THE INFLUENCE OF IT ENVIRONMENT ON HOSPITAL EMPLOYEES' ACCEPTANCE OF HIT

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Abstract

The surge of health information technology (HIT) investment has helped hospitals evolve into an IT-intensive industry. Hospital nurses and physicians spend much time working with computer-based clinic application systems in their daily undertaking of healthcare service, and the effective use of HIT becomes critical to the success of hospitals. Behavioral research on the adoption of HIT lags behind the fast proliferation of the technology. Many researchers frame HIT adoption with theories that have been validated in other industries without examining the special context of hospital operations. This research attempts to study the special IT environment of hospitals and its influences on hospital employees' reactions to HIT systems. A research model was developed, and a field study was conducted at two midsized hospitals to test the hypothesized relationships. Implications of the results for both HIT researchers and practitioners are discussed.

Keywords: Health Information Technology, Technology Adoption, IT Environment, System Integration

INTRODUCTION

In recent years, hospitals have been boosting their investments in information technology (IT) at an unprecedented pace. This is largely because IT, as evidenced in other industries, enhances operation efficiency and improves the overall profitability of business (Raghupathi and Tan, 1999; Chandra, He, Liu, and Ruohonen, 2013). Regulations and federal funding further promote the trend by imposing legal requirements and providing financial supports (Murphy, 2010). For example, the American Recovery and Reinvestment Act and its important Health Information Technology Act provision became law on February 17, 2009, requiring hospitals and physicians to meaningfully adopt and use advanced health information technology (HIT) with an emphasis on electronic health records (EHRs). Under the law, the Medicare and Medicaid Electronic Health Records Incentive Programs began issuing incentive payments in 2011 to facilitate the adoption of EHRs. As of November 2014, 4708 hospitals and 409,974 healthcare professionals had adopted certified EHR technology, and received incentive payments over $26 billion (CMS, 2014).

With the help of increasing HIT investment, hospitals have evolved into an IT-intensive industry (Burke, Wang, Wan, and Diana, 2002). The deployment of HIT systems is necessary but not sufficient for transforming healthcare (Diamond and

Shirky, 2008); to realize the technical potential and achieve desired outcomes, HIT needs to be fully adopted and effectively used (Kolodner, Cohn, and Friedman, 2008). For example, many physicians are quickly implementing EHR thanks to the generous federal incentives, but the actual use of EHR does not meet the expectations described in the federal government's definition of "meaningful use". A 2011 survey study found that only eleven percent of physicians had effectively used "electronic health record systems with the capabilities to support even two-thirds of the stage 1 core objectives required for meaningful use" (Hsiao, Decker, Hing, and Sisk, 2012; p. 1100).

The information systems (IS) research community presents a growing awareness and interest of HIT (Chandra et al., 2013); however, behavioral research on the adoption of HIT lags behind the fast proliferation of the technology (Burke et al., 2002). Many researchers frame HIT adoption with theories that have been validated in other industries without examining the special context of hospital operations. Hospitals have some unique computing practices; the responsibilities of technicians and healthcare professionals (e.g., physicians and nurses) on operating and maintaining clinic systems are often ambiguous due to the complex nature of clinic treatments (Nissenbaum, 1994). The ignorance of distinct contextual characteristics may distract research from addressing the real problem. In a review of the HIT research literature, Chiasson and Davidson (2004) found that "the healthcare context is foreign to many IS researchers" (p. 178), and called for "developing contextually sensitive HISR (health information systems research) within the IS field" (p. 178).

Following Chiasson and Davidson's (2004) appeal for contextually sensitive research, the current study attempts to investigate the operating context of HIT in hospital settings. More specially, the study examines the special IT environment of hospitals and its influences on hospital employees' reactions to HIT. The paper is structured as follows. First, the IS literature is briefly reviewed on the study of system adoption. The hospital IT environment is discussed with an emphasis on the manner in which hospitals manage their IT resources, including the working conditions of computers, the integration of HIT systems, and the support that hospitals provide to assist HIT users. These IT environmental factors are hypothesized to influence hospital employees' attitudinal beliefs of HIT systems and their behavioral intentions of using the systems. A field study is conducted at two hospitals. The paper ends with a discussion of the implications of the results for both HIT researchers and practitioners.

THEORETICAL FOUNDATIONS AND HYPOTHESES

TAM Model and Technology Adoption

This research studies how hospital employees adopt and use HIT in their special operation environment. The technology acceptance model (TAM) serves as the theoretical foundation for framing the formation of behavioral intention of using a particular HIT system.

TAM was developed by Davis (1989) in an attempt to explain how individuals use a technological innovation in organizational settings. After two decades of intensive research, TAM is widely recognized as a dominant IS theory in the study of user behaviors (King and He, 2005). TAM posits that one's behavioral intention to adopt/use a technology is largely shaped by the person's attitudinal beliefs of the technology, including the perceived ease of use (defined as the expected effort of using the technology) and the perceived usefulness (defined as the assessment on the ability of enhancing his/her work performance) of the technology. In addition, the perceived usefulness partially mediates the effect of perceived ease of use on behavioral intention.

Numerous empirical studies have validated TAM as a robust and powerful predictive model (Venkatesh, Morris, Davis, and Davis, 2003; King and He, 2005). Indeed, TAM has evolved into a strong reference for studying user behavior beyond the field of IS. For example, Gentry and Calantone (2002) compared TAM with the theory of reasoned action (TRA) and the theory of planned behavior (TPB) in their study of consumer online behavior. The result that TAM demonstrated superior predictive power to that of TRA and TPB let them call other marketing researchers to use TAM especially in the online shopping context.

In the research of HIT adoption, TAM is also the dominant behavioral theory suggested and used by many researchers (e.g., Chau and Hu, 2001; James, Pirim, Boswell, Reithel, and Barkhi, 2006; Bhattacherjee and Hikmet, 2008; Djamasbi, Fruhling, and Loiacono, 2009; Lin, Lin, and Roan, 2012). Empirical evidence shows that TAM relationships hold true for technology adoption in the hospital industry. The following hypotheses are developed to predict one's intention of using an existing HIT system.

H1. A hospital employee's perceived usefulness of an HIT system is positively associated with the person's intention of using the HIT system.

H2. A hospital employee's perceived ease of use of an HIT system is positively associated with the person's intention of using the HIT system.

H3: A hospital employee's perceived ease of use of an HIT system is positively associated with the person's perceived usefulness of the HIT system.

The IT Environment of Hospitals

An organization's IT environment comprises "the role that IT serves within the organization and the manner by which IT resources are made available to users" (Boynton and Zmud, 1987; p. 60). Hospitals increasingly rely on IT as an important vehicle for delivering healthcare service, as evidenced by the proliferation of computer-based clinic application systems; the manner in which hospitals apply their IT resources differs dramatically from that of other industries. In this study, three aspects of hospital IT environment are examined: the conditions of hospital computers, the integration of HIT systems, and the support that a hospital provides to assist HIT usage.

Hospital Computers. Hospitals is an IT-intensive industry; hospital nurses and physicians spend much time working with computer-based clinic application systems in their daily undertaking of healthcare service, and "computers … are conveniently located at every corner" (Chandra et al., 2013; p. 71). On the other hand, however, computers in hospitals are not usually assigned to individuals. Most hospital employees, nurses in particular, have to share computers with colleagues. Such a computer-sharing environment is rarely observed in other industries. Indeed, hospitals in general do not embrace the recent trend of "work from home" partially due to the practice of sharing computers in the workplace.

Another interesting aspect of hospital computers is the coexistence of different generations of computers and different versions of operating systems. This is largely caused by the complex nature of clinic application systems being used. Many clinic application systems are running on old computers with dated operating systems; these "were often more 'best of breed-like' in their deployments and many now have aging architectures" (HIMSS, 2013; p. 7). However, due to strong computer-system dependence, replacing computers and updating operating systems cannot be done without strong support from system vendors.

Given the above discussion, two aspects of hospital computers should be investigated: computer access and computer performance. Computer access examines how easily hospital employees find computers to work with. Computer performance assesses the extent to which the operation performance of computers meets user expectations. The two aspects reflect the working conditions of hospital computers in the use of HIT systems. With easy computer access and quality computing performance, a hospital employee's experience with an HIT system is likely to be smooth and manageable; a successful experience will in turn affects the person's attitudinal beliefs that direct future behavior (Bem, 1972). Similarly, if computers are difficult to access and/or the performance of computers is poor, a hospital employee will get frustrated during the work with an HIT system; the frustration will transform negatively into the development of key attitudinal beliefs, i.e., perceived usefulness and perceived ease of use of a target HIT system. The following hypotheses are developed:

H4. The working conditions of computers in a hospital employee's workplace will affect the person's perceived usefulness of a target HIT system.

H4a. Computer access is positively associated with a hospital employee's perceived usefulness of a target HIT system.

H4b. Computer performance is positively associated with a hospital employee's perceived usefulness of a target HIT system.

H5. The working conditions of hospital computers in a hospital employee's workplace will affect the person's perceived ease of use of a target HIT system.

H5a. Computer access is positively associated with a hospital employee's perceived ease of use of a target HIT system.

H5b. Computer performance is positively associated with a hospital employee's perceived ease of use of a target HIT system.

Hospital HIT Systems. Hospital employees, nurses in particular, often work on multiple tasks during their daily undertaking of healthcare service. Many of these tasks require the use of HIT systems. Employees have to switch between systems when an operation is interrupted with emergent tasks, and involved systems are unconnected or require different operation procedures. As such, the level of integration among HIT systems will affect a hospital employee's experience with a particular HIT system, and in turn affect the person's development of attitudinal beliefs toward the system.

The IS literature has long recognized the importance of system integration, which refers to that functional computer-based systems communicate with each other and that functional activities are interrelated and handled together (Kim, 1994; Morabito, Themistocleous, and Serrano, 2010). Integrated systems help organizations not merely in automating business activities, but also in reshaping and redesigning business processes (Venkatraman, 1991). The best example of system integration may be the implementation of enterprise resources planning systems (ERPs), which have emerged as the enterprise backbone of modern organizations (Kim, 1994; Nah, Lau, and Huang, 2001). The defining feature of integration makes ERP system the best technological solution for businesses to effectively and efficiently manage data and information. (Françoise, Bourgault, and Pellerin, 2009). In many empirical studies, system integration is viewed as a reflective trait or dimension of system quality (DeLong and McLean, 1992; 2003; Wixom and Watson, 2001), therefore can be surrogated by other quality measures such as ease of use and usefulness. In the hospital industry, however, the assumption that a quality system must integrate across functions and systems may not hold true.

Healthcare is featured with fragmented services (Chaudhry, Wang, Wu, Maglione, Mojica, and et al., 2006). Clinic application systems are often developed in isolation to fulfil specific tasks. HIT systems are "… characterized as a series of standalone systems with little integration." (Burke and Menachemin, 2004; p. 208). The lack of system integration in hospitals is rarely observed in other industries (Austin, Trimm, and Sobczak, 1995; Chandra et al., 2013). Indeed, the popular assessment that hospitals lag other industries in IT adoption by 10 to 15 years (Raghupathi and Tan, 1999) is based on the long standing observation that "few hospitals have truly integrated systems with up-to-date financial, clinical, competitor, and environmental information" (Austin et al., 1995; p. 30), which remains true today. National survey of hospital IT market shows that hospitals focus much on clinical functions when planning for new HIT systems, although the need for integration between clinical and financial systems to support improved claims is growing (HIMSS, 2013).

The lack of system integration implies that hospital employees have to work on different systems to handle different tasks. Given the fragmented nature of healthcare service and the large volume of transactions (Chaudhry et al., 2006), hospital employees must be frustrated with inefficiency when they switch between systems and cope with different operation procedures. Such a frustration will inevitably affect the further development of attitudinal beliefs. Based on Morabito et al.'s (2010) study of IS integration, the current research investigates two aspects of system integration: function integration that refers to the integration across different applications and functions, and communication integration that refers to the communication and data sharing between systems. The following hypotheses are developed:

H6. The level of integration of HIT systems in one's workplace will affect the person's perceived usefulness of a HIT system.

H6a. Function integration is positively associated with one's perceived usefulness of a HIT system.

H6b.Communication integration is positively associated with one's perceived usefulness of a HIT system.

H7.The level of integration of HIT systems in one's workplace will affect the person's perceived ease of use of a HIT system.

H7a.Function integration is positively associated with one's perceived ease of use of a HIT system.

H7b.Communication integration is positively associated with one's perceived ease of use of a HIT system.

Support. Another aspect of IT environment under investigation is the support that hospitals provide to assist the use of HIT systems. Two types of support are examined in the study: technical support and management support. Technical support refers to the technical assistance that hospital employees receive from IT department or other technical supportive groups on using HIT; management support refers to the perceived encouragement from the hospital management on the general use of HIT.

The two types of support have been studied in the IS literature with different theoretical lens. Thompson, Higgins, and Howell (1991) studied technical support under the concept of facilitating conditions, arguing that "provision of (technical) support for users of PCs … can influence system utilization" (Thompson et al., 1991; p. 129). In their attempt of developing a unified theory of acceptance and use of technology, Venkatesh et al. (2003) adapt the concept of facilitating conditions and define it as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the (target) system." This study adopts the term of technical support to emphasize the provision of technical assistance to hospital employees; such assistance is for supporting the general use of HIT systems rather than to promote a particular technology.

Management support has been widely studied in the research of IS implementation. The research argues that "management support is critical because the implementation of IS innovations is resource intensive" and therefore requires commitment from senior managers (Sharma and Yetton, 2003; p. 534). The same argument applies to the use of HIT systems, many of which are sophisticated and require resources such as training, learning, and practicing efforts to overcome difficulties experienced in system use. Support from management endorses the use of HIT systems and encourage hospital employees to expend their efforts required to adopt the systems. A similar concept of social influence, defined as the degree to which an individual perceives that important others believe he or she should use a target system, is also studied in the TAM literature (e.g., Venkatesh et al., 2003). The current study uses the construct of management support to highlight the influence of hospital management in the general use of HIT.

The following hypotheses are developed:

H8. The support a hospital employee receives will affect the person's perceived usefulness of a target HIT system.

H8a. Technical support is positively associated with a hospital employee's perceived usefulness of a target HIT system.

H8b. Management support is positively associated with a hospital employee's perceived usefulness of a target HIT system.

H9. The support a hospital employee receives will affect the person's perceived ease of use of a target HIT system.

H9a. Technical support is positively associated with a hospital employee's perceived ease of use of a target HIT system.

H9b. Management support is positively associated with a hospital employee's perceived ease of use of a target HIT system.

Computer Self-Efficacy

The current study focuses on the influence of IT environment on HIT usage; however, the effect of individual competence of using computer-based systems should not be ignored. Behavior researchers have long recognized that one's behavioral intention is influenced not only by the consequence or the expected outcomes of the behavior, but also by a self-reflection of the competence that the person has on executing the behavior. Bandura (1977) developed a social cognitive theory to emphasize the role of self-referent thinking in guiding human motivation and behavior. Social cognitive theory assumes that people decide on their behavior and activities in a cognitive fashion. The key concept of Self-efficacy, defined as beliefs about one's ability to perform a specific behavior, forms the basis upon which the person decides on performing the behavior.

According to the social cognitive theory, one's efficacy beliefs of using computers form the cognitive basis of the person's use of computer-based applications (Davis, 1989). Computer self-efficacy is defined as one's judgment of his/her capability to use a computer (Compeau and Higgins, 1995). Empirical research finds that the influence of computer self-efficacy on usage behaviors is fully mediated by perceived ease of use (e.g., Venkatesh and Davis, 1996; Venkatesh, 2000). The following hypothesis is developed:

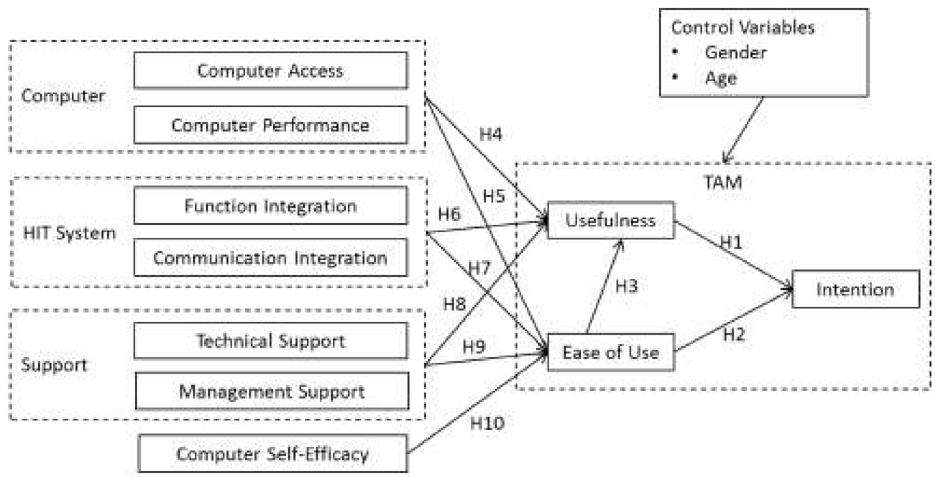
H10. A hospital employee's computer self-efficacy is positively associated with the person's perceived ease of use of a target HIT system.

Control Variables.

The IS literature recommends incorporating individual characteristics into a research model either as control variables or as independent variables to study the cognitive, affective, and/or behavioral reactions of individuals to technology (Gefen and Straub, 1997; Venkatesh and Morris, 2000). In this study, two salient demographic factors, gender and age, are included in the research model as control variables. The effects of the two factors on hospital employees' reactions to HIT systems are tested in an exploratory fashion.

The research model is graphically presented in Figure 1.

FIGURE 1: Research Model



RESEARCH METHODS AND RESULTS

Research Design

A field study was designed to test the proposed research model and a survey was planned as the major method for data collection. The researcher approached two midsized hospitals for the study. The two hospitals are similar in size (each employs about 2000 employees) and the general deployment of HIT. Both hospitals agreed to participate. With the permission from the top management of the two hospitals, the researcher sent to the IT departments a survey invitation with a link to an online survey; the invitation was then forwarded to all hospital employees via email. Participation in the survey was voluntary. The survey was deactivated after one month.

Measurement

The research model involves ten constructs. The operationalization of these constructs is explained below.

The measurements of the three TAM constructs, including perceived usefulness (three items), perceived ease of use (three items), and intention (two items), were adopted from the Venkatesh et al. (2003).

The measurement of computer self-efficacy (four items) was adopted from Thompson, Compeau, and Higgins (2006).

Computer Access was measured by three items asking the extent of computer sharing and the difficulty of finding a computer in workplace. The scales are reversed so that high levels of computer access indicate easy access to computers.

Computer Performance was measured by four items asking for the general performance of the computers in workplace, including the speed of data processing and the operation experience.

Function Integration and Communication Integration were developed from the definition of system integration in Morabito et al. (2010). Respondents were asked to evaluate the systems being used in their workplace in terms of integration across functions and applications (three items), and communication and data sharing between systems (seven items).

Technical support was adapted from the facilitating conditions instrument in Thompson et al. (1991) with three items, asking respondents to evaluate support and assistance from IT department.

Management support was adapted from the social influence instrument in Venkatesh et al. (2003) with three items, asking the degree to which managers support and provide resources to using HIT systems.

Participants

The two participating hospitals had about 4000 employees. 333 people responded to the survey invitation by clicking on the embedded survey link. The demographics of the respondents are summarized in Table 1. One may note that the respondents were dominated by females and nurses.

TABLE 1: Sample Demographics

Demographics	Values	Counts	Percentage (%)
Gender	Female	280	84.1
	Male	40	12.0
	Missing	13	3.9
	Total	333	100
Age	>=20 and <=29	26	7.8
	>=30 and <=39	61	18.3
	>=40 and <=49	92	27.6
	>=50 and <=59	120	36
	>=60	19	5.7
	Missing	15	4.5
	Total	**333**	**100**
Education	< High School	7	2.1
	High School	134	40.2
	Associate Degree	118	35.4

	University Degree	25	7.5
	Master-Level Education	23	6.9
	Doctoral-Level Education	9	2.7
	Missing	17	5.1
	Total	**333**	**100**
Occupations	Physician	5	1.5
	Specialist	11	3.3
	Registered Nurse	171	51.4
	Practical Nurse	84	25.2
	Manager	28	8.4
	Director	10	3.0
	Executive	1	0.3
	Missing	23	6.9
	Total	**333**	**100**

As discussed before, hospital employees intensively use computer-based HIT systems in their healthcare service routines. In the current research, most HIT systems under investigation are clinical systems. The extent of HIT usage was surveyed, and the results are reported in Table 2.

TABLE 2: HIT Usage by Sampled Hospital Employees

		# of HIT Systems	**# of Hours working on HIT**
Average		5.8	4.1
Standard Deviation		4.5	2.1
Respondents	Counts	257	262
	Missing	76	71
	Total	**333**	**333**

In the participating hospitals, an employee on average worked with 5.8 different HIT systems for about 4.1 hours on a typical day. This finding confirms that hospitals have evolved into an IT-intensive industry. The effective use of HIT systems is critical to the success of a hospital.

The low response rate (about 8.3%) may raise the concern of nonresponse error (King and He, 2005). A wave analysis was conducted by comparing early (the first one third of the survey responders) and late responders (the last one third of the survey responders). Results do not suggest any significant existence of such error (F-tests range from 0 to 1.48, with all p-values > 0.22).

Data Analysis

Not all submitted answers were complete. After dropping records with missing values, 198 answers remained for further data analysis.

The test of construct validity was conducted with Partial Least Squares (PLS) – a structural equation modeling (SEM) technique that has been commonly used in IS research. Similar to other SEM techniques (e.g., LISREL), PLS tests the validity of constructs and the structural model at the same time, and is therefore considered methodologically rigorous when compared with regression-based techniques who separate the test of construct validity (e.g., factor analysis) from the test of the research model (Gefen, Straub, and Boudreau, 2000). In addition, PLS is a favorable choice when the sample size is not very large.

Assessing the validity of employed instruments follows the conventional practice based on the examination of construct reliability, convergent validity, and discriminant validity. Construct validity can be assessed by composite reliability calculated in PLS (should be larger than 0.70). Convergent validity can be assessed by the average variance extracted (AVE) among measures (should be larger than 0.50). Discriminant validity can be assessed by comparing the square root of AVEs and inter-construct correlations – the former should be larger than the latter to support discriminant validity. Close examination of Table 3 suggested that all the conditions were satisfied. Thus, validity of the constructs under study was concluded.

TABLE 3: Inter-Construct Correlations

	Composite Reliability	1	2	3	4	5	6	7	8	9	10	11	12
1	0.91	**0.88**											
2	0.93	0.52	**0.90**										
3	0.96	0.42	0.32	**0.96**									
4	0.96	-0.13	-0.01	-0.05	**0.94**								
5	0.91	-0.17	0.01	0.03	0.33	**0.84**							
6	0.89	0.27	0.23	0.21	-0.09	0.03	**0.86**						
7	0.90	0.28	0.22	0.08	0.09	-0.05	0.13	**0.75**					
8	0.88	0.34	0.27	0.22	0	-0.13	0.08	0.30	**0.84**				
9	0.77	0.38	0.51	0.35	-0.06	0	0.10	0.24	0.35	**0.74**			
10	0.86	0.13	0.30	0.06	-0.01	0.06	0.10	0.08	0	0.15	**0.78**		
11	1.00	-0.09	-0.09	-0.14	0	-0.09	0.03	-0.03	-0.03	-0.06	0.02	**1.00**	
12	1.00	-0.14	-0.25	0.04	-0.14	-0.16	-0.18	-0.21	0.04	-0.10	-0.18	-0.10	**1.00**

Note:
1) Variables: 1. Usefulness; 2. Ease of Use; 3. Intention; 4. Computer Access; 5. Computer Performance; 6. Function Integration; 7. Communication Integration; 8. Technical Support; 9. Management Support; 10. Computer Self-Efficacy; 11. Gender; 12. Age.
2) Numbers in bold on the leading diagonal are the square root of average variance extracted (AVE).

Hypothesis Testing

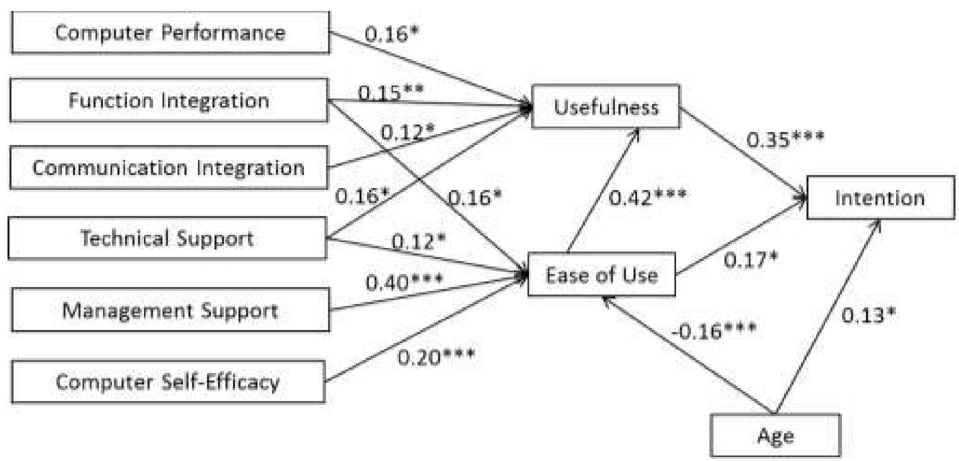
The research model was tested with PLS-Graph 3.0. Table 4 reports the path coefficients of the tested effects and their associated p-values.

TABLE 4: Test Results of the Full Model

Hypotheses	Path Coefficients	*p*-value	Conclusion
H1. Usefulness is positively associated with Intention.	.349	<0.001	Supported
H2. Ease of Use is positively associated with Intention	.160	0.058	Supported
H3. Ease of Use is positively associated with Usefulness	.361	<0.001	Supported
H4a. Computer Access is positively associated with Usefulness	.079	0.221	Not Supported
H4b. Computer Performance is positively associated with Usefulness	.139	0.030	Supported
H5a. Computer Access is positively associated with Ease of Use	.005	0.936	Not Supported
H5b. Computer Performance is positively associated with Ease of Use.	.016	0.822	Not Supported
H6a. Function Integration is positively associated with Usefulness.	.150	0.011	Supported
H6b. Communication Integration is positively associated with Usefulness.	.129	0.048	Supported
H7a. Function Integration is positively associated with Ease of Use.	.131	0.044	Supported
H7b. Communication Integration is positively associated with Ease of Use.	.034	0.716	Not Supported
H8a. Technical Support is positively associated with Usefulness.	.138	0.044	Supported
H8b. Management Support is positively associated with Usefulness.	.099	0.137	Not Supported
H9a. Technical Support is positively associated with Ease of Use.	.124	0.070	Supported
H9b. Management Support is positively associated with Ease of Use.	.370	<0.001	Supported
H10. Computer Self-Efficacy is positively associated with Ease of Use.	.219	<0.001	Supported
Control Variable Effects			
Gender has an effect on Usefulness.	-.059	0.186	Insignificant
Gender has an effect on Ease of Use.	-.085	0.213	Insignificant
Gender has an effect on Intention.	-.086	0.173	Insignificant
Age has an effect on Usefulness.	-.016	0.593	Insignificant
Age has an effect on Ease of Use.	-.162	0.002	Significant
Age has an effect on Intention.	.121	0.058	Significant

Some hypothesized effects were not supported at $p < 0.10$ level. The research model was revised by dropping the insignificant paths. Figure 2 reports the revised model and the results. One may note that the remaining paths were very similar to the test results of the full model in both magnitudes and statistical significance.

FIGURE 2: Revised Model



Note:
1) $p<0.05$, ** $p<0.01$, *** $p<0.001$.
2) R^2(Usefulness) = 0.38, R^2(Ease of Use) = 0.37, R^2(Intention) = 0.20.

Overall, test results lend support to the proposed research model. Hospital IT environment, including the working conditions of computers, the level of system integration, and hospital support, are found to affect hospital employees' reactions to HIT systems. Implications of the test results are discussed in the Discussion section.

DISCUSSION

The Uniqueness of Hospital IT Environment

This research studies the influence of IT environment on hospital employees' reactions to HIT systems. Six contextual factors are proposed to reflect the IT environment of hospitals. Table 5 reports the descriptive statistics of the six factors surveyed in the sample.

TABLE 5: Factors of IT Environment

Factors	Measurement (All using 7-point Likert scale)	Mean	Std	Percentage of Negative Views (<4)
Computer Access	3-item measures to assess computer access using following scales: 1: difficult access; 7: easy access; 4: neutral.	3.68	1.84	53.3
Computer Performance	4-item measures to assess computers performance using following scales: 1: poor; 7: satisfactory; 4: neutral.	4.51	1.56	31.5
Function Integration	3-item measures to assess function integration using following scales:	4.84	1.26	19.3

	1: support single functions. 7: support multiple functions. 4: neutral.			
Communication Integration	7-item measures to assess communication integration using following scales: 1: incapable of sharing data; 7: capable of sharing data; 4: neutral.	3.23	1.14	74.1
Technical Support	3-item measures to assess technical support using following scales: 1: little support; 7: sufficient support; 4: neutral.	4.30	1.43	35.0
Management Support	3-item measures to assess management support using following scales: 1: little support; 7: sufficient support; 4: neutral.	4.63	1.13	22.3

As shown in Table 5, the general perceptions of IT environment in the sampled hospitals were marginally positive at best. For computer access and communication integration, the average perceptions were lower than the neutral anchor of 4. More than half of the survey hospital employees expressed frustration with the difficulty of finding computers in their workplace. This may not be surprising given the special practice of sharing computers on the hospital operation floor. As for system integration, vast majority of hospital employees agreed that HIT systems in general supported multiple functions and applications, but these systems failed to communicate with each other. Such pattern of system integration deviates from the general view of system integration (e.g., Kim, 1994; Morabito et al., 2010) that the two types of integration are interrelated and evolve in parallel. Another warning but not surprising perception is the perceived technical support, which is just marginally positive (= 4.30); 35% of respondents were dissatisfied with technical support. The finding corresponds to the observation of "the continued struggle healthcare providers have in recruiting and retaining clinical system skills for the implementation and support of IT systems" (HIMSS, 2013; p. 2).

Table 5 provides evidence that hospital HIT operates in a special IT environment that is rarely observed in other industries. The following discussion is devoted to the effects of the investigated environmental factors.

The Effects of Computer Access and Computer Performance

Computer access and computer performance, as two aspects that describe the working conditions of hospital computers, are propositioned to affect one's perceived usefulness and perceived ease of use of a target HIT system. Test results show that only computer performance exerts a significant influence on the perceived usefulness. The finding suggests that the special practice of sharing computers does not affect hospital employees' HIT adoption behaviors. Although sharing computers with colleagues is obviously inconvenient as one has to search for a computer in the workplace, hospital employees' perceptions of HIT systems regarding their usefulness and ease of use are not affected. However, computer performance does affect people's perception of HIT usefulness. Underperformed computers, either due to dated operating systems or due to limited computing power, will cause a disappointing performance of a target HIT system, and therefore affect people's perception toward the system. This finding suggests that assessing the functionality of an HIT system should take the workplace computers into consideration; a same HIT system may be evaluated differently if different computers are used for running the system.

The Effects of Function Integration and Communication Integration

Test results demonstrate that the extent to which HIT systems integrate with each other strongly affect one's perception of a particular HIT system. The study investigated two aspects of system integration that involve the integration of functions and inter-system communication for all HIT systems in a workplace. For a special HIT system, function integration was found to affect both perceived usefulness and perceived ease of use of the system, and communication integration was found to affect perceived usefulness. The finding suggests that HIT systems do not work in isolation; whether a system is integrated with others will not only affect hospital employees' perceptions of the target system, but also affect the perceptions of other systems being used in the workplace. Hospital managers and system developers should pay special attention to the IT environment regarding the state of integration among different systems.

The complex state of system integration in hospitals, i.e., the mismatch between function integration and communication integration in terms of users' perceptions (see Table 5 and its discussion), raises the question of whether functional and communication integrations are complementary to improve HIT adoption intention. Future research in this direction is desired.

The Effects of Support

HIT systems are technically sophisticated. Using these systems require individuals to spend significant time and efforts in learning, using, and regular maintenance. Hospital support will play an important role in encouraging people to make such investment. This is evidenced in the researched sample. The results show that technical support enhances people's perceived usefulness and perceived ease of use, and management support enhances people's perceived ease of use, of a target HIT system. The two investigated types of support, developed as environmental factors, are not bundled with any specific system. However, the perception of having such support benefits the use of all HIT systems.

The Effects of Gender and Age

In this study, two salient demographic factors, gender and age, were examined as control variables in testing the research model. Although their effects were not hypothesized; the testing results provide some interesting insight regarding how individual characteristics affect one's behavioral reactions to HIT systems.

Gender was found not affecting any of the three TAM factors. Although gender had a significant zero-order correlation with behavior intention (r = -0.14, p = 0.035, suggesting that females were less likely to develop positive intentions of using an HIT system), such an effect diminished in the test of the research model. The finding is consistent with He and Freeman (2010), which found that gender effects on technology usage in general, and on the development of computer self-efficacy in particular, are fully mediated by computer-related training and experiences.

Age was found exerting strong effects on perceived ease of use (β = -0.16, $p < 0.001$) and behavioral intention (β = 0.13, p = 0.029), suggesting that aged people, in comparison to their young counterparts, are more likely to view a HIT system difficult to use, and more likely to develop positive behavioral intention to use the system. The two effects may seem contradictory and warrant further analysis. The negative effect on perceived ease of use suggests that aged hospital employees may experience difficulty in using HIT; this is consistent with the observation in the literature that cognitive abilities decline with age (Posner, 1996), and aged individuals are more likely to view learning new technology a cognitive burden (Morris, Venkatesh, and Ackerman, 2005). However, in our sample aged people also tend to develop higher levels of behavioral intention of using the system when compared with young colleagues. This is likely that people increasingly recognize the importance of HIT through the accumulation of work experience, which is directly associated with age. Future research is desired to clarify the effects of age in the use of HIT in hospitals.

Limitations of the Study

As with other empirical work, this study is subject to limitations. One limitation was the low response rate and associated small sample size. Although the study had received support from the top management of the two participating hospitals, the response rate was low (about 8.3%) and the final effective sample was of small size (n = 198). This is probably caused by the inconvenience of taking survey by the participants. Nurses of the two hospitals do not have computers assigned for their individual use; they have to share computers in their workplace. In addition, hospital employees are in general not encouraged to work at home. As such, the survey has to be taken during the regular work hours, which may be often interrupted due to the busy work schedule. A close examination of the survey log file reveals that all responses came from the hospital IP addresses and were produced during the regular work hours.

All constructs in the study were measured by self-reported answers. Thus, common-method bias could be another concern for the study. But close examination of the correlation matrix (Table 2) reveals that correlations among investigated constructs are moderate and some are even undetectable (r = 0), suggesting that relationships among data are unlikely to be exaggerated by the use of survey. To further test the existence of common-method bias, Harman's single factor test was performed by loading all measures of multi-item constructs in this study into an exploratory factor analysis. The variance extracted from a single factor was 18.4%, providing evidence that there is no substantial common method variance present.

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