Nursing Informatics
U. Gerdin et al. (Eds.)
IOS Press 1997

Development of a Computerized Database for a Nursing Quality Management Program

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There has been little study on how nurse managers collect, store, process and retrieve quality management data, yet nearly every nursing department has an existing program to provide these functions. We investigated our current paper-based system and found several deficiencies. Guided by structured interviews, task analysis, and focus groups we developed a networked computerized quality management database to provide more timely data reporting and consistency of analysis. This paper describes the development and implementation of the system with discussion on how it will be evaluated in the future.

Introduction

The University of North Carolina Hospitals Department of Nursing has developed an ongoing quality management program based on several risk management screens such as patient falls, skin breakdown, and medication errors. Separate paper-based data collection forms are completed after each event and nurse managers are responsible for: investigating the event; analyzing these data for trends or patterns; reporting findings; and documenting management actions and follow up.

In the Spring of 1996, a task force was formed to address an increase in the number of patient falls during the previous year at our hospital. The team examined existing data collection and reporting mechanisms used in the Falls Continuous Quality Improvement (CQI) Program and found several problems:

- often there was a time delay of several weeks or months in getting information about an incident to the appropriate nurse manager;
- a lack of consistent data collection and reporting formats across nursing units prevented comparison of trends or patterns within the department;
- a further lack of consistency in documenting management action plans diminished the usefulness of these data.

On further review, these problems were identified across all risk management screens and several solutions were recommended by the Task Force:[1]

- develop a common set of data collection tools, reports, and graphics;
- devise a common method for recording nurse manager findings, actions, and evaluations of previous -interventions;
- place these tools within a common conceptual model and deploy the tools across all services using a computerized database and local area network (LAN).

Literature review

A starting point for developing a database system for quality management in nursing is a definition of quality. One seminal writer on the subject, and a major influence on the Japanese

quality improvement efforts of the 1960's and 70's is Joseph Juran. He defines quality as "fitness for use".[2] Expanding on this, Juran argues that quality is products or services that meet a particular need and are free from deficiencies. Since any product or service is an output of a process and a component of a system, quality can be defined as an attribute of a system.

Putting quality management within a wider systems framework is helpful. We can view nursing as part of a complex system of health care. Each component of the nursing system must be viable in order to maintain a certain standard of care. In this sense, quality is the adequacy of the information and control mechanisms to regulate patient care within specific norms. Barnum suggests that nursing management control is made of two mechanisms - feedback and adjustment, and these act in a cybernetic fashion.[3] One of the primary concepts of a cybernetic system is maintenance of internal stability or homeostasis through real-time interaction of information and control. Beer has written extensively in this area and suggests that deviation dampening mechanisms provide a way for the system, whether biological or organizational, to self-regulate.[4-6] For example, the human body regulates temperature through homeostatic actions such as redistribution of blood flow, sweating or shivering. A nursing system would maintain a similar steady-state through other homeostatic mechanisms. For example, deficiencies in care - as Juran describes as an indicator of quality, could be the rate of patient falls on a particular nursing ward. Clinical staff and nurse managers continuously scan the environment for falls (information component) and provide corrective action (control component) to maintain a minimum level or acceptable rate of falls. The key point is that nursing care would not be viable if a high percentage of patients fell or received a high rate of serious injury of death as a result of falls on the ward.

Another important cybernetic concept is the time transaction between information and control within the system. Time lags for receiving critical data can cause system instability, oscillation, or demise.[7] Therefore the real-time relationship between these two concepts to provide optimum self-regulation is an import dimension of the theory. It is also our focus in developing new ways to optimize information flow of quality management data at our institution.

A third perspective used to guide conceptualization and development of the database program draws from the work of Graves & Corcoran.[8,9] These authors use an informatics approach to conceptualizing nursing information systems and argue that data exists at an *atomic level* and interpreting, structuring or organizing these atomic level data leads to information. Information that is synthesized leads to knowledge (*Figure 1*). Within our existing paper-based quality program, these transformations are noted but are fragmented and not comparable across units. We hope that moving to a computerized system will facilitate the processing of common atomic level data across the department and lead to better information and knowledge about the nursing care administered in our institution.

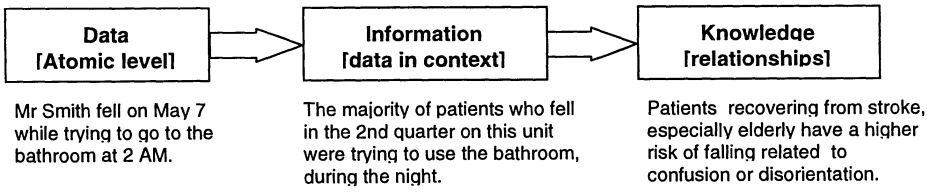

Figure 1. Informatics Concepts

Method

An exploratory method consisting of structured interviews and focus groups was used to guide development of the database. Six nurse managers representing critical care, surgery, and psychiatric services were selected for interviews and a focus group consisting of nurse managers in critical care (N = 7) and the service coordinator were used for feedback during the design process. A second focus group consisting of members of the Falls CQI Team (N=5) also gave pertinent feedback on data content, screen layout and reports. This team consisted of nurse managers from each patient care service in the hospital. Nurses participating in the study had been in their management positions for approximately two to ten years and all were familiar with the current paper-base CQI system at the hospital.

The goal of the interviews was to explore the current methods used by nurse managers to collect, review, interpret, report, and act on nursing quality data. Interviews were conducted individually in one to two hours sessions. A consistent set of questions were used: what method do you use to review, interpret and report quality data in your unit; how do you detect significant patterns or trends from these data; what are the barriers and hindrances of the current paper-based system; and what features would be valued in a redesigned, computerized quality database. The second part of the interview simulated a mock quarterly report session and from this, a task analysis was generated to guide software development. Interviews were conducted during the summer of 1996 and the database prototype was developed in the following months. The critical care focus group and Falls CQI Team reviewed the prototype and provided feedback during formal and informal meetings during the design process.

Results

The interviews confirmed many of the problems identified by the task force. Nurse managers were generally displeased with the time lag in receiving data. The greatest impact on their practice was that they found it difficult to remember or investigate a specific incident several weeks or months past. The participants also agreed that the lack of consistency of how quality data are collected and reported diminished the value of these data since unit performance could not be compared across services.

Other stated issues included: inability to review data in different time periods such as comparison of one quarter to a similar quarter in a prior year; time consuming and potentially inaccurate hand calculation of rate indices such as the falls rate index (falls per 1000 patient days); potential for duplication of data; inability to share data interpretations and management strategies across services (action plans); and difficulty in gathering supporting data such as unit statistics and elements of the medical record during data review.

The mock quarterly report revealed that the nurse managers used a consistent approach for analyzing the CQI data. The process was to gather all original data collection sheets for the period and review them individually. The nurse managers then looked for sentinel events and significant patterns not immediately evident. Several managers stressed the importance of knowing their unit and personnel. This indicated that there was critical data collected by nurse managers in their environment that could not be readily collected in the database.

Based on the interviews and review of the existing paper-base Nursing CQI Program, a prototype electronic database was developed in Microsoft Access®. Several design strategies were used: keep the interface simple and consistent; provide flexibility in choosing nursing ward and date delimiters for reports and data viewing; maintain security and confidentiality through password protection, logging, and automatic shutdown after inactivity; and

implement a multi-user capability that could be deployed using the existing hospital LAN. Each paper-based data collection form was emulated in the computer and common elements were used across risk screens such as: patient and unit demographics, date and time of event, and a brief description of the event. These core date elements will be used to generate a wide range of reports, graphics, and statistical analyses at the unit, service, and department level. In addition to the core dataset, each risk screen has a set of data elements appropriate for that particular event. For falls, this includes data about the location of the fall, patient activity during fall, environmental factors, injury status, admission assessment for falls risk, nursing documentation, management follow up, and some miscellaneous data elements.

Program flow emulated, as much as possible, the strategies identified during the interviews (*Figure 2*). Screen mock ups and reports were produced using "dummy" data. Changes to the database were made in an iterative manner using feedback from the focus group and CQI team. The database was also reviewed by service coordinators and senior nurse executives. This has helped to cultivate broad acceptance from all potential users of the system. The program will be implemented during 1997 and results of the implementation are forthcoming.

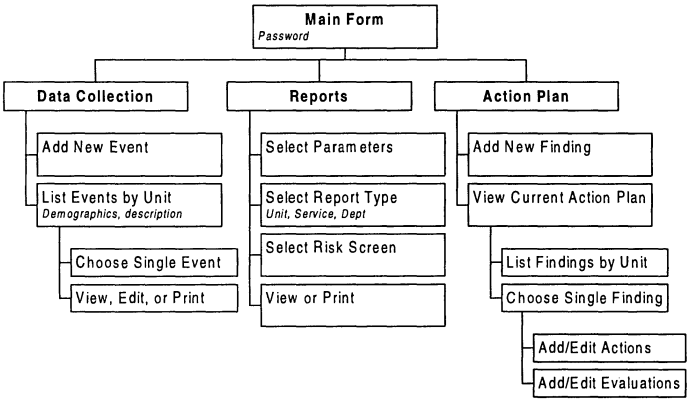

Figure 2. Overview of Program Flow

Discussion

We identified the deficiencies of our existing paper-base quality management program and proposed a computerized alternative based on concepts drawn from literature and results of interviews with nurse managers. A common method was identified in how nurse managers approach and review quality data but submitted reports and action plans varied across different nursing services. This discordance was noted to be a primary source of inadequacy of the existing quality management program. Our solution was to develop a common dataset using a relational database.

The contribution of cybernetics to the database design is noteworthy. The effectiveness of regulation in a complex system is related to how well elements of information and control interact. We hypothesize that the proposed computerized database will enhance regulation of the nursing system by providing information in a more timely manner and that this will allow nurse managers to promptly act on deviations from acceptable care standards. Ultimately this will lead to improved patient care. We expect to see the following measurable benefits:

Potential Benefits of a Computerized Database for Quality Management
enhanced usability and timeliness of data;

- improved documentation and increased consistency of reports and analyses across all nursing units;
- reduction in redundancy of collected data and reports;
- improved time utilization for nurse managers;
- sharing of data across nursing services.

The distinction between quality control and quality improvement should also be explored. Within a cybernetic framework, quality control is similar to homeostasis where the goal is to maintain system stability or self-regulation. Quality improvement deals with moving the current steady state of the system to a new set point. Within cybernetics, this is system adaptation. For example, a nursing unit may have a steady rate of falls but a new goal of a lower rate may be imposed that requires a different set of management and nursing interventions. The proposed database can assist both quality control through monitoring existing care or quality improvement by showing the effects and rate of change of new interventions.

A limitation of this study is the small sample and exploratory design therefore results are difficult to generalize beyond our institution. We suspect that similar methods for collecting and analyzing nursing quality data exist in other settings but there is no research to confirm or refute this. The model we propose may be adequate for organizing quality data in other hospital nursing departments but has not been tested in other settings.

The other unanswered question is how will nurse managers adapt to the new electronic medium? The benefits of computerization are tangible but the efficacy of the program is based in part on end-users' perception. Nurse manager and nurse executive acceptance and utilization of the proposed program is unknown. Several research questions will be explored during and post implementation: how will the system perform in a multi-user environment; will end users be more satisfied with the computerized database over traditional paper-based methods; will the system improve time efficiency for nurse managers; will the system provide better information flow; and overall, can the system improve practice by decreasing time intervals between information presentation and action by nurse managers?

Conclusion

We have identified the limitations of our existing paper-based quality management program and proposed a hospital-wide computerized database as an alternative strategy. The program's specific aim is to improve management practice by developing a consistent approach to collecting, storing, and processing nursing quality management data. We expect to see measurable improvements in the quality management program as well as better information flow of quality data within our hospital. Further study of the effectiveness of this system is planned.

In a larger context, does moving towards a consistent data architecture allow aggregation of data across different nursing settings and will this provide a valid comparison of nursing unit performance? Marks found that the current range of nursing quality management programs are inconsistent and incomparable across hospitals.[10] Yet no concordant structure has been reported in the literature to date. As Grobe has noted, only agreement on data standards and definitions will allow for such comparison.[11] We hope that a design similar to the one we

propose will facilitate discussion on a method to compare nursing care quality across varied settings and guide us towards best practices.

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