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Original Article

Nursing Care and Documentation Assistant with an Electronic Nursing Management System in Neonatal Intensive Care Unit

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ABSTRACT

Background: All nursing cares require decision-making, and the ability to make the best decisions impact upon the quality of nursing care. Moreover, authenticity and accuracy of the best cares may be questioned if not recorded and reported properly and in a standard manner. We aimed to design and implement an electronic nursing management system and then evaluate satisfaction of nurses with the designed electronic system.

Methods: This technical action research was conducted in four phases of a) designing an electronic nursing process decision support system, b) designing an electronic nursing care documentation system, c) integrating these two systems and developing an electronic nursing information management system, and d) implementing the system and system satisfaction evaluation using quantitative methods (satisfaction questionnaire).

Results: The results of this project led to design and development of an electronic nursing information management system for neonatal intensive care units, which enables nurses to carry out standard care and documentation with high level of nursing satisfaction.

Conclusion: In order for an electronic system to support nurses in their care process, it must be accepted by nurses. If nurses are satisfied with the performance and nature of this system, they are much less likely to develop workaround solutions and much more likely to spend their efforts focusing on the professional aspects of nursing care.

Keywords: Documentation, Electronic system, Nursing process

Introduction

Low quality of care is the most important challenge in neonatal intensive care units (NICUs) (1). This problem can be caused by factors such as inadequate skilled and knowledgeable human resources, equipment shortage, errors in decision-making and judgment of medical staff, as well as mental and physical fatigue due to high workload (2). Moreover, high sensitivity and vulnerability of neonates admitted to NICUs, high-risk procedures, and low tolerance of neonates for care errors are the most important obstacles NICU nurses face (3).

Nurses play a key role in improving patient outcomes. Moreover, providing the best care in NICU requires prompt and careful decision-making (4). The critical need for systems to deliver health service information, lack of access to information, and inherent limitations of paper records have led to creation of computer information systems that have the potential of facilitating access to electronic health records (5).

All nursing cares require nurses' decision-making and the ability to make the best decisions influences quality of nursing care (6). In addition, nurses should be held accountable for their

decisions (7). In this regard, clinical decision support systems, using information technology, can assist nurses in making correct and timely decisions (8)

It is worth mentioning that clinical decision support systems are designed to support the decision-making process at the time of patient care based on patient conditions (9, 10). On the other hand, application of nursing process, as the basis of nursing decision-makings especially in NICU, is a serious challenge for nurses (11). Nursing process, as an international standard for nursing practice, is based on evidence-based practice (12). This model is a systematic framework for clinical decision making to evaluate patient needs (13) and includes four integrated processes of assessment, diagnosis, intervention, and evaluation (14).

The focus of nursing decision support systems is to use the "nursing process" as the most important standard of nursing care (15). In addition, studies demonstrated that the problems leading to the limited use of clinical decision support systems among nurses include errors in understanding statements and phrases resulting from not using standard terminology, lack of computer systems, and lack of web-based systems (16). On the other hand, authenticity and accuracy of the best cares may be questioned if they are not recorded and reported correctly and in astandard way. In fact, accurate documentation (reporting) of nursing care is a key responsibility of nurses (17).

It should be noted that the use of nursing decision and documentation system might contribute to more efficient usage of information and knowledge, and consequently, improve patient outcome provided that the systems are designed with meticulous attention to user needs. These systems should be constantly assessed and monitored and necessary amendments should be made (18). Indeed, previous studies emphasized on the importance of context-based design of such systems. Context-based design is a structured methodology for researching user interface, which aims to design a software based on users' needs (19).

The final point that should be noted is that care satisfaction is an important component of nursing practice affecting patient safety and quality of care (20). It is widely recognized that the features of an electronic system must be accepted by nurses in order to support them in nursing care. If nurses were satisfied with the performance and nature of these systems, instead of looking for solutions, they would focus on various aspects of care (21). Thus, it

seems that the use of information technology not only improves the quality of care (22), but also offers an opportunity to change the health care system and provide additional safety (23).

Objectives
In this study, we aimed to a) design and develop an electronic nursing process decision support system, b) design an electronic nursing documentation system, c) integrate these two systems and design and develop an electronic nursing information management system, and d) implement the system and evaluate nurse satisfaction with the use of electronic systems.

Methods
This technical action research was conducted during the following four phases:

1- Designing an electronic nursing process decision support system
In order to design an electronic system for nursing process decision support, some standard phrases were required for every stage of the nursing process. The body of literature showed no standard and specified classification to design the "assessment" as the first step of nursing process. However, Nursing Diagnosis Association (NANDA) categorized nursing diagnoses to 5 main domains and 16 subdomains. This general classification, therefore, was considered as the assessment stage of nursing process.

In the second stage, that is, identification of nursing diagnoses, first the list of NANDA nursing diagnoses version 2015 was translated into Persian. In the next stage, 120 nursing diagnoses were selected according to NICU nurse's selection. To make a list of NICU nursing diagnoses, all nursing diagnoses were given to nurses as a questionnaire and asked them to choose nursing diagnoses related to NICU. Finally, the items with more than 90% agreement were selected. These 120 nursing diagnoses in relation to NICU patients were ultimately incorporated into the system.

In the third and fourth stages, nursing interventions and associated outcomes related to nursing diagnoses in NICU were extracted based on nursing intervention classification system (NIC) and nursing outcome classification system (NOC). In the fifth stage, the extracted contents, including assessment, diagnoses, interventions, sub-interventions, and outcomes, were entered into an excel file, clearly representing the relationships between the items with a relevant

Figure 1. Nursing process decision support system page

definition in front of each term offered by the classification system. In the sixth stage, the excel file was converted into a web-based software with the help of a team of software developers.

2- Designing an electronic nursing care documentation system

This system is a combination of electronic nursing care plan forms (Cardex) and nursing care documentations (nursing note/Report). Here, all information is recorded without typing and with clicking. These forms are smart and able to send the necessary notifications about the care (Figure 2).

3- Designing an electronic nursing information management system (integrated system)

After designing and testing each of the subsystems, an integrated program was developed in collaboration with a team of computer programmers, including all features of the two main programs with a logical relationship among them and the ability to present a general report of all nursing care in each section.

4- Implementing the system and evaluating user satisfaction

Firstly, we implemented the electronic system in a 10-bed NICU with 18 nurses. For implementation of the system, one of the

researchers started to educate the nurses in the hospital in a hands-on and face-to-face manner. After the training phase, the trained nurses started to use the electronic system, and then, we designed the satisfaction questionnaire in collaboration with the participant nurses. The satisfaction questionnaire was developed by the researchers and its face validity was determined by the participant nurses. In addition, content validity of the questionnaire was established by 10 nursing faculty members. Questionnaire reliability was calculated using Cornbrash's alpha (0.86). This questionnaire included 32 items rated using a five-point Likert scale. Satisfaction percent was determined for each item.

Results

Our findings showed that an electronic nursing information management system for NICUs permits nurses provide standard care, documentation with minimal error, and high level of nursing satisfaction. Thus, we explained the results in two sections. In the first one, we described the components of the electronic designed program, and in the second, we illustrated the results of the satisfaction questionnaire.

Nursing process decision support system

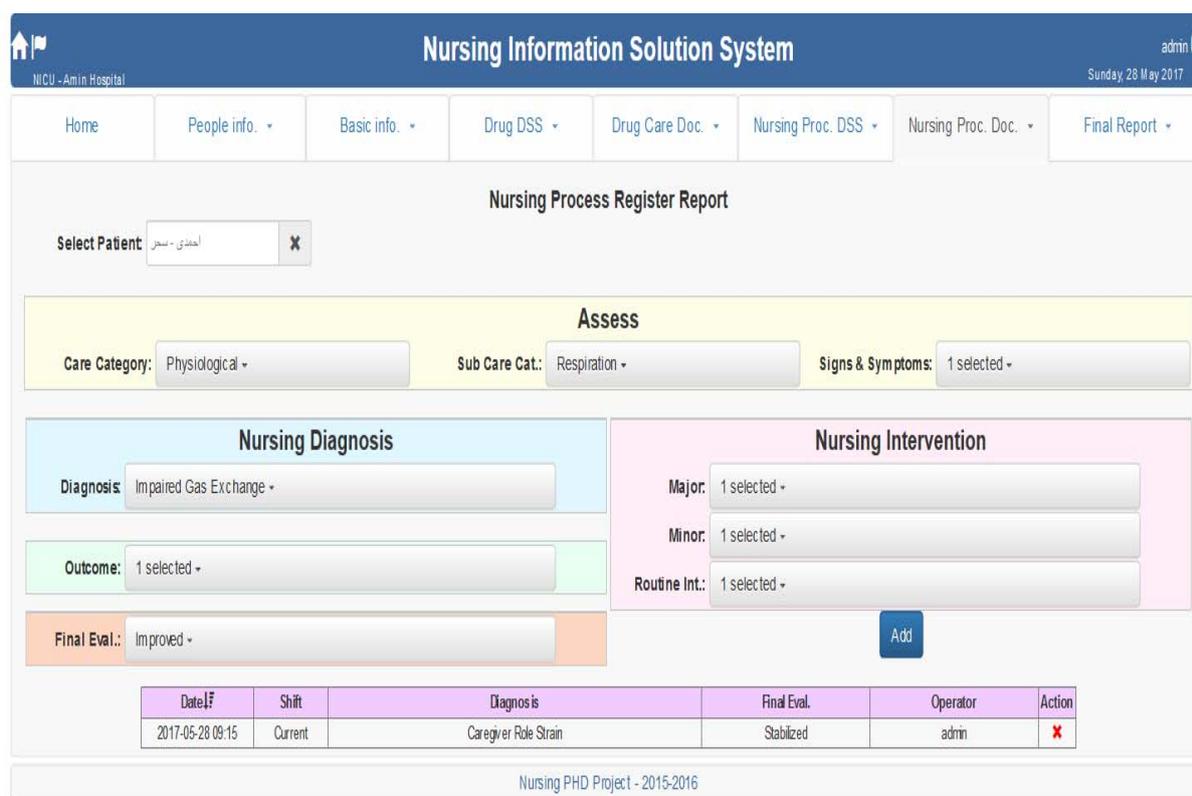This component of system displays all nursing

Figure2. Nursing process documentation system page

process stages in a simple and systematic manner. In the assessment stage, nurses only choose the general scope of patient's problems among five default options of main domains. Afterwards, the system automatically displays the subdomains of the selected domain, out which nurses can select one. For example, the nurse can choose physiological option as a main domain and nutrition as a subdomain. By these two simple and fast clicks, assessment stage of nursing process ends and then system automatically displays the nursing diagnoses related to assessment stage. These nursing diagnoses are limited to four or five options, from which users can select one.

Patient's condition

With selection of nursing diagnosis, the system automatically displays all the nursing interventions related to the selected nursing diagnosis. Nurses can select one or more interventions based on clinical judgment and patient condition. Finally, the system automatically displays outcomes of the related previous nursing intervention. Nursing process stages end simply by selection of one or more options among outcomes (Figure 1).

Nursing care documentation system

This menu presents all the information that must be recorded in nursing care. This part includes 10 submenus such as blood glucose chart, vital signs chart, intake and output chart, and laboratory tests. In this part of system, nurses can select and record all nursing care notes only by clicking. Finally, the system shows all the nursing documentation as an electronic nursing report by clicking on nursing report.

Satisfaction evaluation

In this section, we evaluated satisfaction of nurses who used the system. Satisfaction evaluation questionnaire was given to nurses after each nurse used the system several times to document their nursing care. Satisfaction regarding each submenu was measured by a separate question in our questionnaire. Moreover, one general question on overall satisfaction with the nursing process decision support system, nursing documentation system, and integrated system was included in the questionnaire.

Our questionnaire contained two parts. Part 1 included items on electronic nursing process decision support system (15 items), and part 2 comprised of items related to electronic nursing

documentation system (16 items). The final question was about overall satisfaction with the integrated electronic nursing management system (the whole system; tables 1 and 2).

Findings showed that most of the nurses (55.5%) chose "too much" option for evaluation of nursing process decision support system. Furthermore, most nurses (61.1%) selected "too much" option for evaluation of the nursing management system (integrated system).

Discussion

The nursing information system is a combination of computer science and nursing knowledge, which has been developed to manage nursing data, information, and knowledge, as well as support and cover nursing care plan and performance (24). Several attempts have been made in different countries to develop such systems due to the emphasis of references on the importance of designing customized and user-friendly systems. For instance, a Personal Digital Assistant (PDA) was developed as a result of a research by Su et al. (2012) entitled as "mobile nursing information system for the optimization of nursing care quality". According to the results of that study, users were satisfied with the system;

however, the small screen was reported as a challenge for application of the system (25). Displaying the system on screen according to users' needs was an important point considered in this study due to web-based specification of the system.

In a similar study by Azizi et al. (2012) on designing an electronic health record system, the researchers introduced easy installation, web-based operation, avoidance of typing, and color charts for better diagnosis as the advantages of their system (26). These benefits were also included in the present study given that there is no need to install the application and type.

In another study, Tran et al. (2011) designed and developed an electronic nursing record system for a nursing school in Wilminton (27). Similar to the developed system in the current study, the Tran's system included sections on nursing care information documentation, drug information, and drug documentation forms. Tran's system was designed only for training nursing students based on a standard patient; however, the system developed in the current study has the potential of being used by students and nursing staff based on the real conditions of patients.

Table 1. Nurse satisfaction with nursing process decision support system

	Nursing satisfaction with nursing process decision support system	Too much	Much	Normal	Little	Too little
1	Satisfaction with the impact of system on components of the nursing process teaching	55.5%	39%	5.5%	0	0
2	Satisfaction with the impact of system on applying of nursing process step by step	61%	39%	0	0	0
3	Satisfaction with the impact of system on learning phrases of international standard nursing classification systems such as NANDA, NIC, NOC	44.5%	44.5%	11.2%	0	0
4	satisfaction with the impact of system on standardization of nursing care	55.5%	33.3%	11.2%	0	0
5	Satisfaction with the impact of system on the overall quality of nursing care	39%	39%	22%	0	0
6	Satisfaction with the impact of system on decrease of nursing decision making time	50%	44.5%	5.5%	0	0
7	Satisfaction with the impact of system on increase of accuracy of nursing decision making	66.8%	27.7%	5.5%	0	0
8	Satisfaction with the impact of system on reduction of nursing decision making stress	33.3%	39%	27.7%	0	0
9	Satisfaction with the impact of system on increase of nursing knowledge	44.5%	39%	16.5%	0	0
10	Satisfaction with the impact of system on improvement of nurses' self-confidence in nursing care	39%	33.3%	27.7%	0	0
11	Satisfaction with the impact of system on increase of nursing autonomy in nursing care	44.5%	39%	16.5%	0	0
12	Satisfaction with the impact of system on increase of holistic nursing care	61.1%	27.7%	11.2%	0	0
13	Satisfaction with the impact of system on increase of critical thinking in nursing care	50.2%	33.3%	16.5%	0	0
14	The overall satisfaction with the impact of system on the use of the nursing process as a nursing care framework	66.7%	33.3%	0	0	0
15	The overall satisfaction with electronic nursing process decision support system	55.5%	44.5%	0	0	0

Table 2. Nurse satisfaction with the nursing documentation part of the electronic system

	Nurse satisfaction with the nursing documentation part of electronic system	Too much	Much	Normal	Little	Too little
1	Satisfaction with the impact of system on increase of easy documentation of nursing process	66.6%	33.4%	0	0	0
2	Satisfaction with the impact of system on decrease of nursing process documentation time	55.5%	33.4%	11.1%	0	0
3	Satisfaction with the impact of system on increase of standardizing nursing process documentation	72.2%	27.8%	0	0	0
4	Satisfaction with the impact of system on decrease of nursing process documentation amount	50%	33.4%	16.7%	0	0
5	Satisfaction with the impact of system on increase of accuracy nursing process documentation	72.2%	27.8%	0	0	0
6	Satisfaction with the impact of system on increase of ease of nursing reports based on the nursing process	44.4%	44.4%	11.2%	0	0
7	Satisfaction with the impact of system on identification of disease and recovery course	38.8%	33.4%	27.8%	0	0
8	Satisfaction with the impact of system on identification of importance of nursing care	33.4%	38.8%	27.8%	0	0
9	Satisfaction with the impact of system on increase of easy documentation in the part of nursing care plan (cardex)	72.2%	27.8%	0	0	0
10	Satisfaction with the impact of system on decrease of nursing care plan (cardex) documentation time	44.4%	38.8%	16.7%	0	0
11	Satisfaction with the ability to covering all required nursing care information in the nursing care plan part of system	44.4%	33.4%	22.2%	0	0
12	Satisfaction with the impact of system on increase of easy access to previous patient information in nursing care plan part of system	44.4%	44.4%	11.2%	0	0
13	Satisfaction with the impact of system on record and display of vital signs chart	66.7%	27.8%	5.5%	0	0
14	Satisfaction with the impact of system on record and display of intake and output chart	61.1%	27.7%	11.2%	0	0
15	Satisfaction with the impact of system on record and display of glucose measurements chart	77.8%	22.2%	0	0	0
16	Overall satisfaction with the nursing care documentation part in electronic system	44.4%	44.4%	11.2%	0	0
17	Overall satisfaction with integration of nursing process decision support system with nursing care documentation (nursing management system)	61.1%	38.9%	0	0	0

It is worth mentioning that in the aforementioned studies the nursing process was not used as a part of the system, while in some other studies such as that of Mazloum (2013), only an electronic nursing process system was developed and evaluated. The investigation of this system revealed satisfaction of users including nursing staff and nursing students. Satisfaction was higher among nursing students due to the difference between the designed system and the paper-based forms that were used by nursing staff; a point that has been taken seriously in this study causing least resistance and the highest satisfaction for nurses in using the system (28). A study by Ammenwerth (2011) investigated the effects of nursing information system on the quality of data processing among nurses and evaluated impact of using the system on care and documentation of nurses (29). The researchers in the present study found that the designed system elevated nursing satisfaction.

One of the most important advantages of this system is the possibility of being updated by users without any need to significant changes in the system. In other words, users may keep the system updated by editing the drug information, nursing diagnoses, and other information available in the system; this has been referred to as an applied challenge for the systems in other similar studies (14, 16).

Varzeshnejad et al. (2014) designed a coding and classification system based on clinical care classification (CCC). That system was also based on NANDA and it was a nursing process decision support system. Therefore, that study was similar to the present one in that the designed system was based on the nursing process; however, in the former study, the researchers used the system for transcultural mapping and usability testing of the clinical care classification system for an Iranian NICU population (30).

In the review of the relevant literature, we did

not find a designed system with the same advantages as the current system. Finally, the investigation and comparison of the relevant studies on electronic nursing information systems revealed that these systems were developed and implemented in different countries to satisfy the needs of users. Enhancing the quality of care and satisfaction of users are among the similarities of the current system and the previous ones, while diverse components of nursing information system is among their differences. What is more emphasized in the current study is to develop a system in line with evidence-based care and nursing process to allow quick access to all pharmaceutical information and prompt and accurate documentation of the items currently recorded in nursing reports.

Conclusion

Work satisfaction is a major factor in nurse retention and delivery of quality care, but rapid changes in healthcare services have placed great demands on nurses and raised the need for ways to improve and sustain job satisfaction in nurses (31).

Undoubtedly, nursing information systems contribute to efficient use of information and knowledge and consequently improve patient outcomes if these systems are premised on needs of users and constantly monitored and modified (18). The introduced system has the potential of optimizing the utilization of nursing process, as a key standard for nursing care, to improve evidence-based care, reduce workload of nurses, support nursing decisions, update drug information, standardize nursing care and reports, and consequently, enhance the quality of nursing services and bridge the theory-practice gap in NICU nursing.

Acknowledgments

Conflicts of interests

No conflict.

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