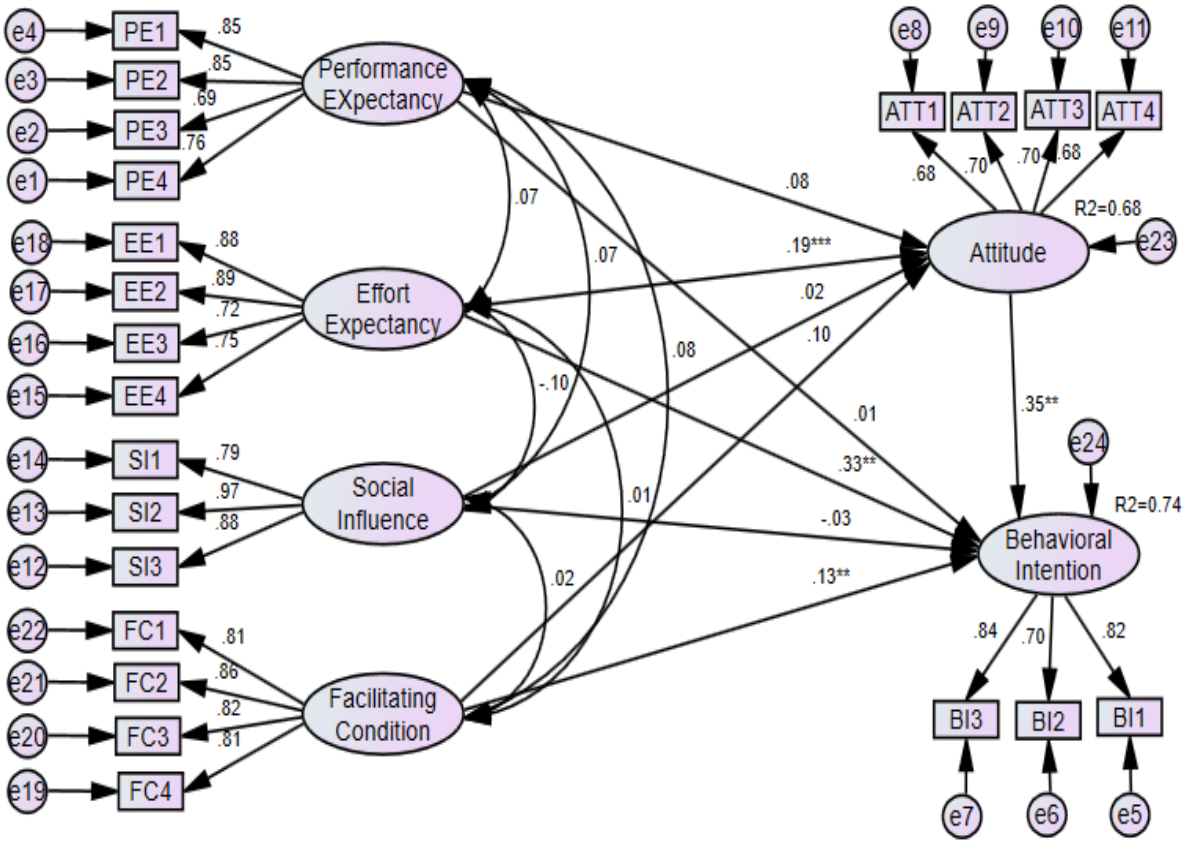
Figure 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Supplemental tables

Supplemental Table 1: Convergent validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Supplemental Table 2: Discriminant validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022





Construct	Indicators /Items	Standard loading	Composite Reliability	AVE	Convergent Validity
Performance Expectancy	PE1 PE2 PE3 PE4	0.85 0.84 0.67 0.74	0.88	0.65	Established
Effort Expectancy	EE1 EE2 EE3 EE4	0.87 0.89 0.69 0.73	0.91	0.69	Established
Social Influence	SI1 SI2 SI3	0.78 0.97 0.88	0.90	0.68	Established
Facilitating Condition	FC1 FC2 FC3 FC4	0.81 0.84 0.83 0.82	0.92	0.72	Established
Attitude	ATT1 ATT2 ATT3 ATT4	0.67 0.71 0.68 0.66	0.78	0.61	Established
Behavioral Intention	BI1 BI2 BI3	0.80 0.64 0.82	0.79	0.64	Established

Note; AVE: Average Variance Extracted

Construct	PE	EE	SI	FC	ATT	BI	Divergent Validity
Performance Expectancy (PE)	**0.806**						Established
Effort Expectancy (EE)	0.143	**0.831**					Established
Social Influence (SI)	0.436	0.516	**0.825**				Established
Facilitating Condition (FC)	0.533	0.178	0.543	**0.848**			Established
Attitude (ATT)	0.366	0.601	0.383	0.511	**0.781**		Established
Behavioral Intention to use (BI)	0.325	0.556	-0.112	0.362	0.603	**0.800**	Established

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-9
Methods			
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*11-12*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11-12
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14-15
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	15,16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	

		(*b*) Report category boundaries when continuous variables were categorized	15-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Healthcare professionals' intention to adopt mobile phone-based SMS and its predictors for adherence support and care of TB patients in a resource-limited setting: A structural equation modeling analysis

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Healthcare professionals' intention to adopt mobile phone-based SMS and its predictors for adherence support and care of TB patients in a resource-limited setting: A structural equation modelling analysis

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Abstract

Objective: To assess healthcare providers' intentions and the associated factors to use mobile phone-based SMS to support adherence and care of TB patients in the Oromia region of southwest Ethiopia.

Study design: An institutional-based cross-sectional study was conducted from October to November 2022.

Setting: Public hospitals which include Mettu Karl referral hospital, Dembi Hospital, Bedelle Hospital, Darimu Hospital, and Chora Hospital.in Ilu Aba Bor and Buno Bedelle zones.

Participants: A total of 625 (54.9% male and 45.1% female) health professionals participated in the study. The study participants were selected using a simple random sampling technique. All health professionals permanently working in Ilu Aba Bor and Buno Bedelle zone hospitals were included in this study. However, health professionals with less than six months of experience and those who were not present during the data collection period were excluded from this study.

Outcome measure: The intention to use mobile phone-based short message service to support TB patients.

Results: Healthcare professionals' intention to use mobile SMS was 54.4%. Effort expectancy had a significant direct effect on attitude (β =0.162, P<0.01) and intention towards using mobile phone SMS (β =0.329, P<0.001). The intention to use mobile phone SMS was directly influenced by facilitating conditions (β= 0.104, P< 0.01) and attitude (β= 0.26, P < 0.001). The relationship between effort expectancy and intention to use SMS was mediated by attitude (β= 0.043, p-value < 0.01).

Conclusions: Overall, intention to use of mobile-based SMS was high. Effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy had a more significant prediction power than others. As a result, system forms that are easily interactive and

applicable should be implemented to improve capacity building and support the adherence and care of TB patients.

Keywords: mobile health, short message service, tuberculosis, UTAUT

Strengths and limitations of the study

- This study used the unified theory of acceptance and use of technology, which is the most accurate and recent model to identify important factors to influence mobile health technologies.
- The study covers public hospitals with a large sample size, which improved its generalizability.
- This study may be tilted in favor of social desirability because it is a cross-sectional survey.
- The study was not supported by qualitative findings
- The study did not include private hospitals

Introduction

Globally, it is crucial to cure tuberculosis (TB) to reduce morbidity, mortality, and the risk of continued transmission, but it can be difficult to support and monitor patients during the entirety of treatment (1, 2). The consequences for patients who experience treatment interruptions with TB therapy include drug resistance, recurrence, and death (2-4). The World Health Organization (WHO) recommends in-person, directly observed therapy, either at home or in a medical facility, to increase TB adherence (5). However, directly observed therapy is frequently difficult and impractical to implement in most areas with a high TB burden(6).

According to studies carried out in northwest Ethiopia, 34% of patients' arguments for not adhering to TB treatment were forgetfulness (7, 8). Community members may be too preoccupied with their daily tasks to remember and monitor patients for such a long time. Thus, the introduction of digital health technologies by healthcare professionals may improve patient adherence to TB therapy.

Digital technology adoption is viewed by health professionals as a key method for improving the efficacy, efficiency, and quality of healthcare delivery because it can improve patient care quality and service delivery efficiency while minimizing medical errors (9-11). For instance, mobile technology's Short Message Service (SMS) feature can be used to track upcoming appointments, preventative immunizations, and long-term self-management treatments (9).To encourage the development of digital health innovations in worldwide efforts to improve TB care and prevention, the WHO has already formed its global task force on digital health, such as mobile health (12, 13).

With extensive adoption in low- and middle-income countries (LMIC), especially those with lower socioeconomic standing, the number of mobile phone subscriptions now outnumbers the number of people worldwide (14). Individuals now have own smartphones, making it possible in some locations with a strong internet connection to conduct video conversations. However, in comparison to other developed regions, the use of mobile technology in the healthcare system in developing countries is too often limited to certain roles for health interventions. The evidence done in Ethiopia showed that mobile phone messaging revealed a positive effect in improving healthcare services (2, 15, 16), but the intention level of healthcare providers to use mobile health with SMS to support patients in the resource-limited setting is uncertain.

Theoretical background and hypothesis development

Different types of models have been used to identify factors associated with the acceptance and use of health information system technologies (17, 18).After looking at eight models, including the theory of reasoned action, the technology acceptance model, the theory of planned behavior, the social cognitive theory, the motivational model, the combined technology acceptance model, and the innovation diffusion theory; the UTAUT model was developed to put forth a unified theory of technology acceptance and it is the most accurate and up-to-date technology acceptance model used to evaluate intention to use and actual use of technology (17, 19).

The acceptance and utilization of mobile-based SMS for TB treatment monitoring depend on the particular patients, healthcare providers, and facilities that serve TB patients. The UTAUT model is suitable for this study due to its robustness and broad use in analyzing technology adoption at the individual level. Accordingly, we used the model by adapting or modifying the constructs in our study setting

Accordingly, after we used the fundamental constructs of the UTAUT model (PE, EE, SI, and FC), we modified it in the context of a comprehensive review of the literature (17, 20-22). So, attitude toward using technology (ATT) may have a substantial impact on the intention to use information technology (BI) in developing nations. Actual use is another factor in the UTAUT model that is important when the solution is frequently accessible. However, this variable was not included in our study because the solution is still not accessible for continuous use (Figure 1). The constructs used and the associations that were hypothesized and tested in this study are provided below.

Behavioral Intention to Use (BI):is the degree to which a person has made deliberate plans to engage in or refrain from engaging in a particular future action (19). In this study, healthcare professionals are questioned about their intentions to employ the proposed solution when it becomes accessible in the future.

Performance Expectancy (PE): Respondents were questioned about the solution's value and how it influenced their task effectiveness, productivity, job effectiveness, quality of work, and the TB monitoring process. Thus, healthcare professionals are more likely to use mobile phone-based SMS, if they think that PE is high (9, 23-27). Based on the above-mentioned literature, the following hypotheses were investigated in this study:

H1-PE has a positive influence on the intention to use mobile phone SMS technology.

H2-PE has a positive influence on attitudes toward using mobile phone SMS technology.

Effort Expectancy (EE): System design has to do with how simple it is to use, learn, and build new skills, and comprehend how the suggested solution interacts with the user. In the treatment value chain, healthcare professionals are expected to enter information, read it, and engage with communication technology like mobile phones. According to studies, users' intention to utilize technology is influenced by their effort expectations (9, 24, 25, 27). Based on these, the following hypotheses were investigated in this study:

H3. EE has a positive influence on the intention to use mobile phone SMS technology

H4. EE has a positive influence on attitude to use mobile phone SMS technology

Social Influence (SI): Play a significant role in the adoption and continued use of the solution given the experience of inconsistent adherence to reporting guidelines and treatment regimens by patients, medical professionals, allied healthcare professionals, and organizations. Intention to use the mobile phone for SMS may therefore be strong, if SI is positive (9, 23, 24, 27). In the context of this, the following hypotheses were investigated in this study:

H5: SI has a positive influence on the intention to use mobile phone SMS technology.

H6: SI has a positive influence on attitudes toward using mobile phone SMS technology.

Facilitating Condition (FC): Conditions in the context of TB treatment monitoring include having the knowledge and tools required to utilize the system as well as the proposed solution's compatibility with existing systems (9, 23, 26, 27). On account of these empirical findings, our study makes the following hypothesis:

H7.FC has a positive influence on the intention to use mobile phone SMS technology.

H8. FC has a positive influence on attitudes toward using mobile phone SMS technology.

Attitude (ATT): In a context with low resources, health professionals have little knowledge about access to technology, which makes changing their attitude about using a new technology (17). We

reasoned that including attitude as a category could seem pertinent to studying behavioral intentions to use new technology in certain contexts (17, 23, 25, 28-31). On account of those findings, our study makes the following hypothesis:

H9: ATT has a positive influence on the intention to use mobile phone SMS technology.

H10: Attitude mediates the relationship between PE and intention to use mobile phone SMS technology.

H11: Attitude mediates the relationship between EE and intention to use mobile phone SMS technology.

H12: Attitude mediates the relationship between SI and intention to use mobile phone SMS technology.

H13: Attitude mediates the relationship between FC and intention to use mobile phone SMS technology.

The main beneficiaries of this study will be patients, health professionals, Regional Health Bureaus (RHBs), and health organizations for health system practices. According to our search of the literature, little research has been done on the subject of healthcare professionals' intentions to use mobile phone short message service using the UTAUT model in Ethiopia. As a result, this study investigates, introduces, and empirically tests a modified theoretical model based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model to identify the main factors influencing healthcare professionals' intention to adopt a mobile phone SMS system.

Methods and materials

Study design and setting

The institutional-based cross-sectional study design was conducted from October to November 2022 at public hospitals in the Ilu Aba Bor and Buno Bedelle zones, Oromia Regional State, southwest Ethiopia. Illu Aba Bor Zone comprises one town administration and fourteen rural districts with a total population of 1,606,502, according to the 2019 District Finance and Economic Development Office annual data report. Among those zones, five hospitals exist, namely: Mettu Karl Referral Hospital, Dembi Hospital, Bedelle Hospital, Darimu Hospital, and Chora Hospital.

Study Population

All healthcare professionals working in the southwest Oromia region of public hospitals in the two zones were used as study populations. All health professionals, working at public health hospitals, who were available during data collection time were included in the study. However, Health professionals with less than six months of working experience and who were on maternal or annual leave, or those who were seriously ill during the study period were excluded from the study.

Operational definition

Intention to use mobile-based SMS:the extent to which a person has made intentional plans to use new technology (32, 33). When a healthcare professional rates intention to use a technology measurement and scores median, and above the median was considered as intended to use mobile phone-based SMS, else not intended to use it, with a five-point Likert scale of three questions (32).

Sample size determination and sampling procedure

The sample size was estimated based on assumptions of determining model-free parameters via the modified model (32, 33) (Figure 1). By considering 25 variances of the independent variables, 6 covariance between independent variables, 16 load factors between latent and latent indicators, and 8 direct effects and 4 indirect effects of regression coefficients were estimated. Finally a total of 59 free parameters was estimated. But the variances of dependent variables, the covariance between dependent variables, and the covariance between dependent and independent variables are never parameters (34, 35). Accordingly, A 1: 10 ratio of responders to free parameters to be estimated was suggested to estimate the sample size based on the number of free parameters in the hypothetical model (32, 33, 36). As a result, the minimum sample size was 590, through taking participants with a free parameter ratio of 10. Since the computed sample size considers the 10% non-response rate. Thus, the final sample size of 649 study participants was calculated.

The number of healthcare professionals from the five hospitals was calculated using population proportional allocation and a simple random sampling technique. Finally, consecutive healthcare professionals who fulfilled the inclusion criterion were included in the study until the allocated size was obtained in each of the five hospitals.

Data collection tools, data quality control, and procedures

To investigate the hypotheses provided by this study, a structured questionnaire was used from earlier investigations (17, 28-31). There are two sections to the questionnaire. Section A; focuses on user demographic data Section B; contains 18 positive statements that symbolize the UTAUT constructs. A five-point Likert scale, with 1 denoting strongly disagree and 5 denoting strongly agree, was used to measure the constructs.

To control the quality of the data, two days of training were given to data collectors and supervisors on the objective of the study, data collection procedures, data collection tools, respondents' approaches, data confidentiality, and respondents right before the data collection date. Before the actual data collection, pretesting of the questionnaire was conducted among 10% of the study participants outside of the study (Jimma Hospital). After obtaining feedback from the respondents, language experts modified the wording of the questions.

The internal consistency of the items was estimated using the Cronbach alpha coefficient (Cα), and composite reliability (CR). The results showed that all of the items' scores were above 0.7. The assumptions were examined for outliers, multi-collinearity, and independent error factors before running the structural equation model. The results showed that there was no existing multi-collinearity, with the overall variance inflation factor (VIF) value being less than 2 and the tolerance being greater than 0.5.

Patient and public involvement

Patients and public were not involved

Data processing and analysis

Data from respondents were entered into Epi-Data version 4.6 and exported to SPSS version 25 for descriptive data analysis. Additionally, model constructs were evaluated using structural equation modelling (SEM) analysis via Analysis of Moment Structure (AMOS) version 26 software. To test measurement model, confirmatory factor analysis (CFA) using standardized data was used. As part of confirmatory factor analysis, a correlation between constructs less than 0.8 and factor loadings greater than 0.6 for each item was examined (37). The chi-square ratio (≤5), the tucker-lewis index (TLI>0.9), the comparative fit index (CFI>0.9), the goodness of fit index (GFI > 0.9), the adjusted goodness of fit index (AGFI > 0.8), the root means square error approximation (RMSEA<0.08), and the root mean square of the standardized residual (RMSR<0.08) were all used to evaluate the goodness of fit (38-40).

Data normality was evaluated using multivariate kurtosis < 5 and the critical ratio between -1.96 and +1.96. Multi-collinearity was also tested using VIF < 10 and tolerance > 0.1, as well as the correlation between exogenous constructs of <0.8, and there were no problems. In the measurement model, Cronbach's alpha test was used to assess construct reliability; each construct in the study met the required threshold of >0.70, and the composite reliability was above 0.70 (41). The Average Variance Extracted (AVE) approach, with values above 0.5, was used to assess the converging validity, while the square root of AVE in Fornell Larcker criterion, with values below 0.9, and the correlations with other latent constructs should have a lower value than the square root of AVE in each construct was used to assess the diverging validity (32, 39, 42, 43).

To evaluate a structural model, the critical ratio (CR) and the path coefficient were used to analyze the relationship between exogenous and endogenous variables. A p-value of less than 0.05 and 95% confidence intervals were used to assess the predictors' statistical significance. The influence and level of significance of each of the four possible mediation paths in the model were explored, partial mediation occurs when a construct's direct, indirect, and total effects are all statistically significant, and full mediation occurs when the direct and indirect effects are both statistically significant but the total effect is not. To confirm mediation, we typically looked for a substantial indirect effect with a p-value < 0.05.

Results

Socio-demographic characteristics of healthcare professionals

A total of 625 study participants were included in the study with a response rate of 96.3% of them who gave their consent and responded to the questions. Of the total of (n=625) respondents, 343(54.9%) of them were males, 293(46.9%) respondents were in the age group of <30 years and the mean age of the respondents was 32±6.01 years About more than half of the respondents 451 (72.2%) had less than or equal to 3 years of work experience. In addition, 228(36.5%) of the respondents were medical doctor professionals (Table 1).

Table 1: Socio-demographic characteristics of health care professionals in a resource-limited setting, 2022 (n=625)

Sociodemographic Characteristics	Category	Frequency(N)	Percentage (%)
Gender	Male	343	54.9
	Female	282	45.1
Age (year)	<30	293	46.9
	30-39	254	40.6
	>40	78	12.5
Profession	Medical doctor	228	36.5
	Nurse	165	26.4
	Midwifery	117	18.6
	Health officer	46	7.4
	Others	115	11
Work experience	1-3	451	72.2
	3-5	62	9.9
	>5	112	17.9

Others: Anesthesia, Radiology, Psychiatry, and Pharmacy

Intention to use mobile-based SMS

Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) healthcare professionals were intended to use mobile phone-based SMS in southwest Ethiopia. The median score of intention to use mobile phone-based SMS was 10.1, with a standard deviation of 3.3. The minimum and maximum scores were 3 and 15, respectively.

Measurement model

Reliability and validity of the construct

All of the constructs had Cronbach's alpha scores between 0.77 and 0.91 and composite reliability scores between 0.78 and 0.92, factor loadings of the items ranged between 0.64 and 0.89, and the value of AVE varied between 0.61 and 0.71. Therefore, all of the constructs had strong convergent validity (Supplemental Table 1).

According to the findings, the bolded values (diagonal values) or the square root of the AVE of the construct were higher than the other values in that column, and the raw. As a result, the model's constructs' discriminant validity has been proven (Supplemental Table 2).

Goodness of fit

The results in confirmatory factor analysis showed that model fit indices with respective values were chi squire difference(x^2/df=2.76), Goodness-of-fit-index (GFI=0.93), Adjusted goodness-of-fit-index (AGFI=0.91), Comparative fit index (CFI=0.94), Tucker-Lewis's index (TLI=0.93), Root means the square error of approximation (RMSEA=0.05) and standardized root mean squared residual (SRMR=0.03). Accordingly, the goodness of fit model's values met the requirements.

Structural equation model

According to the result effort expectancy had a significant direct effect on health care professionals' attitude to using mobile phone short message service (β =0.162, 95% CI: [0.061,0.270], P<0.01) and intention towards using mobile phone SMS (β =0.329, 95% CI: [0.233, 0.433], P<0.001). The facilitating condition had a direct significant effect on healthcare provider's intention towards using mobile phone SMS (β =0.104, 95% CI: [0.025, 0.191], P<0.01), and also

healthcare professionals' attitude towards the system had a direct significant effect on behavioral intention to use mobile phone SMS (β =0.268, 95% CI: [0.163, 0.373], P<0.001). whereas the relationship between performance expectancy (β =0.268, 95% CI: [-0.017,0.170], P=0.109), social influence (β =0.015, 95% CI: [-0.044, 0.075], P=0.610) and facilitating conditions (β =0.055, 95% CI: [-0.026, 0.140], P=0.184) were not significant effect on health care professionals' attitude towards using mobile phone SMS, and the path relationship of performance expectancy(β =0.002, 95% CI: [-0.088, 0.094], P=0.980) and social influence(β =-0.030, 95% CI: [-0.086,0.028], P=0.318) to use mobile phone SMS were not statistically significant (Table 2).

Table 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	B	S. E	C.R	P-Value	95% CI		Decision
						Lower	Upper	
PE → BI	H1	0.002	0.041	0.055	0.980	-0.088	0.094	Not Supported
PE→ ATT	H2	0.076	0.044	1.70	0.109	-0.017	0.170	Not Supported
EE → BI	H3	0.329	0.048	6.583	0.000***	0.233	0.433	Supported
EE→ ATT	H4	0.162	0.050	3.229	0.001**	0.061	0.270	Supported
SI → BI	H5	-0.030	0.030	-1.002	0.318	-0.086	0.028	Not supported
SI→ ATT	H6	0.015	0.032	0.475	0.610	-0.044	0.075	Not Supported
FC → BI	H7	0.104	0.039	2.649	0.011**	0.025	0.191	Supported
FC→ ATT	H8	0.055	0.041	1.317	0.184	-0.026	0.140	Not Supported
ATT → BI	H9	0.268	0.054	4.956	0.001**	0.163	0.373	Supported

Note: ** p value <0.01, ***p value is <0.001 C, R: critical ratio S.E: standard error, CI: confidence interval, β: estimate

According to the finding, performance expectancy, effort expectancy, social influence, and facilitating conditions accounted for 68% and 74% of the variance (R^2) in attitude and intention to use mobile phone short message services, respectively (Figure 2).

Mediation effects

The results revealed that attitude played a mediating role in the relationship between health care professionals' effort expectations and their intention to use mobile phone short message service to support TB patients, as opposed to the relationship between performance expectancy, social influence, and facilitating conditions. Both the relationship between attitude and intention to use the system, as well as the regression coefficient between attitude and effort expectancy, were statistically significant. The indirect effect of the standardized estimation value was 0.043 and P< 0.01. In the context of this, the relationship between effort expectancy and an intention to use mobile-based SMS was statistically significant through attitude (Table 3).

Table 3: Mediating effects of Attitude and health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting

Path	Hypothesis	Effect	β	P-value	Result	Decision
PE→AT→ BI	H10	Total effect	0.025	0.643	No relationship	Not Support
		Indirect effect	0.023	0.090		
		Direct effect	0.003	0.982		
EE→AT→ BI	H11	Total effect	0.365	0.000***	Partial Mediation	Support
		Indirect effect	0.043	0.001**		
		Direct effect	0.323	0.000***		
SI→AT→ BI	H12	Total effect	-0.038	0.390	No relationship	Not Support
		Indirect effect	0.006	0.587		
		Direct effect	-0.323	0.311		
FC→AT→ BI	H13	Total effect	0.136	0.005 **	Direct relationship	Not Support
		Indirect effect	0.017	0.158		
		Direct effect	0.119	0.012*		

*Significance at P< 0.05, **significance at P< 0.01, ***significance at P< 0.001, β: estimate

Discussion

This study was to determine the level of intention and its predictors that may influence the use of mobile phone short message service systems to support adherence and care of TB patients. Overall, 340 (54.4 %; 95% CI: [49.9–58.1]) of healthcare professionals intended to use mobile phone-based SMS to support TB patients in southwest Ethiopia. This finding was higher than the study done on the intention of health providers' electronic medical records in the Amhara regional state of Ethiopia (39.8%) (44). This discrepancy could be due to the study period and the use small sample size. Similarly, the willingness of healthcare professionals to use mobile-based health services in Ethiopia was 44% (45). This possible difference could be due to the study participants only obstetric health providers and they used a smaller sample size.

The findings show that effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' behavioral intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectation and intention to use the system. Thus, H3, H4, H7, H9, and H11 were supported and thus can be used as effective measures of mobile phone SMS adoption in resource-limited settings.

According to the findings, healthcare professional effort expectancy had a positive direct effect on attitude and both direct and indirect effects on the intention to use mobile phone SMS. This suggested that when healthcare professionals perceived the system's simplicity or lack of effort in use, their perceptions of its usefulness, attitude, and intention to use mobile phone SMS were significantly improved. This finding is consistent with findings from other studies in different countries (9, 25, 46-48). This could be because an individual's attitude and acceptance of the use of mobile phone SMS systems are greatly affected by the work required to manipulate the system and if the system is expected to manipulate people's intentions to use mobile phone SMS systems with less effort, the system's performance will improve (49). As a result, when implementing the use of mobile phone SMS technologies, the system should be simple for healthcare providers to understand and use to ensure long-term system adoption.

Facilitating conditions also positively influenced the intention to use mobile phone short message services to support adherence and care of TB patients. This showed the significance of creating

the organizational and IT requirements for this example, including the resources, technical support, and training that are necessary for the adoption and ongoing use of mobile-based SMS-enabled solutions by healthcare providers in the public health system This finding is consistent with findings from other studies in different countries (9, 26, 27, 50). This could be because health professionals think that as mobile phone use has increased, more people have access to them and are familiar with using devices to communicate with their intended recipients. As a result, they are convinced and have no trouble supporting patient care and adherence.

Health professionals' attitudes positively influenced their intention to use mobile phone SMS. Medical experts supported the usage of mobile phone SMS as a tool for bettering their health and the standard of tuberculosis treatment as they observed it being done. This finding is in line with findings from other studies done in different settings (9, 23, 51-53). Therefore, it is important to give priority to initiatives that change attitudes, such as providing mobile devices at work, providing ongoing training and assistance, and fostering knowledge exchange about eHealth technologies such as mobile SMS for the remainder of the patient's care.

Accordingly, this study provides theoretical and practical implications; the findings might alleviate any concerns regarding mobile-based SMS and its acceptability in resource-constrained environments. MHealth and other digital communication technologies have a positive impact on healthcare.The study also offers a framework for future interventional research aimed at developi ng and evaluating mobile text messaging interventions as a means of enhancing tuberculosis prev ention programme.in Ethiopia. Policymakers, healthcare providers, and planners should be concerned about improving the ability of users by providing technological resources, technical support, and training to adopt mobile-based SMS in Ethiopia.

Conclusions

Overall, healthcare professionals' intention to use mobile-based SMS was high. Effort expectancy, attitude, and facilitating conditions were significant factors that determined healthcare professionals' intention to use mobile phone SMS. Effort expectancy also influences healthcare providers' attitudes toward using these systems. Furthermore, the attitude acted as a partial mediator between effort expectations and the intention to use the system. Among the five influencing predictors, effort expectancy had a more significant prediction power for healthcare

providers' intention to use mobile phone SMS systems. Therefore, easily interactive and applicable forms of the system should be implemented for health care professionals, as well as improving capacity and building on the simplicity of technology to support adherence and the care of TB patients. Finally, we recommend that upcoming investigators include external variables, and all health institutions, similarly, support it with a qualitative study.

Abbreviations and acronyms

AMOS: Analysis of Moment and Structure; **ATT**: Attitude; **BI**: Behavioral Intention; **CI**: Confidence Intervals; **EE**: Effort Expectancy; **FC**: Facilitating Condition; **PE**: Performance Expectancy; **SEM**: Structural Equation Modelling: **SI**: Social Influence; **SMS**: Short Message Service; **SPSS:** Statistical Package for Social Science; **UTAUT**: Unified Theory of Acceptance and Use of Technology; **WHO**: World Health Organization

Ethics approval and consent to participate

Ethical clearance was obtained from Mettu University's ethical review committees with approval number MeU/RAC/1036/15. Each hospital provided a letter of permission. Each participant in the study gave their written and oral consent after being informed of the study's goal. Furthermore, all data collectors and investigators strictly adhered to the law's requirements for data privacy and confidentiality. . Furthermore, the study was done according to the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

Upon reasonable request from the corresponding author, the datasets created and/or analyzed during the current work will be made available.

Competing interests

The authors declare that we have no competing interests.

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Authors' contributions

ADW contributed to conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, and writing -original draft, **AWD** did the conception and design, acquisition of data or analysis and interpretation of data, and **MKH** contributed the funding acquisition, investigation, methodology, and resources. **ADW** and **AWD** wrote the final draft of the manuscript, and the final draft of the manuscript was read, edited, and approved by all authors.

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Figures

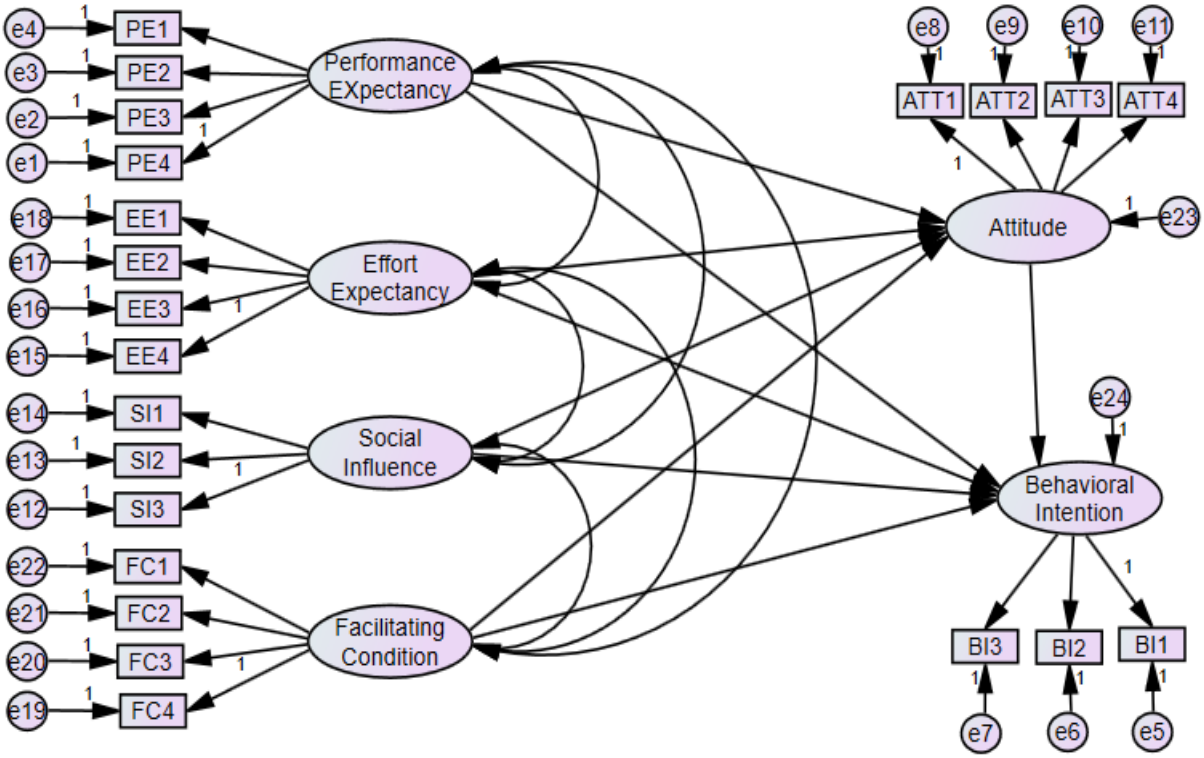
Figure 1: Modified UTAUT models of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

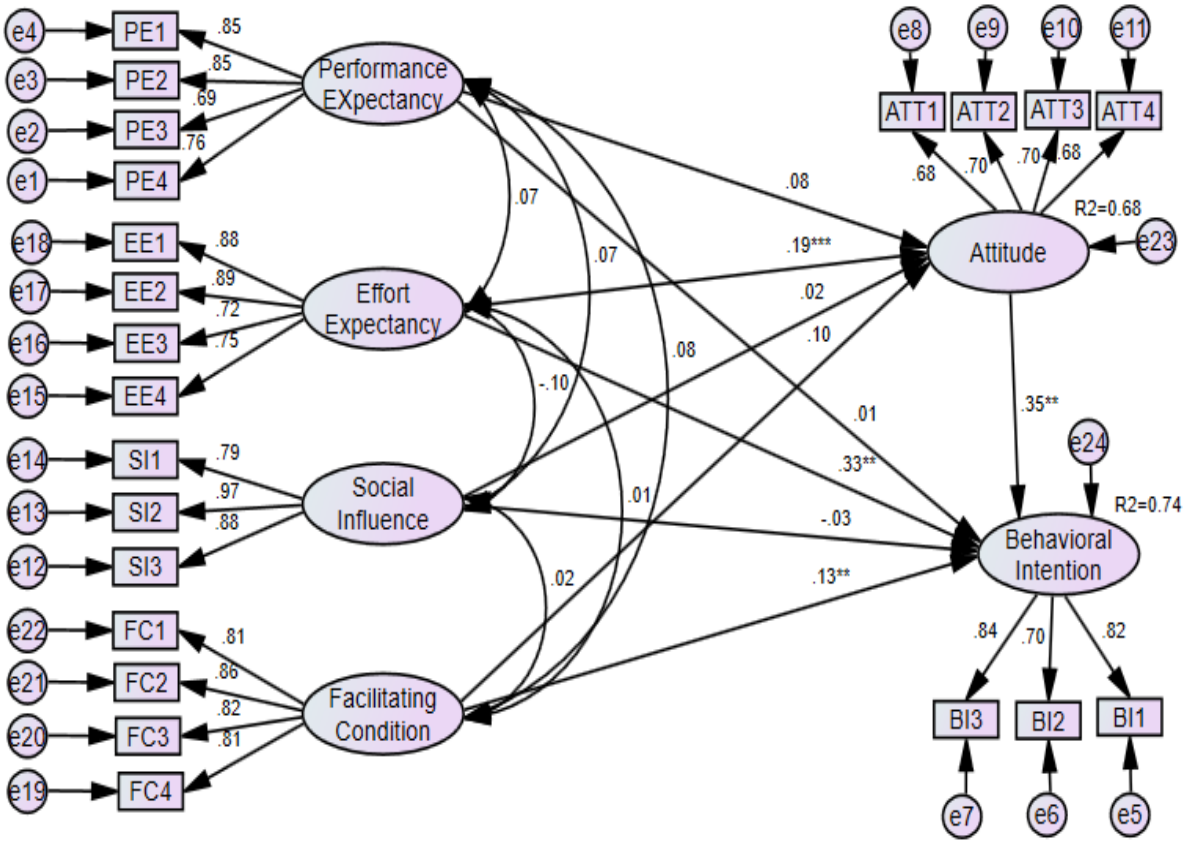
Figure 2: SEM analysis of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Supplemental tables

Supplemental Table 1: Convergent validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022

Supplemental Table 2: Discriminant validity between constructs of health care professionals' intention to use mobile phone short message service and its predictors for adherence support and care of patients with tuberculosis infection in a resource-limited setting, 2022





Construct	Indicators /Items	Standard loading	Composite Reliability	AVE	Convergent Validity
Performance Expectancy	PE1 PE2 PE3 PE4	0.85 0.84 0.67 0.74	0.88	0.65	Established
Effort Expectancy	EE1 EE2 EE3 EE4	0.87 0.89 0.69 0.73	0.91	0.69	Established
Social Influence	SI1 SI2 SI3	0.78 0.97 0.88	0.90	0.68	Established
Facilitating Condition	FC1 FC2 FC3 FC4	0.81 0.84 0.83 0.82	0.92	0.72	Established
Attitude	ATT1 ATT2 ATT3 ATT4	0.67 0.71 0.68 0.66	0.78	0.61	Established
Behavioral Intention	BI1 BI2 BI3	0.80 0.64 0.82	0.79	0.64	Established

Note; AVE: Average Variance Extracted

Construct	PE	EE	SI	FC	ATT	BI	Divergent Validity
Performance Expectancy (PE)	**0.806**						Established
Effort Expectancy (EE)	0.143	**0.831**					Established
Social Influence (SI)	0.436	0.516	**0.825**				Established
Facilitating Condition (FC)	0.533	0.178	0.543	**0.848**			Established
Attitude (ATT)	0.366	0.601	0.383	0.511	**0.781**		Established
Behavioral Intention to use (BI)	0.325	0.556	-0.112	0.362	0.603	**0.800**	Established

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5-9
Methods			
Study design	4	Present key elements of study design early in the paper	10
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*11-12*
Bias	9	Describe any efforts to address potential sources of bias	12
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	12
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	11-12
		(*b*) Describe any methods used to examine subgroups and interactions	
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	14
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	14-15
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	15,16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	

		(*b*) Report category boundaries when continuous variables were categorized	15-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.