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Acceptance and adoption of the innovative use of smartphone

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Abstract

Purpose – The purpose of this study is to investigate human motivations affecting an adoption decision for smartphone among medical doctors and nurses.

Design/methodology/approach – This study investigates smartphone users' perception based on users' perceived adoption under the self-efficacy, technology acceptance model (TAM) and innovation attributes leading to an adoption attitude under innovation diffusion theory by providing research constructs for the domain of medical doctors and nurses, testing them with reliability and validity, and demonstrating their distinctiveness with hypothesis testing.

Findings – The results indicate that behavioral intention to use was largely influenced by perceived usefulness (PU) and attitude toward using smartphone. PU and perceived ease of use positively determine attitude toward using smartphone.

Research limitations/implications – For researchers, this study shows the possible and valuable adaptation of TAM constructs into the smartphone acceptance of doctors and nurses. The perceptions of smartphone adoption in this study are based on a one-time survey. For better reliability a longitudinal study to show the measurement of attitudes will be needed.

Practical implications – One of the important implications is that organizational factors become a significant predictor of users' attitude toward innovative technologies.

Originality/value – The domain of research, smartphone, is a new technology in some industries; thus smartphone adoption deserves investigation in its own right. Although academic research of smartphone adoption in healthcare is limited, this study contributes to the field by adding an important new investigation.

Keywords Innovation, Communication technologies, Doctors, Nurses

Paper type Research paper

Introduction

Many industries have quickly adopted mobile devices, such as personal digital assistants (PDAs) equipped with integrated wireless connections and mobile devices that further pushed the demand virtually in every industry. A new buzzword, "smartphone," describes this popular PDA-phone combination with multiple capabilities. According to Gartner (2006), worldwide PDA and smartphone shipments totaled 3.65 million units in the first quarter of 2006, a 6.6 percent increase from the first quarter of 2005 while pure PDA shipments were slipping and shipments of smart mobile devices rose 55 percent year-on-year in Q2 2006.

Industrial Management & Data Systems
Vol. 107 No. 9, 2007
pp. 1349-1365

0263-5577
DOI 10.1108/02635570710834009

This indicates smartphones and mobile phones have gained popularity over the last few years.

To investigate the use and acceptance of a new technology, many articles have employed technology acceptance model (TAM) and innovation diffusion theory (IDT) as a base model. In the context of mobile technology, researchers have attempted to understand the user adoption by utilizing the two theories (Cheong and Park, 2005; Mao *et al.*, 2005). The literature review reveals that very few studies investigated the smartphone adoption and even fewer studies have empirically tested individual and organizational perceptions that can explain the adoption of smartphone in the healthcare sector.

Numerous studies have demonstrated an increased use of PDAs in health care, and the industry leaders have agreed on a significant impact to the future of health care (Carrol and Christakis, 2004). Because of the dynamic nature of information technology (IT) field, by the time empirical researches of the PDA adoption have been published, this new technology may have been delayed or began to decline in use (Benbasat and Zmud, 1999). The study of smartphone adoption based on user's perception could contribute to the information systems research field as a new breed of mobile technology adoption and be handled better in avoiding the structural problem of time lag.

The objective of this paper is to investigate human motivations affecting an adoption decision for smartphone among medical doctors and nurses. The study will provide a deeper insight into identifying constructs that affect individual's decision to adopt smartphones by employing TAM and IDT as the base model. We hypothesize that individual intention to use smartphone is mostly determined by attitude toward using smartphone, perceived usefulness (PU), and self-efficacy. Other constructs in the model include comparability, observability, trialability, task, individual feature, and environment. At the end, we propose an outcome from the model that helps understanding of the influential factors of smartphone user's behavior and provide future research suggestions in this area.

Healthcare industry and smartphone use

Much literature approaches the issue of the healthcare IT by investigating the design and the adoption of electronic health record system (Kung *et al.*, 2006; Berner *et al.*, 2005). Despite a strong support for adoption of the health record system, progress has been slow but the technology has begun to adopt (Bower, 2005). In a 1999 survey of 769 physicians, 15 percent of them used a PDA (Garritty and Emam, 2006). The data shows that the adoption rate in 2001 rose to about 18 percent among practicing physicians. In 2004 and 2005, the adoption rate varies between 57 and 91 percent depending on the group's specialty (Garritty and Emam, 2006).

A driving force for PDA is wireless connectivity. "PDA-phone combo," now known by the more marketing-friendly tag "smartphone," is finally fit for the rest of us (Kirschner and Powell, 2005). With calling capabilities, smartphones provide doctors and nurses access to e-mail and the web for research and communication, and allow them to work with patient records as well as word-processing and presentation documents for professional research and collaboration (Kirschner and Powell, 2005). One example of the influence of wireless connectivity on the adoption of smartphone is electronic prescription. A small percentage of physicians send electronic prescriptions

using smartphone, but vendors expect a higher demand for the device and are even handing out smartphones to medical doctors and nurses (Goedert, 2003).

Literature review and research hypotheses

Chua and Hu (2001) evaluated physicians' acceptance of telemedicine technology and suggested that TAM may be more appropriate than other theories examining technology acceptance by individual professionals and that the integrated model may not provide significant additional explanatory power. Fang *et al.* (2005) suggested that under wireless PDA context, user intention to perform general tasks is influenced by PU and perceived ease of use (PEOU), user intention to play games is affected by perceived playfulness, and user intention to transact is influenced by PU. Studies postulated that under a wireless internet environment, wireless trust environment, PU, PEOU, system complexity, and social influences affect acceptance of wireless internet via mobile technologies (Lu *et al.*, 2003; Constantiou *et al.*, 2006; Koivumaki *et al.*, 2006). A study of physicians' adoption of a mobile system in Finland found that PU among research factors played an important role in physicians' intention to use the mobile system (Han *et al.*, 2006; Harkke, 2006).

The TAM describes PU on the context to which a system adds to the user's job performance (Davis, 1989). In the broad context of smartphone acceptance, mobile services can be available at any time and any place. Thus, PU is defined as how well consumers believe mobile services can be integrated into their daily activities (Kleijen *et al.*, 2004). Figure 1 shows factors derived from TAM and IDT and the hypotheses tested in this study. The right half of the model describes TAM factors and explains as follows. When PU goes up, users' attitude toward using a smartphone will increase, and this will influence their intention to use. For smartphone services, PEOU can be described as the issue of navigational easiness on the device and availability of personalized elements. PEOU would have a positive impact on attitude toward smartphone and also would have a positive impact on PU. Thus, when smartphone users have negative perceptions on easiness, it is difficult for them to identify PU of the smartphone. Of the last connection between "user attitude and

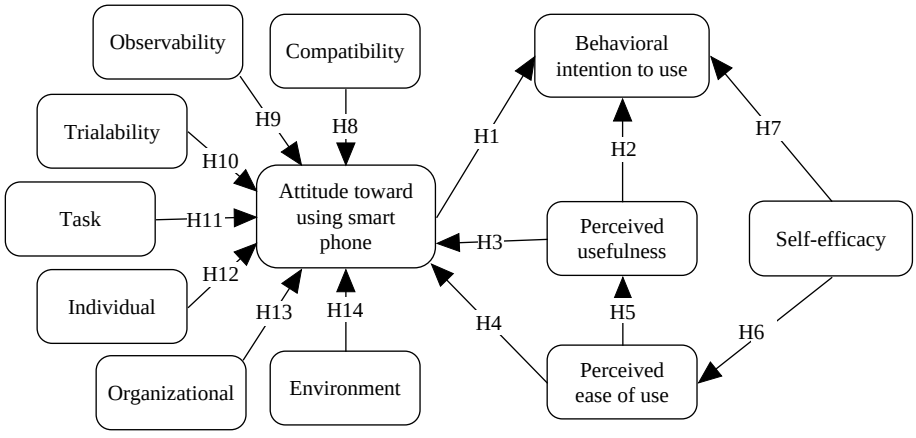

Figure 1.
Proposed research model

intention to use" in the model, it is expected that users' attitude toward smartphone has a positive impact on intention to use smartphone.

Because TAM is used as the baseline model, from the discussion above this research verifies the following TAM hypothesized relationships in the context of smartphone:

H1. A user's attitude toward using a smartphone positively affects his or her behavioral intention to use a smartphone.

H2. A user's PU of a smartphone positively affects his or her intention to use a smartphone.

H3. A user's PU of a smartphone positively affects his or her attitude toward using a smartphone.

H4. A user's PEOU of a smartphone positively affects his or her attitude toward using of a smartphone.

H5. A user's PEOU of a smartphone positively affects his or her PU of a smartphone.

Computer self-efficacy was selected as a construct for this study because other studies have time and again revealed that self-efficacy shows a relationship between the use of new technologies (Compeau and Higgins, 1995). Computer self-efficacy has been defined as "an individual's perception of his or her ability to use a computer in the accomplishment of a job task" (Compeau and Higgins, 1995, p. 193).

Without skill, performance is not possible; without self-efficacy, performance may not be attempted (Compeau and Higgins, 1995). Davis *et al.* (1989) also argued that computer self-efficacy and perceptions contribute to the causal relationship between use of technology and user's cognitive factors. Literature empirically proved that computer self-efficacy affects PU and PEOU (Venkatesh and Davis, 2000; Davis *et al.*, 1989).

From the literature, we postulate that confident users in learning to use a smartphone are likely to perceive it as easier to use. It is also likely that those who are not confident in learning the smartphone use perceive it as harder to use. This proposition displays in the right most part of the research model. The resulting hypotheses are as follows:

H6. A user's self efficacy to smartphone positively influences his/her PEOU of a smartphone.

H7. A user's self efficacy to smartphone positively influences his/her intentions to use a smartphone.

Because we view smartphone devices as innovations, Rogers's IDT is introduced in our investigation. Rogers (1995) defined innovation as a new use of an idea, practice, or object by the unit of adoption. Researchers have taken advantage of the theory in the understanding of whether an individual or organization will adopt one of many new innovations. New technology adoptions in individual IT and healthcare IT are consistent with the definition of innovation (Rogers, 1995).

Kwon and Zmud (1987) suggested that IT might be studied more effectively by combining the IDT with application research. The factors in this model are discussed

as follows. Innovation factors in this study include compatibility, observability, and trialability (Kwon and Zmud, 1987). Individual questions operationalizing the research factors are listed in the questionnaire in the Appendix of this paper.

Comparability is related positively to its rate of adoption. The more an innovation is recognized as compatible with the system, the more it would be adopted (Kwon and Zmud, 1987). Observability would positively influence the user adoption. When innovation is visible by users, it is more likely adopted. Trialability would positively affect the user adoption. Rogers (1983) suggested that if a trial is permitted, adoption and implementation will be easy and quick. Task factors contain task structure, autonomy, and uncertainty (Kwon and Zmud, 1987).

The context of smartphone adoption contains both individual and organizational factors. Individual factors can be education, age, experience, and personal traits. They showed consistently positive relationships with innovation adoption (Kwon and Zmud, 1987). Organizational factors include top management support, size, user involvement, and product champion.

Environmental factors are: competitor pressure, customer satisfaction, and marketing approach (Kwon and Zmud, 1987). Outside support may come either from a third party (e.g. consultants) or a partner company whose best practices are adopted (Ungan, 2004). External pressures can be described as "Firms are constantly under the pressure of external forces such as competition, changing customer needs, government regulations, changing technologies, etc" (Ungan, 2004. p. 507). We can safely speculate that when a company faces an external pressure, it will likely reach for the best solution possible (Ungan, 2004).

The left half of the research model in Figure 1 shows innovation factors discussed from the above. From the above discussion about IDT factors, the following relationships are hypothesized:

H8. Users' compatibility (of personal value, experience, and needs) with smartphone will positively influence their attitudes to use.

H9. Users' observability to smartphone will positively influence their attitudes to use.

H10. Users' trialability to smartphone will positively influence their attitudes to use.

H11. Users' everyday task will positively influence their attitudes to use smartphone.

H12. Users' individual features will positively influence their attitudes to use smartphone.

H13. Users' surrounding organization will positively influence their attitudes to use smartphone.

H14. The environment of the whole industry where users belong will positively influence their attitudes to use smartphone.

Methodology

Instrument

The instrument in this study consists of three sections of a questionnaire. The first section contains definitions of terms that are part of the following sections of the instrument. This section also includes a situation, which may describe a typical day of a medical doctor and the use of a smartphone in his or her work. It is followed by instructions to complete the questionnaire.

The second section contains items used to measure the independent variables assumed to affect smartphone adoption. Multi-items were used to measure each. A five-point Likert scale from strongly disagree to strongly agree was used to measure the items. Most of the items were borrowed from previous studies (Chua and Hu, 2001). Table I shows variables and items along with matching sources.

The third section contains five questions relating to demographic data about the respondent. Individuals can choose either paper version or online survey. Most of the respondents answered with the paper, only five chose to take the web survey. The questionnaire is enclosed in the Appendix.

Sample and procedure

The research population was identified with medical doctors and nurses, such as physicians and nurses in the USA. The sample was conveniently selected of those who work in a local hospital network in the Midwest. This hospital belongs to a non-profit healthcare network that provides multi-specialty group medical practices, regional community clinics, hospitals, nursing homes, home care, behavioral health services, vision centers, pharmacies, and air and ground ambulances. Thus, the subjects' specialties in this study are varied from anesthesiology to urology. The hospital serves multiple cities and towns with about 820 physicians and medical providers.

A total of 823 questionnaires were mailed to medical doctors and nurses, and healthcare providers stationed throughout clinics and the main hospital in the healthcare network. Of those, 135 were received and 20 were returned undeliverable.

Table I.
Summary of research variables

Variable	Item number (instrument)	Source
Self-efficacy (SE)	1-10	Compeau and Higgins (1995)
Perceived usefulness (PU)	11-16	Davis (1989)
Perceived ease of use (PEOU)	17-22	Davis (1989)
Behavioral intention to use (BI)	23-26	Chua and Hu, 2001 and Venkatesh and Davis (1996)
Attitude toward using (AT)	27-30	Davis *et al.* (1989)
Triability (TI)	31-34	Moore and Benbasat (1991)
Observability (OB)	35-36	Moore and Benbasat (1991) and Wu and Wu (2005)
Comparability (CM)	37-39	Wu and Wu (2005) and Moore and Benbasat (1991)
Task (TASK)	40-42	Wu and Wu (2005) and Moore and Benbasat (1991)
Individual (IND)	43-46	Wu and Wu (2005) and Moore and Benbasat (1991)
Organization (ORG)	47-51	Wu and Wu (2005) and Moore and Benbasat (1991)
Environment (ENV)	52-53	Wu and Wu (2005) and Moore and Benbasat (1991)

It turns out 133 samples were usable. We calculated a response rate of approximately 16 percent. While efforts to collect data resulted in a generally low-response rate, given healthcare providers' busy work schedule and authors' limited communication access to the subjects due to the hospital's policy, we consider it would be an acceptable response rate. They consist of 71 physicians and medical doctors, 20 nurses, 17 other specialists (i.e. therapists, residents, and pharmacists), three other staffs, and 22 unanswered.

Of the participants, 10.5 percent indicated total working experience in the field of one to five years; 15.8 percent between six and ten years; 11.3 percent between 11 and 15 years; 21.8 percent between 16 and 20 years; 17.3 percent between 21 and 25 years; and 21.8 percent had more than 26 years. The samples consist of 53 male and 47 percent female. The data indicated that 12 people use some kinds of smartphone and about the half of the samples indicates a possible consideration for smartphone adoption.

Cronbach's coefficient α is widely used to estimate the internal reliability of multi-items and its rate of 0.70 or higher is considered acceptable. Results indicated that attitude, trialability, and task are required to adjust their items in order to remain for further analysis. Thus, related items were corrected before further data analysis. Table II shows means, standard deviation, and Cronbach's α. While inspecting data collected, we have identified that approximately 20 percent of the item values of task and compatibility were missing because respondents did not notice questions appeared on the reverse page. In order to maintain the precision of data statistics, the two variables were removed from the analysis.

One method used to measure construct validity is factor analysis. A correlation matrix was generated for the instrument items. A good rule of thumb for determining the number of factors is an "eigenvalue greater than 1.0" criteria (Stevens, 1986). It appears certain that eigenvalue would explain variance in the model. In the first factor analysis as shown in Table III, five items were removed; SE1, SE2, SE3, SE7, and ORG3. SE1, SE2, and SE3, were loaded on two factors instead of the hypothesized factor. ORG3 was loaded on a non-hypothesized factor and SE7 was not loaded on any factor. All other items had factor loadings greater than 0.50 on the factor hypothesized to load. All of the factors had eigenvalues greater than 1.0.

Construct	Mean	SD	Cronbach's α
Self-efficacy (SE)	3.97	0.61	0.83
Perceived usefulness (PU)	3.41	0.90	0.97
Perceived ease of use (PEOU)	3.29	0.81	0.95
Behavioral intention to use (BI)	3.85	0.77	0.95
Attitude toward using (AT)	3.58	0.81	0.94 (when AT2 is deleted)
Triability (TI)	4.09	0.70	0.85 (when TI4 is deleted)
Observability (OB)	2.14	0.88	0.75
Comparability (CM)	3.15	0.98	0.94
Task (TASK)	3.35	0.76	0.60
Individual (IND)	3.53	0.69	0.74
Organization (ORG)	3.65	0.52	0.59
Environment (ENV)	3.53	0.61	Violated due to negative value

Table II.
Means, SD, and Cronbach's α

	Component								
	1	2	3	4	5	6	7	8	9
PU1	0.885								
PU2	0.890								
PU3	0.896								
PU4	0.857								
PU5	0.868								
PU6	0.888								
PEOU1		0.797							
PEOU2		0.753							
PEOU3		0.855							
PEOU4		0.747							
PEOU5		0.832							
PEOU6		0.836							
SE1[a]		0.549				0.531			
SE2[a]		0.513				0.636			
SE3[a]		0.505				0.730			
SE4			0.522						
SE5			0.624						
SE6			0.808						
SE7[a]			0.347						
SE8			0.545						
SE9			0.809						
SE10			0.740						
TI1				0.884					
TI2				0.877					
TI3				0.769					
IND1					0.710				
IND2					0.773				
IND3					0.785				
IND4					0.649				
ORG1							0.623		
ORG2							0.508		
ORG3[a]	0.695								
ORG4							0.684		
ORG5							0.692		
OB1							0.719		
OB2							0.863		

Table III.
First factor analysis

Notes: [a] SE1, SE2, SE3, SE7, and ORG3 are removed from the research variable items after the first factor analysis; PU – perceived usefulness; PEOU – perceived ease of use; SE – self-efficacy; TI – trialability; IND – individual; ORG – organization; OB – observability

The second factor analysis was carried out using the remaining 31 items of independent variables to evaluate the factors identified in the first factor analysis. The factors in the analysis had eigenvalues greater than 1.0 and the final factor solution represented 70.36 percent of the variance in the data. The rotated factor structure in Table IV shows that the items remained from the first factor analysis load on the proposed constructs. The results from the factor analysis lend support to the validity of the measurement instrument.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
PU1	0.896						
PU2	0.891						
PU3	0.908						
PU4	0.851						
PU5	0.863						
PU6	0.885						
PEOU1		0.833					
PEOU2		0.772					
PEOU3		0.845					
PEOU4		0.706					
PEOU5		0.831					
PEOU6		0.849					
SE4			0.602				
SE5			0.668				
SE6			0.778				
SE8			0.496				
SE9			0.785				
SE10			0.727				
TI1				0.875			
TI2				0.884			
TI3				0.778			
IND1					0.734		
IND2					0.654		
IND3					0.816		
IND4					0.712		
ORG1						0.577	
ORG2						0.712	
ORG4						0.581	
ORG5						0.558	
OB1							0.741
OB2							0.878

Notes: PU – perceived usefulness; PEOU – perceived ease of use; SE – self-efficacy; TI – trialability; IND – individual; ORG – organization; OB – observability

Table IV.
Second factor analysis

Hypothesis testing

Hypothesis testing is based on regression analysis using SPSS. *H1-H7* test the causal relationships demonstrated in TAM. Table V provides the results of hypothesis testing with R^2, standard coefficient, and significance. In sum, this study confirms the results of TAM. Supporting *H1* and *H2*, attitude toward using smartphone and PU had significant effects on behavioral intention to use ($\beta = 0.833$ and $\beta = 0.806$; $p < 0.001$).

PU had a significant positive impact on attitude toward using smartphone, supporting *H3* ($\beta = 0.904$, $p < 0.001$). PEOU had a significant positive impact on both PU and attitude toward using smartphone, supporting *H4* and *H5* ($\beta = 0.575$ and $\beta = 0.539$; $p < 0.001$). Self-efficacy was found to have a significant effect on both PEOU and behavioral intention to use, supporting *H6* and *H7* ($\beta = 0.272$ and $\beta = 0.220$; $p < 0.005$ and $p < 0.05$).

Hypothesis	Relationship	R^2	Standardized coefficient	Result
H1	AT → BI	0.694	0.833	Supported ($p < 0.001$)
H2	PU → BI	0.649	0.806	Supported ($p < 0.001$)
H3	PU → AT	0.817	0.904	Supported ($p < 0.001$)
H4	PEOU → PU	0.331	0.575	Supported ($p < 0.001$)
H5	PEOU → AT	0.291	0.539	Supported ($p < 0.001$)
H6	SE → PEOU	0.074	0.272	Supported ($p < 0.005$)
H7	SE → BI	0.048	0.220	Supported ($p < 0.05$)
H8	CM → AT			Not tested
H9	OB → AT	0.108	0.328	Supported ($p < 0.001$)
H10	TI → AT	0.052	−0.228	Not Supported ($p < 0.05$)
H11	TASK → AT			Not tested
H12	IND → AT	0.000	−0.019	Not supported ($p > 0.05$)
H13	ORG → AT	0.056	0.237	Supported ($p < 0.05$)
H14	ENV → AT			Not tested

Table V.
Tests of hypotheses

Notes: AT – attitude; BI – behavioral intention; PU – perceived usefulness; PEOU – perceived ease of use; SE – self-efficacy; CM – compatibility; OB – observability; TI – trialability; TASK – task; IND – individual; ORG – organization; ENV – environmental

H8-H14 examined the relationship between Roger's innovation attributes and individual attitude toward using smartphone. *H8*, testing the impact of compatibility on user's attitude, was not tested because the variable was discarded due to its large volume of missing values as described in sample and procedure section. Supporting *H9*, observability had a significant positive impact on user's attitude toward using ($\beta = 0.328$, $p < 0.001$). *H10* for testing the impact of trialability on user's attitude received no support ($\beta = -0.228$). The impact of trialability was found, but the direction was opposite from what was expected.

H11, testing the impact of tasks on user's attitude, was not tested because the variable was discarded due to its large volume of missing values. Individual features were not found to have a significant effect on user's attitude toward using smartphone, not supporting *H12*. *H13* was supported. The results showed that there is a significant positive impact of organizational characteristics on a user's attitude toward using smartphone ($\beta = 0.237$, $p < 0.05$). *H14* for testing the impact of environmental conditions on user's attitude was not examined because the reliability of the variable was negative. The negative value probably comes from its negative average covariance among the items.

Discussion

The results indicated that behavioral intention to use was largely influenced by PU and attitude toward using smartphone. PU and PEOU positively determines attitude toward using smartphone. We found that the impact of PU on attitude is stronger than that of PEOU. This result is consistent with previous studies. This may imply that physician's feelings about smartphone usefulness will play a more influential factor than physician's perception of easiness in determining physician's attitude toward using it.

PU was positively affected by PEOU, which is in turn positively influenced by self-efficacy. The relationship between PU and PEOU has been documented and the results confirmed the importance of the link between them. The findings also suggested that self-efficacy has a significant effect on PEOU and intention to use. This implies that if physicians feel confident about computing skills they generally demonstrate a higher perception of ease of use. This also confirms the similar results of previous studies (Compeau and Higgins, 1995). This attempt of adapting TAM into the investigation of medical doctors' and nurses' intention of smartphone use was successfully demonstrated in this study. The importance of attitude in predicting the intention in medical professionals confirms the validity of TAM model.

Additionally, Rogers's innovation factors (observability, compatibility, trialability, task, individual features, organizational characteristics, and environmental factors) in the research model were tested against attitude toward using smartphone. Compatibility and task were not tested in the regression due to large number of missing values and environmental characteristics were eliminated during the reliability test. Constructs that were not significant in the regression include trialability and individual features. In fact, according to prior research (He *et al.*, 2006) trialability shows weak correlation to adoption of technology. Thus, only observability and organizational characteristics in the innovation attributes were positively related with medical doctors' and nurses' adoption decisions. The importance of observability on user's attitude toward using smartphone suggested that the more visible the use of smartphone is, the more likely the user will have a positive attitude toward using it. Given its low-adoption rate (about 10 percent), many medical doctors and nurses probably have not witnessed and experienced smartphone operation and observing others using it would affect their cognitive attitudes toward actual using.

The organizational attributes were significant for smartphone adoption and other studies concluded the same way. Organization size strongly affects the user's smartphone adoption. Top management support held a positive relation to the adoption. Medical informatics literature (Lu *et al.*, 2005) indicated that organizational changes to IT adoption would provide the necessary infrastructure for mobile devices technically and financially.

Studies found that individual factors such as education, job status, and experience are correlated with user attitude. However, the results of this study did not find the significance of individual factors. It is interesting to note that doctors and nurses likely do not perceive individual factors that influence their attitudes toward using smartphone. In regard to trialability, doctors and nurses do not feel that trials before smartphone use would have a positive impact on their attitudes. Owing to the current low-adoption rate of smartphone, physicians may perceive it as a non-essential device and believe that smartphone could not fit into their workflow seamlessly.

Conclusions

We adapted TAM to demonstrate how individual behavioral intentions related to smartphone acceptance among medical doctors and nurses. The results showed that attitude toward using smartphone plays the most powerful predictor for the user intention. PU played the second most powerful predictor followed by self-efficacy. To researchers, this study shows the possible and valuable adaptation of TAM constructs

into the smartphone acceptance of healthcare professionals. Although user's perceived adoption under TAM and innovation attributes have been previously explored, this study extended prior research by providing research constructs for a domain of healthcare professionals, testing them with reliability and validity, and demonstrating their distinctiveness. Our findings agreed with the studies in the main factors of PEOU, PU, and self-efficacy. Further, efforts must be made to address other aspects of these cognitive factors.

Our domain of research, smartphone, is a new technology in some industries, thus, smartphone adoption deserves investigation in its own right. Although academic research of smartphone adoption in healthcare is limited, this study contributes to the field by adding an important new investigation. One of the important implications is that organizational factors become a significant predictor of users' attitude toward innovative technologies. The findings imply that the management should pay attention to the adoption decision of new technologies with positive commitment. Management's enthusiastic support to individuals would promote positive cognitive attitudes toward using the new technology.

The perceptions of smartphone adoption in this study are based on a one time survey. For better reliability a longitudinal study to show the measurement of attitudes will be greatly needed. Our samples are based on a single healthcare network. Testing research relationships across multiple hospitals would improve generalization of the smartphone study among healthcare professionals. In the healthcare industry, millions of dollars are spent on new technologies that eventually are not accepted and adopted. Careful field study would determine whether adopting IT actually promote user performance at work (Carroll and Christakis, 2004). It is our hope that this study helps to provide some answers and a foundation for future investigations.

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Appendix

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I could complete a job using the smartphone…					
Self-efficacy					
1. … if there was no one around to tell me what to do as I go					
2. … if I had never used a smartphone like it before					
3. … if I had only the smartphone manuals for reference					
4. … if I had seen someone else using it before trying it myself					
5. … if I could ask someone for help if I got stuck					
6. … if someone else had helped me get started					
7. … if I had a lot of time to complete the job for which the smartphone was provided					
8. … if I had just the built-in help facility for assistance					
9. … if someone showed me how to do it first					
10. … if I had used similar smartphones before this one to do the same job					
Perceived usefulness					
11. Using the smartphone in my job would enable me to accomplish tasks more quickly					
12. Using the smartphone would improve my job performance					
13. Using the smartphone in my job would increase my productivity					
14. Using the smartphone would enhance my effectiveness on the job					
15. Using the smartphone would make it easier to do my job					
16. I would find the smartphone useful in my job					
Perceived ease of use					
17. Learning to operate the smartphone would be easy for me					
18. I would find it easy to get the smartphone to do what I want it to do					
19. My interaction with the smartphone would be clear and understandable					
20. I would find the smartphone to be flexible to interact with					
21. It would be easy for me to become skillful at using the smartphone					
22. I would find the smartphone easy to use					
Behavioral intention					
23. Assuming that I have the smartphone, I intend to use it					
24. Whenever possible, I intend to use the smartphone in my job					
25. To the extent possible, I would use the smartphone to do different things					
26. I intend to increase my use of the smartphone in the future					

(*continued*)

Table AI. Questionnaire

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Attitude					
27. Using the smartphone for working is (would be) a good idea					
28. Using the smartphone while working is UNPLEASANT					
29. Using the smartphone is beneficial to my work					
30. I like (would like) using the smartphone for working					
Trialability					
31. Before deciding on whether or not to adopt the smartphone, I would need to use it on a trail basis					
32. Before deciding on whether or not to adopt the smartphone, I would need to properly try it out					
33. I would be permitted to use the smartphone on a trial basis long enough to see what it can do					
34. I know where I can go to satisfactorily try out various uses of the smartphone					
Observability					
35. It is easy for me to observe others using the smartphone in my work					
36. I have had a lot of opportunity to see the smartphone being used					
Compatibility					
37. Using the smartphone is compatible with all aspects of my work					
38. Using the smartphone fits into my work style					
39. I think that using the smartphone fits well with the way I like to work					
Task					
40. The best practice of the task in the day-to-day activities is likely to be influenced by adopting the smartphone					
41. Using the smartphone will affect the independence of day-to-day activities					
42. The hesitance to using IS innovation will affect the day-to-day activities					
Individual					
43. Using the smartphone is dependent on one's education of relevant IS areas					
44. Using the smartphone is dependent on the age of the individual					
45. Using the smartphone is dependent on one's experience with relevant IS applications					
46. Using IS innovation is dependent on the personal traits of the individual					
Organization					
47. The greater the support from top management, the more likely the smartphone will be adopted					
48. The size of the organization will affect the smartphone adoption					
49. Using the smartphone affects the quality of the organizational operation					

Table AI.

(*continued*)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
50. Using the smartphone will require user involvement in the development process					
51. Using the smartphone is based on the entrepreneur nature of the organization					
Environment					
52. The pressure from competitors is likely to influence the decision to use the smartphone					
53. The availability of external support for implementing the smartphone is important to the success of using the innovation					

Table AI.

Finally, would you please provide the following information? All the answers will be kept confidential. Thank you very much

54. Smartphone model being used:
55. Gender: ☐ Male ☐ Female
56. Job title:
57. Current job experience: ☐ less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ 21-25 years ☐ 26 years and above
58. Total working experience: ☐ less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ 21-25 years ☐ 26 years and above

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