Are Physicians Likely to Adopt Emerging Mobile Technologies? Attitudes and Innovation Factors Affecting Smartphone Use in the Southeastern United States

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Abstract

The smartphone has emerged as an important technological device to assist physicians with medical decision making, clinical tasks, and other computing functions. A smartphone is a device that combines mobile telecommunication with Internet accessibility as well as word processing. Moreover, smartphones have additional features such as applications pertinent to clinical medicine and practice management. The purpose of this study was to investigate the innovation factors that affect a physician's decision to adopt an emerging mobile technological device such as a smartphone. The study sample consisted of 103 physicians from community hospitals and academic medical centers in the southeastern United States. Innovation factors are elements that affect an individual's attitude toward using and adopting an emerging technology. In our model, the innovation characteristics of compatibility, job relevance, the internal environment, observability, personal experience, and the external environment were all significant predictors of attitude toward using a smartphone. These influential innovation factors presumably are salient predictors of a physician's attitude toward using a smartphone to assist with clinical tasks. Health information technology devices such as smartphones offer promise as a means to improve clinical efficiency, medical quality, and care coordination and possibly reduce healthcare costs.

Keywords: physicians, smartphone adoption, innovation factors, health information technology, information systems, strategic health management

Introduction

The medical profession has recently emerged in the marketplace targeted by mobile technology device vendors. Historically, physicians embraced pagers as the primary method of communication in the hospital. This was principally because of the dependability and reliability of a pager. However, with recent national concerns regarding the quality and increasing costs of healthcare,[1, 2] health information technology (HIT) has emerged as one of the possible solutions for lowering healthcare costs and reducing medical error rates.[3–5] With physicians treating an ever-increasing number of patients and hospitals encountering many additional pressures to become more cost efficient, business vendors have seized the opportunity to highlight how advanced mobile technology devices such as the smartphone can ease occupational errors and burdens.

The smartphone is a mobile telecommunication device with advanced features such as medical applications, word processing, Internet access, and other computing capabilities. Traditionally, physicians have been criticized for not using information technology and mobile technology devices to the extent that other professionals do.[6–8] For instance, a recent study reports that as few as 4 percent of physicians currently are using electronic medical records.[9] Moreover, even many healthcare organizations such as hospitals have been similarly slow to adopt electronic health records or other health information technology. Yet, this phenomenon may be changing at least with respect to smartphones. These mobile devices are increasingly being embraced by healthcare professionals principally because smartphones provide a bevy of programs, as well as convenience and efficiency that cannot be duplicated with traditional computers and pocket drug references.[10–13] It was estimated that in 2004 approximately 25 percent of practicing physicians in the United States used a personal digital assistant (PDA) or smartphone, and the percentage increased to approximately 35 to 40 percent in 2008.[14] According to *Healthcare IT News,* in 2010, more than 50 percent of physicians were using smartphones or PDAs on a regular basis in clinical decision making.[15] Clinicians increasingly are shedding their tool belt of onsite and wide-area pagers and replacing them with a single device—the smartphone.[16–18] Many healthcare professionals are requesting all communications (including code calls) to be transmitted to their smartphones.[19] Thus, smartphones are increasingly becoming an essential component of clinical decision making and hospital operations.[20–22]

Recently, many academic medical centers and hospitals have begun to distribute smartphones to physicians and other healthcare professionals. For instance, the University of Pittsburgh Medical Center distributed smartphones to nurses and doctors in one of its emergency rooms and surgical floors.[23] The objective of this project was for healthcare professionals to use smartphones in place of pagers for communication with each other. The hospital also intends to add medical applications to the smartphones for the clinicians.[24] In summer 2009, Stanford Hospital & Clinics began a trial with several information technology (IT) companies to test software that will enable medical staff to access patient charts on their smartphones.[25] It appears that as more hospitals adopt electronic health record systems, cell phones will likely become an even greater component of the system.[26, 27] Smartphones appear to possess great promise, especially as mobile-computing companies continue to expand the functionality of devices. Many mobile-computing companies are developing more powerful medical applications.[28] For instance, it is conceivable that more physicians in the near future will use medical applications on smartphones to submit electronic prescriptions, monitor disease management, and view radiological images. These recent developments regarding smartphones demonstrate their significance and broad applicability. Physicians using smartphones will possess handheld clinical information devices, equipped with applications, tools, and relevant literature references to assist with decision making.

Previous academic studies have utilized the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) theory to examine the adoption and acceptance of technological innovations. The TAM and the DOI theory have also been applied to mobile technology.[29, 30] Yet, only a few studies have examined innovation factors affecting the adoption of smartphones based on clinicians' perceptions.[31, 32] Thus, we developed and tested a slightly modified version of the aforementioned research models to help explain physician intentions and attitudes toward using a smartphone.

This study investigated the decision to adopt a smartphone among physicians in their daily clinical practices. A technological device such as the smartphone and its corresponding interface should satisfy the requirements of the functions that the device is intended to support. This is pertinent principally because not every device can support salient functions, and one of the central keys to adoption is whether the particular device and the user interface meet the clinician's requirements for effectiveness, screen size for readability, and suitability for other related functions that may be needed. More specifically, we examined the constructs that affect a clinician's decision to adopt a smartphone by employing the innovation attributes leading to perceived attitude. Our hypothesis was that physicians' intentions to use a smartphone are mostly determined by attitudes toward using a smartphone, which are affected by innovation characteristics. This examination of smartphone adoption among physicians should further assist with the understanding of the salient factors that affect a smartphone user's behavior and further contribute to the body of HIT knowledge.

Literature Review and Research Hypotheses

Previous research has shown that social interactions affect the acceptance of mobile wireless technologies.[33–35] Moreover, many recent IT adoption and diffusion studies have relied heavily on the TAM and modified versions of the TAM. The TAM has been replicated in various IT adoption studies, and strong empirical findings have supported the model's use in survey instruments.[36] The TAM and modified TAMs examine the relationship between attitude and behavioral intention.

The TAM is a well-known theory regarding user acceptance and behavior related to new technologies. It was developed by Davis in 1989.[37] The model investigates the determinants of user acceptance that help explain a user's behavior with respect to the user's general attitude toward the use of computing technologies.[38] The TAM claimed that perceived ease of use and perceived usefulness are the most important factors in considering the actual use of the system. If the system is perceived as easy to use and useful, a user would have a positive attitude toward the system, which would facilitate the user's intention to use the system. Thus, in conclusion, the intention delivers an actual decision to use the system.

A previous study conducted by Chau and Hu (2001) examined acceptance of telemedicine technology among physicians.[39] This study suggested that the TAM is a particularly appropriate model to evaluate technology acceptance among clinicians.[40] Other studies have indicated that the behavioral intention to use a smartphone was largely influenced by perceived usefulness and attitude toward using a smartphone.[41, 42] Park and Chen (2007) postulated that perceived usefulness and perceived ease of use positively determined attitudes toward using a smartphone.[43] Thus, as a consequence of previous empirical validity, we incorporated aspects of the TAM into our investigation.

Researchers have used the DOI theory to better understand whether an individual or an organization will adopt new innovations.[44] The DOI theory postulates that innovation factors impact a user's perception of the innovation prior to adoption of the innovation. These factors presumably affect the rate of adoption of the innovation. These attributes provided a theoretically based set of behavioral beliefs for our study. Rogers defined innovation as a new use of an idea, a practice, or an object by the unit of adoption.[45] The smartphone was introduced as a new device at the turn of this century. Thus, we view the smartphone as a recent innovation and consequently employed Rogers's DOI theory within our study.

A previous study conducted by Kwon and Zmud (1987) suggested that information technology may be studied more effectively by adjusting research factors related to DOI theory with application research.[46] Consequently, we utilized a modified version of the TAM to examine attitude and behavioral intention to use a smartphone with seven pertinent innovation factors: compatibility, observability, job relevance, personal demographics, personal experience, the internal environment, and the external environment. Compatibility, observability, and job relevance are derived from Rogers's DOI. We removed trialability from our model to reduce any possible confusion with the innovation characteristic of observability based on pretesting with several participants. Personal demographics and personal experience were included because they have shown significant relationships with attitudes toward the adoption of information technology. Incidentally, Rogers has stated that individual personalities and personal characteristics are important characteristics of technology adopters in the innovation decision process.[47] We also introduced the internal and external environment as independent variables because they have shown significant influence with respect to the adoption of novel information technologies.

Compatibility in smartphone adoption refers to the alignment of aspects of an individual's work with the individual's work style and habits. We assume that compatibility has a positive effect on the rate of adoption. When a smartphone offers compatibility to a user, then the innovation is more likely to be adopted.[48] Observability can promote adoption of the smartphone because increased opportunities to observe the smartphone being used presumably will increase the adoption rate. Thus, observing colleagues using smartphones in a workplace setting can positively affect a physician's attitude toward using a smartphone. Job relevance, in the context of smartphone adoption, relates to the frequency of smartphone use and the effectiveness of using a smartphone regarding job performance. Consequently, job relevance is assumed to show a positive effect on the adoption of a smartphone.

The personal demographic characteristics that were surveyed include the physician's age, gender, and individual personal traits. Smartphones may be considered a relatively new technology especially among more experienced, older physicians. The personal experience factor includes elements such as a participant's educational background with computers and other technologies. For instance, education is related to the willingness to embrace technological change. Consistent with this premise, we postulate that positive associations related to personal experience with the smartphone will increase smartphone adoption.

The internal environment refers to management support, organizational size, and user involvement. For example, organizational size has been a widely investigated antecedent of innovative behavior.[49] It is also expected that smartphone adopters would have a higher level of top management support. External environmental factors include competitor pressure, the availability of external support, and current trends of smartphone use.[50] Physicians are expected to be influenced by these factors with respect to adopting smartphones presumably because they tend to exchange information with outside colleagues, ancillary providers, and other healthcare organizations.

Figure 1 displays the seven innovation factors (CM: compatibility; OB: observability; JR: job relevance; PD: personal demographics; PE: personal experience; INV: internal environment; EXV: external environment) represented by ovals. Based upon the innovation factors, the following relationships were hypothesized:

1. A physician's attitude toward using a smartphone is affected by the physician's compatibility with a smartphone.
2. A physician's attitude toward using a smartphone is affected by the observability of a smartphone.
3. A physician's attitude toward using a smartphone is affected by the relevance of a smartphone to the physician's job.
4. A physician's attitude toward using a smartphone is affected by the physician's personal demographics.
5. A physician's attitude toward using a smartphone is affected by the physician's personal experience.
6. A physician's attitude toward using a smartphone is affected by the physician's internal environment.
7. A physician's attitude toward using a smartphone is affected by the physician's external environment.
8. A physician's behavioral intention to use a smartphone is affected by the physician's attitude toward using a smartphone.

The rightmost oval and the middle oval in Figure 1 represent two of the TAM factors: behavioral intention (BI) and attitude toward use (AT). In this study, we hypothesized that a physician's attitude toward using a smartphone would have a positive effect on the physician's behavioral intention to use a smartphone.

Methods

To operationalize the innovation factors, a questionnaire executed individual queries. Most of the questionnaire items were taken from previous studies. Table 1 shows questionnaire items and corresponding sources.

The study sample consisted of physicians, conveniently selected from two community hospitals and one academic medical center in the southeastern United States. One community hospital was a nonprofit, and the other was a for-profit hospital. The third hospital was a nonprofit teaching hospital. The hospitals provided myriad services such as emergency services; care at the primary, secondary, and tertiary levels;

nursing home care; behavioral health service care; pharmaceutical services; and air and ground ambulance transportation. Each hospital was centrally located to accommodate citizens from the city and several adjoining towns.

The emerging mobile technology examined was the smartphone. The study instrument consisted of a questionnaire partitioned into three sections (the questionnaire may be found in the appendix). The first section provided a definition of a smartphone, included a hypothetical situation that described a physician's typical day, and suggested how the use of a smartphone may assist with his or her decisions. This first section concluded with instructions to assist with further completion of the questionnaire. The next section contained the constructs we used to measure the independent variables that presumably affected the adoption of a smartphone. Multiple questions were used to measure each innovation variable. We utilized a customary five-point Likert scale ranging from "strongly disagree" to "strongly agree" to measure the responses. The final section consisted of sociodemographic questions regarding the respondents.

The survey was disseminated to 400 practicing physicians by one of two methods: site visits with concomitant survey dissemination and mail surveys. We conducted site visits to each of the hospitals, where we attended physician meetings and directly distributed the survey to a total of 43 physicians. We further collected a list of physicians affiliated with each hospital from the human resource departments. We proceeded to mail surveys to each of the 357 physicians on the personnel list who had not previously attended one of the hospital meetings. The site visit surveys were completed over a three-month period, while the mail surveys were successively conducted over the following five months. We maintained respondent confidentiality by destroying any recorded identifiable information. The survey was reviewed and approved by the institutional review boards at our academic university and at each of the respective hospitals.

After the collection of the surveys, reliability and convergent validity assessments were completed. Following each of the assessments, items that did not satisfy the assessment were omitted from further analysis. Next, a factor analysis was performed to eliminate unfitted items and to identify correct items to form a factor in the research model. Once the factors were confirmed, regression analysis was used to find the model fit and assess each of the hypotheses. The direct relationships between independent variables and dependent variables were tested using regression analysis. Statistical analysis was performed using SPSS. This process is further explained in the Results section.

Results

The two dissemination methods yielded 103 responses (16 of which were not utilized due to incomplete or missing survey responses) from a total of 400 physicians. This translated into a response rate of 26 percent. A low response rate may create nonresponse bias if non-respondents differ statistically from respondents. We attempted to limit nonresponse bias by offering individual mailings, financial incentives, and multiple contacts.

Comparison of means between early and late respondents found no significant difference in age, education, or years of work experience. Thus, we concluded that nonresponse bias was not a significant problem in our sample.

The data collection efforts reflected the typically low number of respondents that are commonly seen in information system studies among physicians. Our sample classified by gender was composed of 64 males (74 percent) and 23 females (26 percent). The respondents consisted of primary care physicians (e.g., internists, pediatricians, gynecologists) and specialty physicians (e.g., emergency medicine physicians, cardiologists, pulmonologists). Many physicians in our sample had 11 or more years of experience practicing medicine (83.3 percent). Among our sample of participants, 27 physicians reported using smartphones to complete their clinical tasks. Table 2 provides additional details of the sample demographics.

After the surveys were collected, reliability and convergent validity assessments were performed by examining item-to-total correlation, calculating Cronbach's alpha coefficients, and employing a factor

analysis. Following each of the assessments, items were omitted from further analysis.[51] The Cronbach's alpha coefficients were computed to estimate the reliability of each construct. In refining the measures and eliminating lower alpha coefficients, we used item-to-total correlation. Items with item-to-total correlation coefficients of less than 0.50 were eliminated.[52] Based on these criteria, three items were deleted (AT2, INV2, and EXV2). For constructs with only two items remaining (OB, PE, and EXV), the inter-item correlation should be greater than 0.3 and significant.

The Cronbach's alpha of the final measures ranged from 0.610 to 0.916, which is considered within the acceptable range. The reliability coefficient (Cronbach's alpha) of the constructs is presented in Table 3.

After achieving the minimum levels of reliability, a factor analysis was used to test the construct validity of the item. The analysis consisted of an extraction of eigenvalues greater than 1.0 and a varimax rotation method for each construct separately. Items with factor loading less than 0.5 in the corresponding factor were eliminated from further consideration. The remaining items had factor loadings greater than 0.50 on the factor hypothesized to load. All of the factors had eigenvalues greater than 1.0. See Table 4 for factor loadings.

The regression model in Table 5 displays that attitude toward using a smartphone regressed on the innovation characteristics of observability, compatibility, job relevance, personal demographics, personal experience, the internal environment, and the external environment. The overall *F* value for the model is 16.19. This statistic was significant at the 0.01 alpha level. For effective commitment, 60 percent of the observed variance is accounted for by the linear combination of the independent variables. The regression model was used to assess each of the hypotheses.

As shown in Table 5, attitude toward using a smartphone was affected by several independent variables: observability ($\beta = .40$, $t = 4.02$, $p = .00$), compatibility ($\beta = .71$, $t = 9.28$, $p = .00$), job relevance ($\beta = .62$, $t = 7.30$, $p = .00$), personal experience ($\beta = .23$, $t = 2.13$, $p = .04$), the internal environment ($\beta = .42$, $t = 4.21$, $p = .00$), and the external environment ($\beta = .21$, $t = 1.99$, $p = .05$). In the regression of attitude toward using a smartphone on behavioral intention to use a smartphone, the results showed $\beta = .83$ (see Table 6). We calculated beta values to provide further insight into the importance of a predictor in the model. A higher beta value with respect to an independent variable indicates a stronger relationship.

Discussion

This study provided empirical support for seven of our eight hypotheses. The relationship of attitude toward using a smartphone and behavioral intention to use a smartphone was found to be statistically significant. We examined innovation characteristics and found that observability, compatibility, job relevance, personal experience, the internal environment, and the external environment had an influence on a user's attitude toward using a smartphone. A few recent studies involving healthcare professionals have shown that several of these innovation factors were influential.[53, 54] However, our study exclusively examined physician attitudes and yielded additional insight with slightly different pertinent innovation factors.

The magnitudes of the beta values show that the innovation factors of compatibility, job relevance, and the internal environment had a higher impact than the other variables. For instance, the beta value for compatibility (.71) indicated that it had the strongest relationship among the factors with respect to the attitude toward using a smartphone. Job relevance showed the next strongest relationship ($\beta = .62$), followed by the internal environment ($\beta = .42$).

The first innovation characteristic, compatibility, impacted a physician's intention to use a smartphone. When a physician felt a smartphone was suitably matched with other devices and technologies in the hospital, the clinician had a positive attitude toward using a smartphone. As physicians continue to embrace smartphones to assist with clinical care, it will be particularly important for the healthcare organization to effectively manage mobile devices to ensure that compatibility and security are maintained. Legal, managerial, and interface issues regarding the use of personal smartphones versus smartphone devices provided by the organization will need to be addressed. Second, healthcare

organizations will increasingly need carefully constructed risk-management policies such as password protection and encryption to ensure compatibility and security of information. Moreover, infrastructure platform issues such as bandwidth size, network monitoring, and syncing of portable mobile devices to other stationary desktop and portal devices will also be important.

The job relevance factor also was significant. If a physician believed the smartphone assisted with improving overall patient care, then the clinician would be more willing to adopt and use a smartphone. Thus, the smartphone appears to offer hope as a means to improve the efficiency of completing clinical tasks while perhaps also reducing medical errors. This is principally because physicians can access medical applications on smartphones that facilitate monitoring clinical signs as well as obtaining laboratory values, viewing diagnostic results, and retrieving pertinent research studies to assist with clinical decision making. Physicians are also employing smartphone applications to facilitate electronic prescriptions. Moreover, the possibility of improved communication between physicians is increasingly possible with smartphones. Smartphones connected via a networking platform application facilitate connection among physicians to exchange contact information and HIPAA-compliant messages. According to a recent analysis of more than 400,000 physicians conducted by Bulletin Healthcare, mobile consumption of medical news increased by 45 percent in the first half of 2011.[55] These recent tools and applications available on smartphones demonstrate both their significance and occupational applicability.

The previous data regarding the innovation characteristic of personal experience and the relationship to innovation adoption is mixed. A study conducted by Kwon and Zmud (1987) showed a positive relationship between personal experience and innovation adoption.[56] However, a more recent study in which the participants were nurses demonstrated the lack of a relationship between personal experience and innovation adoption.[57] Yet in this study, the innovation characteristic of personal experience was found to be significant. One possible explanation for the results of this study may be that the cohort of physicians in our study was both older and experienced. More than 50 percent of the participants had more than 21 years of clinical experience. It may be that older physicians with significant clinical experience require extensive personal experience with a device such as a smartphone along with greater technological exposure prior to accepting and adopting a new mobile technology.

Previous studies, including the work of Kwon and Zmud, showed a positive relationship between personal demographics and innovation adoption.[58] Yet in our study, the innovation characteristic of personal demographics was not found to be significant. One possible explanation for this finding may be that just as with other electronic devices, physicians' perception of factors such as age and gender is minimal with respect to utilizing mobile devices in healthcare organizational settings. Moreover, these demographic factors increasingly appear to be less salient according to other recent studies.[59, 60] The findings that age and gender perceptions are less significant with respect to adoption of technological devices is contrary to the earlier perceptions reported in previous studies.

The internal environment has also been shown to significantly impact a user's attitude in a similar fashion to that reported in previous studies.[61, 62] This study found that the internal environment was a significant independent variable for smartphone adoption. The internal environment consisted of organizational characteristics such as the size of the organization, the support from executive management, and the ease and efficiency of operational management. Previous studies have shown that organizational changes related to information technology adoption provided the necessary infrastructure to facilitate the adoption of mobile devices.[63, 64] Our results demonstrated the significance of management support as similarly established in other studies, as well as the significance of information system interface compatibility, in relation to the adoption decision of clinicians to embrace emerging technologies such as a smartphone. This is principally because hospital policies and operational support of technologies appear to promote a positive pervasive attitude among affiliated physicians. Thus, smartphones are becoming increasingly recognizable as an indispensable component for assisting with clinical decision making.

Our research had a few limitations. The results of this study are tempered by the size of our sample due to the low response rate. A second limitation is that our study was conducted in one region of the United States. It is possible that smartphone use among physicians may differ in other geographical

regions of the country. Moreover, although the study sample consisted of physicians chosen from one of three hospitals, the sample demographics consisted of a majority of older, more experienced physicians. It is possible that the intention to use a smartphone may differ among a different sociodemographic cohort of physicians. Thus, additional research is warranted with a larger sample of clinicians.

Conclusion

Another longer-term ambition of our study is to lead to the development of mobile technology platforms that are attractive to healthcare professionals. As the use of smartphones continues to proliferate, our study should help researchers more fully understand salient factors that encourage adoption of emerging mobile technologies. Thus, future smartphone applications and software programs can target specific needs of professionals. For instance, programs and corresponding content may be customized to particular specialists, providing them with the latest health applications regarding disease, treatment, and practice management issues.

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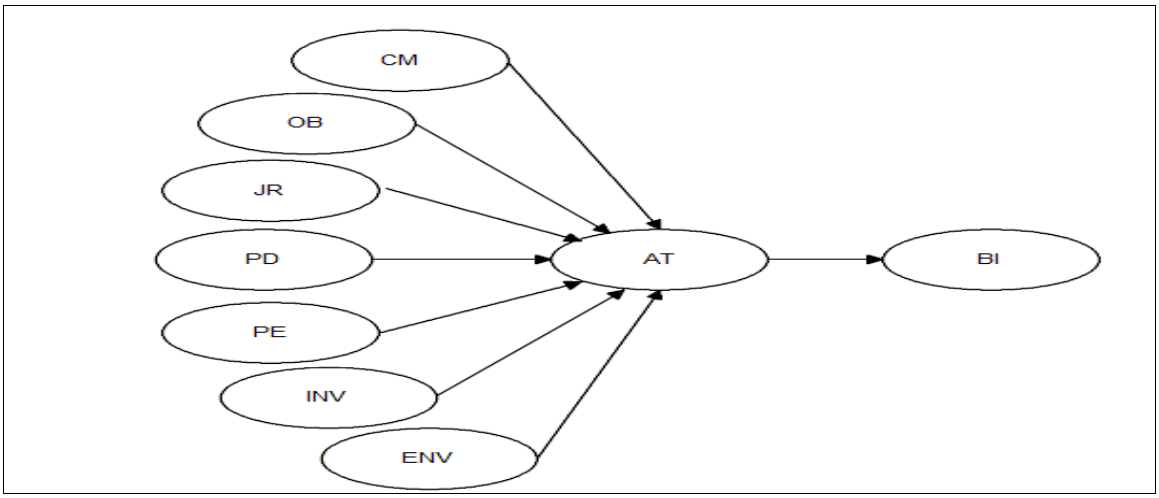
Figure 1

Research Model



Key:
BI: Behavioral intention to use smartphone
AT: Attitude toward using smartphone
CM: Compatibility
OB: Observability
JR: Job relevance
PD: Personal demographics
PE: Personal experience
INV: Internal environment
EXV: External environment

Table 1

Summary of Questionnaire Items and Sources

Variable	**Item Numbers**	**Sources**
Behavioral intention to use smartphone (BI)	1–4	Venkatesh and Davis (1996)
Attitude toward using smartphone (AT)	5–8	Davis, Bagozzi, and Warshaw (1989)
Observability (OB)	9–10	Moore and Benbasat (1991);Wu and Wu (2005)[42]
Compatibility (CM)	11–13	Wu and Wu (2005); Moore and Benbasat (1991)
Job relevance (JR)	14–16	Wu and Wu (2005); Moore and Benbasat (1991)
Personal demographics (PD)	17–19	Wu and Wu (2005); Moore and Benbasat (1991)
Personal experience (PE)	20–21	Modified from Wu and Wu (2005); Moore and Benbasat (1991)
Internal environment (INV)	22–25	Wu and Wu (2005); Moore and Benbasat (1991)
External environment (ENV)	26–28	Wu and Wu (2005); Moore and Benbasat (1991)

Sources:

Davis, F. D., R. P. Bagozzi, and P. R. Warshaw. "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models." *Management Science* 35, no. 8 (1989): 982–1003.

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Table 2

Sample Demographics

Characteristics	Frequency	Percentage
Gender		
Male	64	74
Female	23	26
Total	87	100
Current job experience		
Less than 1 year	2	2.3
1–5 years	13	14.9
6–10 years	21	24.1
11–15 years	15	17.2
16–20 years	11	12.6
21–25 years	11	12.6
26 years and beyond	14	16.1
Total job experience		
Less than 1 year	0	0
1–5 years	4	4.6
6–10 years	10	11.5
11–15 years	18	20.1
16–20 years	8	9.2
21–25 years	18	20.7
26 years and beyond	29	33.3

Table 3

Summary of Cronbach's Alpha

Variable	Cronbach's α
BI	.897
AT	.886 (AT2 deleted)
OB	.727
CM	.916
JR	.849
PD	.677
PE	.627
INV	.569 (INV2 deleted)
EXV	.610 (EXV2 deleted)

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Table 4

Factor Analysis of Constructs

Construct	Loading
BI1	.92
BI2	.90
BI3	.87
BI4	.82
AT1	.86
AT3	.91
AT4	.93
CM1	.88
CM2	.96
CM3	.94
OB1	.89
OB2	.89
JR1	.84
JR2	.92
JR3	.88
PD1	.83
PD2	.78
PD3	.73
PE1	.93
PE2	.93
INV1	.81
INV3	.74
INV4	.62
EXV1	.85
EXV3	.85

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Table 5

Summary of Regression Model

Independent variable	B	SE B	beta	*t*-value (*p*-value)
Observability	0.35	0.09	.40	4.02 (.00)
Compatibility	0.61	0.07	.71	9.28 (.00)
Job relevance	0.56	0.08	.62	7.30 (.00)
Personal demographics	0.13	0.11	.12	1.15 (.25)
Personal experience	0.24	0.11	.23	2.13 (.04)
Internal environment	0.62	0.15	.42	4.21 (.00)
External environment	0.23	0.11	.21	1.99 (.05)

Notes: Dependent variable: attitude toward using a smartphone; overall $F = 16.19$; $p = .01$; $R^2 = .60$; adjusted $R^2 = .59$; B: unstandardized coefficient; SE: standard error.

Table 6

Summary of Regression of Attitude (AT) on Behavioral Intention (BI)

Independent variable	B	SE B	beta	*t*-value (*p*-value)
Attitude toward using a smartphone	0.74	0.05	.83	13.71 (.00)

Note: Dependent variable: behavioral intention to use a smartphone.

Appendix

Situational Description for Physicians

*Please first read the situational description about the functions of a **smartphone** and then answer the corresponding questions.*

A smartphone functions to facilitate the integration of the computer, personal digital assistant, digital camera, and cell phone into one mobile device.

Suppose the hospital provides each physician with a smartphone. In the morning before arriving at the hospital, you can use the smartphone to access your schedule and pertinent registered patient data (patient records, SOAP notes, labs, etc.). In addition to the daily census of patients, you discover a posted message on your smartphone regarding a grand rounds seminar being conducted by a leading expert. The topic concerns a novel pharmaceutical approach to treating a chronic disease. After completing morning rounds, you receive a message from the floor nurse. She explains that one of your patients is uncomfortable, so you respond by researching available drugs and dosages on your smartphone. You then electronically submit the appropriate prescriptive treatment.

When you have a moment in the afternoon, you use the smartphone to scan the relevant medical literature which you previously downloaded to remain abreast of recent advances in medicine. You have a presentation later that afternoon before colleagues to present your recent clinical research data. In anticipation of this presentation, you prepare PowerPoint files and install them into your smartphone. Through using a transmission line, you will be able to view these files from the overhead projector. The clinical presentation is informative. First, you briefly record the information into your smartphone. Then, you can ask the other presenters for the related files to record into your smartphone.

After the meeting, you scan your schedule for any relevant changes related to your patients' clinical status on your smartphone. You also review the information of the new medicine, which was discussed during the grand rounds, for necessary dosing and side effects.

Thus, the smartphone not only integrates the functions of day-to-day planning, communication and messages from the hospital, but also integrates business PowerPoint, recording, and other functions which are helpful to improving the efficiency and quality of your work.

The following survey questions are designed to assess how much you would accept this medical computing device—the smartphone. Thank you for your participation.

I could complete a job using the smartphone…

Behavioral Intention

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Assuming that I have the smartphone, I intend to use it.					
2. Whenever possible, I intend to use the smartphone in my job.					
3. To the extent possible, I would use the smartphone to do different things.					
4. I intend to increase my use of the smartphone in the future.					

Attitude

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. Using the smartphone for working is (would be) a good idea.					
6. Using the smartphone while working is UNPLEASANT.					
7. Using the smartphone is beneficial to my work.					
8. I like (would like) using the smartphone for working.					

Observability

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. It is easy for me to observe others using the smartphone in my work.					
10. I have had a lot of opportunity to see the smartphone being used.					

Compatibility

	Strongly Disagr	Disagree	Neutral	Agree	Strongly Agree

	ee				
11. Using the smartphone is compatible with aspects of my work.					
12. Using the smartphone fits into my work style.					
13. I think that using the smartphone fits well with the way I like to work.					

Job Relevance

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
14. In my job, usage of the smartphone is high.					
15. In my job, usage of the smartphone is relevant.					
16. The best practice of completing tasks in the day-to-day activities is likely to be influenced by adopting the smartphone.					

Personal Demographic

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
17. Using the smartphone is dependent on the age of the individual.					
18. Using the smartphone is dependent on the gender of the individual.					
19. Using information systems (IS) innovation is dependent on the personal traits of the individual.					

Personal Experience

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
20. Using the smartphone is dependent on one's education of relevant IS area.					
21. Using the smartphone is dependent on one's experience with relevant IS applications.					

Internal Environment

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
22. The greater the support from top management, the more likely the smartphone will be adopted.					
23. The size of the organization will affect the smartphone adoption.					
24. Using the smartphone affects the quality of the organizational operation.					
25. Using the smartphone will require user involvement in the development process.					

External Environment

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
26. The pressure from competitors is likely to influence the decision to use the smartphone.					
27. The availability of external support for implementing the smartphone is important to the success of using the innovation.					
28. The trends of smartphone usage will influence my decision to use.					

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

29. Smartphone model being used:

30. Gender: □Male □Female

31. Job Title:

32. 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

33. 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