Validity and Reliability of the Arabic Version of Telemedicine Awareness, Knowledge, Attitude, and Skills Questionnaire

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Abstract

Objectives: This study aimed to assess the validity and reliability of the Arabic version of the telemedicine awareness, knowledge, attitude, and skills (AKAS) questionnaire among healthcare practitioners in Hadhramout, Yemen.

Methods: A pilot methodological study was conducted from December 2024 to January 2025 among 30 purposively sampled healthcare professionals, including physicians, nurses, technicians, and assistants, working in hospitals and primary care centers in Hadhramout. The AKAS questionnaire was translated into Arabic following a rigorous forward-backward translation process and reviewed by a multidisciplinary expert panel. Data were collected via an online survey, and analyses included descriptive statistics, Cronbach's alpha for internal consistency, and exploratory factor analysis (EFA) for construct validity.

Results: The Arabic AKAS questionnaire demonstrated excellent internal consistency, with Cronbach's alpha coefficients of 0.854 (awareness), 0.747 (knowledge), 0.858 (attitude), and 0.944 (skills), and an overall Cronbach's alpha of 0.927. EFA confirmed strong construct validity, with factor loadings for all items exceeding 0.30 and total variance explained above 60% for each subscale. Content validity was further supported by expert and participant feedback, which led to minor improvements in questionnaire clarity and usability.

Conclusions: The Arabic version of the AKAS questionnaire is a valid and reliable instrument for assessing telemedicine competencies among healthcare professionals in Yemen. Further research with larger and more diverse samples is recommended to confirm these findings and explore the impact of educational interventions on telemedicine adoption.

Keywords: telemedicine, attitude, awareness, knowledge, skills, Yemen.

Introduction

Telemedicine is an emerging method that allows health professionals to provide medical care even at a distance. This method ensures equivalent quality of healthcare is available to individuals in different parts of the world, particularly in remote or rural areas.[1] This integration has proven particularly critical in areas with limited traditional healthcare infrastructure or where travel access issues prevent prompt medical attention.[2,3] In

addition to the recent emergence of artificial intelligence (AI), which can provide huge enhancements in healthcare outcomes.[4] The history of telemedicine dates back to the early twentieth century, marking the inception of the concept of transmitting clinical and diagnostic data, such as heart sounds, remotely via the telegraph.[5] This is followed by transmission of radiographs via radio or telephone between health facilities in the United States in the mid twentieth century.[6] In the Middle East region, telemedicine has seen some success stories; however, there have also been hurdles in its development and practice. These hurdles include resistance from health professionals and users, lack of infrastructure, budget constraints, poor ownership, delays in using the system, and skills shortage in IT.[7] Telemedicine has a potentially promising future in Yemen with pilot experimental projects by local and international organizations. There have been basic and provisional programs for consultancy services during specific times in constrained experiments.[8-11] One of the recent telemedicine interventions in Yemen was a pilot project conducted by Médecins Sans Frontières (MSF) to provide remote diagnostic and therapeutic services by using portable ultrasound with a teleconsultation platform.[11] Nevertheless, the potential for wider implementation of telemedicine remains insufficiently explored in existing literature concerning the feasibility and preparedness of local health facilities.[10] It is essential to assess the level of awareness, knowledge, attitudes, and skills related to telemedicine. Furthermore, a suitable instrument in the Arabic language is required. This study seeks to address this gap by assessing the validity and reliability of the Arabic version of the telemedicine awareness, knowledge, attitude, and skills (AKAS) questionnaire in Hadhramout, Yemen. The study tool was designed by Zayapragassarazan[12] and constructed after reviewing the previous literature.[13,14] It was earlier validated and underwent a prior assessment to determine its reliability. Although the AKAS questionnaire has been validated in English and other languages, a specific validated Arabic version that suits the Yemeni healthcare setting does not exist.[15-17] This lack of a culturally and linguistically appropriate tool leaves a methodological gap, hindering precise assessment of telemedicine readiness among Arabic-speaking healthcare professionals in Yemen. Therefore, this study aimed to establish the validity and reliability of the Arabic-translated version of the AKAS questionnaire.

Methods

The study was a pilot methodological research conducted among healthcare practitioners related to telemedicine applications in the health facilities of the Hadhramout governorate in Yemen from December 2024 to January 2025. It was part of a comprehensive study designed to evaluate the readiness for telemedicine as a digital health intervention.

The targeted participants included the medical specialists, physicians, nurses, and medical auxiliary staff (technicians and medical/paramedical assistants) employed at hospitals and primary healthcare centers. A default sample of 30 participants was recruited purposively to confirm the content validity of the translated materials, as recommended for questionnaire pre-tests.[18] This sample number represented 10% of the projected sample for the main study, which was also suggested by Connelly.[19] The sample for this pilot study was drawn from institutions other than those that will be recruited for the final study. The inclusion criteria included those participants who were employed as medical professionals at study sites as medical specialists, physicians, nurses, technicians, or medical/paramedical assistants; had a minimum of 6 months of employment experience at the participating facility; were aged 18 years or older; and were willing to participate voluntarily and provide informed consent.

The study AKAS questionnaire was a self-administered questionnaire designed by Zayapragassarazan[12] and comprised a first introductory part and four major AKAS parts. The first part of the questionnaire includes the socio-demographic information of the participants, such as hospital name, area, age, gender, educational level, and specialty. The first AKAS part was the telemedicine awareness, which encompassed 12 items to evaluate participants' telemedicine awareness through a three-point response scale: "know about it" (2 points), "heard of it" (1 point), and "don't know" (0 points). Individual and percentage awareness scores were calculated, with categorization into three levels: low (≤ 49%), average (50-70%), and high (≥ 71%) as were established in the original AKAS questionnaire.[17] The second AKAS part was the telemedicine knowledge consisted of 11 closed-ended statements to evaluate participants' knowledge of patient e-management, e-communication, follow-up, and record-keeping practices in telemedicine. Responses were limited to "yes" (1 point) and "no" (0 point), with the option to skip the question if they were not sure about the answer. The skipped answers were valued as (0 points). Similar to the awareness section, individual and percentage knowledge scores were calculated by categorizing them into low, average, and high levels based on score ranges. The third AKAS part was the telemedicine attitude, which measured participants' sentiment towards telemedicine utilization in healthcare settings using an 11-item, 5-point Likert scale. Scores ranged from 11 (least positive) to 55 (most positive). Based on score ranges of the individual. The percentage attitude scores were calculated by dividing the attitude

score by 55 and multiplying by 100 to be categorized into low, average, and high levels according to the original AKAS questionnaire.[17] The last AKAS part was the telemedicine skills, containing 13 statements that evaluated participants' practical abilities related to TM. Responses included "expert" (3 points), "mediocre" (2 points), "learner" (1 point), and "unskilled" (0 points). Total skill scores ranged from 0 (lowest) to 39 (highest), with individual and percentage scores calculated and categorized into low, average, and high levels based on score ranges.

The questionnaire was translated into Arabic to ensure a full understanding of the questionnaire statements, especially for nursing staff who predominantly study in the Arabic language. The translation process followed recommended guidelines for translating questionnaires into different languages, and it was conducted through a forward and backward translation method to guarantee clarity and accuracy.[20] The translation process commenced with forming a committee consisting of three experts from Hadhramout: an Arabic language specialist, a digital/computer science expert, and a health management professional. Then, the forward translation step was conducted by sending the original study tool to the committee members for translation from English to Arabic. Following this, the backward translation step was performed, where the Arabic version was translated back into English. Finally, the completed Arabic questionnaire was proofread to ensure linguistic rigor and precision. Afterward, the questionnaire was prepared using Microsoft Forms and distributed online to the assigned respondents through WhatsApp. Furthermore, qualitative feedback was systematically obtained from the participants and the panel of experts as a complementary measure of content validity. This was conducted by asking them to write an open-ended comment in a free-text response box after completing the online form, focusing on the questionnaire's content in terms of linguistic clarity, comprehensibility of wording and phrasing, and any ambiguous or confusing items.

Questionnaire responses were exported as a Microsoft Excel spreadsheet. For analysis, IBM SPSS v29.0 statistical software was employed. Descriptive statistics were presented as means along with standard deviations (SD) for continuous variables and as frequencies and percentages for categorical variables. Normality of the data was assessed before analysis using the Shapiro–Wilk test paired with the Q-Q plots for visual examination. The Spearman's correlation coefficient was utilized to examine the bivariate associations between the four AKAS subscale scores (awareness, knowledge, attitude, and skills). P-values <0.05 were considered statistically significant. The internal consistency was assessed by calculating Cronbach's alpha and item-total correlation coefficients for each AKAS subscale and for the overall 47-item scale, which are acceptable for preliminary estimation of internal consistency in pilot and scale validation studies.[21,22] Exploratory factor analysis (EFA) was used to assess construct validity using principal component analysis with varimax rotation. The minimum factor loading criterion was set at 0.30, where the loadings above 0.30 were considered acceptable for the small sample.[23,24] The overall shared variance of the scale, which reflects the extent of variability in each dimension, was also evaluated to confirm that the levels of explanation are acceptable.

The questionnaire was used with permission from the original authors. The study received ethical approval from the Research Ethics Committee (REC) of Hadhramout University and the Human Research Ethics Committee (JEPeM) of Universiti Sains Malaysia (USM) (Protocol code: USM/JEPeM/KK/24121062, and date of approval 19/05/2025). Participants provided informed consent for their participation. This study was conducted in line with the guidelines of the Declaration of Helsinki.

Results

From the total participants of this study (n=30), comprising 16 females (53.3%) and 14 males (46.7%), with an age range of 26-50 years (mean 33.87, SD ±5.58). The professional composition was diverse: physicians were 33.3%, with the same number of technicians and assistants, while medical specialists and nurses were 16.7% for each of them. The majority of participants were based in Mukalla (56.7%). The education qualification percentage was relatively close together, with 40% holding bachelor's, 33.3% holding master's, PhD, or board qualification, and 26.7% holding diplomas.

The internal consistency of the Arabic Telemedicine AKAS subscales showed strong coefficients across all four domains. Cronbach's alpha coefficients were 0.854 for awareness, 0.747 for knowledge, 0.858 for attitude, and 0.944 for skills, with an overall alpha of 0.927 for the entire 47-item scale as shown in Table 1. This surpasses the commonly accepted threshold of 0.70 for research instruments. Inter-item correlations ranged from 0.203 to 0.569 on average, indicating good scale homogeneity, and item-total correlations average varied between 0.183 and 0.806, where the majority of items demonstrated item-total correlations well above 0.30, except three items in the knowledge subscale fell below the threshold. The detailed findings of Cronbach's

Alpha for all items of AKAS, including the Corrected Item-Total Correlation and the Cronbach's Alpha if an item is deleted, are presented in the appendix table.

Table 1: Cronbach's Alpha for the AKAS Subscales (n=30)

Subscale	Number of Items	Cronbach's Alpha	Inter-Item Correlations	
			Average	Range
Awareness	12	0.854	0.337	0.784
Knowledge	11	0.747	0.203	0.780
Attitude	11	0.858	0.362	0.668
Skills	13	0.944	0.569	0.476

Correlational analysis of the scores of the subscales of the AKAS questionnaire revealed highly positive correlations among awareness, knowledge, and attitude. The awareness and skills demonstrate the strongest correlation. Attitude was also related to knowledge, but the correlation between attitude and knowledge was stronger than that with skills, which was not significantly correlated with knowledge and attitude, as shown in Table 2.

Table 2: The correlation between the scores of AKAS subscales of Telemedicine Questionnaire (n=30)

AKAS Telemedicine Subscale	Awareness	Knowledge	Attitude	Skills
Awareness	-	0.372*	0.408*	0.540*
Knowledge	0.372*	-	0.541*	0.224
Attitude	0.408*	0.541*	-	0.156
Skills	0.540*	0.224	0.156	-

*: P<0.001.

Construct Validity: Exploratory Factor Analysis (EFA):

The Kaiser-Meyer-Olkin (KMO) measures in Table 3 indicated good sampling adequacy for the Awareness (0.714), Attitude (0.732), and Skills (0.840) subscales, while the Knowledge subscale value fell at the lower boundary of acceptability (0.537) for a small pilot sample of 30. Bartlett's test of sphericity was significant for all subscales ($p < 0.001$), confirming suitability for factor analysis.

Table 3: Kaiser-Meyer-Olkin (KMO) and Bartlett's Tests for the AKAS Subscales (n=30)

Subscale	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity	
		Approx. Chi-Square	Sig.
Awareness	0.714	137.371	<.001
Knowledge	0.537	94.873	<.001
Attitude	0.732	127.430	<.001
Skills	0.840	309.576	<.001

EFA indicated communality values over 0.50 for all items, all eigenvalues exceeded 1.0 across all subscales, with Total Variance Explained ranging from 61.51% (Awareness) to 69.57% (Skills). Factor loadings for individual items ranged from 0.301 to 0.842, suggesting that all items made strong and meaningful contributions to the underlying construct represented by each subscale. Figure (1) illustrates the Scree Plots of the eigenvalues, and the detailed Total Variance Explained and Rotated Component Matrix findings are clarified in the appendix table.

Based on qualitative feedback from participants and expert panels, recommendations were raised to clarify and enhance the questionnaire's usability. Proposed changes included adding instructional text at the beginning of each section, such as this statement in the outset of the Awareness section: "Read the following statements, then indicate your response according to the appropriate option", and defining each option. For instance, in the Awareness section, the three options were delineated; one of these options, "Know about it", was described as "If you are already familiar with this information and have a clear understanding of it." Additionally, five respondents suggested improving the visual design of the online form by making all the sections on a single-page scrolling survey rather than the sectioned or multi-page design. Four participants suggested enhancing the format of questions by bolding the statements in the Awareness and Attitude sections to be more intelligible and substituting open-ended response items (such as age and experience) with multiple-choice or drop-down options for answers. Besides language proofreading and correction, the expert panels emphasized the significance of

maintaining consistency in common health terminology, such as telemedicine and e-health, by keeping the terms in English, along with their translated versions, to facilitate understanding.

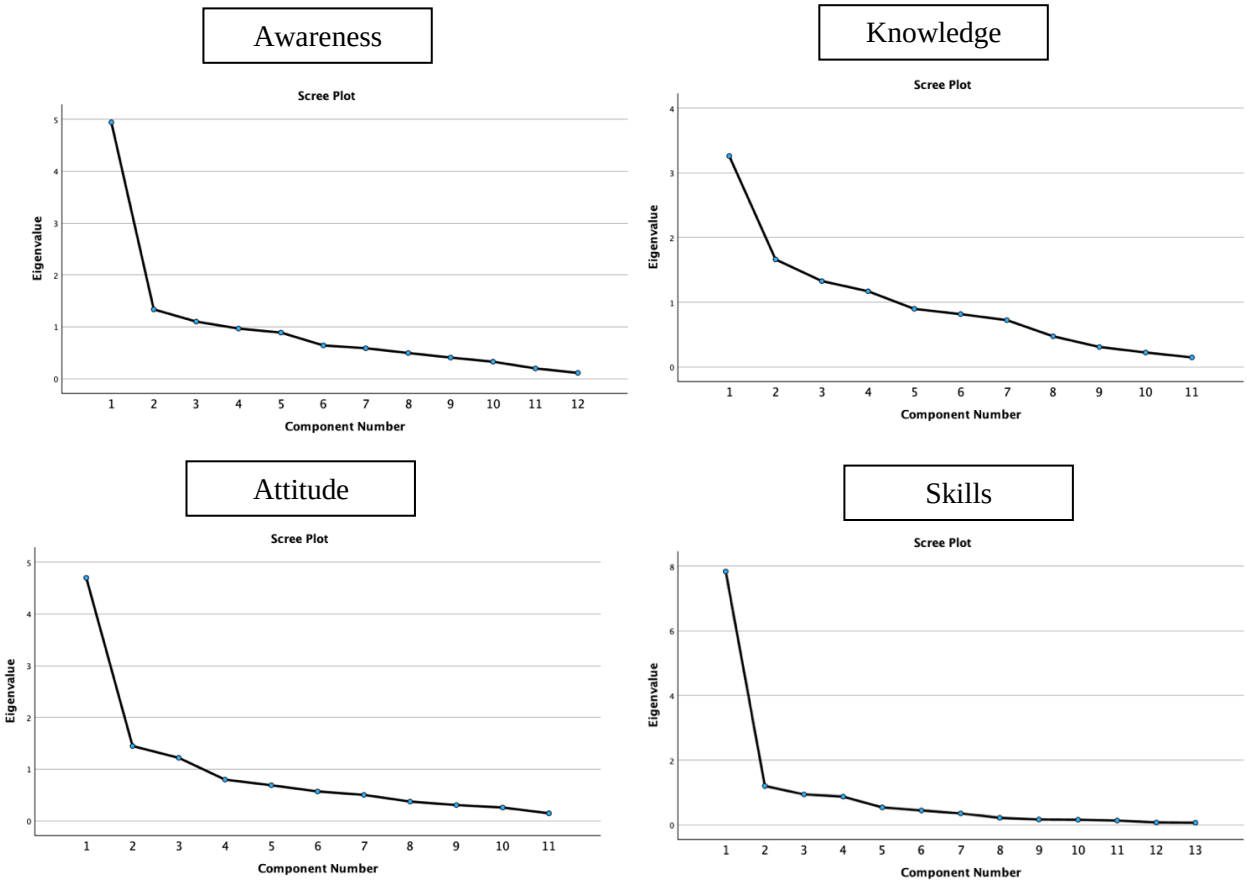

Figure 1: Scree plots of the eigenvalues tests for the AKAS Subscales (n=30).

Discussion

This study assessed the validity and reliability of the Arabic version of the AKAS questionnaire, which measures the telemedicine awareness, knowledge, attitude, and skills among healthcare practitioners in Hadhramout, Yemen. The findings indicate a preliminary validity of the Arabic AKAS as a measure of telemedicine readiness in this context.

Internal consistency results were promising in this pilot for the AKAS questionnaire, with all Cronbach's alpha coefficients of the four subscales (awareness, knowledge, attitude, and skills) exceeding 0.70, the acceptable value for a disease-specific instrument. The overall Cronbach's alpha for the 47-item scale was 0.927, suggesting good homogeneity and reliability. However, these estimates were obtained from a pilot sample (n=30) and should be interpreted as preliminary. Although the sample size is small, it is noteworthy that the AKAS subscales contained 11–13 items each with strong inter-item correlations, which some methodologists suggest may support reliability estimation even with limited samples.[25] These findings align with previous research regarding the validation of the AKAS in other languages, including Turkish and Persian.[26,27] Notwithstanding that these studies employed considerably larger sample sizes, they exhibited comparable or slightly higher Cronbach's alpha coefficients, thus corroborating the reliability of the AKAS among healthcare professionals.

Although the pilot sample size (n=30) is relatively small, it is considered the minimum sample size required for estimating reliability in instruments with items that demonstrate strong intercorrelations (eigenvalues >6) or contain 10–15 items per scale with expected alpha values above 0.70. In this study, the AKAS subscales contained 11–13 items each, and all produced Cronbach's alpha coefficients substantially above 0.70 (ranging from 0.747 to 0.944), suggesting relatively homogeneous items.[21] Nevertheless, the present pilot results should

not be considered definitive evidence of reliability. The small sample size was intentionally designed to assess content validity, feasibility, and preliminary psychometric properties prior to full-scale validation, not to establish final reliability coefficients. Therefore, the reported alpha coefficients are considered preliminary estimates for the main study, which will be confirmed in the forthcoming research with a larger sample.

Content validity was supported by expert and participant feedback, which contributed to improving the questionnaire's clarity and ease of use. Based on EFA, the construct validity was demonstrated, as all subscales met the minimum factor loading criteria, with communalities above 0.50 and total variance explained exceeding 60% for each subscale. These results are consistent with the Turkish validation study, which has robust cut-off points and high explained variance, which are considered indicative of strong construct validity.[21] KMO and Bartlett's tests further indicated data appropriateness for factor analysis, where most of the subscales showed good sampling adequacy. While KMO=0.537 of Knowledge subscale is generally considered marginal rather than clearly adequate by Kaiser's original criteria, some methodologists suggest that KMO values ≥0.50 are minimally acceptable for preliminary exploratory work, particularly with small samples.[28] The minimum factor loading criterion of 0.30 was set as the theoretical threshold for preliminary item retention, which reflects the exploratory nature of the pilot phase and the small sample size (n=30). Established psychometric guidelines recommend more stringent thresholds—specifically, factor loadings of 0.30 are considered minimally acceptable, and 0.40–0.50 are preferred for samples exceeding 300 participants.[23,29]

The validated Arabic AKAS questionnaire could be used as a basis for larger scale evaluation of Yemeni healthcare providers' telemedicine awareness, knowledge, attitudes, and skills. As the country has diverse challenges like weak infrastructure, limited resources, and varying levels of digital literacy, a validated tool is important to identify gaps and guide targeted interventions. The study's results also underscore the necessity of continued training and increasing capability for successful telemedicine implementation under resource-limited settings.

This pilot study was limited by its small sample size, which, while appropriate for pre-testing and validation, may not fully capture the diversity of healthcare practitioners in Yemen. Future research should involve larger, more representative samples and explore the questionnaire's predictive validity and test-retest reliability over time. Additionally, further studies could investigate the impact of targeted educational interventions on AKAS scores and telemedicine uptake.

Conclusion

This pilot study preliminarily demonstrated that the Arabic version of the AKAS questionnaire could be a valid and reliable instrument for evaluating telemedicine competencies among healthcare workers in Yemen. An excellent internal reliability was observed on the instrument for all subscales, strong construct validity as demonstrated by exploratory factor analysis, and strong content validity with both the participant and expert feedback. These results suggest that the Arabic AKAS questionnaire can efficiently detect shortcomings, which can help direct targeted interventions to improve digital health capacity in low-resource settings, such as Hadhramout. It is recommended to conduct a scaling-up of the validation of the AKAS questionnaire with a larger sample to ensure the stability and applicability of the instrument in diverse Yemeni healthcare environments and for different practitioners.

Disclosure

The authors declared no conflicts of interest. No funding was received for this study.

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Appendix

The detailed EFA findings for all the AKAS Subscales (n=30)

No	Item	Corrected Item - Total Correlation	Cronbach's Alpha if Item Deleted	Communalities Extraction	Factor load (Rotated Component Matrix)	Total Explained Variance Cumulative %
	Awareness					
1	Information and communication Technology (ICT) can be effectively used in health services	.622	.838	.907	0.736	61.51%
2	Information Technology (IT) and ICT enabled services are the latest advancements in medical field.	.667	.837	.846	0.864	
3	Telemedicine is part of medical education technology	.685	.831	.886	0.698	
4	Telemedicine and e-health are synonymous terms	.225	.863	.850	0.836	
5	Face to face interaction of patient and doctors is possible through telemedicine	.658	.833	.844	0.655	
6	Telemedicine provides health care services where distance is a problem	.615	.837	.907	0.696	
7	Images can be transmitted to a remote specialist for consultation	.632	.836	.860	0.770	
8	Electronic home visits are possible for elderly patients through telemedicine	.405	.853	.891	0.659	
9	Rural practitioners can transmit ECG and X-ray to consultants elsewhere in the world and seek their opinion.	.495	.845	.837	0.455	
10	CME programmes can be done effectively and, in a cost, effective way through telemedicine.	.442	.849	.891	0.815	
11	Telemedicine can be used in battlefield casualties, prisons, for disabled patients and during natural and man-made calamities distance.	.369	.854	.901	0.429	
12	Telemedicine helps in making medical education to a wider group of teachers and students.	.615	.836	.872	0.673	
	Knowledge					
1	Telemedicine is the use of telecommunication to provide medical information and services.	.183	.749	.919	0.751	67.44%
2	Patients' management with drugs can be done through telemedicine	.389	.729	.790	0.602	
3	Direct full consultation of patients is possible through telemedicine	.389	.729	.812	0.642	
4	Through Telemedicine Consultation of patients through another professional via the internet is common	.430	.723	.839	0.693	
5	Patients' examination can be communicated through telemedicine	.486	.715	.924	0.859	

6	Patients' investigations can be communicated through the telemedicine	.323	.738	.871	0.448	
7	Follow-up of patients can be done through telemedicine	.212	.747	.908	0.798	
8	Management of patients including surgical procedure through the telemedicine	.253	.749	.795	0.653	
9	Electronic medical record of patients' registration can be maintained through telemedicine	.618	.697	.860	0.750	
10	Electronic medical record of patients' consultation with doctor	.630	.692	.882	0.749	
11	Health care through the internet is a recognized service	.378	.731	.811	0.745	
	Attitude					
1	Knowing more about computers and applications of ICT in medical field is a must for health professionals	.556	.846	.844	0.746	66.95%
2	Telemedicine encourages team working among health professionals which leads to quality health care	.568	.846	.874	0.793	
3	Application of ICT in health care services reduces the financial burden to government	.679	.835	.876	0.597	
4	Health for all can be easily achieved through ICT enabled health services	.497	.851	.886	0.651	
5	Health professionals can personally benefit from being more aware of what Telemedicine can offer	.472	.851	.815	0.812	
6	I would attend training courses in Telemedicine if they were offered at my hospital	.352	.858	.855	0.908	
7	patients should be encouraged to have access to medical information through e-mails and websites so that they become better informed of their medical condition	.613	.841	.853	0.725	
8	Telemedicine combined with easy public access to health information and advice will make for a healthier population in the future	.656	.840	.905	0.736	
9	use of Telemedicine will blur the distinction between primary and secondary healthcare by improving the links between patients, nurses, GPs and consultants	.621	.840	.920	0.505	
10	use of Telemedicine could encourage more team working in healthcare	.444	.854	.842	0.878	
11	use of Telemedicine could make the distribution of healthcare more even with more emphasis on prevention	.652	.838	.841	0.577	
	Skills					
1	Use E-mails with file attachments	.733	.940	.869	0.610	69.57%
2	Scan documents and pictures	.649	.943	.909	0.535	
3	Videoconferencing	.740	.940	.894	0.770	
4	Digital photography	.751	.939	.867	0.793	
5	Gain access and search a medical site such as 'Medline', etc	.806	.938	.959	0.624	
6	Participate in e-discussion forums	.779	.938	.850	0.691	
7	Download and upload WebPages and images	.758	.939	.888	0.889	
8	Install and uninstall software	.735	.940	.900	0.585	
9	Use relevant software for reading medical images	.717	.940	.852	0.834	
10	Set up a web camera	.699	.941	.853	0.914	
11	Online chatting	.696	.941	.823	0.531	
12	Burn disc or copy files to external storage devices	.727	.940	.876	0.855	
13	Establish connectivity	.720	.940	.908	0.753	