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Nurses' Perceptions of the Impact of a Computerized Information System on a Critical Care Unit

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Critical care nurses work in complex environments and encounter a vast amount of information daily. To learn how a computerized information system (CIS) impacted nursing practice on a critical care unit, this foundational research was conducted before and after implementation of a CIS. Qualitative methods using interviews and open ended questions were employed. Results showed that nurses felt positive overall about the implementation of a bedside CIS. Nurses liked the readability of the information and having the CIS near the bedside. They disliked the periodic slowness or downtime. Broad themes of reflection, questioning and action emerged from the content analysis. The themes were in accord with the theoretical framework that guided the study. Recommendations for future research included exploring nursing medication documentation, use of hand held devices, and having resource databases within the CIS.

Introduction

Critical care units have evolved over the past few decades as a highly information intensive environment[1] A major resource to assist in managing the information is the computerized information system (CIS). To be effective a CIS needs to be integrated and to operate in a seamless fashion "in which all components work together to respond to the needs of patients."[2]. The following report describes results from research interviews of nurses working on a critical care unit and their written responses to open ended questions before and after system implementation. This research was part of a larger study examining nursing practice in a critical care unit in which a computerized information system was introduced.

Historically, computerized systems in critical care units assisted with the collection of physiological data such as heart rate and blood pressure[1] In 1987 Brimm reported that "the focus for computer use in the ICU in the next decade will shift from instrumentation, which can generate ever more measurements, to systems, which assist a reduced staff in caring for sicker patients by reducing the burden of paperwork."[3]. Since that time CISs have become more capable in handling information related to patient care, clinical decision making, and administrative activities on the critical care unit[4]. CISs have been shown to increase the extent of data collected [4] however they can also add to the difficulty of the work environment for nurses.[6]Recognizing benefits to be derived from CISs and also possible problems, the investigators felt a study was needed to document the effects of implementation of a CIS.

The problem.

Nurses in critical care units face many challenges as they work in life-threatening situations and rapidly paced environments.[7] A dynamic interaction occurs with the critically ill patient, the critical care nurse, and the critical care environment. [8] A CIS becomes an important part of

the critical care environment and work related to it needs scrutinization to better understand any improvements in direct patient care or other aspects of nursing work resulting from its vast capacity to handle clinical information. Computerized information systems have improved the nurses' work in areas such as the quality of care plans and charting.[9], [10] Computer driven nursing documentation has carried a negative attitude by nurses that is thought to be due to the additional time needed to learn the system. [11] The problem addressed in this research is the lack of clarity regarding the impact of CISs on the work activities of critical care nurses.

Research question

The study aimed to reveal how nurses perceived the impact of a CIS on their work activities. The research question raised was: What are the nurses' perceptions of the impact of a CIS on nursing work activities in the critical care unit? To answer this question descriptive data were sought.

Methods

The research incorporated qualitative methods using interview and written responses to open ended questions. The interview consisted of a schedule of questions aimed to reveal nurses' perceptions of changes in work activities after implementation of the CIS. The open ended questions were asked in printed form.

Sample and setting

For the open ended questions given before and after the CIS implementation, the sample was a convenience one of 16 staff nurses who worked at the bedside in the critical care unit. Charge nurses, nurse managers, nurse educators and clinical nurse specialists were excluded from the sample. After implementation of the CIS, four of the subjects who expressed willingness were interviewed. The research was conducted in a critical care unit of a university medical center located in north-eastern United States. The critical care unit was a ten bed neuro-trauma unit within a hospital certified to provide Level I trauma care. The unit had been in existence for seven years. Approximately 1/2 of the staff were CCRN certified. After approval of the research through the institutional review board and the site initially, the unit nurse manager was contacted and the research project was explained. The nurse manager informed the staff nurses about the study and the subjects were solicited individually on the unit. Nurses who volunteered received an information sheet which indicated they could withdraw at any time from the study without consequences. Questionnaires and interview tapes were handled only by the members of the research team.

Description of the computerized information system

The new CIS implemented in the setting was from EMTEK Health Care Systems, Inc. This point-of-care system has been designed with the critical care clinical environment as the primary emphasis. The system has been installed in approximately 25 other sites across the country and has been contracted for an additional 33 sites.[12] The EMTEK System 2000 has applications for nursing including patient assessment screens, nursing care planning, Kardex/worklist, and charting. Data may be entered directly through the interface between the medical monitoring equipment and the system. Additional data entry is by keyboard, mouse or trackball. There was 24 hour system support every day by phone by the vendor and onsite clinical and engineering system support. The institution had 24 hour system support. Initial orientations to the system were provided to the nurses by the institution. To gain insight about nursing impressions of the EMTEK clinical information system, two interviews were conducted in advance of the study with critical care nurses who had used the system when it

was implemented on another unit. The nurses shared that the CIS streamlined data collection and that short assessments became more comprehensive. They conveyed the ease in reading nurses' notes in typed form. However, some nurses complained of the need for free text typing. It was felt that as more menu screens became available, free text typing time would be reduced. It took about three to four months for the nurses to feel comfortable with the new CIS.

Instruments

The investigators developed the Impact Perception Interview Schedule and local nurse experts reviewed it for importance of content in the questions. It was also analyzed according to findings described by Summers[6] who had done a review of the literature over a 20 year period on nurses' responses to computers and had identified a list of main problem areas. When interviewing, the investigator reviewed with each subject the meaning of direct and indirect care. Table 1 shows the questions asked in the interviews.

Table 1 Impact perception interview schedule

1. About how often do you use the bedside computer system during a shift?
2. When you use the bedside computer system, about how much time is used for entering patient data and how much is used for looking up existing patient data?
3. How is your work different since the availability of a bedside computer system on the unit?
4. How has direct care for patients, that is, when you are in direct contact with the patient or family, been affected since the bedside computer system was installed?
5. How has indirect care for patients, that is, clinical but not direct patient contact activities such as charting or verifying physician orders for the patient, been affected since the bedside computer system was installed?
6. How have other times been affected since the bedside computer system was installed, such as lunch breaks or general business phone calls?
7. How has the bedside computer system enabled you to work better in this information intensive critical care unit?
8. When were you initially oriented to the bedside computer system?
9. How frequently are you updated on the changes of the screens on the bedside computer system?
10. What possibilities exist for you to initiate ideas for any needed changes in the computer screens?
11. What limitations or barriers do you see with the use of bedside computer systems?
12. What additional comments would you like to make regarding the nurse's use of a bedside computer system in a critical care unit?

The investigators developed open-ended questions for individual written responses regarding CISs. Before and after CIS implementation on the unit, subjects were asked the following questions: (1) What do you like most about the current computer system? (2) What do you like least about the current computer system? (3) In general, how do you feel about the introduction of bedside computer systems in the critical care unit? The before situation consisted of a limited computer system used at the nurses station to bring up lab values and for certain clerical functions. The new system would be implemented near the bedside for each patient.

Data analysis

Audiotaped responses to the schedule of interview questions were transcribed and entered into the computer using word processing. The same procedure was used for the set of printed open ended questions. The data then underwent content analysis as described by Miles and Huberman.[13] A coding system was developed that reflected the research question emphasizing perceptions of impact on work. Coding also reflected the theoretical framework for the study which integrated components of General System Theory[14] (system relationships in, through, and out of the system), Change Theory[15] (diagnostic process, barriers, change strategies, and restabilization), and Learning Theory[16] (developmental milestones, person environment interaction, screening, overload, and behavioral change). Commonalities and differences were identified. After a number of readings, the data could be grouped into broad themes. The investigators reviewed each other's groupings and discussed differences eventually arriving at an agreed set of themes.

Results

Summary based on interview questions

Following implementation of the CIS, interviews were conducted (n=4). The CIS was reported to be used frequently during a shift. It was used at least every 2 hours and on some occasions used 20 or more times during a 12 hour shift. Most of the usage was reported for entering data. The actual work was reported to be similar before and after the CIS for the categories of direct, indirect and non patient related activities. In response to the question asking how the CIS enabled the nurse to work better in an information intensive environment, having information in one place, i.e. in the computer, was seen as helpful. Although the complete chart was not computerized, for example the physicians' progress notes and the medication record, the part that was, enabled nurses in their work. The convenience of looking up laboratory reports was particularly noted. In response to this question were also suggestions that installing other databases of clinically relevant information would be useful such as drug facts, information on less common diseases, and norms for laboratory values. For the question asking when the nurse was initially oriented to the CIS, each nurse was oriented at least one month or more before the unit went 'live' with the system. One nurse had been pulled to another unit that already had the system during that time and was oriented then. Nurses reported being updated on changes of the screen in advance and felt they could communicate problems encountered. Limitations or barriers were reported. For example, in trying to determine trends, whereas a paper chart permitted flipping through the pages and gaining a sense of the whole patient quickly, it took time to find the separate computer screens for the patient that would yield the same understanding. Some specific barriers were reported such as having to sign off with each screen being closed took time and when the nurse accompanied the patient off the unit for a scan or other procedure, patient vital signs and other information had to be manually recorded, then entered into the computer upon returning to the unit.This meant duplication.

Written open ended questions

These questions were administered initially prior to the training for the new CIS (n=16). To the question asking what nurses liked most about the current computer system, before the CIS, there were mostly comments about not or rarely using the computer and not being oriented to the system. After the CIS had been implemented, subjects gave much more information such as preferring typing to writing, the readability of everyone's numbers and nursing notes, the idea that data were stored safely, and having patient information at the bedside. To the question asking what nurses like least about the current computer system, before CIS implementation, comments were that the nurse didn't have an orientation yet or

wasn't experienced enough to comment. After CIS implementation comments included the periodic slowness or downtime and signing off each time a screen was closed.

Discussion

Themes

Broad themes were identified as a result of data analysis. The themes of reflection, questioning and action were integrated and they were repeated in an ongoing way. Nurses entered situations, reflected on observations being made and raised a variety of questions as a result. Action or another period of reflection before action, occurred next. The themes related to the concepts of the theoretical framework including system relationships, diagnostic process, barriers, change strategies, restabilization, developmental milestones, person environment interaction, screening, overload, and behavioural change. From the research question was the concept of perceived impact. System relationships, diagnostic process, screening and restabilization could be seen in comments made about emergency situations. Emergency situations were viewed to require team work with sometimes one person entering data on the computer and the other or others being with the patient. Paper code sheets continued to be used during rapidly changing emergency situations. Nurses showed an ability to diagnose the situation and choose from among options the best way of accomplishing work activities under emergency conditions. Barriers such as any problems encountered on the computer required change strategies. Nurses knew strategies such as communicating with the nurse who sat on the technical committee or conferring with the nurses who were more completely trained to use the system, also called the super users. Overload was prevented by using timely change strategies. Person environment interaction was reported in numerous comments such as when nurses needed to accompany patients off the unit. Here the nurse became aware that a different method of recording had to be used because the now accustomed environment with the CIS had changed. Developmental milestones, behavioral change, and perceived impact could be seen through the many comments indicating how much had been learned since the CIS was implemented on the unit.

Future research

This research, while foundational, is in accord with recommendations made by the priority expert panel for nursing informatics formed by the National Center for Nursing Research (NCNR) in conjunction with the development of the National Nursing Research Agenda. The recommendations were that priority should be given to "develop evaluation methods that: a) assure valid and reliable methods in studying the effects of complex information systems on nursing practice; b) measure the contribution of information systems to nurses' clinical decision making; c) measure, if possible, the contribution of information systems to patient outcomes, and d) provide measurable, dependable predictors of nurses' optimal use of automated information systems."[17] The investigators of this research recommend future study addressing the following areas: nursing documentation with emphasis on medications, exploration of handheld devices that could be used to input data such as patient vital signs when nurses take patients off the unit, and the effects of having databases such as drug facts, information on less common diseases, and laboratory norms in the CIS.

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