Computers and Anaesthesia

Development of a computerized database for the study of anaesthesia care

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To record, tabulate and report problems associated with anaesthesia, we have developed an information collection system and computer software to follow all patients attended by an anaesthetist at a teaching hospital in Canada. For the last 15 mo, data for 17,000 patients have been collected and the system is ongoing. Data collection is from three sources: carbonless copies of the handwritten Operating Room (OR) and Post Anaesthetic Care Unit (PACU) records, other hospital databases, and postoperative visits. Adverse events (observations which differ from specific physiological variables, or require an intervention and do not normally occur during the routine conduct of anaesthesia), are defined directly on each OR and PACU record. These events are recorded when they occur by the attending anaesthetist or the PACU nurse. All data are verified by a research nurse and an anaesthetist. Computer software, developed from DBase IV, is used to track 95 individual items on preoperative status and anaesthetic technique and another possible 1,450 selections for drugs, physicians, airways, surgical procedures and events for each patient. Data are analyzed with SAS software and reports generated to link the casemix and process with outcome. Comparison of data entered into the computer programme to a retrospective chart review revealed discrepancies of less than 0.5%. Collection, verification and computer entry takes five minutes per patient and the on-going cost is estimated at $4 per patient record. Analysis of the information collected in this database has been useful for research of adverse outcome following anaesthesia, resident expertise profiles, and the administrative management of an anaesthesia department.

Nous avons mis au point un système de recueil de l'information et développé à partir de dBASE IV un logiciel servant à compiler et classifier les incidents associés à l'anesthésie. La collection des données se réalise à partir de trois sources: 1) le dossier anesthésique original et de celui de la salle de réveil, 2) les banques de données hospitalières, 3) les visites post-anesthésiques. Le logiciel est conçu pour détecter 95 éléments isolés se rapportant à l'état pré-opératoire et à la technique anesthésique ainsi que 1450 autres choix comme la médication, les médecins intervenants, les gestes chirurgicaux, les techniques appliquées au maintien des voies respiratoires, les événements survenus. Les incidents notés sont vérifiés par un anesthésiste ou une infirmière associée de recherche puis analysés par le logiciel SAS de façon à établir une relation entre les différentes variables et l'issue clinique. La durée totale de collection, de vérification et d'enregistrement des données de chacun des 17 000 dossiers pendant les 16 derniers

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mois est évaluée à cinq minutes et le coût total à 4$ par patient. Une comparaison des données introduites dans le programme informatique avec une étude rétrospective des dossiers a démontré une divergence inférieure à 0,4%.

This paper describes the details of creating and instituting an anaesthetic database which systematically and prospectively collects information on anaesthetic care. There were two objectives when this database was constructed. The first was to collect accurate information on preoperative patient status (casemix), anaesthetic techniques (processes) and intraoperative and early postoperative complications (outcomes). The second was to determine the relationship between these three aspects of anaesthetic care: casemix, process and outcome. Previously most of the major complications in our Operating Room (OR) and Post Anaesthetic Care Unit (PACU) were identified through anecdotal reports and mortality reviews. Complete information was not collected on all patients and, therefore, rates of adverse events could not be determined. Thus there was no systematic assessment of the quality of anaesthesia care provided at the hospital. No mechanism existed to determine the aetiology of complications by examining the interaction between casemix or anaesthetic processes and these adverse events. This approach is new. Other databases have focused either on limited preoperative and intraoperative variables,[1–3] or on outcome.[4] Others have used such complex designs and definitions that they are only able to follow a selected proportion of patients.[5,6]

The limitations and costs of this unique anaesthetic database have been examined by using the system in 17,000 consecutive patients attended by an anaesthetist in the operating room at St. Michael's Hospital in Toronto over a 15-mo period.

Development

Following approval from the Committee for the Use of Human Subjects in Research at St. Michael's Hospital, which required no direct consent from patients, we began a comprehensive follow-up system for all patients at the hospital. This institution is a 500-bed, tertiary care referral centre affiliated with the University of Toronto.

Data collection

OR & PACU RECORDS

In the planning stages, two possibilities were considered for the mode of data collection: to add an additional form to the existing perioperative records, or to incorporate the desired data into revised OR and PACU forms. Both methods have been used successfully for similar purposes at other centres.[1,3] The latter was deemed superior for compliance, prospective charting and accuracy.[7,8] As well, forms would be less likely to be misplaced or neglected. Both records, OR and PACU, were subsequently redesigned to facilitate data collection (using PerForm software Delrina Technology, Toronto, Ontario). Meetings of staff anaesthetists, PACU nursing staff and an epidemiologist were held to develop a consensus on the data items and definitions relevant to anaesthesia practice to be used in the study. Eight revisions to the forms were completed and piloted by our Anaesthesia Department and the PACU nursing staff. They were reviewed by the Hospital Forms Committee and Malpractice Insurance Association. There was involvement of staff anaesthetists for the OR record, and the PACU nurses for the PACU record, with rounds and in-servicing following each revision to overcome problems with using the new forms. There remains continual feedback to OR anaesthetic staff and PACU nurses who complete their respective records to improve and standardize interpretations of all definitions.

INTUBATION:

☐asleep ☐direct ☐oral
☐awake ☐blind ☐nasal R L
☐in situ ☐fiberoptic ☐trach

☐pre-oxygenation ☐cricoid pressure
☐easy mask ventilation ☐rapid sequence
☐EASY INTUBATION ☐DIFFICULT INTUBATION:
☐equal A/E #laryngoscopic
☐no trauma attempts:

FIGURE 1 Tracheal intubation section of the OR anaesthetic record. Multiple check boxes (☐) are used to describe the technique and difficulty. The open space at the bottom is for handwritten comments.

Check-off boxes were used wherever possible for preoperative, OR and PACU variables for both ease and accuracy of record completion. A limited amount of space was provided for those who preferred a written assessment.

On the OR record, the tracheal intubation technique check boxes account for the multiple situations encountered (Figure 1). From these check boxes, 65 on the OR record and 30 on the PACU record, we obtain information for 95 fixed variables used in the database. Recorded variables on the OR record include casemix data (age, weight, sex, urgency, inpatient status, presence of past illnesses or current medications, ventilatory status, airway assessment and examination, dental warning, ASA status, preoperative creatinine, blood sugar, sickle cell and oxygen saturation); and process data (anaesthetic technique, monitors, heating devices, position, type of ventila-

		RESPIRATORY:
1	I M E	desaturation - SaO_2 < 90 X 1 min/PaO_2 < 60
2		hypercarbia - $EtCO_2$ > 55 X 5 min/$PaCO_2$ > 50
3		hypocarbia - $EtCO_2$ < 20 X 5 min/$PaCO_2$ < 25
4	I M E	laryngospasm - stridor ± A/W obstruction
5	I M E	bronchospasm - exp. wheezes heard
6	I M E	high Paw - > 40 cm H_2O X 5 min
7	I M E	regurgitation - gastric contents in oropharynx
8	I M E	aspiration - gastric contents suctioned from below cords/ETT
9	I M E	pneumothorax - dx on intra-op CXR, needle or CT aspiration of air
10	I M E	pulmonary edema - frothy sputum/crackles on auscultation

FIGURE 2 Respiratory events and definitions from the OR anaesthetic record. (Paw is pulmonary airway pressure and CT is chest tube.) Timing is included for some events (I induction – when the anaesthetist is in attendance with the patient until the surgery starts, M maintenance – until surgery is completed, E emergence – until the patient leaves the OR).

		INTUBATION-RELATED:
1		difficult > 2 laryngoscopic attempts by staff a ☐ successful b ☐ failed c ☐ alternate approach
2	I M E	ETT blocked - tube kinked and/or filled with secretions
3		endobronchial intubation - noted after taping of tube or positioning of patient
4		unintentional extubation
5		esophageal intubation - at any time, by anyone
6	I M E	unplanned intubation
7	I M E	dental damage

FIGURE 3 OR tracheal intubation events and definitions from the OR anaesthetic record. One of three possible outcomes (successful, failed or alternate approach) follows a difficult laryngoscopy.

tion, airway, tracheal intubation technique and difficulties, use of oxygen, and inhalation agents, fluid balance and occurrence of events).

The variables from the PACU record include airway, respiration, monitors, drains, lab investigations, PACU admission and discharge times, OR duration, delays, discharge ward, Aldrete scores[9] on admission and discharge, fluid balance, oxygen saturation on discharge, and the occurrence of events.

To improve consistency and compliance, lists of common OR and PACU adverse events and their definitions are displayed prominently on the records. An event is "any observation which deviates from specific physiological variables or requires an intervention and normally does not occur during the routine conduct of anaesthesia." Events do not necessarily imply that errors have occurred.

On the third page of the OR record there are 43 intraoperative events for each of seven major systems, each clearly defined beside the event (Figure 2 and 3, OR respiratory and tracheal intubation events). Twenty-eight of these are further classified depending on when they occurred, i.e., with induction, maintenance or emergence. As well, 32 events from five systems are listed on the reverse of the PACU record (Figure 4, respiratory events in PACU). On the PACU record, 21 of the events were further classified depending on management of the case. All defined variables of physiological variance and time periods are highlighted in red on both records. If no events occurred in the OR or PACU for a given patient, the final staff person responsible for the chart completion checks the nil box for events, located at a central location on each chart (OR and PACU).

Each record (OR and PACU) consists of two parts. The original is placed in the patient chart while the completed carbonless pink copy is collected for the study. These duplicates of both the OR and PACU records are separated from the originals at the time of patient discharge from the PACU and checked against the main registry of patients going through the OR to ensure no cases are missed. Only the copies contain the list of adverse events.

POSTOPERATIVE VISITS

Patients entering the Intensive Care Unit (ICU) directly from the Operating Room and a limited number of elective patients defined by their surgical procedure are visited

Respiratory			Treatment:	Definitions:
1		desaturation	a ☐ nil c ☐ to floor with O2 b ☐ $IFiO_2$ d ☐ intubation	SaO2 < 90% at any time and/or cyanosis and/or PaO2 < 60
2		hypoventilation	a ☐ nil b ☐ drug reversal c ☐ intubation	RR < 8/min and/or PaCO2 > 50 and/or EtCO2 > 55
3		upper A/W problem	a ☐ A/W manipulat c ☐ racemic epi b ☐ oral/nasal A/W d ☐ intubation	problem requiring intervention eg. stridor, obstruction, laryngospasm
4		arrive intubated	a ☐ extubated in the PAR b ☐ left PAR intubated c ☐ expired in PAR	
5		reintubated in PAR	a ☐ extubated in PAR b ☐ left PAR intubated c ☐ expired in PAR	
6		pulmonary edema	a ☐ nil b ☐ drugs c ☐ intubation + IPPV	coughing or suctioning up frothy sputum ± bilateral fluffy infiltrates on CXR ± crackles on auscultation
7		bronchospasm	a ☐ nil b ☐ drugs c ☐ intubation + IPPV	wheezes on expiration
8		pneumothorax	a ☐ nil b ☐ needle aspiration c ☐ chest tube	new x-ray confirmation in the RR
9		aspiration	a ☐ nil c ☐ bronchoscopy b ☐ $IFiO_2$ d ☐ intubation + IPPV	visualization of gastric contents below cords OR x-ray confirmation

FIGURE 4 PACU respiratory events and definitions from the PACU record. All of these events are further classified by one or more treatments.

after surgery. For ICU patients, on the day following surgery, the duplicate OR record is collected and each ICU patient is assessed to determine the overnight course, e.g., ventilatory status and use of inotropic drugs. A questionnaire, based on a brief patient interview and chart review, is completed to determine if any problem occurred after leaving PACU for the smaller predefined surgical group of patients (n = 2,500 patients · yr^{-1}).

OTHER HOSPITAL DATABASES

Information regarding date of hospital discharge, date of death, discharge diagnosis or cause of death is recorded by the Medical Records Department using a UNISYS computer system. This information is downloaded, transferred by floppy disk and electronically matched to the records in our database using the unique patient ID number as well as each patient's unique hospital number. Patients not matched (<10 patients per month, 0.1%) are identified and corrections completed. Similarly, specific additional details (e.g., Injury Severity Score and cardioplegia technique) for OR patients followed by the trauma service or the cardiovascular surgical service are transferred electronically.

Data verification

All copies of the OR and PACU record are reviewed by a nurse who has been trained to identify anaesthetic drugs, interventions and problems. This review is completed either the day of or the day after the operation. This nurse consults with individual anaesthetists or the PACU nurses to explain and correct confusing records. Corrections are added only to the copies and include clarification of drug dosages or illegible entries. This review is also necessary for procedure coding, cumulative drug totals, and completion of missing information about patient variables, drugs and events. This step in the data collection helps maintain consistency in the methods of entry and ensures adherence to specific definitions by 30 anaesthetists, 6 residents, and 24 PACU nurses. As well, all records are further reviewed daily by two clinical anaesthetists involved in the study to ensure accuracy and comprehensive data collection.

Computer software

The database has been organized as a relational database on DBase IV to facilitate storage of only relevant information on each patient. Entry to the programme and all files is password protected and all identifying information on

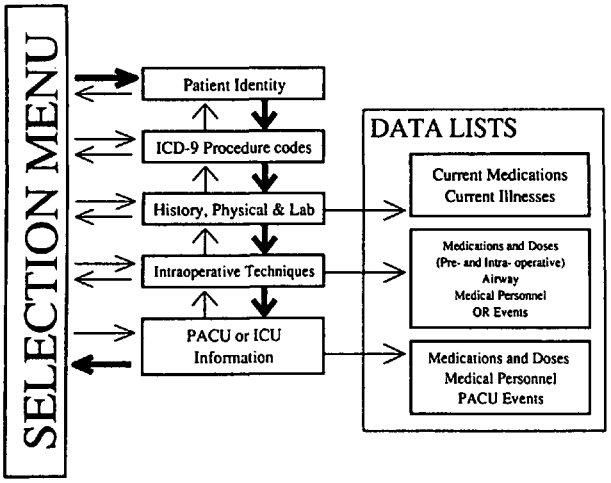

FIGURE 5 Menus for computer entry programme. An initial selection menu accesses five submenus (patient identity, ICD-9 Procedure codes, history physical and lab, intraoperative techniques, PACU or ICU information) for entry of 95 fixed variables. The direction arrow (↦) shows the typical progression from one submenu to the next submenu, but this pathway can be altered (↦). Data lists for an extensive selection of other variables (1450) are shown for three submenus.

physicians and patients is encrypted. In writing the computer programme, considerations were given to the following points:

(a) rapid data entry by a non-medical data entry operator (ideally less than two minutes per chart),
(b) flexibility in the programme, so that changes may be made easily and quickly when the numbers and kinds of variables and outcomes are changed,
(c) the amount of missing data which cannot be obtained can be quantified,
(d) incorporating data checks to minimize errors,
(e) simple editing mode to allow correction of mistakes,
(f) easy data conversion for statistical analysis by a commercially available software package.

The data entry programme is menu driven. An outline of the menu screens is shown in Figure 5.

Each record is identified by a unique encrypted patient number (assigned by the hospital), the date, and time of completion of the surgical procedure. Data are organized into 13 files (according to the relational database model). The data entry programme is essentially an electronic form onto which data must be copied from the patient chart. This process is simplified by organizing data entry screens to appear similar to the actual OR and PACU forms. There are four selection operations: *entry, search, edit,* and *delete*. Data may be *entered* only if it is uniquely identified. A *search* may be conducted in stages based on part of the unique identification, date of entry or the operator. When a *search* is successful, this data may be *deleted* or *edited*, or simply observed to obtain information about a particular patient's past anaesthetic experience.

The fixed variables on the records are handled in three ways. Many are dichotomous, "yes"/"no" variables (e.g., use of arterial line), several are numerical (e.g., preoperative blood sugar); while for others only one option of several may be chosen (for example, position, supine, prone or lateral). We record 95 of these fixed variables on every patient's computer record.

Many of these fixed variables (e.g., method of tracheal intubation, use of nitrous oxide) are the same for a majority of cases. These common techniques and agents are programmed by the default mode so the operator can rapidly space or skip through these sections if no changes are necessary. These default values can be easily changed as required.

Information about preoperative illnesses, procedures, medications and events that do not involve the majority of patients are handled differently, as it would be inefficient to occupy each computer record with a list of all choices. Instead, we have developed data lists or libraries for these choices along with corresponding abbreviated codes such that no variables or an unlimited number of these variables may be entered on a single patient's record. These lists include choices for 60 different preoperative illnesses, 24 current medications, 590 surgical procedures, 340 doctors, 10 different airways, 260 drugs, and 250 adverse events in the OR and PACU. These lists also include several aliases for standard terminology of drugs and procedures to ease data entry by nonmedical personnel. For example, both hip replacement and hip arthroplasty are listed but each has an identical abbreviated code. We now have 775 names for 590 different surgical procedure codes. Codes for surgical procedures are based on the clinical modification of the International Classification of Diseases 9th Revision (ICD.9.CM) codes. All data from these lists are entered by typing only the first two or three letters of the name. For all medications, a drug dosage screen follows each entry. A summary on the computer screen allows the data entry operator to review the list contents to ensure correct entry. These libraries are stored under separate sub-databases apart from the patient records to minimize space and computing efforts. Furthermore, the libraries can be altered as needed to keep abreast of new drugs or expanded to include a special item that may be the focus of some specific study in the future.

To minimize delays in finding records and changing data entry screens, a 2 Mb disk cache in RAM is used to reduce the time taken to access data on the fixed disk. Active data are kept in small differential files while less active data are kept in larger master files. Before merging differential and master files, all records are scanned and duplicate entries identified for correction. All data is

backed up daily, on tape, so that the carbonless copies of the OR and PACU can be shredded after verification and computer entry.

Several variables must be entered at the time of data entry, but if data are missing and cannot be retrieved (e.g., preoperative drug use in patients who are unconscious), frequency of the symbol (.) (period = missing) is determined for these variables.

A major concern with any database is that data should be entered accurately and reflect actual practice. Numerical validity checks for age, weight, and laboratory results are incorporated into the programme, for example, preoperative oxygen saturation cannot be less than 60% or >100%. Options are limited for other variables (for example, ASA physical status I–V only). After completion of a single day's records, another error-checking function scans all files for missing or illogical data. Some specific data are mandatory for all records, such as the staff anaesthetist present, and the surgical procedure. If this information is incomplete an error message appears. Illogical sequences (e.g., mask ventilation for a patient with an endotracheal tube) are also detected on this error check. Reports of these errors are printed daily for correction and determination of problem areas in the original data collection.

Computer hardware

The microcomputer initially used was an IBM PC AT compatible 286 equipped with 2 Mb RAM and a 40 Mb fixed disk but has since been upgraded to a 486 with 8 Mb RAM.

Data analysis and reports

Data is transferred from the DBase IV files to a commercial statistical package (SAS) for analysis. Analysis and reporting of data requires an extensive knowledge of statistical packages, but once programmes are developed to focus on specific problem areas, they may be used without additional programmer input. Multiple reports are generated by this means and include information about the preoperative status of all patients, the frequency of anaesthetic techniques, monitors and drugs during the operative period, and any adverse outcomes. This extensive profile of data for casemix, anaesthetic techniques, and adverse outcomes has been developed such that it can be used for any data-set (e.g., all patients who have laparoscopy cholecystectomies, all outpatients, or all patients attended by a particular anaesthetist).

Information from these reports is given to all anaesthetists and PACU nurses. The denominator for the calculation of these events may be all patients studied, or limited to specific subgroups. Surgical procedures associated with specific risks are identified. Advantages and disadvantages of new monitors (e.g., automatic blood pressure), drugs (e.g., propofol) and techniques (e.g., use of laryngeal mask airway) are followed in all patients. For teaching purposes, profiles are created for anaesthesia residents, listing caseload, surgical procedures, use of monitoring, tracheal intubation techniques and frequent complications during a three and six month interval of their rotation. For administrative purposes, reports of outpatient utilization, operating room time utilization on days, evenings, and nights, ICU admissions, use of supplies and equipment and caseloads by service are also created. These reports are available for distribution within one week of the collection date.

Assessment

To determine the reliability of our data entry, 20 cases were randomly selected from the operating room lists (elective and emergency) using a computer-generated list of random numbers. Charts were reviewed retrospectively and compared with profiles generated by the computer for each of these patients and the number of and types of errors were noted.

Following retrospective review of these 20 computer records and corresponding hospital charts, each with 95 fixed and another possible 1,450 variables from the drug, physician, airway, procedure and events lists, only 11 errors were identified due to computer entry (0.5% of 2100 keystrokes).

As well, on a single day, copies of the OR and PACU records for 54 consecutive patients were reviewed. The number and location of all changes from the original handwritten record made by the anaesthetic nurse and anaesthetist who reviewed the records, were recorded. Additions, deletions and clarifications made during the verification process on one day's handwritten charts were more frequent than the computer entry errors (7% or 405 of a possible 5670 entries). The majority were clarification of incomplete data concerning the examination of the airway and illegible drug and dosage notations. On 12 of these 54 charts, events not circled on the event list by the anaesthetist during the anaesthetic time were identified from the graphic recording or handwritten notes. A total of 22 events were edited or added.

Cost analysis

Expenditures for this database were based on two time periods. The one-time costs for implementation were necessary to develop the database and buy computer hardware. The ongoing operating costs are for the OR and PACU records and personnel required for verification and data entry. All costs are given in 1991 Canadian dollars.

One time implementation costs included a computer programmer to customize DBase software (one day per

week over a one-year period $8,000) and an IBM PC AT compatible 486 with 8 Mb memory and a 33 Mb hard drive ($10,000) which has made possible our rapid data entry and analysis time. This upgraded system has markedly decreased data entry time and shortened the time to run some SAS programmes.

Ongoing operating costs include personnel for the retrieval of forms, verification and correction of the carbonless copies (15 hr · wk^{-1} or three minutes per record) and for data entry (12 hr · wk^{-1} or two minutes per record). The costs for postoperative patient interviews and chart reviews are not included in this cost. Statistical analysis and generation of reports requires another 20 hr per week. These employment expenses are 1.5 person equivalents per year and the OR and PACU records are more costly than the forms they replaced. Total ongoing cost is now estimated to be $4 per case (14,000 cases/year).

Comments

We have developed a comprehensive system to study multiple preoperative patient factors and intraoperative anaesthetic variables. We link this data, describing the casemix and process of care, to several measures of outcome in a large group of patients. Our data focus on the immediate consequences of patient care (OR and PACU) which is particularly appropriate for the speciality of anaesthesia. The system, as described, has been used to observe anaesthetic care in 17,000 consecutive patients from January 1, 1991 to March 31, 1992. Our system tracks over 100 variables on each patient, has an extensive verification process, and includes a list of intraoperative observations and PACU complications. We have developed a rapid and flexible computer programme to enter, edit and report data quickly (within one week of the completed collection date). Reports focus on specific issues which have been identified by the users.

Initially we studied 100 consecutive ophthalmology patients to test our definitions and develop the computer programme.[10] During this learning phase, we documented which variables and events needed to be recorded and became aware of the difficulties associated with data collection and retrieval from multiple personnel. The initial step took six months followed by a three-month trial of all patients admitted to the PACU during which time we tracked only the surgical procedures and adverse events, from the PACU record. Future adaptations will focus on a more extensive follow-up programme when the patient leaves the PACU.

Alternative systems to collate utilization and outcome data are available, but few describe the details of the collection mechanism or the computer programme. Some have used data sheets separate from the OR record,[3,5,6,11,12] while others take data directly from on-line monitors which are joined with automated charting systems.[13–16] Still others have employed retrospective chart reviews.[4] In one centre, data were entered into a computer by the anaesthetist who participated in the case from a copy of his own record.[2] More sophisticated computer systems using voice activation are available to record intraoperative variables directly from the anaesthetist at the time of the case.[17] Some systems have been described which are connected directly to a billing programme[3] or other hospital databases (personal communication: Lawrence Borland, University of Pittsburgh).

These alternative systems have specific advantages as well as limitations. Separate data sheets would avoid the problem of illegibility due to carbon copies. Automatic charting systems are more sensitive in detecting changes in intraoperative physiological variables[18] and they help to eliminate the problems of bias and inaccurate recording. Automated systems may be very helpful in transmission of information about continuous variables which we cannot capture (e.g., changes in end–tidal concentration of inhalation agents). However, the problems associated with mechanical interference have not all been solved, nor have the problems associated with a new source of inattention in the OR been addressed.[19] An even more extensive verification of data would be necessary to avoid these problems of interference and artifact. A 10% limit of accuracy of numeric data has been documented in some automated systems.[20] Furthermore, not all data or events can be detected and recorded automatically; some codes must always be added manually, e.g., ICD.9.CM surgical procedure codes, drugs, and methods of tracheal intubation. The cost of automatic recording devices for all anaesthetic locations and PACU stations may be a limiting factor. Data acquired directly from the patient or anaesthetists using a sophisticated computer system, such as preadmission screening or voice activated charting, may be easier to capture, but time and monetary impact may be excessive. Systems linked to billing may reflect the financial implication of patient care rather than the physiological trespasses related to anaesthesia. When other hospital computer information is available to add to the system it still requires verification.

Our system also has limitations. Handwritten anaesthetic records may not be complete or accurate.[21] To minimize errors and bias, we encourage our OR anaesthetists and PACU nurses to record all observations outside the normal range as they occur. Frequent educational seminars for nurses and anaesthetists have made it clear that observations do not necessarily imply errors and may be caused by multiple factors. As well, trained personnel verify all records to minimize errors. Future adaptation to our system will involve increased use of electronic data from new sources (e.g., monitors), but extensive verifica-

tion will always be a considerable cost factor. The initial time spent to develop the system was lengthy and the investment in computer hardware costly. However, ongoing expenditures are moderate when compared with the cost of treating complications, new technology, and total health care expenditures.

In conclusion, our system has been developed for and by anaesthetists to track an extensive number of clinically relevant variables in a large and varied hospital practice. We have developed a computerized database to link all three components of anaesthesia care: casemix, process and outcome.

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