Anesthesia information management systems

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Documentation is the last component of anesthesia patient management to be affected by technology. Anesthesia information management systems (AIMS) have been introduced in a limited number of practice sites. The automated systems provide unbiased reporting of most patient information. This results in improved patient care and possible medical legal advantages. AIMS also allow anesthesia departments to monitor their business related activity.

Key words: **Automated, database, documentation, information management, vendor.**

Over the past 2 decades, there have been significant advances in the management of surgical patients during their perioperative experience. Most of these improvements occurred with the introduction of pharmacological agents that have better pharmacokinetic and pharmacodynamic profiles. Additionally, patient monitoring has improved through the introduction of new modalities as well as the refinement of those that have existed in previous years.

Information management and documentation is one area that has not historically changed significantly. An example of this can be seen in the fact that only 1% of anesthesia departments in 1998 used automated documentation of patient activity in the operating room.[1] Now that automation is invading healthcare, it can be speculated that the use of automated anesthesia records has increased since 1998 and that this trend will continue over the next decade. Because of this, it is important that nurse anesthetists become knowledgeable of anesthesia information management systems (AIMS).

The primary function of AIMS is to collect and present patient data in a digital format. This data placed into the AIMS is used primarily in real time to facilitate the anesthesia management of patients. The data that is put into the AIMS can come from the provider or external devices that are used in the management of patients. The AIMS can possess internal functions that can facilitate the immediate care of patients. Listed below are some examples of the functions:

- Alarms for abnormal input data,
- Provider reminder (eg, drug dosing interval or urine output summations),
- Provider information (eg, drug interactions),
- Research protocols, and
- Paging and/or digital communication system.

An important characteristic of AIMS is that the data collected on a specific patient can be stored in a database to be retrieved at a later date. Queries (search language) put into the database can retrieve specific patient or aggregate data. Aggregate data usually will be related to specific information drawn on a large number of nonspecific patients. An example of aggregate data would be the arterial pressure response to a drug when administered to all female patients aged 30 to 40 years. Patients do not need to be identified when performing such a database query. When performing research with aggregate data, patient consent is not needed, and institutional review boards will many times require an expedited or less involved review during the approval process.

AIMS, like all computers, consists of both hardware and software components. The core component of hardware is central data acquisition computer equipment that can collect data from remote input sources. The input devices include computer associated equipment that are used by the provider, such as keyboard, touch screen, mouse or track ball, and, in some instances, bar code scanners. Additionally, patient data comes into the system from external monitoring input devices. These include end-tidal gas analyzer, anesthesia machine (eg, ventilatory data), hemodynamic data device, and pulse oximeter. Much of the input information may come from only 1 or 2 patient monitoring systems.

As referred to previously, the main functional component of AIMS is to receive data from multiple recording stations (eg, operating rooms, postanesthesia care unit) for storage and later retrieval. This component is usually located at a site outside the operating room complex. The functional component consists of a file server that organizes, stores, and replicates the received data. Storage devices usually consist of optical disks, large capacity hard drives, and/or groups of hard drives.[1] At the present time, file servers (central component) are accessed from personal computers in the operating room. At the conclusion of the surgical procedure, patient data col-

lected by the core system can be used to print a paper anesthesia record for the patient's chart.

Information presented thus far is common to any computer system, health or industrial, that collects and stores data from multiple input sites. What makes the AIMS unique are the software packages serving as the "brain" of the system. The software must be designed or written to handle data that is unique to the practice of anesthesia. It must primarily have the ability to recognize and categorize anesthesia data. The computer program also must be able to sort the data in a time ordered manner and format the data for storage, replication, and analysis.[1] A standard database program can be used to retrieve and analyze data collected during the perioperative care of patients. For example, Microsoft Access (Microsoft Corporation, Redman, Wash) is the database used by the AIMS at the University of Alabama Hospital, Birmingham, Ala.

Functionality and benefits of AIMS

• *Patient care issues.* The primary function of AIMS is to improve the care of patients during anesthesia. The information system collects and reports input from external devices in a timely, accurate, and unbiased format.[1] In addition, many automated anesthesia records prompt the provider to enter important data that might otherwise be excluded.

Of course, information entered at the discretion of the anesthesia provider can be subject to inaccuracies and bias. Nevertheless, studies have indicated that automated records are more accurate than manual records.[2-4] This should indicate that better patient care will result by providing the nurse anesthetist with more accurate, timely information. Importantly, stored information can be easily retrieved from the database at a later date when the patient returns for another procedure. Greater access to patient information should result in the anesthesia providers being more thorough in the entry of comments into the record. (Information becomes more meaningful because the providers realize that they or their colleagues can more easily access the entered comments at a later date.) Because prior anesthesia problems can be more easily discovered, better documentation and ease of retrieval with an AIMS certainly should facilitate the care of patients. Of course, this benefit results only if the patient has had a previous procedure at a facility that has the automated system.

As stated previously, aggregate data created by AIMS can be used to assess patient care issues related to a large number of patients or to perform research on specific topics related to care of patients. A good example of how an AIMS can be used to access aggregate patient data and facilitate research can be seen in an article by Lesser et al.[5] In this study, the researchers were interested in the incidence of bradycardia associated with spinal and epidural anesthesia. The anesthesia department where the study was conducted used an AIMS to scan a database for heart rates less than 50 beats/min.

Having an AIMS allowed the researchers to scan 57,240 total cases (general and regional) conducted over the study period. The results of the query found that 6,663 of the total cases were spinals and epidurals. An additional query revealed that 677 cases (spinal and epidural) met the criteria of bradycardia. Having an AIMS allowed for the extraction of this data with minimal effort. Prior to use of AIMS, such studies would be either limited in scope or extremely manpower intensive because of time required for manual chart review. In fact, the authors of this study indicate the major advantage of this study over prior studies on this topic is the larger number cases that could be included because of the use of the AIMS.

From a time management perspective, anesthesia record keeping (manual or automated) occupies 10% to 15% of anesthesia time.[6] Record keeping tasks can result in a distraction from the gathering, analyzing, and acting on contemporaneous patient information. There is controversy in the literature as to whether the automated record reduces documentation time.[6]

A study has indicated that automated anesthesia records do not negatively affect vigilance.[7,8] That very same study demonstrated that automated records do facilitate the organization of intraoperative activities. An ergonomic benefit should certainly be seen during times of high, intense activity considering that most of the data entered into the automated system is automatic, contemporaneous, and continuous. Under these conditions, manual entries can be added to the record at a time when the situation is more controlled.

• *Department quality assurance and medical-legal issues.* The database that stores the anesthesia information can be used to retrieve aggregate, multiple patient data for the purpose of making quality assessment.[9-11] This is accomplished by searching a large database for practice trends or specific incidents. Gathering such data can be accomplished by simply entering queries into the system. Extracting the same information from manual records would be extremely time consuming and prone to human error. In addition, the information extracted from the database should be intrinsically more accurate because of automation.

The medical-legal implications of automated anesthesia records are difficult to assess because of their

limited use. It is perceived that comprehensive, accurate anesthesia records protect anesthesia providers as defendants in malpractice litigation. By being more contemporaneous and unbiased than paper records, it may be easier for the defendant to make a case that their actions were appropriate.[1]

• *Department management issues.* Automated anesthesia records facilitate the monitoring of department activity. Data that reflect the overall function of the anesthesia department can easily be retrieved. Examples of functional data that can be extracted from the system are as follows.

- Room turnover time by provider or provider type
- Duration of surgical cases
- Time from in the room to induction
- Time from induction to intubation
- Days of maximal operating room use
- Provider costs for a designated period of time

AIMS will allow anesthesia departments to assess the use of major budgetary expenditures, such as drugs and supplies. An automated anesthesia system facilitates the implementation and monitoring of programs initiated for cost-effective use of resources.[12] Anesthesia providers that are being monitored by a system that yields timely feedback from a database are more likely to comply with departmentally established guidelines. This has been substantiated by a cost reduction study conducted by the anesthesia department at Duke University Medical Center, Durham, NC.[13]

Purchasing considerations

• *Scope issues.* Prior to purchase, the anesthesia providers within a department must first determine what functions they want the AIMS to perform. Do they want the system to include all perioperative activity (eg, same day admission, holding, postanesthesia care unit, intensive care unit, labor and delivery, freestanding outpatient) and remote anesthesia locations (eg, magnetic resonance imaging)? What information does the department want the system to record and retain? Do they want the system to have an educational mode, eg, drug information or tips for managing patients with unique pathological conditions? Should the system have the ability to connect to specific websites for information? Lastly, an important question is whether you want the AIMS to have the ability to interact with the hospital's overall computer system.

A decision must be made that relates to whether the AIMS will be able to interface with the existing devices in the department. If not, will the hospital be willing to upgrade to equipment that has the ability to communicate with the AIMS that is being considered? This issue will be discussed in greater detail under purchase issues. Other considerations that have to be addressed relate to where to place the computer equipment in the operating room and the types of data connection wiring that will be necessary for connecting use locations with the central system (server).[1]

A personnel infrastructure must be immediately available that has the ability to manage and maintain information systems that are as complex as AIMS. Individuals that have had any experience with computers or other technology realize that things will go wrong. Since the AIMS obviously manages very critical information, there must be a support system immediately available, which can rapidly correct problems. If such a support system is not in place, the attempted use of AIMS will surely fail.

• *Vendor issues.* After taking the above considerations into account, the department decision makers are ready to determine what is available in the marketplace. The 2 basic categories of AIMS that exist are proprietary and nonproprietary. A proprietary system interacts only with anesthesia and monitoring equipment from a single manufacturer. The systems are usually associated with large vendors who have significant experience in developing and manufacturing equipment used in an operating room. This assures an understanding of what the needs of anesthesia providers are by the vendor of the proprietary system. The main disadvantage of proprietary products is that there is a good probability they will not be compatible with existing equipment, making additional purchases necessary.

Nonproprietary AIMS have the advantage of interfacing with a wide array of equipment or monitors. Because existing equipment can still be used, it is obvious that these systems can be initiated within a department with less expense. The main disadvantage of nonproprietary companies is that they are small and may not survive competition from their proprietary counterparts.

When selecting a vendor, care must be taken because an investment made in this technology is greater than that seen with any other equipment purchased by an anesthesia department.[1] In this phase of the process of acquisition, consideration should be given to hiring a consultant, such as a health information management expert or an anesthesia provider with significant experience with the technology. Consultants with such expertise should be able to facilitate the matching of the appropriate product/vendor with the department's needs. Nonexpert providers who have worked in departments where automation has been initiated can certainly provide information concerning problems that they encountered.

Summary

This article has attempted to provide the nurse anesthetist with knowledge concerning anesthesia information systems. Certainly, the use of this technology will increase in the future. The article has provided information related to the patient and businesses related uses of computerized anesthesia record keeping. Knowledge of these topics will provide nurse anesthetists with the ability to have valid input in the purchase and implementation of an information management system.

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