

Research on the Informatics Literacy of Clinical Nursing Personnel

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Abstract

The application of medical information on various professional fields in healthcare has increased through information technology. Moreover, in recent years medical policies and the national insurance system have accelerated the computerization of hospital information systems in Taiwan. The use of information technology in healthcare has created tremendous impacts on medical professionals. Among them, clinical nursing personnel, constituting the largest group in hospital and one of the important information managers in medical care teams, not only need learn to use computer to support nursing care but also need to acquire information and knowledge by using information technology. Therefore, information literacy of clinical nursing personnel is a fundamental requirement when they want to meet the challenges of job. Understanding the content of information literacy pose an important challenge for the nursing administrators.

In order to realize the information literacy education of clinical nursing personnel, the purpose of this study is to determine the content of information literacy. A Delphi study approach was used to achieve consensus about content of informatics literacy required for nurses and determine study framework.. Then, a pilot test was conducted to identify the questionnaire items. Structured questionnaire was administered to survey nursing administrators at regional hospitals or higher levels or nursing personnel designated by these administrators to promote nursing information. A total of 84 questionnaires were distributed, 44 of which were retrieved, constituting a recovery rate of 52.4%.

The findings of this study indicate:

- (1) High-level administrators know the importance and hospitals are widely computerized.
- (2) The development of information technology for hospital is typically unable to satisfy the needs of clinical nursing personnel at work.
- (3) For the present, information education for clinical nursing personnel is not widely available, which may affect the elevation of information technology skills of nursing personnel and hamper the development of hospital information systems and computerization of nursing.

(4) Occupation-oriented information literacy for clinical nursing personnel includes three dimensions: information knowledge, information technology skills, and information attitude. Information knowledge: spans basic concepts of information technology, information security, and hospital information system knowledge. Information technology skills, computer operation skills, information technology application skills, foundation of Web network. Information attitude : behavior of applying information technology and attitude towards using information technology.

1、Introduction

The application of informatics on various professional fields in healthcare has increased through IT (information technology). Moreover, in recent years medical policies and the national insurance system have accelerated this trend in Taiwan. The use of IT in healthcare has created tremendous impacts on medical professionals. Among them, clinical nursing personnel, as the major stakeholder in hospital, not only need learn to use IT to support nursing care but also need use IT to acquire nursing knowledge. Therefore, information literacy of clinical nursing personnel is a fundamental requirement when they want to meet the challenges of nursing job. Understanding the content of information literacy pose an important challenge for the nursing administrators.

In the last decade, hospitals have increasing numbers of nurses moved toward higher levels of information literacy, particularly as the science of nursing informatics becoming increasingly important to delivering quality nursing care to all patients. Nursing informatics, which is the application of computer science and information science, although still in its infancy, have a significant effect on health care information gathering and clinical practice. Nursing administrators need to consider the information literacy an important new skill for nurses to take care of patients.

The IS (information systems) planning and implementation are intimately related to nursing personnel, who play an important role in deciding the IS outcome (Dumas, Dietz, & Connolly, 2001; Bowles, 1997). One of the major obstacles is that most people lack knowledge about IT in most hospitals (Marion, Mike, & David, 1999). Bowles (1997) points out that the informatics literacy of

clinical nursing personnel will influence the quality of their care. It is important to understand how good informatics literacy clinical personnel have.

Many researches enquiries into the informatics literacy of local public health nursing personnel and clinical nursing personnel (Yang, Yu, Lin, Hsu, 2004; Chiu, 2000). Those studies are basically focused on investigating the informatics literacy of computer skill. Information education for nursing personnel in Taiwan and in other countries is not exactly the same thing. So there is a need to conduct deep investigations into nursing informatics literacy in Taiwan. Besides, the rapid innovation of information technology that has been made recently has made people think about the application of IT in a different way. In consideration of times, technological progress, and needs at workplaces, this research is conducted with the hope to find out the content of the informatics literacy of clinical nursing personnel. The findings will be used in guiding nursing information education and helping clinical nursing personnel apply IT in information management. The findings will also be used by academicians and practitioners in conducting informatics literacy cultivation and in-service education.

This research has two purposes: (1) define the content of informatics literacy of clinical nursing personnel, and (2) find out current conditions of informatics literacy education in clinical nursing.

Nomenclature

Clinical nursing personnel refer to nursing personnel that hold the title of “nurse” or “professional registered nurse,” who currently are hired and work at a hospital, carrying out nursing clinical field work.

2 · Literature Review

2.1. Definition and Content of Informatics Literacy

American Library Association (ALA, 1989) defines informatics literacy as the ability of an individual to realize the need for information and to effectively search for, evaluate, and use this information. In other words, an individual that has sufficient informatics literacy knows how to organize, find out and use information and can convey this information in different patterns so that others can also learn to use this information. Huang (2002) points out that the ability of medical personnel to use computer and their willingness to share knowledge can be influenced by the institutional culture and the environment in which they live.

Other researchers point out that to meet the needs of a medical environment in which information is computerized, clinical nursing personnel should have informatics literacy composed of three dimensions: information knowledge, information skills, and information attitude. In other words, informatics literacy refers to the attitude, knowledge, and skills an individual should have in dealing with an information environment (Staggers, Gassert, & Curran, 2002). The dimensions are described as follows.

(1) · Knowledge dimension:

Information knowledge refers to information-related knowledge one should have operating in an era which is dominated by thriving technological development, covering such basic concepts of information technology as: knowledge of the basic components of a computer system, including PC, terminal monitor, computer network, computer software, general programming languages, and peripheries; knowledge of the basics of the Internet and communication technology and of the establishment and application of database; with regard to information security, familiarity with information security, guard of data security, propagation and prevention of computer viruses, personnel and communication security, and understanding of the prevention of computer damage and reply; with regard to knowledge of using information system, understanding system operation, including data storage, retrieval, analysis and application.

(2) · Skill dimension:

Information skills refer to the ability to use such tools as computer, the Internet, and communication technology and basic ability to operate data input-output equipment and system. Information skills span computer operation abilities: knowledge of how to use Word, Excel, graphics and PowerPoint software; information technology application abilities: the ability to clean peripheries, shoot simple troubles, and use instruments of information technology; network basics: familiarity with network operation, ability to use intranet and solve simple problems, ability to use the Internet and solve simple problems, familiarity with searching for, using and managing network resources, skillfulness at the authority of managing users, familiarity with specialized information systems and ability to execute such systems.

(3) · Information attitude dimension:

Information attitude refers to an individual's attitude toward, behavior of or literacy of using computer, Internet and communication technology, covering how much the individual trusts IT and how much satisfaction the individual gains in using such technology, and how eager he wishes to use IT, for example, perseverance and endurance shown in trying to obtain information and tools needed at the workplace; elevating one's competitiveness by using such tools as IT; knowing the meaning, implication of work ethics and related laws and regulations and abiding by them; knowing and abiding by laws concerning intellectual property rights; removing fear of IT; understanding the benefits of IT and developing a positive attitude toward IT, and increasing satisfaction with and acceptance to applying IT.

With regard to research on the informatics literacy of local nursing personnel, Yang et al. (2004) conducted research on the basic computer skills of local public health nursing personnel and has found: in an information learning environment, nursing personnel should have basic computer skills including at least: Word, Excel, Power Point, Windows 98, and IE & Outlook Express. Chiu (2000)

conducted a survey of the abilities of nursing chiefs and front-line nursing personnel to use computer, in which Word, Excel, and Internet were used as the basis of measurement. In addition, foreign-based research focuses on the enquires of the informatics literacy of nurses, i.e. investigating the informatics literacy of nursing personnel from the aspect of supply. The findings of a series of research on computer literacy, informatics literacy, and nursing informatics literacy are described as follows:

Thomas (1990) points out in his research on nursing personnel's attitude toward computer application that the impact of computer attitude on nursing personnel's general informatics literacy can be measured based on their idea, concern, and initiative about using computer. Staggers et al. (2002) mentions assessment of nursing personnel's informatics literacy including general application skills, knowledge of computer, application and knowledge about HIS (hospital information system), and recognition and play of information technology application role. Furthermore, there are scholars, in their research on incorporating information technology in curriculum for nursing students, use basic computer skills, electronic mail, word processing, and search for library information as the basis for measuring the information skills of nursing students (Birx, Castleberry, & Perry ,1996); Jayasuriya and Chaputi (1996). In their survey research on the computer skills of the nursing personnel at community nursing service institutes, the scholars measure the computer skills of the nursing personnel by using Word, Excel, file management, graphics, and electronic mail application, depending the needs of their work patterns. Saranto and Leino-Kilipi (1997) point out in their research on the cultivation of computer literacy in nursing information education that the basic abilities of nursing personnel to use computer include: basic components of computer system, computer application skills, ability to remove errors, ability to use HIS, ability to use computerized patient monitor, system security and error in automated message treatment and necessary conditions. Many research has found that the elevation of the information knowledge of nursing personnel will help their clinical effectiveness (Travis & Flatley-Brennan,1998; Verhey, 1999). Graveley, Lust, Fullerton (1999) also mention that nursing personnel should have computer literacy suitable for workplaces covering: Word, Excel, Power Point, Windows, Internet, and the application of electronic mail. Liu, et al., in their research on the informatics literacy of nursing personnel in hospital, use computer knowledge, attitude, and ability to measure their informatics literacy, and has found significant relationships among the three factors. Hobbs (2002) analyzed literature on the informatics literacy of nursing personnel published after 1988 and the measurement items used in these research, and has summarized that the informatics literacy nursing personnel should have covers three major dimensions: computer knowledge, computer attitude, and computer skills. The computer knowledge dimension consists of basic computer knowledge, word processing, The information knowledge factor includes three variables:

management and control of information system security, and nursing personnel using medical information systems. The computer attitude dimension consists of the degrees of satisfaction with using the systems and belief in choosing better systems, motivation of the users and their intellectual models of positive orientation. The computer skills dimension consists of basic operating ability, word processing, ability to use electronic forms and graphic tables, information security, electronic mail, and ability to use the Internet and correctly execute specialized HIS. In summary, the informatics literacy of nursing personnel should include: information knowledge, information skills, and information attitude dimensions.

2.2. Informatics Literacy Required at Workplaces

Christin (1999) conducted research on workplace-oriented informatics literacy and has found that, when a workplace has a higher degree of computerization, its employees are more motivated by the needs of workplace and the driving force of informatics literacy has seven elements: (1) use IT to help information awareness and communication, (2) know the suitable sources that needed information can be found, (3) informatics literacy is a process in which a mission is executed, (4) control information, (5) establish knowledge base of a new domain that one is interested in, (6) be able to adopt new perspective, (7) intelligently use information so as to benefit others.

The motivation provided by these workplace needs for informatics literacy and the impact on nursing personnel of the introduction of IT into medical institutions have combined to give rise to a condition in which the informatics literacy at workplace will influence the care quality of nursing of these personnel (Bowles, 1997). So it is important to understand the informatics literacy of clinical personnel.

Research framework

Through literature review, this research summarized the preliminary form of research framework and then, through alternating "pilot study" and "expert conference," revised the preliminary form of research framework that had been summarized from literature review. Then the research framework was established, including three factors: information knowledge, information skills, and information attitude, shown in Figure 1.

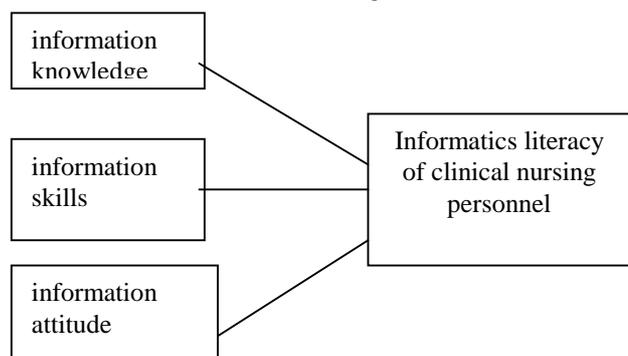


Figure 1. Research framework

concepts of basic IT, information security, and knowledge of using HIS. The information skills factor includes three variables: ability to operate computer, ability to use IT, and network basics. The information attitude factor includes

two variables: behavior of using information technology, and attitude. Definitions and measurement of the variables are summarized as follows (Table 1):

Table 1. Definitions and Measurement of Variables

Variable	Measuring Items
Concepts of basic information technology (Saranto.et.al.,1997 Verhey,1999 Staggers et al., 2001)	<ul style="list-style-type: none"> ● Know the basic elements of a computer system, including personal computer, terminal monitor, computer network, computer software, general programming languages, and computer periphery equipment. ● Have basic knowledge about the Internet and communication technology. ● Know the forms of information storage and sites of the storage.
Information security (Saranto & Leino-Kilipi ,1997 ; Staggers et al.,2001)	<ul style="list-style-type: none"> ● Competent of information security, guard of information security, propagation and prevention of computer viruses. ● Know laws about information security and protecting patients, personnel and communication security. ● Understand guard against computer damage and reply operation.
Knowledge of using medical IS (Hobbs, 2002)	<ul style="list-style-type: none"> ● Know how to retrieve patient data from HIS. ● Know to use some data. ● Know how to use different IS set by health care. ● Know how to use HIS.
Ability to operate computer (Hobbs,2002 ; Yang et al., 2002)	<ul style="list-style-type: none"> ● Know how to use Word, Excel, graphic and Power Point software. ● Know how to use blank form programs. ● Know how to use database programs. ● Know how to apply existing directories. ● Know how to use email. ● Know how to combine different programs.
Ability to use information technology (Staggers et al, 2001 Hobbs, 2002)	<ul style="list-style-type: none"> ● Ability to clean periphery equipment. ● Simple errors and removal, ability to use instruments of information technology. ● Familiarity with specialized medical information systems and ability to correctly execute the systems.
Network basics (Saranto,1997 Graveley et al., 1999)	<ul style="list-style-type: none"> ● Familiarity with operating network systems. ● Ability to use intranet and solve simple problems. ● Ability to use the Internet and solve simple problems. ● Familiarity with searching for, using and managing network resources. ● Skillfulness at the authority of managing users.
Behavior of using information technology (Hobbs, 2002 ; Jayasuriya & Chapman, 1997)	<ul style="list-style-type: none"> ● Perseverance and endurance in obtaining information and tools needed at work. ● Using related tools such as information technology to elevate one's competitiveness. ● Familiarity with and abiding by the meanings and implication of work ethics and related laws. ● Familiarity with and abiding by laws governing intellectual property rights.
Attitude toward using information technology (McBride&Nagle, 1996 ; Hobbs,2002)	<ul style="list-style-type: none"> ● Remove fear of information technology. ● Understand the benefits of information technology and develop positive attitudes towards information technology. ● Degrees of satisfaction with and acceptance of information technology application.

3 · Method

3.1 Subjects:

The subjects of this research are senior administrators of nursing (e.g. vice superintendent for nursing, director of nursing department, vice director, etc.) or personnel in charge of implementing nursing information of 84 regional or higher-categorize hospitals in Taiwan.

3.2. Research tool:

The research tool is questionnaire. First, the questionnaire was mainly adapted from two questionnaires (Staggers et al. 2002; Yang et al., 2002). Then a Delphi study approach was used to achieve consensus about a questionnaire items of informatics literacies required for nurses. If the questionnaire items were far different from literature-based questionnaire items, a modified questionnaire items better suited to a clinical nursing personnel was developed. After delphi study in expert conferences, this questionnaire was revised through pilot research. Finally, the questionnaire consists of three parts, demographic data in the first part, the second part surveying the status of nursing information in hospital, and the third part containing the content of informatics literacy of clinical nursing personnel required at workplace. The Likert five-point scale was adopted in designing the measuring standard of informatics literacy content, with the point of five indicating “Highly agree” to this measuring item, the point of four indicating “Agree” to this measuring item, the point of three indicating “Reservedly Agree” to this measuring item, the point of two indicating “Not Agree” to this measuring item, and the point of one indicating “Highly Disagree” to this measuring item. In order to confirm the reliability and validity of the questionnaire, the questionnaire questions were examined one by one so as to determine whether the words used in the questionnaire were complete and clearly understood and whether the questions were appropriate. And any inappropriate question that could puzzle the respondents was revised. After the questionnaire was designed, experts were invited to examine the questionnaire to elevate the content validity and reliability of the questionnaire.

Cronbach’s α is adopted to test the reliability of this research, and the Cronbach’s α of each variable is presented in Table 2. In general, reasonable value of Cronbach’s α is above 0.8. A value of 0.7 or larger, however, is acceptable for an exploratory study (Hair et al. 1998). this study, Cronbach’s α of this questionnaire was determined ranging between 0.76 and 0.96, indicating the reliability of this study is acceptable. For validity analysis, a principle component analysis was adopted to conduct factor extraction whose eigenvalues were greater than 1 to evaluate the measurement of efficiency. In total three factors were extracted based on the values of characteristics and Scree plot. To facilitate explanation, Varimax in the Orthogonal Rotation was

adopted to rotate these factors so as to make the meanings of each factor clearer. The composing factors after the rotation are similar to the three factors in the research framework, and the three factors can explain 80.61% variance.

Table 2. Reliability and Construct Validity

Dimension	Construct	Cronbach's α	Factor Loading	Explanatory Variance
Information knowledge	Concepts of basic information technology	0.9239	0.8590	70.128
	Information security	0.9428	0.6083	69.436
	Knowledge of using HIS	0.8943	0.8430	72.473
Information skills	Ability to operate computer	0.9574	0.7035	67.37
	Ability to use information technology	0.7607	0.8086	51.798
	Network basics	0.957	0.7960	79.731
Information attitude	Behavior of using information technology	0.9239	0.8590	70.128
	Attitude toward using information technology	0.8646	0.8430	56.721

3.3. Steps of research

This research was conducted in two stages. In Stage 1: the preliminary form of the research framework summarized from literature review was revised by using expert conference and pilot research. To elevate the reliability of this model, this research held several expert conferences to make sure that this model would be appropriate for regional hospitals. Expert panel members using delphi method to discuss the questionnaire items and suggested potential case study subjects. Pilot research adopted single study case. Two clinical practitioners and one academician joined in the conference. One of the practitioners was director of the nursing department at a medical center in central Taiwan, with experience in implementing nursing IS of more than ten years. The other was nursing supervisor of a medical center in southern Taiwan, in charge of developing and implementing nursing IS. The academician was departmental chairman of a junior college of nursing, with experience in developing nursing IS and teaching of more than ten years and very familiar with how clinical nursing personnel perform their work. A regional teaching hospital in central Taiwan was selected as the case study. This hospital strives to create a workplace

without paper with HIS. Nursing chiefs that had decision-making authority over clinical affairs and nursing personnel that participated in nursing IS were selected to receive interview and questionnaire survey. These people included nursing directors, nursing supervisors, head nurses, vice head nurses that have managerial authority. In Stage 2: 84 regional hospitals or higher around the country were given questionnaire survey. The survey was administered from March 15, 2004 to April 20 of the same year. The survey was given to vice superintendent for nursing, nursing department director, or person in charge of implementing nursing IS that was recommended by the nursing director. In conducting the questionnaire survey, this research considered adopting proper incentive lure, urge and verification over telephone to elevate the external validity of this research. A total of 84 questionnaires were given, and 50 valid questionnaires were return, accounting for 59.5% response rate.

4.Result

4.1.Demographic data

The demographic data show that more than 89.8% of respondents are middle- and Senior executives (supervisor, vice director, director, vice superintendent), 56% are 40 ~ 50 years of age, 64.0 % have graduate education or more, 87.6% have worked at hospital for more than ten years, 60.% have assumed executive positions for less than five years, and 22.0% have assumed executive positions for five to ten years, indicating that the education, work experience and positions of the respondents are representative.

4.2.Computerization in hospital

With regard to the degrees of computerization in hospital: for the better part, nursing executives have high degrees on approval of computerization in hospital. As to very high degrees on IT application in medical information systems, respondents that checked "Agree" or "Highly Agree" account for 72.0% in total. As to very high degrees on IT application in administrative information systems, respondents that checked "Agree" or "Highly Agree" account for 70.0% in total. As to very high degrees on importance attached to the IT application by the most senior executives in hospital, respondents that checked "Agree" or "Highly Agree" account for 76.0% in total.

With regard to the hospital environment for IT application: nursing personnel that usually use computer at clinical work have the highest degree of approval, the respondents that checked "Agree" or "High Agree" accounting for 76.0% in total, the highest approval rate. The respondents that "Agree" or "Highly Agree" that the hospital personnel that are in charge of the IS have sufficient skill levels account for 44.0% in total. The respondents that "Agree" or "Highly Agree" that the hospital has very good information quality (correct,

prompt, real-time, complete, convenient, and easily understood information) account for 40.0% in total. The respondents that "Agree" or "Highly Agree" that the hospital has sufficient computer software, hardware and facilities account for 36.0% in total. Only 32.0% of the respondents that "Agree" or "Highly Agree" that the hospital has sufficient information professional workers, the lowest approval rate.

With regard to the cultivation of informatics literacy of nursing personnel , 44.0% of the respondents in total "Agree" or "Highly Agree" that the hospital attaches much importance to the development of nursing information systems.. 70% of the hospitals surveyed include it in their in-service training. 32% of the surveyed hospitals arrange information courses as part of their pre-service training. 14.0% of the surveyed hospitals have advanced nursing information education, 34.0% cultivate seeds for nursing information, and 24.0% include information technology application courses in their in-service training for executives.

4.3.The content of the informatics literacy of clinical nursing personnel

The degrees of approval of the workplace-directed measuring items of the informatics literacy of clinical nursing personnel were designed by using a five-point Likert scale. The items that scored 4 points or more (representing "Highly Agree" and "Agree" respectively) are included in the content of the informatics literacy of clinical nursing personnel of this research. The statistics show:

The information knowledge factor consists of three variables: concepts of basic information technology, information security, and knowledge of medical information systems. The concept variable has 7 questions, the information security variable has 9 questions, and the knowledge of medical information systems variable has 5 questions.

The average score for each of the seven questions in the concept variable is higher than 4 points. All the respondents agree that these seven items are the content that clinical nursing personnel should have with relation to knowledge of basic information technology (Table 3).

Table 3. Concepts of Basic Information Technology

Question	<u>M</u>	<u>SD</u>
1. Can describe the basic components of modern personal computers (including CPU, hard disk, CD drive, floppy disk drive).	4.02	.769
2. Can describe experience in using computer network (including sending and receiving email, browsing web pages, downloading or uploading documents, searching for information on the Internet, etc.).	4.32	.587
3. Can describe what one learns about the benefits of using the tool – computer (including reducing workload, elevating efficiency, assisting in daily work or learning, etc.)	4.26	.723
4. Can describe the periphery equipment that one has used (including CD drive, portable disk, printer, etc.).	4.22	.616
5. Know the basics about the Internet and communication technology.	4.04	.638
6. Understand how to use network as the tool of electronic transmission and communication.	4.22	.708
7. Understand how to conduct online literature search.	4.26	.723

The questions in the information security variable that scored more than four points average include: Can describe in detail how bad results loss or leakage of data of patients can cause, Can describe the rights of patients in computerized information management, Can describe the importance of keeping patient information credential, Can describe clearly what laws will be violated in the wake of leaking information about patients and the possible consequences, Can describe clearly what threats in daily operation information security may be vulnerable to, and Can describe what moral principles should be followed in protecting patient privacy. The respondents agree that these six items should be included in the informatics literacy that clinical nursing personnel should have in relation to information security (Table 4).

In the knowledge of medical information system variable, three questions scored higher than four points average, including: Can understand how to use the HIS to help manage patient care, Can properly use the HIS to obtain needed data of patients, and Can process, key in, and check out part data of patients. The respondents agree that these three items should be included in the informatics literacy content that clinical nursing personnel should have in relation to the knowledge of medical information system (Table 5).

Table 4 Information Security

Question	<u>M</u>	<u>SD</u>
8. Can describe in detail how bad results loss or leakage of data of patients can cause.	4.26	.633
9. Can describe the rights of patients in computerized information management.	4.16	.766
10. Can describe the importance of keeping patient information credential.	4.10	.735
11. Can describe clearly what laws will be violated in the wake of leaking information about patients and the possible consequences.	4.06	.843
12. Can describe clearly what threats in daily operation information security may be vulnerable to.	4.04	.832
13. Can describe what moral principles should be followed in protecting patient privacy.	4.18	.691
14. Can describe critical points or conditions in which threats to security in transmitting data may likely to happen.	3.82	.941
15. Form the habit of regularly making backup of data.	3.98	.915
16. When any damage happens, can promptly find out the needed data backup files.	3.88	.872

Table 5 Knowledge of Medical Information System

Question	<u>M</u>	<u>SD</u>
17. Can properly use the medical information system to obtain needed data of patients.	4.12	.627
18. Can process, key in, and check out part data of patients.	4.16	.548
19. Can obtain needed data from different HIS.	3.88	.849
20. Can understand how to use the HIS to help make decisions and judgments.	3.94	.682
21. Can understand how to use the HIS to help manage patient care.	4.10	.622

Information skills include three variables: the ability to operate computers, the ability to use information technology, and network basics.

The items in the computer operation skills (Table 4.9) that scored more than four points average include: (1) Can use word processing software to complete a report, (2) Can use the basic functions of word processing software, (3) Can use the advanced functions of word processing software, (4) Can use Power Point to complete a projector transparency briefing, (5) Can execute the basic functions in the projector transparency, (6) Can

execute basic graphic functions, (7) Can operate the basic functions in the menu, (8) Can operate the file management in software systems to manage files, (9) Can read, send, delete email messages, (10) Can establish email correspondence and alter the data in the correspondence inventory, and (11) Can affix files to email messages. The respondents agree that these eleven items should be included in the informatics literacy content that clinical nursing personnel should have in relation to computer operation skills (Table6).

Table 6 Computer Operation Skills

Question	<u>M</u>	<u>SD</u>
22. Can use word processing software to complete a report.	4.38	.602
23. Can use the basic functions of word processing software (format, form design, layout, etc.).	4.40	.639
24. Can use the advanced functions of word processing software (including word cluster search and substitute, item marks and serial setting, column and section setting, etc.).	4.08	.724
25. Can use EXCEL to complete an Excel form.	3.78	.798
26. Can execute the functions of a statistics figure or table (including: using graphic assistant, etc.)	3.84	.817
27. Can use Power Point to complete a projector transparency briefing.	4.24	.716
28. Can execute the basic functions in the projector transparency (including: add, delete, copy, move, etc.).	4.02	.685
29. Can execute basic graphic functions (including drawing pictures, drawing lines, etc.).	4.34	.688
30. Can operate the basic functions in the menu (including add, delete, etc.).	4.32	.713
31. Can operate the Microsoft file management to manage files.	4.00	.835
32. Can read, send, delete email messages.	4.34	.688
33. Can establish email correspondence and alter the data in the correspondence inventory.	4.14	.774
34. Can affix files to email messages.	4.32	.713

In the ability to use information technology variable (Table 7), the item that one can solve the problems on his own when the periphery equipment of the computer breaks down scored 3.84 average, and the item that one can remove the document in printing when the printer jams scored 3.95 average. Both items scored less than four points average. The other three items each scored more than four points average, including: when the computer shuts down, one can restart the computer; one can operate computerized tech instruments (for example, physical monitor, respirator, vein liquid controller, oxyhemoglobin monitor, etc.), and one can skillfully

operate HIS. The respondents agree that these three items should be included in the informatics literacy content that clinical nursing personnel should have in relation to the ability to use information technology.

Table 7. Abilities to Use Information Technology

Question	<u>M</u>	<u>SD</u>
35. Can remove the document in printing when the printer jams and reset the printer.	4.00	.835
36. When the computer shuts down, one can restart the computer.	4.24	.716
37. Can solve the simple problems on one's own when the computer and its periphery equipment break down.	3.84	.817
38. Can operate computerized tech instruments (for example, physical monitor, respirator, vein liquid controller, oxyhemoglobin monitor, etc.).	4.20	.728
39. Can skillfully operate HIS.	4.14	.535

In the network basics variable, there are seven items (Table 8), each of the items scored more than four points average. The items are: Can connect to the Internet and find out the needed websites by using search engines; Can upload, download business-related documents through the intranet; Can obtain suitable assistance through the intranet when simple problems are encountered; Can conduct literature search online; Can classify and organize Internet data into a report or document; Can download from the Internet items that are interesting or related with business or study them, for example, patient or nursing resources; Can retrieve and store data according to one's authority and functions (for example, nursing personnel are authorized to enter HIS to register health materials, to execute medical prescriptions but not to prescribe,...). These items should be included in the informatics literacy content of clinical nursing personnel with relation to network basics.

The information attitude factor consists of two variables: behavior of using information technology, and attitude towards using information. There are five items in the variable of behavior of using information technology; the average score for each item is above four points (Table 9). The respondents agree that these should be included in the informatics literacy content that clinical nursing personnel should have in relation to the behavior of using information technology.

Each of the seven items in the variable of attitude towards using information technology (Table 10) scored more than four points average. The respondents agree that these should be included in the informatics literacy content that clinical nursing personnel should have in relation to the attitude towards using information technology.

Table 8. Network Basics

Question	<u>M</u>	<u>SD</u>
40. Can connect to the Internet and find out the needed websites by using search engines.	4.30	.614
41. Can upload, download business-related documents through the intranet.	4.28	.701
42. Can obtain suitable assistance through the intranet when simple problems are encountered.	4.18	.700
43. Can conduct literature search online.	4.18	.774
44. Can classify and organize Internet data into a report or document.	4.18	.720
45. Can download from the Internet items that are interesting or related with business or study them, for example, patient or nursing resources.	4.30	.647
46. Can retrieve and store data according to one's authority and functions (for example, nursing personnel are authorized to enter HIS to register health materials, to execute medical prescriptions but not to prescribe,...).	4.06	.652

Table 9. Behavior of Using Information Technology

Question	<u>M</u>	<u>SD</u>
47. Have perseverance and patience in innovation with regard to the tools required to use information technology at work.	4.06	.652
48. Are willing to use information technology to improve quality of patient care.	4.32	.587
49. Are willing to learn new information technology so as to elevate one's competitiveness.	4.40	.535
50. Stiffly conform with work ethics.	4.52	.544
51. Stiffly conform with laws and regulations governing the right to intellectual property.	4.52	.544

Table 10. Attitude Towards Using Information Technology

Question	<u>M</u>	<u>SD</u>
52. Have no fear of information technology.	4.30	.678
53. Are willing to enroll in courses on new information technology.	4.12	.689
54. Know that it takes time, constant and unwavering effort, and skill to make computers effective tools.	4.30	.580
55. Know that computers are a tool, used to provide information about nursing care, that they cannot replace humans in executing functions of humans.	4.40	.535
56. Know that one doesn't need to be a programmer before one can make computers more effective.	4.40	.571
57. Can obtain effective resources to improve their daily activities through information technology.	4.20	.535
58. Apply information technology can help elevate efficiency or increase competitiveness.	4.26	.527

5. Discussion and Suggestions

The conditions of IT application in hospital were found: most nursing executives have highly approval on computerization in hospital (all above 70.0%), and 76.0% of nursing executives agree that clinical nursing personnel need to use computers at work usually. This result is agree with the finding of Christin (1999). In other words, when a hospital is more dependent on IT, its employees are more motivated to cultivate informatics literacy. Although 76.8% of the respondents agree that nursing personnel need to use computers at clinical work, only 44.0% agree the personnel have reached sufficient levels of skill, 36% agree their hospital has sufficient software and hardware facilities, 40.0% agree their HIS have good information qualities, and 32% agree their hospital has sufficient numbers of information specialists. These findings indicate that local hospitals above the regional level do not have proper IS that can satisfy the needs of clinical nursing personnel at work. Therefore, how hospitals effectively use IT to improve service quality is one of most important issues.

The survey of the current conditions on nursing information education has found: 70% of the surveyed hospitals have included information education in the in-service education of front personnel and executives, 32.0% of the surveyed hospitals include information education in their pre-service education programs, but only 14% of the hospitals have nursing information advanced education. 34.0% of the hospitals have programs for cultivating nursing information seeds, and 24% of the hospitals offer information education for the

executive levels. This finding indicates that hospitals have made considerable efforts to implement nursing information education, and these efforts are primarily given to pre-service education. However, there is still much needed to be done in relation to advanced information education and the informatics literacy of executives. More extensive computerization in hospital will have a stronger impact on clinical nursing personnel. However, the need for continuous in-service training should still be prudently considered. This result agrees with the findings of previous research: the cultivation of employees' ability to use computers will affect the personnel's acceptance of IT and performance. Therefore, education and training are indispensable to promote the IT skills of nursing personnel. Those findings agree with the study by Marrion et al. (Marrion et al. 1999).

When clinical nursing personnel lack the abilities to use IT, the development of HIS will be impeded. Therefore, there is a need to unequivocally define and require that they have sufficient informatics literacy. In addition, nursing personnel at different levels have different functions and responsibilities, so their information abilities are different accordingly. Therefore, nursing executives should not ignore the topic: how to develop informatics literacy courses relevant to the needs of nursing personnel at different levels. It is suggested that nursing executives give necessary training to nursing personnel at different levels according to the conditions of their hospital and by referring to the variables of this research so as to facilitate computerization in hospital.

5.1. The Content of the Informatics Literacy of Clinical Nursing Personnel

According to questionnaire analysis and literature review (Hobbs, 2002; Staggers et al., 2002), this research defines the informatics literacy of clinical nursing personnel as consisting of three factors: information knowledge, information skills, and information attitude that one should have. 100% of the respondents agree (above four points) that the items in information security, network basics, behavior of applying IT, and attitude towards applying IT should be included in the content of the informatics literacy of clinical nursing personnel, indicating that at present the content of the informatics literacy of clinical nursing personnel emphasized by nursing executives is closely related to the recent thriving development of medical information and the related issues derived from this development, such as information security, patient privacy, network application (Huang, 2002). Besides, in the content of nursing informatics literacy, each of the 12 items about information attitude scored above four points average, the same as the findings about nursing personnel's attitude towards using computers presented by Hobbs (2002), Thomas (1988), Jayasuriya and Caputi (1996), and McBride and Nagle (1996). Thomas (1990) also states in his research on nursing personnel's attitude towards computer application that the impact of

information attitude on the general informatics literacy of nursing personnel can be evaluated by their belief in, concern about, and initiative for computer use. It can be inferred that nursing executives have a special consideration of attitude in relation to the cultivation of informatics literacy of clinical nursing personnel. It takes time and proper environment for nursing personnel to cultivate positive attitudes, which will be very helpful to personnel in learning skills. With constant innovation of IT and ever increasing complicatedness of medical information, persistent learning of nursing personnel and their understanding that IT is a tool that can aid professional care and their right attitudes are the foundation for the cultivation of informatics literacy.

6. Conclusion

According to the results obtained from data analysis and the research purpose, the conclusions of this research have been drawn as follows:

- I. The workplace-directed informatics literacy of clinical nursing personnel includes three factors: knowledge of information, information skills, and information attitude. The knowledge of information factor is composed of 16 items of informatics literacy content, including concepts of basic information technology, information security, and knowledge of HIS. The information skills factor is composed of 22 items of informatics literacy, including ability to operate computers, ability to use information technology, and application of network basics. The attitude factor is composed of 12 items of informatics literacy content, including behavior of information technology and attitude towards using information technology. The preceding items of informatics literacy can help hospitals in planning programs for cultivating the informatics literacy of clinical nursing personnel.
- II. Current conditions of the IT application in hospital and the cultivation of the informatics literacy of clinical nursing personnel: most nursing executives consider that the degree of computerization in hospital is high, senior executives attach importance to computerization in hospital, and nursing executives of different levels of hospital realize that nursing personnel have to use computer to aid their nursing care. However, the hospital environment in which IT is used has drawbacks, including: lack of information specialists and of their abilities, insufficient computer software and hardware facilities, and lack of good information quality.
- III. At present, about 70% of the surveyed hospitals include the cultivation of the informatics literacy of nursing personnel in their in-service

education, but only 14.0% have education for advanced nursing information, 34.0% have programs for the cultivation of nursing information seeds, and 24% hold information education for executive levels. This may be related to the fact that the development of nursing information has germinated in recent years and the school information education for nursing personnel has received increasing attention. But this research has not investigated whether incumbent clinical nursing personnel have sufficient informatics literacy. So it suggests studies in the future to refer to the results of this research to measure the informatics literacy content of clinical nursing personnel.

7.Limits of research

This study employs case study and survey method to investigate the informatics literacy content of clinical nursing personnel. Thus, there are two limitations. First, research used the hospital evaluation standards as the basis of selecting target cases. Regional (teaching) or higher hospitals that have achieved considerable success in medical care, teaching and research were selected as the subjects. It is not known whether the findings can be applied to hospitals below the regional level. Second limitation is the relatively small size of the samples, this research used only a regional hospital to conduct revision of the preliminary form of research model. From a statistical point of view, larger samples would have given more reliable results.

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