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Technological Feasibility of a Nursing Clinical Information System

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Abstract

Introduction: A successful implementation of an information system is impossible without sufficient knowledge of available technical resources of an institute. The aim of this study was to determine technical feasibility of a nursing clinical information system (NCIS) in Mazandaran province, Iran, 2015.

Methods: This cross-sectional study was conducted in three steps. In the first step, a data gathering tool was developed through an unsystematic literature review. In the second step, a questionnaire was developed and validity of the tool was confirmed by receiving opinions of faculty members and calculating indices of Content Validity Index (CVI) and Content Validity Ratio (CVR). The questionnaire reliability was confirmed by calculating Cronbach's alpha coefficient (α= 0.72). In the third step, the feasibility of implementation of NCIS was evaluated by forming a panel of IT experts (n= 30), and through a questionnaire. Data were collected by 5-point Likert scale, very low to very high (scoring 1-5). Scores of each item were calculated and score percentage was determined. Chi-square and Fisher Exact tests were used.

Results: Maximum possibility of implementing NCIS were in the hardware area, additional equipment (92.6%), in the area of software, financial software (99.4%), in the area of network equipment, the possibility of integration with other internal systems, (92.6%) and in the area of network security, the possibility of backup version for security purposes (97.4%). Type of employment was statistically significant according to IT experts' opinions (p= 0.014)

Conclusion: Hardware and software infrastructures for implementation of NCIS were desirable. The provision of more portable computers, advanced equipment such as barcode scanner, Radio-frequency identification (RFID), some approaches for increase accessibility of the system and essential databases from other resources and also increase of network lines' speed are necessary.

Keywords: Feasibility, Nursing Clinical Information, Nursing Information System, Technological Feasibility

1. Introduction

Technological feasibility determining hardware and software components and communication development capability and/or available technologies of the organization are defined to achieve functional objectives of a system (1, 2). This type of feasibility study is commonly used to evaluate available system function or an organization's ability to implement a new system (3, 4) and helps to identify required technology, determine problems ahead and measure technical readiness of an organization to use a new system (5). A nursing information system is a computer-based integrated system with a storage for clinical and demographic data that predicates the activities of nursing and patient care outcomes, organizes data in accordance with the need in information structures, and provides access to

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related knowledge bases and patients' data (6). The main functions of a nursing information system include: care planning, nursing clinical recording, care assessment, discharge planning, personnel management, staff list, attendance record, cost and budget management, and management of complex skills (Skillmix) (7). The results of research conducted in North Africa showed, nursing information systems need better technology to develop, and most of the systems implemented in terms of technology have problems (8), because in addition to the need for access to a computer, an optimized use of these systems requires the presence of new technology tools such as barcode scanner equipment, RFID, advanced equipment for word processing, special software tools such as off-line inquiry software (9), the presence of LAN network communication and integration between systems (10). Currently, reports show that most implemented nursing information systems cannot share patient data and exchange information (11). For this reason, when setting-up a system, considering hardware and software components and network communications, it is very important to prevent problems during implementation. Furthermore, it had been reported in a study that the lack of attention to a network, while setting up a system, led to delayed installation and local networks in the computer system could not be used for six weeks (12). Another study has stated that a network's insufficient speed resulted in poor performance (13). Also, in Iran, despite hospital information systems being implemented for many years, there are contradictory reports of problems with these systems. In some studies it has been pointed out that these systems are faced with technological problems and lack of electronic communication between organizations, lack of proper hardware and software equipment and shortage of technical staff (14-16). While other findings have stated necessary infrastructures in terms of additional equipment, a centralized network, a database to deploy a system and access to external databases as sufficient (17). Therefore, in implementing health information systems, it is necessary to consider various factors, especially technological needs (18). Given that a system feasibility study and analysis leads to a better understanding of the system and can be used to improve health care delivery and enhance the function of each component of the system (19), Mazandaran province in Iran has been selected as a pilot plan. The aim of this study was to determine technological feasibility of NCIS in hospitals of Mazandaran University of Medical Sciences in 2015.

2. Material and Methods

2.1. Design

This cross-sectional study was conducted in 2015. The study was carried out in hospitals at Mazandaran University of Medical Sciences, Iran in three steps: 1) developing the tool, 2) tool validation, and 3) feasibility study of implementing of NCIS technologically.

2.2. The first step: Developing the tool

Developing the tool of the possibility of implementing technologically of NCIS was carried out by the method of unsystematic literature review of related papers. The international database, including: Science Direct, Google Scholar, PubMed, Proquest, Ovid, Elsevier, Springer, EBSCO, and national databases including Magiran, Scientific Information Database, and Persian Journal Citation Report (PJCR), were searched using the keywords such as Nursing Clinical Information, Nursing Information System, and Technological Feasibility. Only the studies either in English or Persian were selected. The papers derived (3, 14, 17, 20) were investigated by content analysis. Concepts and their themes were extracted and classified. Searching the paper continued until data saturation and accordingly the tool was developed.

2.3. The second step: The tool validation

Face validity of the tool was confirmed by four faculty members of health, information technology, management and nursing disciplines at Kashan Medical Services University. To confirm the validity of the content, the necessity of each question was confirmed by fifteen professors of health, information technology, management, and nursing disciplines at Kashan Medical Services University. The content validity ratio (CVR) was the criterion for determining the necessity of each question, which was measured by three options:" It is necessary", "It is useful but not necessary", and "It is not necessary". The content validity index (CVI) of each question was obtained based on simplicity, relevance and clarity of the questions. Choices and scores of CVI questions included: "No, score 1", "Yes, but needs fundamental revisions, score 2", "It is, but needs minor revisions, score 3" and "Completely Yes, score 3" (21, 22). Items with CVI> 0.7 were accepted and CVI <0.7 were rejected or revised. Items with CVR> 0.49 were accepted and CVR <0.49 were rejected or revised. To determine the reliability of the data collection tool, questionnaires were distributed among the 15 members of health, information technology, management and nursing disciplines at Kashan Medical Services University. Cronbach's alpha coefficient was obtained 0.72 using the split-half method.

2.4. The third step- Feasibility study of implementing NCIS technologically

Technological feasibility was evaluated by forming a panel of thirty IT experts. Inclusion criteria were considered knowledge of at least 2 years of work experience in the field of hospital information systems and the tendency and adequate time to participate in the study. Sampling was carried out using purposive sampling method. In order to judge the possibility of implementing NCIS, a feasibility study questionnaire was developed, based on the designed tool (the previous step). Data were collected by a 5-point Likert scale from very low (score 1) to very high (score 5). The average score was calculated for each question and multiplied by 5 to convert to 100. Score percentage of less than 30 was considered poor level and undesirable state, score 30 to 70 was considered average level and semi-desirable state and a score of more than 70 was considered high-level and desirable state. Chi-square and Fisher exact tests were used.

3. Results

From a total of 30 IT experts, 60% were male; 23.3% were in the age range of 25-29 years, 50% were in the age range of 30- 34 years and 26.7% were in the age range over 35 years. 86.7% had a bachelor degree, 73.3% were employed under a contract and 10% were formally employed. Work experience of 5-9 years was calculated as 50%, whereas 26.7% work experience was 2- 4 years and 23.3% work experience was 10-14 years. The results of developing a technological feasibility study tool showed that implementing NCIS requires four main concepts of hardware, software, network and network security (3, 14, 17, 20). In assessing the tool validity, the results showed, the CVI score of all technological items were greater than 0.7 and were accepted. Only in 2 items, the CVR score was less than 0.49 they were removed from the tool and others were accepted (Table 1). The results of the feasibility study showed that the maximum possibility of implementing NCIS technologically was in software section and the minimum possibility was in the network section. In the hardware area; the minimum possibility was the existence of a barcode scanner and RFID equipment (30%) and the maximum possibility of the implementation of the system was additional equipment (92.6%). In the area of software; the score of off-line inquiry tools was the lowest score (34.6%) and the score of financial software was the highest score (99.4%). In the network area; the score of access to external databases was 26.6%, minimum possibility; and the score of integration with other internal systems was 92.6%, which was the highest score. In the area of network security; the score of a user tracking system was 57.4%, minimum possibility; and the score of a backup version for security purposes was 97.4%, maximum possibility of implementing NCIS (Table 2). The results showed, a maximum possibility of implementing NCIS in terms of technological facilities in the male community was 72.2%, aged 30- 34 years it was 66.7% and staff under a contract was 81.8%. From the perspective of official personnel, the technological feasibility study was not at a high level. Type of employment was statistically significant according to IT experts' opinions ($p= 0.014$) (Table 3). Average score of technological feasibility study was 72.11%, and needs' supply percentage was 70% and desirable.

4. Discussion

The aim of this study was to determine the technological feasibility study of NCIS in 2015 in Mazandaran University of Medical Sciences, Iran. The feasibility study results showed, the speed of the network lines was 54.6% and the score of existence of portable computers was 49.4%, indicating low number of portable computers and network lines. The score of providing of integration with internal systems and rapid access to records was respectively 92.6% and 86.6%. The results of other consistent studies showed that in clinical information systems, due to the presence of the communication and integration with other systems, rapid access to records (23-28) is generally possible. Also in the present study, the number of portable computers and the network lines' speed are semi- desirable to run a NCIS, which is consistent with the result of a Montini (2013) study, reporting lack of portable computers, poor wireless communication and the network lines' speed in a feasibility study of the backup system of a clinical decision in treating tobacco consumption in a dental clinic (29). But it is not consistent with the results of other studies that reported; the number of portable computers and the network lines' speed are adequate (17, 23, 26, 30, 31). Given that the study findings show that by using information systems, planning and documentation are enhanced due to the communication and integration with other information systems therefore rapid access to a patient information, documentations are comprehensively presented. Furthermore, due to the absence of hand- written data and writing data, data writing time is reduced and information readability is increased (24). Also the quality of a patient's care is improved through sharing a patient's information during care (23, 28) and low network speed, results in poor system function, delayed response time, and irregularity, especially at the time of high-volume (13, 32). Therefore, it is essential to provide a proper ground in terms of adequate computers, the network speed and rapid access to information in medical centers.

The study results showed that existence of additional hardware for implementation of the NCIS was 92.6% which was at a high level and in a desirable situation. Existence of off-line inquiry software tools were 34.6% and feasibility of integration with other external systems was 65.4% which was at an average level and in a semi-desirable situation. Existence of barcode scanner and RFID equipment was 30% and feasibility of access to external databases was 24.6% which were a poor level and in an undesirable situation. The findings of an Ammenwerth et al. (2001) study showed, there were enough computers, and additional software and hardware to set the system (23). In the study of Ozkan (2006) there was no terminal to search web external resources such as PubMed and off-line inquiry software, for users' support (27). Blignaut et al. (2001) also showed that there was no off-line search facility in the database (31). In a study that was conducted to evaluate an electronic system to predicate clinical care, while access to computers and technology was provided, new technology tools have not been predicted (9).

Table 1. CVI and CVR on Technical Feasibility of Study of Implementation NCIS

Technical Feasibility Questions	CVI			CVR	Status
	Relevance	Simplicity	Clearly		
Sufficient Number of Computer Hardware Engineers	0.87	0.80	0.87	0.60	Accepted
Sufficient Number of Computer Software Engineers	0.93	0.87	0.93	0.73	Accepted
Sufficient Number of System Analysis Engineers	0.93	0.93	0.87	0.73	Accepted
Existence Auxiliaries Equipment	1	1	1	0.73	Accepted
Enough Portable Computers (Laptop, Tablet)	0.93	0.93	1	0.60	Accepted
Existence Workstations and Mainframes	0.93	0.93	1	0.87	Accepted
Existence Scanner and Printer	0.93	0.93	1	0.87	Accepted
Existence Point-of-Care Mobile Terminals	0.93	0.93	0.93	0.60	Accepted
Existence RFID and Barcode Reader	1	1	1	0.60	Accepted
Existence Backup Tools	0.93	0.93	1	0.87	Accepted
Support Services	0.87	0.93	0.93	0.60	Accepted
Reducing Nurses Resistance through the Training	1	1	0.93	0.87	Accepted
The Possibility of Currency Support	0.87	0.93	1	0.73	Accepted
The possibility of Farsi language Support	0.87	0.93	0.93	0.87	Accepted
Designing User Interface	0.87	0.87	0.87	0.87	Accepted
The Possibility of Software to Customize User Interface	0.87	0.87	0.87	0.60	Accepted
The Possibility of Software for Sending and Receiving Information	0.93	0.93	0.93	0.60	Accepted
The Ability of Support for Data Storage	0.93	0.93	0.93	1	Accepted
Data Management Tools	0.93	0.93	1	0.87	Accepted
Query Offline	0.93	0.93	1	0.87	Accepted
Tool Reporting	0.93	0.93	1	0.87	Accepted
The Possibility of Support to Integration and Combining Data	0.93	0.93	1	0.87	Accepted
Existence Software for Quick Access to Records	0.87	0.87	0.87	0.73	Accepted
Existence Network Equipment	0.93	0.93	1	0.87	Accepted
Appropriate Cabling	0.80	0.87	0.87	0.60	Accepted
Sufficient Network Speed	0.93	0.93	0.93	0.87	Accepted
Existence Internet and Intranet	0.93	0.93	1	0.87	Accepted
Integration with Internal Information Systems	1	1	1	0.87	Accepted
Integration with External Information Systems	0.93	0.93	0.93	0.60	Accepted
The Possibility of Access to External Databases	1	1	1	0.60	Accepted
Existence Standards of Sending Massages, Security, Confidentiality and Data Definition	1	1	1	0.87	Accepted
Existence Database	0.93	1	0.93	0.73	Accepted
Access to Websites (virtual sites)	0.93	1	1	0.47	Not accepted
The Possibility of Electronic Communication between Hospitals and Medical Centers	0.87	0.93	0.93	0.47	Not accepted
Taking Advantage of the Data Protection Method	1	1	0.87	0.87	Accepted
The Ability to Use User Tracking System	1	1	0.93	0.87	Accepted
Ability to Backup for Security Purposes	1	1	1	0.87	Accepted

Table 2. Technical Feasibility Study of Implementation of NCIS

Area		Needs Assessment Items	Status
Existence Hardware equipment	Manpower	Computer Hardware Engineers	Desirable
		Computer Software Engineers	Desirable
		System Analysis Engineers	Semi-desirable
	Equipment	Auxiliaries Equipment	Desirable
		Portable Computer (Laptop, Tablet)	Semi-desirable
		Workstations and Mainframes	Desirable
		Scanner and Printer	Semi-desirable
		Point-of-Care Mobile Terminals	Semi-desirable
		RFID and Barcode Reader	Undesirable
	Support	Backup Tools	Desirable
		Support Services	Semi-desirable
	Training	Reducing Nurses Resistance through the Software Training	Semi-desirable
Existence software equipment		Database	Desirable
		Currency Rate Support	Desirable
		Farsi Language Support	Desirable
		User Interface	Desirable
		Software to Customize User Interface	Desirable
		Software for Sending and Receiving Information	Desirable
		Support for Data Storage	Desirable
		Data Management Tools	Desirable
		Query Offline	Semi-desirable
		Reporting	Semi-desirable
		Support to Integration and Combining Data	Desirable
		Software for Quick Access to Records	Desirable
Existence network equipment		Network Equipment	Semi-desirable
		Cabling	Desirable
		Sufficient Network Speed	Semi-desirable
		Internet and Intranet	Desirable
		Integration with Internal Information Systems	Desirable
		Integration with External Information Systems	Semi-desirable
		Access to External Databases	Undesirable
Existence Network security system		Standards Sending the Message, Security, Confidentiality and Data Definition	Desirable
		Methods of Information Protection	Desirable
		User Tracking System	Semi-desirable
		Backup for Security Purposes	Desirable

Table 3. Demographic Status of Participants and Levels of Feasibilities of Implementation of Technical NCIS

Status: Variable		*Weak	*Moderate	*Upper	p-value
Gender	Male	0	5 (27.8)	13 (72.2)	N.S
	Female		4 (33.3)	8 (66.7)	
Age	25-29	0	3 (42.9)	4 (57.1)	0.46
	30-34	0	5 (33.3)	10 (66.7)	
	+35	0	1 (12.5)	7 (87.5)	
Education	BS	0	7(26.9)	19 (73.1)	0.56
	MS		2 (50)	2 (50)	
Type of Employment	Formal	0	3 (100)	0 (0)	0.014
	Contract 5 Years Old	0	2 (40)	3 (60)	
	Contractual	0	4 (18.2)	18 (81.8)	
Job Experience	2-4	0	5 (62.5)	3 (37.5)	0.063
	5-9	0	3 (20)	12 (80)	
	10-14	0	1 (14.3)	6 (85.7)	

*Weak: Less than 30%, Moderate: 30%-70%, High: More than 70%)

The results are consistent with the results of the present study and the study of Swansburg et al. (2013), which reported lack of hardware, software and advanced equipment for processing words, barcode scanner and RFID equipment (10) together with the results of the Asadi et al. (2012) study, reporting lack of electronic communication between organizations, access to online resources and databases outside an organization (14). But the results are not consistent with studies of Mcbride (2012) which showed that the time of implementing advanced equipment system such as barcode scanner, RFID and off-line search tools was provided (30). Gholam Hosseini et al. (2012) reported that information systems have the ability to communicate effectively with external databases and use online resources (26) and Nasiripour et al. (2008) reported access and use of external databases and online resources were provided (17). Given that, identifying complications using new technologies has improved patient safety (33) and advanced biomedical equipment and technologies can electronically transfer data from medical devices and monitors and facilitate drug compliance using a barcode scanner. Also the use of off-line inquiry software, access and use of databases outside the hospital can facilitate the use of nursing knowledge. Therefore, it is essential to pave the way for greater use of nursing information systems, by the development and application of new information technologies. Given that the presence of necessary hardware and software infrastructures has been allowed to be set in the system, it is recommended that these facilities deploying clinical nursing, national plans and access to scientific sites and external databases are provided.

5. Conclusions

Successful implementation of NCIS is impossible without determining the feasibility of technological resources. According the results, necessary hardware and software infrastructures are technically desirable to set the system. For rapid access to information, providing more portable computers, advanced biomedical equipment and technologies such as barcode scanners RFID, off-line inquiry software, some approaches for increase accessibility of the system, essential databases from other resources and also increase of network lines' speed are necessary. Further research on other aspects on feasibility of the implementation of NCIS such as legal and behavioral are recommended.

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Conflict of Interest:
There is no conflict of interest to be declared.

Authors' contributions:
All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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