ORIGINAL PAPER

Critical Factors for the Adoption of Mobile Nursing Information Systems in Taiwan: the Nursing Department Administrators' Perspective

Shih-Jung Hsiao · Yi-Chang Li · Ying-Ling Chen ·
Hsi-Ching Ko

Abstract The trend towards point-of-care and the advance in mobile technologies bring the potential to employ Mobile Nursing Information Systems (MNIS) in nursing care routines. However, adopting the MNIS is not simply a case of purchasing the required hardware and software, but rather a social interaction process between users, organizations, and the environment. Therefore, this study developed a framework of twelve factors affecting the decision to adopt/not to adopt the MNIS in the nursing department, and tested it from the perspective of the nursing administrators. A mail survey was conducted to collect the opinions of 84 nursing administrators, and a discriminant analysis was used to identify the critical factors for the adoption/non-adoption of the MNIS. Business competition, external suppliers' support, and internal needs were identified as being significantly associated with the adoption of MNIS. Potential adopters can apply the results of this study as a reference when making the adoption decision regarding MNIS, while non-adopters and vendors can examine the resistance to MNIS.

Keywords Nursing administrator ·
Mobile nursing information systems · Adoption

S.-J. Hsiao
Dept. of Information Management,
National Chung Cheng University,
No. 168, University Rd., Min-Hsiung,
Chia-Yi, Taiwan
e-mail: benjamin@mis.ccu.edu.tw

Y.-C. Li (✉)
Dept. of Health Services Administration,
Chun Shan Medical University,
No. 110, Sec. 1, Jianguo N. Rd.,
Taichung, Taiwan
e-mail: ycli1970@csmu.edu.tw

Y.-L. Chen
Dept. of Information Management,
Nan-Kai University of Technology,
No. 568, Chung-Cheng Rd., Tsao-Tun,
Nantou, Taiwan
e-mail: peetan@chepb.gov.tw

H.-C. Ko
Dept. of Mechatronics Engineering,
National Chang-hua University of Education,
No. 2, Shi-Da Rd,
Chang-Hua, Taiwan
e-mail: kksc@emome.net

Introduction

The nurse shortage is a world-wide problem. Many factors, such as increased patient load and decreased time to provide direct patient care, have contributed to the increased dissatisfaction that nurses experience with their work environment [31]. If allowed to continue, these problems will be self-perpetuating, as the work environment becomes even more stressful and more nurses leave the direct care setting. As the shortage becomes worse, hospitals will need to use every means possible to support nurses. The consequence of hospitals improving the working conditions for their nurses is significant. Although the use of IT may not be directly correlated with improved recruitment and retention, it is becoming part of a comprehensive strategy to address nursing needs.

In practice, nursing is information intensive. Nurses handle enormous volumes of patient care information during every tour of duty. Lee et al. [28] identified six factors that affect the daily use of Nursing Information Systems (NIS). However, most of the conventional NIS are deployed in nursing stations in nearby wards. While

delivering care to their patients, nurses usually record the processing information manually on paper, on their clothes, or, to save going back and forth, even on their skin! Most of the tasks of the inpatient care process are carried out at the point of care. If nurses need to input or retrieve information from the care records for decision-making, they must stop the caring process and return to the nursing station. Therefore, the "off-line" and "batch" types of computer services provided by conventional NIS do not meet the needs of inpatient nursing care.

As a result of the nursing shortage and the disadvantages of conventional NIS, a new model for information handling and communication is required in order to guarantee quality-oriented nursing care. The currently available mobile technologies have been recognized as appropriate tools for managing and accessing clinical information at the point of care [6]. Mobile Nursing Information Systems (MNIS) are produced through the integration of portable computers and wireless communication networks. These systems offer nurses portability and mobile access when information is needed. Portable computers are laptop computers, tablet computers, or personal digital assistants (PDAs). Wireless communications and networks allow mobile computers to access the data in the hospital information system (HIS) online without wires. Popular wireless communications and networks include GSM, the Wireless Local Area Network (WLAN), and Bluetooth. WLAN is suitable for use in typical medical as well as nursing scenarios [4]. WLAN can work as an independent network or in conjunction with an already existing LAN. While MNIS-related IT applications in nursing practices have been discussed and evaluated by many studies (e.g. [11, 13, 14, 17, 27, 29, 30]), little empirical research was found on the determinants of adoption.

Nursing administrators are often in the position of assessing and deciding whether or not to adopt a new technology in their departments. As for the trend of evidence-based medicine and point-of-care, MNISs are expected to make drastic changes to the field of nursing care by making care more efficient while also improving quality through the more timely dissemination of medical records and decision making support [8, 37]. However, the administrator's decision about adopting MNIS is not simply a case of purchasing the required hardware and software, but rather a social interaction process among users, organizations, and the environment. The decision making process of adopting an innovation is an information-seeking and information-processing activity in which the adopter is motivated to reduce uncertainty about the advantages and disadvantages of an innovation from every perspective. An ill-planned adoption procedure can cause serious budget overruns and disappointing performance. Therefore, the purpose of this study is to examine the factors that may affect the adoption of MNIS from the perspective of the nursing administrators.

The healthcare industry is experiencing a major transformation in its information technology base [44]. By nature, hospitals are in an information-intensive industry and hence they will benefit greatly from the adoption of IT applications, ranging from medical systems to administration systems. In other words, the proper and correct adoption of IT can significantly affect the quality and performance of the medical services provided by a hospital. However, not all hospitals adopt IT without hesitation. The issue about which factors promote the adoption of IT in a healthcare setting becomes an important question for all healthcare administrators. This study used a survey to obtain the self-reported critical factors and a discriminate analysis to separate adopters from non-adopters of MNIS. It describes the process of adopting MNIS through a statistical analysis aimed at distinguishing adopters from non-adopters.

Conceptual framework

The modern medical environment is now experiencing a major transformation in its IT base with the increasing technological complexity and the need to handle more patients with fewer resources, which results in higher demands being made on medical practitioners. The information system (IS) discipline has undergone a similar transformation in other industries and developed theories and methods that should prove useful in healthcare applications [44]. Consequently, this study employed a mature framework in the IS discipline to explain the adoption decision of IT innovation in hospitals.

In the IS research area, the factors affecting the adoption of a new IT can be summarized into three dimensions related to the environment, the organization, and the technology [19, 25, 36, 39, 40].

Environmental factors

The degree of competition is often directly associated with the adoption of new IT in healthcare organizations [7]. Government policy (e.g., regulatory/legal frameworks) plays an important role in the adoption of new technologies [39]. For example, the new payment schemes announced by the Taiwan Health Department, such as case payment and global budgeting, have forced the medical providers to seek information technologies that will lower care costs and still maintain care quality. Meanwhile, mobile technologies are a new phenomenon for most medical providers in Taiwan. Before the hospitals acquire adequate internal personnel and expertise, vendors can be used as a supplement to provide ideas and assistance [8]. The vendors' services may

range from product installation and training to a full-blown business intelligence consultancy engagement. Sufficient support from the vendors will facilitate the smooth and efficient adoption of mobile technologies.

Organizational factors

In a Taiwanese hospital, a project team is usually formed for new technology adoption. Planning abilities and communication skills are essential for members of a project team [16]. Top management support is also a key factor affecting the adoption of IT [18]. Their support may take both philosophical and financial forms. The more top management support there is, the easier it is to overcome the difficulty and complexity encountered in the adoption of mobile technologies in the hospital. The participation of the end users has a direct impact on the adoption of IT in an organization [12, 21, 35]. Mobile systems significantly change the work procedures during the clinical process [22]. Nurses may resist accepting new systems and try to terminate their further adoption because they dislike the changes [26]. The design of MNIS requires complex medical knowledge and expertise among the nursing staff. Therefore, the lack of the active participation of medical users may result in inadequate system quality.

The existence of internal champions has a positive influence on technology adoption [45], because champions play a critical role in providing information, related resources, and the required assistance in the process of adopting new IT [5, 18]. In this case, an internal champion may have a background and understanding of both computers/mobile computing technologies, and healthcare administration/medical informatics. Meanwhile, the adoption of new technology results from internal needs [10, 19, 45]. Investing in MNIS does not generate direct profits for hospitals. Hence, the internal needs must be significantly strong to support the adoption decision.

Technological factors

Three classes of attributes of mobile technology need to be considered: attributes of mobile devices, attributes of mobile communication, and attributes of a mobile system. Several attributes of mobile devices should be surveyed and evaluated for their suitability for use within a nursing department. The considered attributes include reliability, battery or power supply, user interface, ease of use, portability, theft prevention, and electro-magnetic interference from mobile devices with electronic medical equipment [2, 6, 9, 11, 32, 43].

The attributes of the suitability of mobile communication are evaluated by the compatibility with the existing network infrastructure, data transmission speed, availability and reliability of the wireless network, patient confidentiality, and radio interference from other mobile communication with electronic medical equipment [4, 14, 15, 27]. The third technical factor considers the integration of MNIS with the existing HIS. Tornatzky and Klein [41] suggest that the compatibility of innovations with the existing technologies has an obvious effect on the adoption of innovation. Rogers [36] also indicates that higher compatibility would encourage users to adopt the innovation. Especially as the Electronic Medical Records (EMR) advance, much of the information required about nursing care is kept in the EMR database. The patient data should be shared among the hospital's computer systems.

Finally, most hospitals have a limited project budget. If the assessment of adopting mobile technology is favourable, the management will examine its return on investment (ROI) and financial or other benefits [24, 41]. The costs of adoption include the software, hardware, upgrading of the hospital's network, the mobile devices themselves, and the required support [14, 37].

Based on the aforementioned related literature, this study develops a conceptual framework to identify the variables that influence the decision to adopt MNIS (See Fig. 1).

Materials and methods

Based on the measures of the three dimensions identified in the aforementioned literature, a draft questionnaire was translated into Chinese by a bilingual research associate. The translation accuracy was verified by two senior researchers in NIS. Then, two senior administrators in the nursing department examined the content and face validity of the questionnaire. A pretest with three nurses in a medical center was conducted to eliminate any possible confusion and ambiguity in the wording of the questions.
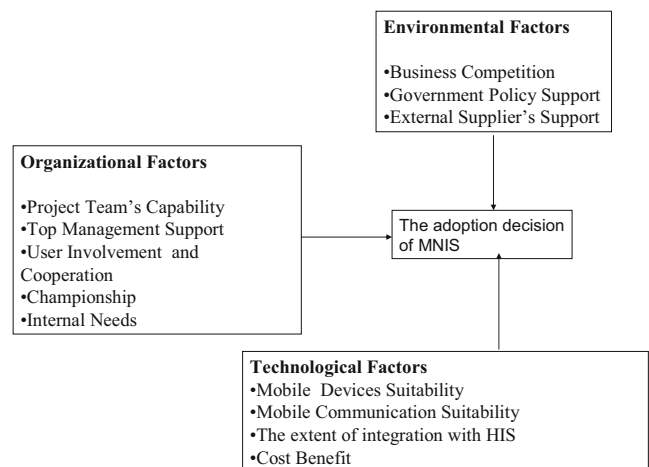
Fig. 1 Conceptual framework

The final items, in the form of a five-point high/low Likert scale questionnaire (see Appendix), were mailed out to nursing administrators in hospitals in Taiwan.

Prior to mailing out the questionnaire, one of the authors made a brief telephone call to determine the name of the nursing department director of all hospitals in Taiwan. Incentives, such as a ball-point pen and stickers, were mailed out with the questionnaire to promote the response rate. Two weeks after the questionnaires had been sent out, a follow-up telephone call was made to ensure that they had received the questionnaire; if not, a copy was mailed out straightaway. Of the 450 questionnaires, a total of 84 nursing department directors responded, with a response rate of 18.6%. A nationwide investigation by the Department of Health of Taiwan reported that 11.15% of hospitals in Taiwan have adopted some kind of mobile technology in their clinical practices [23]. Nursing department directors with no experience of the adoption of mobile technologies in their hospitals may have been less willing to mail back the questionnaire. Over 70% of the respondents had five to ten years of nursing administration experience. Among the respondents, 42 directors indicated that their departments had adopted or were implementing the MNIS (Fig. 2). Others responded that they would not consider adopting MNIS in their department in the near future.

The items on the questionnaire are listed in the appendix. As aforementioned, each item on the questionnaire was measured on a five-point high/low Likert scale and the scores for each construct were used to calculated the values of Cronback's α and perform the exploratory factor analysis (EFA) (please see Table 1). EFA with a varimax rotation was performed to assess the underlying factor structures of the measurement items. As Table 1 shows, the EFA result revealed that each of the measures showed sufficiently convergent validity because the factor loading of each item in the construct is above the threshold of 0.5 [20]. Also, all of the values of the Cronbach's α of the construct were higher than the threshold level of 0.7 which was deemed to provide satisfactory reliability [33]. Altogether, it was concluded that all of the scales used in this study were acceptably reliable and valid.

Results

A discriminant analysis was performed to identify the critical factors that affect the adoption decision of MNIS.

Fig. 2 Refined model of Adopting MNIS

Discriminant analysis is an appropriate statistical technique when the dependent variable is categorical and the independent variables are quantitative. It has widespread applications in situations where the primary objective is determining which variables discriminate between two or more groups [20].

Table 2 presented the result of the discriminant analysis and independent t test for a mean comparison of each construct between two groups (adopters vs. non-adopters). The overall model fit of the discriminant analysis was acceptable (Wilks' lambda=0.751, chi-squared value= 21.726, df=12, p=0.041<0.05). In other words, the aforementioned factors in the analytic model can be used to distinguish between the adopters and non-adopters of MNIS. A further indicator of the effectiveness of the discriminant function is the degree of predictive accuracy measured by the percentages of cases classified correctly. The discriminant function correctly classified 75% of the sample, which exceeded the hit ratio of 50% that would be expected due to chance [20]. The individual correct classification rates for adopters and non-adopters were 73.8% and 76.2% respectively. The discriminant loadings reflect the variance that the independent variables share with the discriminant function and can be used to assess the relative contribution of each independent variable to the discriminant function. Generally, variables exhibiting absolute discriminant loadings greater than or equal to 0.30 are considered significant [20]. The results showed that adopting MNIS was significantly associated with business competition, external supplier's support, and internal needs. Among the three variables, "business competition" had a higher discriminant loading, "internal needs" came second, and "external suppliers' support" last.

Discussion

The data analysis shows that three factors, including business competition, internal needs, and external supplier support, have a major effect on the adoption of MNIS among the respondents. Both adopters and non-adopters perceived that business competition was high, with means of 3.830 and 3.478 respectively (see Table 2). However, the adopters perceived significantly higher business competition among hospitals than non-adopters, and tended to adopt mobile technologies to gain a competitive advantage. This confirmed the belief that competition increases the likelihood of innovation adoption [7] and adopting IS creates a competitive advantage by giving businesses new ways in which to outperform their rivals [34]. Competition leads to environmental uncertainty and increases both the need for and the rate of innovation adoption. As a result, business competition can be seen as a motivation for the adoption of MNIS.

Table 1 Reliability and construct validity

Dimension	Construct	# of Items[a]	Cronbach's α	Minimum factor loading in the construct
Environmental factors	Government policy's influence	2	0.737	0.818
	Business competition	4	0.716	0.716
	External supplier's support	3	0.711	0.689
Organizational Factors	Project team's capability	3	0.729	0.744
	Top management support	4	0.834	0.650
	User involvement and cooperation	5	0.875	0.601
	Championship	3	0.794	0.733
	Internal needs	5	0.901	0.827
Technological Factors	Mobile devices suitability	7	0.906	0.722
	Wireless communication suitability	6	0.897	0.660
	The extent of integration with HIS	3	0.769	0.715
	Cost benefit	5	0.822	0.650

[a] # of items depicts the number of items in each construct.

Adopters perceived more internal needs of MNIS than non-adopters, with means of 4.093 and 3.882 respectively (see Table 2). In other words, adopters had higher internal needs to use IT to streamline the nursing process and increase the quality of care. This result confirmed the prior research [45] that the internal needs of an organization are an important factor in adopting new IT. The finding also supported the conclusion [38] that 'Perceived Usefulness' is an important attribute for the adoption of IT in the healthcare context.

Finally, adopters valued the vendors' support as being more important than non-adopters did, with means of 3.778 and 3.537 respectively (see Table 2). Mobile technologies are still evolving and the technological and managerial issues of MNIS are still unfamiliar to most hospitals. Sufficient support from vendors will facilitate the smoother, more efficient implementation of the information systems.

When introducing MNIS into their departments, both adopters and non-adopters had similar perceptions about the influence of government policy, the project team's

Table 2 The result of discriminant analysis and mean comparison between two groups (adopters vs. non-adopters)

Factors(Constructs)	Discriminant Loading	Adopter		Non-adopter		Independent t test (p value)
		Mean[a]	SD	Mean[a]	SD	
Government policy's influence	−0.071	3.703	0.658	3.775	0.929	0.714
Business competition	0.482	3.830	0.456	3.478	0.371	0.014**
External supplier's support	0.325	3.778	0.578	3.537	0.275	0.095*
Project team's capability	−0.136	4.263	0.296	4.350	0.336	0.480
Top management support	0.088	4.150	0.376	4.089	0.361	0.647
User involvement and cooperation	0.012	4.178	0.519	4.169	0.283	0.949
Championship	0.244	4.032	0.308	3.880	0.294	0.208
Internal needs	0.333	4.093	0.447	3.822	0.584	0.087*
Mobile devices suitability	0.073	4.323	0.291	4.101	0.263	0.706
Wireless communication suitability	−0.221	4.289	0.358	4.368	0.289	0.254
The extent of integration with HIS	0.075	4.269	0.400	4.261	0.356	0.696
Cost benefit	0.144	4.187	0.295	4.101	0.298	0.456

*$p<0.1$; **$p<0.05$

[a] Mean was derived from calculating the summation of each response of each item weighted by factor loading of that construct using the following formula:

$$Mean(FS) = \sum_{i=1}^{m} \sum_{j=1}^{n} FL_i X_j$$

where

FS=factor score

FL_i=the factor loading of each item (i=1, 2)

X_j=the item response of each responders (j=1, 2,3, …, 84)

m: number of items in the construct

n: number of responders

capability, the top management support, users' involvement and cooperation, and internal champions. Finally, regarding all of the technological factors, it is believed that mobile devices' suitability, wireless communication suitability, the extent of integration with HIS, and cost benefit are key considerations for organizations in deciding to adopt MNIS. However, these factors were not supported in this study which reveals some insights about the nature of the healthcare industry. Due to the heavy outsourcing of hospital IT in Taiwan, the healthcare IT vendors often have strong willingness to demonstrate and to give trials in order to promote their mobile technology products. Besides, the geographic proximity between hospitals in Taiwan makes it very convenient to communicate about IT adoption with other hospitals. Thus, most nursing directors tended to rate the mobile technology construct most highly due to their high familiarity with the subject area. In summary, the research model is refined as follows:

Implications

This study provides a reference for nursing directors to follow when they are evaluating a MNIS before making the adoption decision. Based on a survey to which 84 nursing directors responded, it is concluded that nursing directors who worry more about business competition and trust external suppliers' support to streamline their internal nursing process tend to adopt. Therefore, our suggestions for potential adopters are: (1) continually scan and evaluate the industrial competition; (2) identify specific mobile needs in nursing practices; and (3) communicate with vendors and gain better support from them. Meanwhile, vendors can use these findings to increase potential adopters' interest in the MNIS.

While gaining the benefits that mobile devices offer, the following issues need to be addressed to ensure patient safety. Mobile communication and applications should comply with the Health Insurance Portability and Accountability Act (HIPAA) to ensure patient confidentiality [9]. The issue of data transferring speed should be noted because the data volume of nursing care delivery information is increasing with the growing sophistication of medical information systems and multimedia needs. Also, radio interference occurs when signals cross. The 2.4-GHz ISM band spectrum is used in a great variety of technologies, such as Bluetooth, medical systems, as well as IEEE802.llb, and it could become a major problem in hospitals, as more WLANs are deployed and the frequency bands become more crowded [3].

Nursing care is the main reason why patients are admitted to hospital. Healthcare leaders have strong evidence that nurse staffing has a significant effect on patient outcomes [1]. However, much of the technology in the field of healthcare is directed towards the diagnosis and treatment of disease, and little has been done to transform the work environment for nurses [42].

This study illustrates the applicability of the IS model that underwent similar transformations in other industries and developed theories and methods that should prove useful in healthcare applications [44]. This study may contribute to researchers of medical systems by shedding some light on future IS and healthcare interdisciplinary research in the e-healthcare area. This paper confirms some of the findings from previous IS studies of the factors affecting the IT adoption decision. The possible reason why our findings vary from prior studies is that previous studies surveyed multiple organizations in multiple industries. Also, the decisions to adopt new technology in those organizations were most often evaluated by the MIS department managers.

In this study, the nursing directors all revealed a high recognition of mobile technology. An awareness of the nursing directors' concerns may contribute to the practitioners of medical systems. As mobile technologies rapidly advance, the importance of MNIS adoption will only grow. Therefore, an understanding of nursing administrators' concerns in evaluating MNIS is imperative. Developing the MNIS to address nursing concerns may eventually help with its adoption and implementation.

Limitation

While our model has proven to be useful in distinguishing the adopters and non-adopters of MNIS, three limitations should be noted. The respondents might tend to favour the technology and were therefore willing to mail back the questionnaire. Those who did not favor the technology might have been unwilling to take the time to respond. Also, without the DOH providing official adoption status of MNIS in each hospital, the self-reported status collected in this study may be biased. Besides, this study used a static cross-sectional approach which may not reveal the dynamics of the technology adoption processes. Therefore, more rigorous study is needed further to explore the issues uncovered by this study. For instance, a longitudinal study would provide more insight into the adoption process.

At the time when this research was conducted, the innovation diffusion of MNIS in Taiwan was still at an early stage. As more adopters join in the diffusion, a future study to investigate the critical factors that affect the performance or effectiveness of MNIS may be necessary. Meanwhile, user's acceptance, cost benefit analysis, and the

cross-culture aspects of MNIS, are issues that could be explored. Practitioners could also pay attention to the findings about these research issues in order to smooth the adoption of MNIS in their nursing departments.

Appendix: Questionnaire Items

Environmental Factors

Business competition

1. Pressure from industry regarding the usage of MNIS as a standard nursing practice.
2. Pressure of the loss of competitive edge due to the lack of MNIS development.
3. Number of competitors in my area who have adopted MNIS.
4. The need for the development of MNIS for patients.

Government Policy Support

1. The extent of the clarity of the government policy for supporting MNIS.
2. The extent of the physical support (i.e., funding, expertise) provided by the government units to our hospital.

External Supplier's Support

1. The sufficiency of technical support in MNIS development
2. The sufficiency of technical support in MNIS maintenance
3. The sufficiency of user training and support provided by vendors

Organizational Factor

Project Team's Capability

1. The capabilities of the information-system's development of the project team.
2. The capabilities of the information-system's planning of the project team.
3. The project team's understanding of the nursing needs

Top Management Support

1. The ability of the top management to take the risk involved in the adoption of MNIS.
2. The commitment of the top management to provide adequate financial and other resources for the development and operation of MNIS.
3. The vision of the top management to project the firm as a leader in the usage of new IT.

4. The level of top management support for MNIS usage in nursing care.

User Involvement and Cooperation in MNIS projects

1. The degree of user participation in the requirement analysis of the projects.
2. The degree of user participation in the vendor's proposal review of the projects.
3. The degree of user participation in the system testing of the projects.
4. The degree of user participation in the meetings about MNIS projects.
5. The mutual understanding and support between the IT and the nursing departments.

Championship

1. The degree of the champions' understanding of the mobile needs of nursing departments.
2. The capability of champions in acquiring an organization's resources to support MNIS projects.
3. The capability of champions to coordinate the top management and the nursing department.

Internal Needs

1. The need for speeding up the response time of nursing care
2. The need for reducing the costs of nursing care
3. The need to enhance the productivity of nursing care
4. The need to access high quality information at the point of care
5. The need for improving the quality of nursing care

Technological Factors

Mobile Devices' Suitability

1. Reliability of mobile devices
2. Battery or power supply duration
3. User interface friendliness
4. Ease of use
5. Portability of mobile devices
6. Theft prevention
7. Electro-magnetic interference from mobile devices with electronic medical equipment (negative item)

Wireless Communication Suitability

1. The compatibility with the existing network infrastructure
2. Data transmission speed
3. Availability of wireless networks
4. Reliability of wireless networks
5. Patient confidentiality protection

6. Radio interference from mobile communication with electronic medical equipment (reverse scoring)

The integration of MNIS with the existing hospital information systems

1. Database integration
2. Interface compatibility
3. The abilities of integration

Cost Benefit

1. Benefits of adopting MNIS.
2. Expected ROI increase
3. Resource allocation feasibility
4. Implementation cost (reverse scoring)
5. Training cost (reverse scoring)

References

1. Aiken, L. H., Clarke, S. P., Sloane, D. M., Sochalski, J., and Silber, J. H., Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. *J. Appl. Nurs. Res*. 288 (16):1987–1993, 2002.

2. Ammenwerth, E., Buchauer, A., Bludau, B., and Haux, R., Mobile information and communication tools in the hospital. Int. *J. Med. Inform*. 57(1):21–40, 2000 doi:10.1016/S1386-5056 (99)00056-8.

3. Aspinwall, J., *Installing, troubleshooting and repairing wireless networks*. The McGraw-Hill, New York, 2003.

4. Banitsas, K., Istepanian, R. S. H., and Tachakra, S., Applications of medical wireless LAN systems (MedLAN). *Int. J. Med. Mark*. 2(2):136–143, 2002 doi:10.1057/palgrave.jmm.5040067.

5. Beath, C. M., Supporting the information technology champion. *MIS Q*. 15(3):355–371, 1991 doi:10.2307/249647.

6. Buchauer, A., Pohl, U., Kurzel, N., and Haux, R., Mobilizing the health professional's work station- results of an evaluation study. *Int. J. Med. Inform*. 54(2):105–114, 1999 doi:10.1016/S1386–5056(98)00170–1.

7. Burke, D. E., Wang, B. B. L., Wan, T. T. H., and Diana, M. L., Exploring hospitals' adoption of information technology. *J. Med. Syst*. 26(4):349–355, 2002 doi:10.1023/A:1015872805768.

8. Chaiken, B. P., Evidence-based medicine: a tool at the point of care. *Nurs. Econ*. 19(5):234–235, 2001.

9. Chen, E. S., Mendonca, E. A., McKnight, L. K., Stetson, P. D., Lei, J., Cimino, J. J., et al, A wireless handheld application for satisfying clinician information needs. *J. Am. Med. Inform. Assoc*. 11(1):19–28, 2003 doi:10.1197/jamia.M1387.

10. Chen, Y. C., Chiu, H. C., Tsai, M. D., Chang, H., and Chong, C. F., Development of a personal digital assistant-based wireless application in clinical practice. *Comput. Methods Programs Biomed*. 85(2):181–184, 2007 doi:10.1016/j.cmpb.2006.11.001.

11. Choi, J., Chun, J., Lee, K., Lee, S., Shin, D., Hyun, S., et al, MobileNurse: hand-held information system for point of nursing care. *Comput. Methods Programs Biomed*. 74(3):245–254, 2004 doi:10.1016/j.cmpb.2003.07.002.

12. Doll, W. J., and Torkzadej, G., Discrepancy model of end-user computing involvement. *Manage. Sci*. 35(10):1151–1171, 1989.

13. Farrell, M., Mcgrath, I., D'arcy, M., and Abaloz, E., Improving patient health outcomes in acute care hospital units using mobile wireless technology and handheld computers, CIN: Computers, Informatics. *Nursing*. 25(5):308–309, 2007.

14. Fischer, S., Steward, T. E., Mehta, S., Wax, R., and Lapinsky, S. E., Handheld computing in medicine. *J. Am. Med. Inform. Assoc*. 10(2):139–149, 2003 doi:10.1197/jamia.M1180.

15. Frenzel, J. C., Data security issues arising from integration of wireless access into healthcare networks. *J. Med. Syst*. 27(2):163–175, 2003 doi:10.1023/A:1021865011765.

16. Gemmill, G., and Wilemon, D., The hidden side of leadership in technical team management. *Res. Technol. Manag*. 37(6):25–32, 1994.

17. Gillette, B., Wireless technology serves as next logical step in care service. *Manag. Healthc. Exec*. 14(6):54–55, 2004.

18. Grover, G., *Identification of factors affecting the implementation of data warehousing*. Unpublished Ph.D. Dissertation, Auburn University at Montgomery, 1998.

19. Grover, V., and Goslar, M. D., The initiation, adoption, and implementation of telecommunications technologies in US organizations. *J. Manage. Inf. Syst*. 10(1):141–163, 1993.

20. Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C., *Multivariate data analysis*, 5th edition. Prentice-Hall International, New Jersey, 1998.

21. Hartwick, J., and Barki, H., Explaining the role of user participation in information system use. *Manage. Sci*. 40 (4):409–430, 1994.

22. Hauser, S. E., Demner-Fushman, D., Jacobs, J. L., Humphrey, S. M., Ford, G., and Thoma, G. R., Using wireless handheld computers to seek information at the point of care: an evaluation by Clinicians. *J. Am. Med. Inform. Assoc*. 14(6):807–815, 2007 doi:10.1197/jamia.M2424.

23. Hwang, H. G., Chang, I. C., and Liu, C. F., *Current states of development of electronic medical record in healthcare organizations–a national-wide investigation*Department of Health, Taiwan, 2005.

24. Jason, K., and Yen, D. C., Breaking the barriers of connectivity:an analysis of the wireless LAN. *Comput. Stand. Interfaces*. 24(1):5–20, 2002 doi:10.1016/S0920-5489(01)00101-5.

25. Kimberly, J. R., and Evanisko, M. J., Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations. *Acad. Manage. J*. 24(4):689–713, 1981 doi:10.2307/256170.

26. Kirkley, D., and Stein, M., Nurses and clinical technology: sources of resistance and strategies for acceptance. *Nurs. Econ*. 22(4):216–223, 2004.

27. Kuziemsky, C. E., Laul, F., and Leung, R. C., A review on diffusion of personal digital assistants in healthcare. *J. Med. Syst*. 29(4):335–342, 2005 doi:10.1007/s10916-005-5893-y.

28. Lee, T. T., Lee, T. Y., Lin, K. C., and Chang, P. C., Factors affecting the use of nursing information systems in Taiwan. *J. Adv. Nurs*. 50(2):170–178, 2005 doi:10.1111/j.1365–2648.2005.03376.x.

29. Lee, T. T., Patients' Perceptions of Nurses' Bedside Use of PDAs. CIN: Computers, Informatics. *Nursing*. 25(2):106–111, 2007.

30. Lee, T. T., Lin, K. C., and Lin, J. S., Development and testing of an evaluation scale of personal digital assistants. CIN: Computers, Informatics. *Nursing*. 25(3):171–179, 2007.

31. Lynn, M. R., and Redman, R. W., Faces of the nursing shortage: influences on staff nurses' intentions to leave their positions or nursing. *J. Nurs. Adm*. 35(5):264–270, 2005 doi:10.1097/00005110-200505000-00010.

32. Nelson, L., Step-by-step guide to selecting mobile wireless devices. *Nurs. Manage*. 30(11):12–13, 1999 doi:10.1097/00006247–199911000–00004.

33. Nunnally, J. C., *Psychometric theory*, 2nd edition. McGraw-Hill, New York, 1978.

34. Porter, M., and Millar, V. E., How information gives you competitive advantage. *Harv. Bus. Rev.* 63(4):149–160, 1985.

35. Reich, B. H., and Benbasat, I., An empirical investigation of factors influencing the success of customer-oriented strategic systems. *Inf. Syst. Res.* 1(3):325–347, 1990.

36. Rogers, E. M., *Diffusion of innovations*. The Free Press, New York, 1995.

37. Simpson, R. L., A few points about point-of-care technology. *Nurs. Manage.* 29(11):19–21, 1998 doi:10.1097/00006247-199811000-00007.

38. Spil, T. A. M., and Schuring, R. W., *E-health system diffusion and use*. IDea Group, Hershey, 2006.

39. Teo, T. S. H., and Tan, M., An empirical study of adopters and non-adopters of the Internet in Singapore. *Inf. Manage.* 34 (6):339–346, 1998 doi:10.1016/S0378-7206(98)00068-8.

40. Thong, J. Y. L., An integrated model of information systems adoption in small business. *J. Manage. Inf. Syst.* 15(4):187–214, 1999.

41. Tornatzky, L. G., and Klein, K. J., *Innovation characteristics and innovation adoption-implementation: a meta-analysis of findings*. National Science Foundation, Division of Industrial Science and Technological Innovation, Washington, DC, 1981.

42. Watson, C. A., Integration of technology and facility design: implications for nursing administration. *J. Nurs. Adm.* 35(5):217–219, 2005 doi:10.1097/00005110-200505000-00001.

43. Varshney, U., A framework for supporting emergency messages in wireless patient monitoring. Decision Support Systems, In Press, Available online at http://www.science-direct.com, Accessed on 4/8/2008.

44. Wilson, E. V., and Lankton, N. K., Interdisciplinary research and publication opportunities in information system and healthcare. *Commun. Assoc. Inf. Syst.* 14(17):332–343, 2004.

45. Zmud, R. W., An examination of push-pull theory applied to process innovation in knowledge work. *Manage. Sci.* 30(6):727–738, 1984.