A Qualitative Comparison of Paper Flowsheets vs A Computer-Based Clinical Information System*

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Demonstrating the value of computerized clinical information systems (CIS) relative to its cost has been difficult. Decreased mortality in the intensive care unit or a reduction in nursing staff have not been apparent, but CIS does lead to a significant improvement in documentation over handwritten flowsheets, both in volume and accuracy. This may have a medicolegal and quality assurance impact, as well as enhancing patient care. (Chest 1991; 99:155-57)

CIS = clinical information system; FTE = full-time equivalent; SDU = step-down unit; ICU = intensive care unit; I&O = intake and output; CBC = complete blood cell count; ABG = arterial blood gas

Since the development of the concept of intensive care units (ICU) and postanesthesia recovery rooms to enhance the care of the critically ill or unstable patients, methods to collate and present large volumes of information have also evolved. Flowsheets were found to be useful because they enhance accuracy and legibility, are helpful to display ongoing and serial data collections, and, by their very structure, act as templates to assist nursing assessment. The same advantages have been attributed to computerized clinical information systems (CIS) as well. However, despite mounting clinical evidence since the mid-1970s for the clinical efficacy of CIS, establishing its value relative to its cost has been difficult.

Prohibitively large numbers of patients would be needed to demonstrate that CIS decreases mortality. For example, Hilberman et al² calculated that their cardiopulmonary unit would need 6,000 patients to demonstrate a 10 percent decrease in mortality from the existing 16 percent rate. Multiple authors³ have demonstrated that, while nurses are the main users of CIS, and computerization leads to a decrease in nonnursing clerical work required of the nurse, this does not translate into a decrease in full-time equivalents (FTE). The economic advantages of CIS, as viewed by a finance-conscious medical administration, therefore, would appear to be in the improvement in patient care as a result of increased documentation and accuracy, and in the coordination with hospital information systems to enhance billing and collecting.

Unfortunately, too often these systems are judged by their ability to improve the latter stated financial aspects of hospital care, namely, enhancing billing and collecting. The CIS, however, is primarily designed to improve collection, organization, and retrieval of a single patient's data. It should, therefore, be judged on those terms. Because of an episode of software failure that rendered our CIS inoperative for four days, we had the opportunity to explore the value of CIS over handwritten flowsheets to improve the volume and quality of documentation.

METHODS

The University of Miami/Jackson Memorial Hospital Burn Center is a 23-bed facility consisting of a five-bed ICU and an 18-bed step-down unit (SDU). Approximately 300 patients per year are admitted to the center and remain in either the ICU or SDU until hospital discharge. The ICU is serviced by five CIS video terminals, one per bed, and three full ASCII terminals located in the ICU nursing station, the adjacent computer room, and rehabilitation therapy room. The SDU has three ASCII terminals located at the nurses' station and hallway.

Vital signs data are automatically continuously captured by the CIS; the nurse periodically validates the entry according to physician order. All progress notes and procedure notes, including physician, nursing, rehabilitation, social service, and dietitian, are entered either freehand or menu-assisted. The CIS hard-copy is the patient record. The only information not directly entered onto and stored in the computer currently involves physician orders and a laboratory link (both planned), data from the emergency and operating rooms, and notes written by outside consultants. Our CIS, currently a Hewlett-Packard Patient Data Management System, has been in operation since 1986. Periodically, during times of routine maintenance or program configuration, the nurses use handwritten flowsheets for data collection during CIS "down" time. All nurses in our unit are fully oriented to both flowsheet and CIS use prior to the end of a probationary period. No "float" or part-time nurses are used.

In May 1989, a software-related failure secondary to a hospital power failure resulted in loss of CIS capability for four days. We

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used this opportunity to study volume, completeness, and accuracy of data entry for CIS vs handwritten flowsheets. The four-day period of flowsheet use was compared with the three days preceding and three days following CIS shutdown. It was assumed that nursing practices would remain the same and physician orders would not be altered by the change in documentation mode. It was also taken as an assumption that all CIS notes and entries would be, by definition, legible and that intake and output (I&O) calculations would be accurate. Vital sign and medication entry via CIS can also be assumed to be fully compliant, either due to menu entry prompting or configuration that does not allow incomplete data entry.

Since previous studies in our unit and elsewhere demonstrated that the nurse is the focal point of any CIS, contributing more than 80 percent of data entry and usage, we elected to concentrate on nursing functions. The absolute number of nursing progress notes per 12-hour shift was recorded, and a subjective evaluation by two observers as to legibility was made. No attempt was made to judge content. Accuracy parameters were judged in four areas: vital signs, I&O, medications, and laboratory values (Table 1).

Five patients, two from the ICU and three from the SDU, requiring intravenous fluid and medications for at least the three days prior to and three days after the incident formed the study group. This comprised 100 12-hour nursing shifts.

RESULTS

In the ICU, the number of CIS progress notes was 13 times greater than flowsheet notes and four times more often than in the SDU (Table 2). Instead of entering observations as events occurred, nurses using the flowsheet tended to write a summary note at the end of the shift based on recollection or cribbed notes. This practice has been shown to increase overtime costs. In addition, legibility was subjectively poor and unreadable on parts of the handwritten flowsheets for 16 of the 40 nurses’ shifts. Nine (25 percent) of 36 progress notes were found to be illegible.

Vital signs recording errors, most often omission of the route of temperature measurement, was found in nine of 40 nursing shifts (Table 3). The I&O errors, most frequently arithmetic errors, were found in one quarter of the nursing shifts. Medication documentation errors, which included not recording the route of drug administration, time given, or dose, were found in nine of 40 nursing shifts and involved nearly 2 percent of all drugs administered. No I&O or medication error was noted on the CIS records. Laboratory data recording practices were evaluated for two common laboratory studies: arterial blood gases (ABG) and complete blood cell count (CBC). Of the 15 ABGs sent, 14 were recorded on the flowsheet and recorded accurately. Only ten of 19 CBCs were recorded, although all were transcribed accurately. This discrepancy may reflect the more urgent value of the ABG values as perceived by the nurse.

DISCUSSION

Human error in the ICU is not uncommon, and it is indeed more prevalent than equipment error. Shulman and coworkers noted 180 errors in three months in a six-bed ICU. Of these, 41 percent were in drug charting or administration, and 31 percent were in non-drug-related charting or relay of information between shifts. Twenty-two of these 180 human errors directly led to clinical deterioration of the patient. Girotti and others documented 102 medication errors in 16 days in a 15-bed ICU, a frequency rate of 2.2 percent. Thirty-one percent of these errors were omitted doses, although it is not clear whether the doses were omitted, or given but not charted.

These types of documentation errors noted by ourselves and others have important clinical implications. Clinical observation of the patient is used by the physician to make treatment decisions only one fifth of the time. Laboratory data, drug and fluid balance data, and monitored data are far more frequently used in an ICU for treatment decision making. At least one study has suggested that timely
access to information as provided by CIS may lead to decreased ICU length of stay. Thus, the accuracy of these data is essential.

Moreover, the patient chart must be considered a medicolegal document. As such, if data are not charted, it can then be assumed that it was not done. This then implies that the clinical team was deficient in patient care. However, if increased charting is deemed desirable, then this may result in increased clerical needs by the clinical team above those already required. A potential advantage of CIS can be seen in its improvement of documentation practices, enhanced accuracy, and decrease in clerical nursing function. In other words, more and better documentation is accomplished in less time.

In summary, this study documents that errors occur at least once in 25 percent of handwritten flowsheet records for each 12-hour nursing shift. These errors include arithmetic errors, data omission, and legibility errors. Such errors can be eliminated with the use of a computerized CIS, which has medicolegal implications.

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