

F E A T U R E

A R T I C L E


Evaluating the Impact of Computerized Clinical Documentation

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Use of healthcare information systems in hospitals began in the 1960s, primarily to support financial and administrative functions. Vendors then began to develop systems that interfaced with ancillary departments to enable order processing and display of patient results that provided more tangible benefits to clinicians. However, the development of systems to support documentation has generally not met functional requirements for nursing.¹ It was expected that the introduction of computerized documentation systems might improve the efficiency of charting, thus reducing overall time spent documenting. However, the transition from paper to online documentation presents a major challenge within the context of a complex healthcare setting. Despite these constraints, software designed to capture nursing care delivery has grown significantly in the past 5 years, stimulated by patient safety mandates and the realization that nursing must be integrated with pharmacy- and physician-driven systems so as to capture all dimensions of patient care.

BACKGROUND

In the spring of 1999, a 370-bed academic hospital in the western United States began the process of computerizing nurse care planning and documentation. Prior to this, significant time was spent conceptualiz-



A computerized system for care planning and documentation of patient care was initiated at a western teaching hospital, using the framework of Nursing Interventions Classification and Nursing Outcomes Classification standardized languages. The software integrates care planning and documentation, and includes both order entry as well as a charting application. Prior to initiating the project, a study was conducted to evaluate staff attitude toward computerization, time needed for documentation, and comprehensiveness of charting entries. Data from staff surveys, observations, and chart audits conducted pre- and post-computer project implementation demonstrated that the staff attitudes toward computers were less positive, the time required for charting was unchanged, and there were improvements in how completely the nurses documented charting elements.

KEY WORDS

Computerization • Documentation quality •
Documentation time • Nursing attitudes •
Nursing Interventions Classification

ing and planning the nursing leadership's belief that the care plan should be integrated with charting and that use of a standardized language offers the opportunity to define and capture critical elements of care delivery. The standardized languages of Nursing Interventions Classification (NIC)² and Nursing Outcomes Classification (NOC)³ were selected to provide the organizational framework for nurse care planning and documentation.

The technical problem of displaying NIC and NOC in an information system that was not designed to accommodate standardized terminology was first

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addressed. It was decided that the order entry system would be used to construct the care plan and display it both online as well as by printed report. The nurse would assess the patient, determine patient goals using NOC indicators, place NIC interventions as “nursing orders” on the care plan, and use an electronic time-based grid to replace the paper caredex. By using a chart link feature of the care planning grid, nurses could then directly connect to custom-built NIC charting screens so that elements of the care plan would clearly connect to the documentation.

In the spring of 2000, electronic care planning and charting were introduced on a pilot unit. Staff provided feedback after 3 months of use, and as a result the system was redesigned to reduce complexity and increase efficiency. The revised system was implemented on two additional clinical units, which provided the sample for this study. Currently, all medical-surgical units as well as multiple healthcare disciplines use the system to document patient care, with the intensive care units scheduled for start-up in the near future.

LITERATURE REVIEW

Attitudes

The study of nurses' attitudes toward computers began in the late 1960s. Investigators felt that if attitudes were adequately assessed, then implementation strategies could be developed to support nurses who were less willing to accept computerization.⁴ At that time nurses voiced concern that the technology was impersonal and took time away from patients. Numerous studies have examined the importance of nurses' attitudes toward how successfully computers are introduced onto a nursing unit.^{5–19} Study designs ranged from one-time descriptive studies examining demographic variables influencing computer acceptance, to studies comparing users with nonusers, and measurement of attitudes precomputerization and postcomputerization. Descriptive studies attempted to correlate nurse attitudes with such variables as age, educational level, and previous computer experience. However, results are equivocal. Lowry¹¹ and Simpson and Kenrick¹⁴ found age to be a factor in attitudes, while Scarpa et al¹⁰ and Murphy et al¹² found no such correlation. In addition, the entry of education into nursing practice has not been found to be a variable that influences attitudes.^{8–12} The impact of previous experience with computers also showed mixed findings. Positive attitudes associated with prior experience were reported by Krampf and Robinson⁶ and Scarpa et al¹⁰ while Bongartz⁷ and Burkes⁹ demonstrated that nurses with more computer experience had less positive attitudes.

Attitudes pre- and post-computer implementation were studied and contradictory findings were reported.^{12,16,18,19} Prophet et al¹⁶ reported more positive attitudes while Murphy et al¹² and Sleutel¹⁸ reported less positive attitudes. Ammenworth et al¹⁹ studied acceptance of computers in nursing and found increased acceptance scores on three of four study units 9 months postimplementation.

In summary, review of numerous studies spanning almost 20 years shows no consistent demographic variable that identifies those nurses more or less likely to have a positive attitude toward computerization. In addition, no conclusive evidence either from past or recent literature has been found to provide a rationale for attitude changes pre- and post-computer implementation, information that could guide an effective computer implementation strategy.

Documentation Completeness

It is widely recognized that customization of screens and the ability to build charting cues to guide nurses improves the quality of documentation. Many studies^{16,20–24} reported improvement in nurse charting compliance in the postmeasurement time frame, which varied between 3 and 18 months postimplementation. The longer the time interval between implementation and follow-up measurement, the greater the improvement. These studies used either a modified form of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) closed medical record audit tool or a self-developed tool. Documentation improvement (defined by percent of completeness) ranged from 13% to 34%. In conclusion, all studies demonstrated improvement in documentation, with one reporting no initial improvement, although improvement was demonstrated over time with repeated measures.²⁴

Computerized Documentation and Nurses' Time

It is generally believed that improved accuracy and quality of documentation, efficiency in communications, and better accessibility to and retrieval of a patient's data are benefits of clinical information systems. The more difficult question is whether electronic documentation systems improve efficiencies in nursing time. In an early review of evaluation studies of six information systems, Hendrickson and Kovner²⁵ found that computerization only saved time in indirect activities such as organizing and keeping track of orders. No time savings were found in the two systems that examined charting time.

However, more recent studies report a decrease in time spent by nurses when charting by computer as compared,^{15,21,22,26–28} to paper charting, Pabst et al,²² Wong et al,²⁸ and colleagues reported an actual increase in time spent in direct patient care. Kahl et al²⁶ and Smith et al²⁷ even reported a financial savings in overtime and differentials paid.

Methodological Considerations

Evaluation study outcomes can be affected by several significant variables, making it difficult to draw comparisons. First, technical issues such as different types of software and uneven proficiency of users will produce variable results. Other technical factors include the quality of network infrastructure and the extent to which the software has been customized for use at the local site. Second, it is not always apparent what has been evaluated. For example, definition of documentation time often varies, with some researchers including all processes related to data management while others just include input of patient information. In addition, some studies have only measured the documentation of vital signs, assessments, and interventions, while others have included care planning and/or medication administration. Third, measurement issues are influenced by when investigators evaluate the outcome variables. Considerable variation exists as to the timing of postimplementation analysis, with some researchers measuring benefits immediately postimplementation while others wait as long as 18 months.

Other factors that add to the challenge of informatics evaluation include organizational variables such as staffing pattern, changes, unequal acuity, census, and workload issues. It is, therefore, difficult to draw conclusions from these varied study results. Despite these methodological constraints, systems evaluation is still critical to provide information to vendors so that further development and refinement of the software can be realized.

METHODOLOGY

Purpose and Study Questions

The purpose of the study was to determine the impact of online documentation on staff attitudes, completeness of documentation, and the time needed for documentation. The specific research questions were formulated as follows:

1. What is the difference in nurse scores on the Nurses' Attitude Toward Computerization questionnaire pre- and post-computer implementation?

2. What is the difference in charting time requirements pre- and post-computer implementation?
3. Is charting more complete postcomputerization?

Methods

A quasi-experimental design was used to answer each research question, with data collection occurring both precomputerization and postcomputerization. Each question generated different samples and data collection methods, which will be described by section. The study was reviewed and approved by the appropriate institutional review boards.

NURSE ATTITUDES

Survey Tool. Nurses' attitudes toward a computerized system were measured using the Stronge and Brodt Nurses' Attitudes Toward Computerization⁴ questionnaire, consisting of a 20-item, Likert-type 1 to 5 rating scale, with a total score range of 20 to 100, with a higher score indicating a more positive attitude. Questions are organized into five domains: patient care, benefit to institution, job threat, legal aspects, and capabilities of computers. The authors reported a split-half reliability quotient of $r = 0.90$ as a measure of internal consistency. Subsequent studies by other researchers^{10,29} have found the instrument to be reliable with Cronbach's α of .92 and .93, respectively.

Sample. A convenience sample of 46 registered nurses (RNs) employed on a 26-bed orthopedic and neuroscience unit and an 18-bed pulmonary unit participated in the study. Surveys were distributed to staff on the two study units 1 month prior to computerization, then 1 year post-computer project implementation. Demographics on nurse subjects were collected as part of the data procedures. There was no attempt to match the presamples and postsamples.

CHARTING TIME REQUIREMENTS

Observation Tool. Documentation time of nursing care was measured by observations using an investigator-developed tool. The observation measure was piloted and validated for 10 selected activities that nurses frequently perform while delivering care. These activities included medication preparation and administration; direct patient interaction; information review, including paper and computer; communication with other care team members; documentation; and personal breaks. *Documentation* was defined as charting patient care either on the paper nursing flow sheet, or electronically using NIC screens.

Sample. Observations were conducted on a convenience sample of 82 RNs for 2-hour time periods. The time periods were purposely chosen to reflect likely documentation times. Data were collected by trained observers who had interrater reliability verified to ensure consistency of observations. Data elements included time of day, type of nursing activity, and the location of that activity. Observation time periods were matched precomputerization and postcomputerization for day of week and time of day. The observations were completed between 1 and 4 months precomputerization and 1 year post-project implementation. Observation times were totaled for each activity, then aggregated to obtain preobservation and postobservation time/averages by minutes for each activity.

COMPLETENESS OF DOCUMENTATION

Documentation completeness was determined by the presence or absence of 89 patient care elements contained within eight core NIC interventions. Core NIC interventions are those that are applicable to all patients, and include pain, falls, physical assessment, skin assessment, discharge planning, vital signs, hygiene, and teaching. For both the preaudits and postaudits, a stratified sampling method was used, selecting every fourth patient from a 31-day list of discharges by a diagnosis-related group for each unit. The pre-chart audit was performed approximately 1 month prior to going live, and the post-chart audit was conducted in the same month, approximately 11 months postcomputerization. The purpose of the audit was to determine the documented presence or absence of each patient care element within the eight core nursing interventions.

Data Analysis

Standard descriptive and comparative statistics were used to analyze the data. Tests of significance, including analysis of variance, Student *t* tests, and Pearson product moment correlations, were used to test differences and correlations between variables. Alpha was set at .05. Nursing units were identified by the letters A and B to preserve confidentiality.

RESULTS

Nursing Attitudes

Twenty-six RNs completed the preimplementation survey representing a 58% response rate, and 35 surveys were returned postimplementation representing a 78%

response rate. The majority of RNs had worked in nursing between 1 and 5 years, were between 20 and 30 years of age, female, BSN-prepared, and had variable experience with computers. No significant demographic differences were found between the preimplementation and postimplementation respondents. Cronbach's α for this sample was .916.

There were statistically significant differences ($P = .004$) in nurses' attitudes toward computerized documentation between the pre- and post-project implementation groups. Nurses had more negative attitudes postcomputerization, as evidenced by a decline in mean attitude score from 70.7 to 61.4 (Figure 1). Of the five domains of the instrument, the greatest declines in the attitudes were in the domains of patient care and capabilities of computers, while the domains of benefit to institution, job threat, and legal aspects were not significant. The most significant decrease in scores was seen in the following survey statements:

- Computers make nurses' jobs easier ($P \leq .001$).
- Computers save steps and allow nursing staff to become more efficient ($P = .002$).
- Increased computer usage will allow nurses more time for patient care ($P = .002$).
- A computer increases costs by increasing the nurse's workload ($P = .002$).

Completeness of Documentation

Sixty charts were audited before computerization, and 81 audited postproject. Eight NIC categories were reviewed containing 81 documentation elements. Of these 81 data points, 28 or 34% were significantly more complete postcomputerization. These were pain assessment, safety surveillance, teaching, skin surveillance, neurological assessment, and discharge planning. There were 49 (60%) unchanged data points, and five (5%) that were less complete. The items less complete were pain reassessment, MD notification of pain outcomes, and

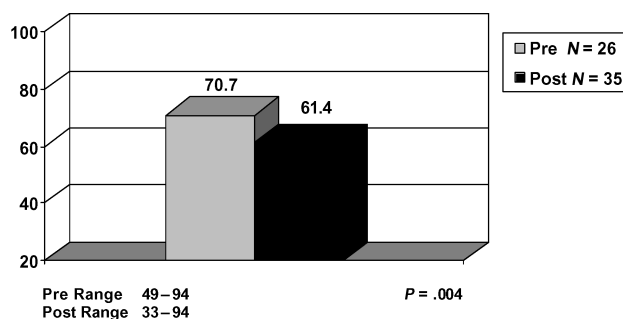


FIGURE 1. RN attitude toward computers survey: computerization pre- and postcomputerization scores.

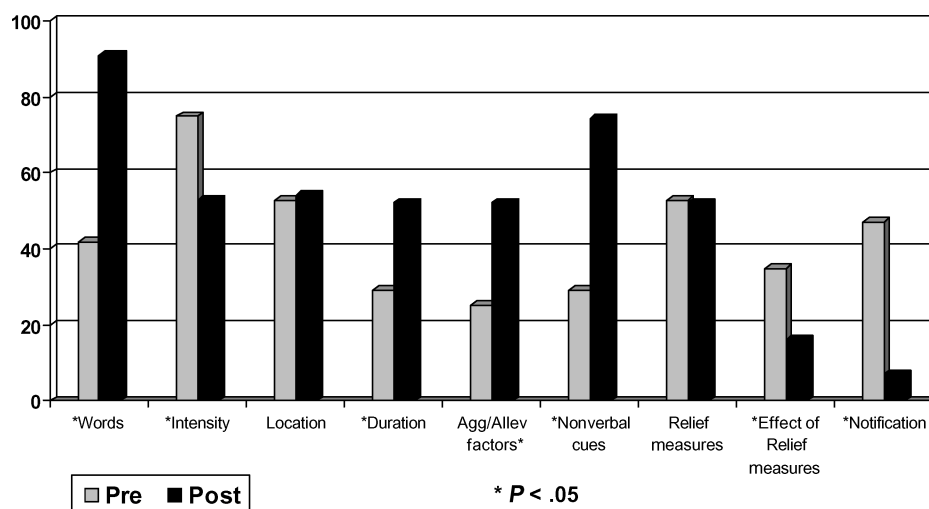


FIGURE 2. Completeness of documentation: Pre/post pain management category.

neurological assessment elements of gait, skin, and diaphoresis. A sample of results for one NIC intervention, pain management, is illustrated in Figure 2.

Documentation Time

The time nurses spent charting, measured in minutes, showed no statistical change from precomputerization to postcomputerization (25.1 minutes and 30.2 minutes, respectively). While the activity of direct patient care decreased from 40.4 minutes precomputerization to 35.5 minutes postcomputerization, this was not a significant finding ($P = .15$). There was however a significant difference ($P = .002$) between overall time taken to chart between the two study units. Nurses on the pulmonary unit took longer to chart than nurses on the orthopedic/neuroscience unit, both precomputerization and postcomputerization.

DISCUSSION

When considering the results of this study, it is helpful to first understand the extent of the changes experienced by nurses on the study units during implementation and postimplementation. The goal had been to introduce a framework for practice using standardized language as well as to build a tool for documentation that would manage and connect care planning with documentation. Since NIC was used as the organizing framework, the nurses first had to move from a task- and systems-oriented care plan to one more focused on patient problems and subsequent interventions. This required additional education and a longer learning curve than if we had merely replicated the paper system.

For example, documentation related to the care of a patient with a chest tube was previously placed on the flow sheet in the respiratory category as well as on a separate teaching form. Using NIC now required the RN to conceptualize the intervention as a whole by selecting the NIC intervention: Tube Care: Chest, placing it on the care plan, then documenting all related nursing activities, including assessment, care of the tube, and patient teaching in one place. In addition, a software feature was used that required an NIC intervention to be placed on the care plan before documentation screens became available, with the goal of increasing awareness and accuracy of the care plan. As a result of these changes, the plan and subsequent documentation were clearly connected and previous fragmentation was reduced. However, these changes created more challenges for RNs making the transition from paper to computer.

The authors found it difficult at first to distinguish the actual source of the staff's frustration as reflected in their postcomputerization attitude scores. It was important to know if negative attitudes were related to the technical system or to the introduction of a new framework for practice using NIC. A focus group of staff nurses was convened, and through this forum nurses shared that although NIC provided challenges, greater dissatisfaction was related to poor system navigability, lack of automatic prompts, slow system response, and lack of an efficient way to view the overall picture of patient progress and care. This was further substantiated by the fact that the majority of statements in the attitude survey that showed the most significant decrease in score were related to the capabilities of the computers.

Finding a less positive attitude toward computers postcomputerization was disappointing but was still valuable because the feedback has been used to continually

improve and refine the technical system, as well as to develop more effective implementation strategies. These results helped focus on those areas of concern reported by nurse users relating to efficiency and increased workload. Darbyshire³⁰ conducted a qualitative study to determine the experience of nurses using a computer system in everyday practice and reported similar findings. His results demonstrated the gap between the nurse's expectation of a computer information system and the reality. Some of the staff nurse criticisms included lack of availability of devices, cumbersome access and navigability of the software, and overall failure to enhance efficiency in nurses' everyday work.

More encouraging were the findings that time spent charting electronically was not significantly longer compared with time spent charting by paper. In addition, utilizing the software in a way that electronically and conceptually connects the care plan with subsequent charting has provided improved function and meaning for the care planning process. Nurses initially begin with a care plan prebuilt for specific patient problems and diagnoses, then individualize and customize the plan to meet individual needs, including core nursing activities such as pain management, fall risk assessment, skin surveillance, and patient education. The potential for more complete documentation has increased due to the customized screens developed for each NIC that includes key nursing activities for the intervention. Charting screens provide cues and prompts for the nurse following a standard format that includes elements of assessment, patient care, communication, and teaching. This was one of the most striking benefits of utilizing NIC as an organizing framework for practice and may explain why there was a significant improvement with mandatory documentation requirements in five of the eight charting categories that were investigated.

CONCLUSION

The major findings in this study were a significant decrease in attitude scores postcomputerization, no significant change in time spent charting, and significant improvement in the quality of nursing documentation. These results reflect the challenge and benefits of introducing nurses to a new framework for practice, and a technical system that does not support workflow as efficiently as the patient care process demands. Hopefully, as software evolves, making system design and implementation easier with enhanced nurse- and patient-focused features such as Web-enabled resources and greater overall efficiency, nurses will realize more benefit from computerized information systems.

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I wish to thank the authors for conducting this important study and sparking such controversy. In addition to controversy, I hope this sparks the incorporation of evaluation into CPOE projects for ongoing measurement of outcomes. More studies are needed to provide evidence on what works, and what does not, so that we have a stronger knowledge base to guide our practice as nurse informaticists.

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