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An Empirical Study on the Use Behavior for the Integration of Mobile Devices and Teleradiology Systems in Taiwan

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1. Abstract

The purpose of this study is to determine whether the integration of mobile devices and teleradiology systems can be effectively applied to clinical consultations to substantially improve healthcare quality and patient safety. This study combined the Task/Technology Fit (TTF) model and Technology Acceptance Model (TAM) as the research framework. Questionnaires were used to survey medical staff that had actual experience implementing a teleradiology system at a medical center in Taiwan. The results show that, although TAM has no significant effect on ease of use, significant effects on other variables exist. The research concludes that mobile devices applied to teleradiology systems can effectively improve clinical consultation mechanisms, as well as provide timely image information for diagnosis, with which medical staff can perform immediate medical treatments to improve healthcare quality and conform to the philosophy of patient-centered safety for hospital assessments.

2. Keywords: Mobile devices; Teleradiology system; Task/technology fit; Patient-centered

3. Introduction

The establishment of Picture Archiving and Communication Systems (PACS) has radically transformed traditional medical imaging operations. Using information technology to digitize radiological images and transmit them through a network has enabled clinicians to access patients' image information directly in clinics and also conserve time for retrieving, filming, managing, distributing, and filing medical images. In addition, PACS greatly reduces or eliminates any possibility of images being lost. Furthermore, PACS avoids wasting time in manual procedures during consultations. With the support of image-reading workstations and Hospital Information Systems (HIS), a radiologist can complete a prompt examination report, which can further serve as a medical reference for clinic diagnoses and treatments (Michel & Franco, 2014) [1].

The integration of mobile devices and teleradiology systems allows rapid and accurate clinical management of acute neurologic disorders, such as stroke, decreases the rate of misdiagnosis, shortens the recovery time of patients, and effectively enhances quality of care (Takao et al, 2012) [2].

The present study explores the potentials of integrating mobile devices and teleradiology systems to increase the effectiveness and quality of medical practices and clinical consultations. Questionnaires were used to survey medical staff of a medical center and its affiliated branches in central Taiwan. The authors hypothesized that, when hardware limitations are removed, medical practice and clinical consultation will change greatly, and medical benefits and quality will be significantly improved. If teleradiology image systems were employed more efficiently, more optimal clinical consulting mechanisms can be expected, and high levels of medical quality and patient safety can be further ensured. With the assistance of skilled staff and requisite system operations training, the research results may be applied to clinical practice, resulting in efficient operating procedures and greater quality of medical care.

4. Literature Review

1. Relationship between Task/Technology Fit (TTF) model and Technology Acceptance Model (TAM)

The effectiveness of the Technology Acceptance Model (TAM) has been verified in numerous studies (Adams et al, 1992; Chin & Todd, 1995; Davis, 1989) [3-5], indicating a positive influence of "perceived usefulness" and "perceived ease of use" of information systems on user attitudes, as well as an indirect influence on both user intention and behavior.

The concept of task/technology fit (TTF), proposed by Goodhue and Thompson (1995) [6], constitutes the mainstream research model for investigations of the relationship between information technology and job performance. TTF assumes that, in order for a particular information technology to have a positive impact on individual performance, adequate suitability to support the task is required. In other words, users will utilize the technology only when its functions match and support the specific needs of the users' activities, show in Figure 1.

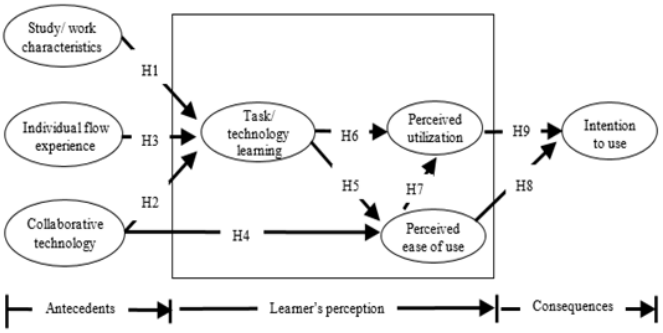

Figure 1: TTF integrated model.

2. Analysis of the feasibility of mobile devices in teleradiology systems Due to the immediacy, personalization, regionalization, high-speed bandwidth, and high-capacity of third generation mobile communication systems (3rd-generation, 3G), mobile multimedia with network accessibility have become a major emerging trend for diverse applications and the development of mobile multimedia.

A mobile phone with a Video Graphics Array (VGA) camera and Multimedia Messaging Service (MMS) capability renders medical care more convenient for most consultations can be performed with MMS-enabled mobile phones. Moreover, CT/MRI images can be viewed from the screen of the PACS with a network connection. After a 12-month trial period, a questionnaire was administered to all clinical doctors in the study to ascertain the usefulness of the MMS teleradiology service. The result of the survey regarding the use of the MMS service demonstrated that the technology significantly improved the level of confidence of the staff in emergent clinical decision-making. It is also worth noting that the MMS images exhibit sufficient video quality and resolution.

3. Short Message Service (SMS) acceptance model/ MMS acceptance model and mobile devices with a built-in Digital Imaging and Communications in Medicine (DICOM) viewer program (based on a 3G network).

4.1. SMS paging

The medical center in southern Taiwan and the central regional teaching hospital of focus in the present study have achieved significant success in the application of mobile technology since 2000. In addition to cooperation with telecommunications companies, the integration of the current information system, hospital-wide smart enterprise mobile network and SMS system, telephone extensions, and cell phone enable medical staff to take immediate appropriate action in consultations, work-shift arrangements, signing in and out, request for repairs, sickbed supply in intensive care units, and active feedback of abnormal test values. As mobile network data technology has been continually advancing, the successive completion of risk-feedback mechanisms and medical order message-review systems has provided clinical staff with the most rapid test information and feedback of abnormal test values, which has significantly promoted timely and optimal medical care.

4.2. MMS conveying graphic data

Graphic data, namely, non-digital tables and graphs of electrocardiography, electromyography and electroencephalography, can be digitized by scanners. Static image data, namely, images in DICOM format that are produced by X-ray, CT, MRI, ultrasound, and nuclear medicine (NM) can be compressed and transmitted directly. Non-DICOM images must be converted into digital form via graphic or video capturing technology prior to MMS being used for effective transmission to meet current demands. However, technical problems remain to be solved.

4 Built-in DICOM viewer program (mobile devices with a 3G network)

OsiriX, a popular medical image viewer released by Mac, was utilized by scientists at Johns Hopkins University in research conducted at The University of Virginia, Charlottesville. Through using an iPhone 3G and OsiriX to examine computed tomography images via a wireless network, the researchers were able to diagnose acute appendicitis correctly in 99% of the scans of 25 patients.

Revealed that this new technology can expedite diagnosis, and therefore treatment can be more rapidly performed [7]. The study demonstrated that diagnosis can be made not only for possible appendicitis cases, but also for a wide range of illnesses, such as aneurysm or stroke, which requires immediate diagnosis. As an extension of an earlier desktop application, OsiriX is capable of displaying and analyzing several common graphic types, such as ultrasound and computed tomography, magnetic resonance images, as well as Positron Emission Tomography (PET) images that fit the DICOM format [7]. Stated that [7], "We hope that this will result in improved patient outcomes, as evidenced by decreased rates of ruptured appendicitis, shorter hospital stays and fewer complications." In fact, accurate diagnoses and thrombolytic treatments can be made within 3 h of the patients arriving at the ER. The abovementioned beneficial functionalities are made possible by the teleradiology system.

5. PACS Application and Research

PACS and hospital information systems, laboratory information systems, and radiological information systems constitute the current medical network information system [8]. The main purpose of PACS is to provide digital storage and transmission of the images of a medical system via a network, allowing image viewing and interpretation by users on a remote computer screen. In addition, it also serves as a tool for image transmission and exchange between different medical systems. Advancements in software and applications of PACS may also further assist physicians with diagnosis, teaching, and research in the future.

Suggested that teleradiology systems have dramatically transformed the ways that clinicians and radiologists conduct consultations [9]. Teleradiology systems have greatly improved healthcare through the greatly reduced time necessary for diagnosis and treatment, as well as the greater diagnostic accuracy rates achieved with PACS.

A number of studies that performed cost-effect analysis of PACS focused on the technical skills, designs, and installations of hospital information departments. However, there has been an absence of extant literature investigating the cost-effect in management sciences and qualitative research in Taiwan. One of our main research purposes is to compare the cost of PACS systems with that of traditional film systems. In addition, we measure and evaluate the change of medical service, teaching, and research after using PACS in a hospital setting [8].

6. Relationship of Teleradiology Systems and Medical Quality

6.1. Clinical application in emergency departments

Emergency physicians are able to increase diagnosis accuracy through multidisciplinary consultations. For example, through a consultation with a radiologist, computed tomography, magnetic resonance images, and other image examinations may be utilized for accurate image interpretation, which may greatly affect patient treatment, as well as management of any prognostic complications. In fact, insufficient ability to accurately interpret images could threaten the life of the patient and seriously worsen medical quality. For example, an emergency physician, who had ordered a computed tomography examination for a patient with symptoms of stroke at the emergency department, did not have the proper ability to interpret the image properly, since a stroke can be categorized either as ischemic stroke or hemorrhage stroke. A reliable distinction between hemorrhage and ischemic stroke can only be made through neuroimaging. That doctor, however, could not consult the neurologist or radiologist because they were not on duty at that time. The emergency physician eventually administered an anticoagulant to the stroke patient in order to treat the stroke patient within 3 h. The patient, who actually had a hemorrhage stroke, ended up with a more serious stroke since the misuse of anticoagulant exacerbated the illness.

6.2. Clinical application in orthopedics

As another example, a director of orthopedics from a southern medical center participated in a seminar held in northern Taiwan. The doctor had to rush back to the hospital after being called in for an urgent

bone fracture surgery. However, the doctor found that the patient did not actually need the surgery. This waste of valuable resources was the direct result of failing to obtain the patient's immediate images and medical inspection information. In addition, the patient and his family complained about the inconsistency of medical explanations and management between the emergency physician and the orthopedist. As this example shows, a teleradiology system, if effectively implemented, would greatly improve medical management protocol and treatment.

6.3. Clinical application in internal medicine

In many elderly patients with heart disease complications, it is critical to monitor clinical changes and laboratory reports, such as in Echocardiography and Electrocardiogram (ECG). For example, the doctor on duty at a particular time, who is usually not a cardiologist, may not make an accurate diagnosis of a cardiac disorder, or differentiate among arrhythmia, acute myocardial infarction, or other heart diseases.

However, if the doctor on duty could have an instant consultation with a cardiologist via a teleradiology system, immediate emergency treatment and/or proper medical treatment for heart disease could then be provided. In this way, the delay of treatment can be prevented, and complications can be substantially decreased.

6.4. Application in radiology

A radiologist, who may not need to communicate with patients face-to-face, interprets X-ray images and sends a report to the clinician who requested the imaging. In this case, whether the information is mailed or transmitted by MMS is irrelevant. Store-and-forward technologies allow radiologists to connect to the hospital PACS network anytime and anywhere, without the necessity of physical presence. Obviously, this is a very convenient system for doctors who are either busy or not on duty. Clinicians can have direct access to the patient's images from the information equipment in a consulting room or outside of the hospital via a network, greatly saving time for image changing, filming, sorting, and filing. Moreover, in a synchronic consultation, the system also conserves both time and manual labor for retrieving application forms, issuing invoices, transporting image files, and prevents the loss of images. Radiologists can rapidly complete their medical examination reports after interpreting the images obtained from the workstation and Radiology Information System (RIS), and provide them as references for diagnosis and treatment by clinicians.

6.5. Application in geriatric medicine

The use of teleradiology in geriatric medicine constitutes a typical application (Michel & Franco, 2014). Complicated interactions involved in geriatric care include specialized medical services, long-term care, hospital care, nursing, social services, mental health services, and public health prevention services, of which the elderly may need one or more. The delivered care, however, is frequently sub-optimal due to poor communication among medical, nursing, and health information systems.

The primary benefit of a telemedicine system is that it enables the circulation of information that would otherwise remain in closed systems. Through this expansive availability of information, nursing care could be evaluated more precisely in essential areas, such as popularity of health services, supply of local healthcare, degree of unmet needs, and quality and efficacy of overall health services. Thus, teleradiology systems are necessary for geriatric care, as well as specifically for the elderly who are immobile.

6.6. Application in neuroscience

Telemedicine is the use of telecommunications and information technology to exchange patients' clinical information and expert knowledge for providing healthcare without time or space constraints [10].

Telemedicine that integrates computers and communications technologies with the knowledge possessed by medicine professionals makes distance video conferencing and consultation possible. This, in turn, provides further access to medical services which might otherwise be unavailable to more distant rural communities.

Telemedicine has gradually become feasible in recent years with the continuous development and application of communications technology, image processing and analysis, transmission of multimedia information, computer technology, and information systems.

Timely and accurate diagnosis is critical for patients requiring emergent neurosurgery [11]. Telemedicine, including image scanning, can decrease major complications after surgery and improve patient survival rate.

Multimedia Messaging Service (MMS) mobile phone technology offers a simple, inexpensive, readily available, and effective solution to the problem of medical image consultation. An MMS requires only a few minutes to transmit and receive medical images, and allows specialists to view images and make clinical diagnoses to enhance patient management in a critical condition.

7. Methodology

7. 1. Research design

Based on the above-mentioned literature review, our study assessed the modified model, shown in Figure 2.

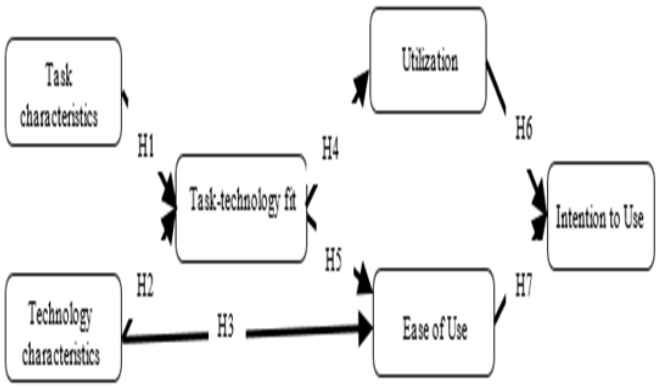

Figure 2: Research hypotheses.

(1) Subjects/ participants

a. The subjects of the study were divided into two groups. The first group was composed of clinical staff, including doctors, nurse practitioners, and those who required image consultations. The other group comprised specialists and radiologists who offered consultation services.

b. A medical center and related hospital system in central Taiwan that provided teleradiology services.

c. Specialists and clinical staff at the institution and its hospital system under study.

(2) Research tool

This study conducted an empirical investigation of use intention of a teleradiology system combined with the Task/Technology Fit (TTF) and Technology Acceptance Model (TAM) by the clinical staff.

We used a seven-point Likert scale in our questionnaire for an anonymous survey to measure the subjects' attitudes under investigation. The questionnaire was designed by neurologists and neurosurgeons, with assistance from information engineers on technical considerations regarding adequacy and sensibility.

Remote image consultations are in high demand for neurologists and neurosurgeons, offering important clinical information for more optimal and rapid decision-making. The application of this idea to medical management can express the intention of the users in a timely manner and also identify any possible disadvantages.

8. Results

Those samples were collected between December 1, 2020 and February 15, 2021.

The purpose of this study is to evaluate the intention of clinical staff using a teleradiology system to elucidate the relationship between task characteristics and technology characteristics.

A total of 238 clinical staff, enrolled in a medical center and related hospital system in central Taiwan, were selected to participate in this study and take the questionnaire survey.

We conducted descriptive statistics regarding demographics, such as gender, age, education level, clinical experience, duration of computer use, job title, service division or unit, hospital level, hospital region, and PACS experience. There were 10 variables in total.

Sample characteristics and distribution for a further understanding of samples were tested as a follow-up.

8.1. Analysis of demographic data

Table 1: Analysis of gender distribution

Variable	Category	Number of samples	Percentage
Gender	Male	106	44.5%
	Female	132	55.5%

The results of the demographic analysis, shown in Table 1, indicate that women accounted for 55.5% (n=132), while men made up 44.5% (n=106).

Table 2: Analysis of age distribution.

Variable	Category	Number of samples	Percentage
Age	21-30 yrs. old	51	21.4%
	31-40 yrs. old	98	41.2%
	41-50 yrs. old	68	28.6%
	51 yrs. old and above	21	8.8%

As shown in Table 2, the age of the subjects was divided into four groups (21-30, 31-40, 41-50, and over 51-years-old), showing that 41.2% (n=98) were from the 31-40 age group, 28.6% (n=68) were from the 41-50 age group, and 8.8% (n=21) were from the over 51 age group.

Table 3: Analysis of education level.

Variable	Category	Number of samples	Percentage
Education level	Junior college	45	18.9%
	Bachelor's degree	116	48.7%
	Master's degree	67	28.2%
	Ph.D.	10	4.2%

The subjects who held a college degree (48.7%, n=116) constituted the majority, followed by those with a postgraduate degree (28.2%, n=67), and those with a Ph.D. degree as the smallest group (4.2%, n=10) Table 3.

Table 4: Analysis of duration of computer use.

Variable	Category	Number of samples	Percentage
Duration of computer use	1-3 yrs.	17	7.1%
	4-6 yrs.	23	9.7%
	7-9 yrs.	70	29.4%
	10-12 yrs.	83	34.9%
	13 yrs. or more	45	18.9%

PACS alone cannot achieve the desired results unless it is fully integrated with a DICOM-compatible radiology information system (RIS), which is usually integrated with a hospital information system (HIS). Thus, we surveyed the duration of computer-use experience. The majority (34.9%, n=83) of the subjects had used a computer for 10-12 years, and the minority had only used a computer for 1-3 years (7.1%, n=17) Table 4.

8.2. Analysis of clinical experience

Table 5: Analysis of duration of clinical experience.

Variable	Category	Number of samples	Percentage
Seniority level	Shorter than 5 yrs.	39	16.4%
	6-10 yrs.	94	39.5%
	11-15 yrs.	69	29.0%
	16-20 yrs.	26	10.9%
	More than 21 yrs.	10	4.2%

The characteristics of the clinical experience of the subjects are presented in Table 5. The majority of the subjects had 6-10 years of clinical experience (39.5%, n=94), followed by those with 11-15 years of clinical experience (29%, n=69), and the smallest group had clinical experience of more than 21 years (4.2%, n=10).

The most common job title of our study population was "Attending Physician" (41.2%, n=98), and the least common was "Dean of the Hospital" (1.3%, n=3) Table 6.

Table 6: Analysis of job title.

Variable	Category	Number of samples	Percentage
Job title	Dean of the Hospital	3	1.3%
	Vice Dean of the Hospital	21	8.8%
	Attending Physician	98	41.2%
	Resident	28	11.8%
	Nurse Practitioner	70	29.4%
	Nurse	18	7.6%

Table 7: Analysis of divisions or units.

Variable	Category	Number of samples	Percentage
Divisions or units	Internal medicine	54	22.70%
	Department of surgery	38	16.00%
	Pediatrics	3	1.30%
	Obstetrics and gynecology	2	0.80%
	Orthopedics	77	32.40%
	Ophthalmology	2	0.80%
	Ear-nose-throat department	2	0.80%
	Emergency department	60	25.20%

Table 7 shows the distribution of service units or divisions of our study population. The most common department is orthopedics (32.4%, n=77), and the second is emergency department (25.2%, n=60). The least common department is obstetrics and gynecology, ophthalmology and the E.N.T. department, with only two subjects in each department.

Table 8: Analysis of duration of PACS use.

Variable	Category	Number of samples	Percentage
Use of PACS	1-4 yrs.	57	23.9%
	5-8 yrs.	87	36.6%
	10 yrs. or more	94	39.5%

Finally, Table 8 presents the distribution of different durations of PACS use.

Over 70% of the subjects had more than five years of experience, and nearly 40% had more than 10 years. Therefore, the majority of the subjects were proficient in working with PACS.

8.3. ISO path factor analysis

This study used a one-tailed test in the path analysis, and the results are shown in Table 9. The t-value of hypothesis 1 is 1.8950 > 1.645 for a path coefficient to be significant (p-value<0.1).

Table 9: Analysis of path.

Inter-dimensional path correlations	Path coefficient (β)	t-value	p-value
H1: Task characteristics → task / technology fit	0.1757	1.8950	P<0.1*
H2: Technology characteristics → task / technology fit	0.5726	6.6778	p<0.001****
H3: Technology characteristics → ease of use	0.2921	1.7183	p<0.1*
H4: Task/ technology fit → usefulness	0.5886	9.4993	p<0.001****
H5: Task/ technology fit → ease of use	0.1225	1.2188	p>0.1
H6: Usefulness → intention to use	0.2963	2.1094	p<0.01***
H7: Rase of use → intention to use	0.3105	4.9704	p<0.001****
t>1.645*, t>1.96**, t>2.58***, t>3.29**** (one-tailed test) p<0.1*, p<0.05** p<0.01***, p<0.001**** (one-tailed test)			

The t-value of hypothesis 2 is 6.6778 > 3.29 for a path coefficient to be highly significant (p-value<0.001). This shows that task characteristics and technology characteristics (technological synergy?) highly positively correlate with task/technology fit.

The t-value of hypothesis 3 is 1.7183>1.645 for a path coefficient to be significant (p-value<0.01). This indicates that there exists a positive correlation of technology characteristics with ease of use of the system.

The t-value of hypothesis 4 is 9.4993>3.29 for a path coefficient to be highly significant (p-value<0.001). This demonstrates that task/ technology fit highly positively correlates with usefulness of the system.

The t-value of hypothesis 5 is 1.2188<1.645 for a path coefficient to be insignificant (p-value>0.1). This shows that task/technology fit does not correlate with ease of use of the system.

The results of the path analyses revealed that statistically significance exists in hypothesis 6 and hypothesis 7. These results demonstrate that utilization and ease of use of the system have a positive relationship with intention to use the system.

9. Conclusions/Discussion

The hypotheses of this study were confirmed by questionnaire data analysis. It is also anticipated that the study results could be effectively utilized for evaluation prior to the installation of a teleradiology system, whose service will improve the workflow of radiological consultation, decrease significant delays in providing after-hours interpretation of images, and promote patient safety.

9.1. Influence of a teleradiology system on task characteristics and task/technology fit

Task characteristics can be defined as features that are used to improve the efficacy of medical image consultations through the collaboration of different systems. We investigated the relationship between task characteristics and task/technology fit, and determined whether clinical staff could fulfill their medical needs and use the system actively.

The results support our hypotheses that there is a positive correlation between task characteristics and task/technology fit.

H1: task characteristics → task / technology fit P<0.1*

9.2. Influence of a teleradiology system on technology characteristics on task/technology fit

The definition of "technology characteristics" in our study constitutes the features of tools used for distance clinical image consultations by clinical staff. We investigated whether the integration of the system and information can effectively meet the demands of the clinical staff and assist them with diagnosis and treatment. Then, we evaluated the relationship between technology characteristics and task/technology fit. The results reveal a significant correlation, and therefore support the hypothesis.

H2: technology characteristics → task / technology fit
p<0.001****

9.3. Influence of a teleradiology system on technology characteristics and ease of use

The definition of "ease of use" in our study is the degree of the ease of using the system expected by the users. We evaluated the relationship between technology characteristics and the ease of use of the system. The results reveal a positive correlation, and therefore support the hypothesis.

H3: technology characteristics → ease of use p<0.1*

9.4. Influence of a teleradiology system on task/technology fit and usefulness

This section investigates the influence of the combined systems for clinical consultations on workflow efficacy and quality of medical care. We assessed the relationship between the task/technology fit and usefulness. The results demonstrate a significant correlation, and therefore support the hypothesis.

H4: task / technology fit → usefulness p<0.001****

9.5. Influence of a teleradiology system on task/technology fit and ease of use

The definition of "task/technology fit" in our study is the degree of ease of using mobile devices with a teleradiology system for clinical image consultation. We evaluated the relationship of task/technology fit and the ease of use of the system. The results show that no correlation exists between task/technology fit and ease of use of the system in our study. Thus, the results reject the hypothesis.

H5: task / technology fit → ease of use p>0.1

9.6. Influence of a teleradiology system on usefulness and intention to use

This section investigated whether perceived usefulness of the system by the subjects has a direct influence on user attitudes and behaviors. We evaluated the relationship between usefulness and intention to use the system. The results show a significant correlation, and therefore support the hypothesis.

H6: usefulness → intention to use p<0.01***

9.7. Influence of a teleradiology system on ease of use and intention to use

This section investigated the relationship between the ease of use of the system and user intention. The results demonstrate that the more positive the user attitudes are, the stronger the intention the users have to utilize the system. The results show a significant correlation between ease of use and intention to use, and therefore support the hypothesis.

H7: ease of use → intention to use p<0.001****

This study combines mobile devices and medical systems to integrate medical processes and behaviors into a digitized mechanism, using teleradiology for efficient clinical consultations, as well as timely diagnosis and treatment. Appropriate and instant medical management not only makes healthcare more efficient, but also improves the quality of medical care in order to conform to the philosophy of patient-centered safety for hospital assessment. It assists clinical staff in understanding the requirements of the medical environment and the trend of integrating medical behaviors with information technology to facilitate high quality of care. Task/technology fit (TTF) was employed as the research framework to elucidate acceptability, user intention, and change of clinical behavior after the system was put to actual use.

References

1. Michel JP, Franco A. Geriatricians and Technology. Journal of the American Medical Directors Association. 2014; 15: 860-862.

2. Takao H, Murayama Y, Ishibashi T, Karagiozov KL, Abe T. A new support system using a mobile device (smartphone) for diagnostic image display and treatment of stroke. Stroke. 2012; 43: 236-239.

3. Adams DA, Nelson RR, Todd PA. Perceived usefulness, ease of use, and usage of information technology: A replication. MIS Quarterly. 1992; 16: 227-247.

4. Chin WW, Todd PA. On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution. MIS Quarterly. 1995; 19: 237-246.

5. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly. 1989; 13: 319-340.

6. Goodhue DL, Thompson RL. Task-technology fit and individual performance. MIS Quarterly. 1995; 19: 213-236.

7. Choudhri AF, Radvany MG. Initial experience with a handheld device digital imaging and communications in medicine viewer: OsiriX mobile on the iPhone. Journal of Digital Imaging. 2011; 24: 184-189.

8. Buabbas AJ, Al-Shamali DA, Sharma P, Haidar S, Al-Shawaf H. Users' Perspectives on a Picture Archiving and Communication System (PACS): An In-Depth Study in a Teaching Hospital in Kuwait. JMIR Medical Informatics. 2016; 4: e21.

9. Aas IM, Geitung JT. Teleradiology and picture archiving and communications systems: Changed pattern of communication between clinicians and radiologists. Journal of Telemedicine and Telecare. 2005; 11(suppl 1): 20-22.

10. Deslich S, Coustasse A. Expanding technology in the ICU: the case for the utilization of telemedicine. Telemedicine and e-Health.2014; 20: 485-492.

11. Jain S, Kumar S, Sam A, Khatana R, Taksande A, Kashikar S. Mobile Multimedia Messaging Service Teleradiology-in Otorhinolaryngological Emergencies. Journal of Disease and Global Health. 2015; 2: 23-30.