Medical Information Bus usage for automated IV Pump data acquisition: Evaluation of usage patterns

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Accepted 5 May 1997

Key words: automation, infusion pump, automatic data processing, communication, computerized patient record

Abstract

Objective: To identify factors which influence the choice of nurses to use automated collection of IV pump data from a prototype Medical Information Bus. Design: Observational study for a duration of three and one-half months. Setting: Four intensive care units, each with different missions, in an adult hospital. Subjects: One hundred fifty-eight registered nurses including both full and part time. Measurements and Main Results: Data were collected from the hospital information system about infusion orders including the type of medication, the number of rate changes, the method of documenting rate changes and the infusion methods. The method of documentation for infusion rate changes was defined as either automated, using a prototype Medical Information Bus (MIB), or manual, using the keyboard at a bedside computer terminal. The method of infusion was defined as either straight gravity feed without an IV pump (‘no pump’), infusion using a pump but without connection to the hospital information system (‘pump only’) and infusion using a pump which was connected to the hospital information system using a prototype Medical Information Bus (‘automated’). A total of 22,199 rate changes were documented during the study period and of those, 22,055 (99.35%) used the ‘automated’ method. Medications with the highest average rate change per single container were; Nitroprusside Sodium (9.50), Epinephrine (9.08) and Epoprostenol (7.50). Conclusions: The nurses used automated IV pump data acquisition with medications which required frequent rate changes.

Introduction

Providing optimum health care requires the availability of accurate, complete and timely information [1, 2]. Nowhere is the need for timeliness more important than in an intensive care unit (ICU) where the survival of critically ill patients requires that appropriate interventions be performed within minutes. Automated data acquisition has the potential to improve the health care process by providing data collection capabilities that were previously unattainable. It is for this reason that researcher investigators and clinical engineers at LDS Hospital began development of a prototype Medical Information Bus (MIB) in 1986 [3]. Initially the prototype MIB was used on an experimental basis to collect data from infusion pumps, but it soon became part of routine care and was later extended to other medical devices [4, 5]. Recently, a MIB standard has been adopted by the Institute for Electrical and Electronic Engineers (IEEE 1073 MIB) which defines both the hardware and software configuration for linking medical devices to a computerized information system [6–10].

Informal interviews with clinical engineers and nurses indicated that the MIB was valuable because of the ability to automatically document IV pump flow. These same interviews found that nurses felt that automated data collection using the MIB saved them charting time, especially with infusion medications requiring frequent rate changes. Automated collection of IV pump data using the MIB has existed at LDS Hospital since 1987, however no study to date has identified why the nurses use the MIB in some cases and not in others. The goal of this study was to identify factors which influence the nurses choice to use automated collection of IV pump data.
Materials and Methods

The study was conducted from mid December 1995 through March of 1996 in four adult ICUs at LDS Hospital in Salt Lake City, Utah. LDS Hospital is a 520-bed tertiary care center with 60 adult ICU beds: Shock-Trauma Respiratory ICU (STRI), (12 beds), a Medical-Surgical ICU (MICU), (16 beds), Coronary Care Unit (CCU), (16 beds), and the Thoracic ICU (TICU), (16 beds). Each of the ICU’s has a specific mission serving patients with specific conditions. The nursing staff varied from 35 in the CCU to 52 in the TICU and was made up entirely of Registered Nurses (RN), of which about 80% were full time. Nursing shifts are 12 hours, from 7 A.M. to 7 P.M. with staffing varying from 5 to 10 nurses per unit per shift, depending on the occupancy and unit size. Generally, each nurse cares for one or two patients. The four units are managed by two full time Nurse Managers, one for CCU and TICU, one for STRI and MICU.

Each ICU has a specific mission and patient population. The STRI receives the ‘sickest of the sick’ patients. These patients usually present with single or multi-system respiratory, medical, trauma or neurological disorders. The unit also receives liver and kidney transplant patients. There are permanent house staff and physician intensivists assigned to the unit 24 hours a day. The MICU receives patients similar to STRI, but with less severity. About 30% of the MICU patients come from the STRI and 70% from the operating room or the emergency room. The CCU receives medical cardiac patients such as myocardial infarctions, arrhythmia’s, cardiomyopathies, heart failures, etc. The TICU provides critical care to patients who are post thoracic surgery or vascular surgery, such as, coronary artery bypass, heart transplants, abdominal aortic aneurysm, and valve replacements.

To assess how the nurses used automated data collection with IV pumps, several programs were written to extract data from the hospital information system, known as the HELP system [11, 12]. The HELP system is a computerized patient record system which includes a module for medication charting. Data were collected regarding the medication infused, the method of infusion and the number of rate changes per container of medication. The data collection programs were run once a day and the information was stored into a daily file. Analysis was performed by reading the daily files into a spreadsheet program. The study lasted three and one-half months and contained information documented by 158 nurses including 9,644 containers of medication infused and 22,199 infusion rate changes.

For the purposes of this study, the method of infusion was broken into three categories. The first category, ‘no pump’ were those medications in which the infusion rate was controlled by a manually adjusted roller clamp and rates were calculated in drops per minute and converted to milliliters per hour. In this case, documenting the infusion rate for the medication was done by manual entry through a keyboard at the bedside computer workstation. The second category, ‘pump only’ were infusions that were controlled by an infusion pump, but the pump had no MIB communication link to the HELP system. Again, as in the ‘no pump’ case, documenting the infusion rate was done as manual keyboard entry. The third category, ‘automated’ were those infusions which were controlled by an infusion pump and the pump communicated with the HELP system through the MIB. In this case, rate changes were automatically sent to the HELP system without requiring manual keyboard entry.

The prototype MIB is the system used at LDS Hospital for automated collection of infusion pump data. It is enabled through the computerized medication charting module on the HELP system. The prototype MIB is a high speed serial communication link running at 375 K bits/sec and when connected, an infusion pump communicated with the HELP system through the MIB. Once connected, an infusion pump provided information such as the infusion rate, total volume infused and any other information provided by the manufacturer through the remote communications port. At the moment, the MIB is only used for IV pump data acquisition, not control.

Results

A total of 22,199 infusion rate changes were documented in all units during the three and one-half month study period. Table 1 shows the frequency of rate changes for