

The Anesthetic Record: How Content and Design Influence Function In Anesthetic Practice and Beyond

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Abstract

The anesthetic record is used in the course of every anesthetic and its origin can be traced to the earliest days of the practice of Anesthesia. Primarily a medical record, it fulfills other roles: patient-safety tool, medico-legal document, and research and quality assurance aid. After detailing these functions, the author aims to identify the content requirements for the anesthetic record and explain the factors that affect accuracy and completeness. The impact of format on the functions of the anesthetic record is explored. In particular, handwritten and electronic formats are compared and contrasted. With a fuller knowledge of these issues, the Anesthesiologist (individually, departmentally and professionally) will understand that the design and use of the anesthetic record warrants attention to ensure its optimal contribution to patient care.

Keywords: Anesthetic record; Electronic medical record; History of anesthesia; Automatization; Medical informatics

Introduction

The original anesthetic record was developed during the early days of the practice of Anesthesia to record pulse, as part of an effort to improve outcomes which at the time were poor. Though many aspects of our modern anesthesia practice would be unrecognizable to the pioneers of our specialty, the current handwritten anesthesia record looks remarkably similar to the original charts produced over a century ago [1]. Despite the superficial similarities, today's anesthetic record serves myriad functions beyond its central role as a medical record of anesthetic care. It is a key interdisciplinary communication tool, a source of information for research and quality assurance projects and a legal document that can be used in a wide range of medico-legal proceedings. The evolution of the record from handwritten to electronic form has advanced these roles, while at the same time bringing forth new challenges.

The anesthetic record should promote the user's ability to achieve specific goals. Although it is an essential tool used by the Anesthesiologist on a daily basis, there is relatively little literature to guide its design and use. This article will describe the history of the anesthetic record and outline its use in our practice today. The content requirements, driven by legislative, medico-legal, professional and clinical factors, will be summarized. Finally, the impact of formatting choices, including handwritten and electronic media, is discussed.

History and Terminology

The first anesthetic records were devised in 1894 by two medical students, Harvey Cushing and Amory Codman. Often charged with delivering anesthetics for their surgical supervisor, Dr. F.B. Harrington, their descriptions of the use of those first charts offers a glimpse into the harrowing early days of the practice of Anesthesiology [1]. Cushing credits the charts with formalizing what had been, to that point "the very casual administration of a dangerous drug" [1]. His writings reveal how the recording of vital signs (pulse, respiratory rate, and later, blood pressure) along with the amount of ether administered was key in developing the understanding of cause and effect that modern-day anesthesiologists take for granted. The formative role that the anesthetic record played in both patient safety and the development of the specialty itself was noted by several observers, including Harold Griffith [2].

The amount of information collected continued to increase and with the dawn of the digital age, the first electronic anesthetic records were introduced in the 1980's [3,4]. The electronic record allows automated capture of a large volume of physiologic and mechanical data. It also allows manual inputting of information by the clinician (by keyboard, mouse, touch-screen or microphone) and together, the automated and inputted data are organized to become the electronic anesthetic record which can be both stored in a database as well as printed out in paper form to be put on a physical chart. The electronic anesthetic record, in its current manifestation, is just one part of a more complex "anesthesia information management system" (AIMS) where the anesthetic record component interfaces with numerous other hospital data bases, such as medical records, preoperative assessments, laboratory results and surgical scheduling. The AIMS can also be expanded to create research, quality assurance and professional services (billing) databases [5].

Evidence suggests that the AIMS' greatest strength (powerful capabilities) is also its main drawback (complexity) which has hindered its widespread adoption [6] despite vigorous endorsement by the Anesthesia Patient Safety Foundation [7]. Nonetheless, evidence also suggests that implementation of AIMS is on the cusp of an upward surge [6] and it may be that the handwritten anesthetic record, having served our specialty for over 100 years, is soon to be of historical interest only.

Function

Medical record and communication tool

The anesthetic record is a template which facilitates the Anesthesiologist's efficient documentation of patient care. The

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completed record must “tell the story” of an individual patient’s care, from the pre-induction period to recovery in the post-anesthetic care unit (PACU) or to the intensive care unit where accountability is transferred. The story must be told clearly so that other physicians and allied health care professionals can readily understand the care that was given and any complications that ensued. This is true for the patient’s current admission as well as any subsequent admissions to the same or other institutions. In the instance of a patient with a non-reassuring airway examination, a carefully completed anesthetic record describing a previous encounter is an invaluable tool for the anesthesiologist caring for that patient in the future.

Medico-legal document

Like any medical record, the anesthetic record is a legal document that can be used to provide evidence in a wide range of proceedings. Examples include billing reviews by state or insurance payers and investigative proceedings by the Coroner’s office, licensing bodies or civil court. Physicians should not overestimate their ability to recall details of a case that might present to court many years later. Moreover, a written or electronic record of care, completed at the time that the care was given, is more compelling from an evidentiary perspective than the physician’s stated recollections [8]

The ideal anesthetic record documents the truth in a clear and complete fashion, allowing a medico-legal expert to determine whether a clinician adhered to the accepted standard of care. A complete and accurate anesthetic record supports the preparation of a proper defense or clarifies the appropriateness of a timely settlement.

The most common and vexing impediment to a successful defense of an Anesthesiologist is an inadequate anesthetic record [8]. It warrants emphasizing that an incomplete or illegible anesthetic record can only hurt, and never help, an anesthesiologist’s efforts towards a successful defense. “The failure of meaningful, supportive, or exculpatory documentation raises serious questions about the quality of care rendered [8].” In lay terms, an incomplete or illegible anesthetic record gives the impression to the court that the patient management was equally careless and haphazard, even if, in fact, it was just the opposite. Conversely, careful record keeping in the setting of a clinical error in judgment suggests to the court that that error was within the realm of tolerable human error, as opposed to being one of negligence [8]. Even in the instance where care was agreed by both sides to have been sub-standard, “it is better to explain a problem that did occur and was properly charted than to have to defend against charges of cover-up and fraud [9].”

There have been concerns that the automated record could increase the anesthesiologist’s medico-legal exposure as lawyers may be able to exploit either artifactual recordings or the faithful recording of the transient physiologic abnormalities that occur commonly under anesthesia but are of doubtful clinical significance [10]. An early study found that artifacts were readily identified and screened out in the electronic record [11] and subsequent experience has borne out that artifacts are indeed, a non-issue medico-legally [10]. Nonetheless, as recently as 2008 [6], a survey of academic anesthesiology centers showed that concern for increased medico-legal exposure was one of the most frequently-cited reasons among those who had not adopted an AIMS. An anecdotal report of missing data on an electronic record [12] accounted for one instance of medico-legal liability, although undoubtedly, many unpublished cases of incomplete handwritten records have impeded efforts towards a successful defense. Feldman surveyed centers using AIMS in 2004, and the reported experience, in

addition to finding no evidence of increased exposure, suggested that the AIMS was a risk-management asset [10]. The same year, Feldman addressed many of the “real-world” concerns surrounding the AIMS in an article that vigorously endorsed its medico-legal attributes [13]. Indeed, as well as being more likely to be legible and complete [13-16], the electronic record is completed contemporaneously without being subject to the biases of the anesthesiologist, all factors which have contributed to the handwritten record being seen as somewhat suspect in medico-legal proceedings [15,17-24].

Recording errors on handwritten records do occur and should be corrected contemporaneously with a single strike-out, then initialed and dated. Altering the record “after the fact” is never warranted and has been judged very harshly by the courts [8]. Should the clinician feel compelled to provide additional or even contradictory information at a later time, a separate note should be written or dictated and dated.

Source of information for research and quality assurance projects

A carefully-completed anesthetic record is a required resource for retrospective research studies. In prospective trials, information from the handwritten record may be frequently referenced to clarify a clinical issue in a study patient. The anesthetic record is also a key tool in institutional quality assurance programs and death-review proceedings. The electronic record has the advantage of creating a digital database that can be more readily searched for the purposes outlined above. Furthermore, due to its capability of storing large volumes of anonymous physiologic data, the AIMS has the potential to be an invaluable tool in prospective outcomes research.

Quality of care tool

Although its central function is to document care, the anesthetic record has a more subtle role in guiding care. A written template prompts the anesthesiologist to pay attention to details of intra-operative management that might otherwise have been overlooked. For example, a record that requires the anesthesiologist to record airway pressures at periodic intervals might bring more timely attention to a change in that variable. Perhaps Codman, in 1920, put it most succinctly in a letter to his colleague Dr. Cushing: “...Dr. Keen intimated that too elaborate a record of this kind might take the administrator’s mind from his primary job. I feel, most emphatically, that it keeps his mind on his job” [1].

The advent of automated capture of physiologic data brought with it the concern that without the need to manually record the data, the clinician would lose the vigilance-enhancing effect described by Dr. Codman above. This concern has not been borne out [25,26] although the role that manual recording plays in the processing of visually-presented monitor data remains unclear. A respondent to Feldman’s survey [10] suggests that the automated record has a decidedly positive impact on vigilance, implying that the fact that the vital signs will be recorded accurately prompts the clinician to make more of an effort to avoid undesirable hemodynamic swings:

“...the practitioners have changed their practicing methods so that the period of hypertension or hypotension on induction...has been reduced in time.... If a practitioner is worried about auto recording of vital signs... then the practitioner needs to change ... rather than changing the vital signs on the record [10].”

Furthermore, because manual inputting of physiological data can occupy 10-15% of the anesthesiologist’s time [27] the automated record

releases this time for higher-order cognitive or management roles. In addition to its ergonomic benefits, the AIMS has informatic features that are felt to promote patient safety [7]. For example, AIMS can allow point-of-care access to other medical and laboratory information. Some systems have been designed to provide alerts for allergies [5] or to improve timely surgical antibiotic re-dosing by offering the clinician reminder prompts [28]. Other potential applications in which the anesthesia information system plays an active role in improving patient care are likely limited only by one's imagination.

Content

Published guidelines

Each anesthesia department must consider the published guidelines, practice standards and laws that govern their own jurisdiction. These requirements will flow from a variety of bodies which may include:

1. National Professional Society: e.g. American Society of Anesthesiologists (ASA), Canadian Anesthesiologists' Society (CAS)
2. Local Regulatory Body: e.g. State Medical Board (United States), Provincial College of Physicians and Surgeons (Canada)
3. Malpractice Insurers e.g. the Canadian Medical Protective Association (CMPA)
4. Institutional (hospital) bylaws

Requirements do vary according to each individual body's specific mandate but the overriding theme from all regulatory and accrediting bodies is that a comprehensive, legible and retrievable medical record must be produced for every patient encounter. Published guidelines tend to avoid over-inclusivity and accordingly, can be vague and open to interpretation. Of note, compliance with regulatory bodies was listed as one of the motivating factors for adopting AIMS by those teaching centers that had done so in the United States [6]. At least one provincial regulatory body in Canada has reported increasing requests for reviews of departmental anesthetic records for compliance [29].

Practicing Anesthesiologists, and in particular, chiefs of departments, are responsible for being aware of and complying with any state legislation within their jurisdiction. Much of the legislature dealing with medical records focuses on the safeguarding of patient confidentiality, a critical issue in which handwritten and electronic records present distinct challenges [30].

The Canadian Anesthesiologists' Society's "Guidelines to the Practice of Anesthesia" is a yearly publication which includes a brief paragraph on anesthetic records [31]. The American Society of Anesthesiologists has published a more detailed statement on anesthetic documentation [32] which provides a useful content list for use in the design of an anesthetic record.

The most detailed publication outlining requirements for anesthetic documentation that the author was able to find is the template for the Practice Assessment Report for Anesthesiology from the College of Physicians and Surgeons of Ontario (Canada) [33]. The form is used by peer assessors and includes detailed expectations for pre-operative, intra-operative and post-operative phases. Although it focuses on practice, of which documentation is just one part, the clinical items that are important to perform are also important to record. Other jurisdictions may have similar templates, and being aware of the expectations for documentation of one's local regulatory body is a key

step to ensuring that one's own anesthetic record facilitates compliance with those expectations. It has been identified that many of the documentation deficiencies are attributable to the institutional record design rather than to the individual [29].

Clinical factors

The record should facilitate the documentation of clinically important information through all three phases of peri-operative management. Over time our patient population changes. As well, anesthetic knowledge and practice are continually advancing. Periodic updates allow the anesthetic record to evolve along with the clinical practice that it is meant to reflect. The development and use of new monitors and equipment such as the bispectral index (BIS) and ultrasound might lead to changes to the intra-operative portion of the record.

Documentation of airway management should be detailed enough to stand up to medico-legal scrutiny and to serve as a guide to anesthesiologists whose future management of that patient's airway could be improved by a clear, precise description of findings. Simply stating the "grade" of laryngoscopy is insufficient. A structured template offering descriptive narratives of the ease of intubation is a helpful supplement to the laryngoscopic grade. Diagrams of laryngoscopic grade may also be helpful to improve inter-rater reliability. Additionally,

Supraglottic Airway

Nasal Prongs / Facemask
 Oropharyngeal Airway

Mask ventilation





Easy
 Difficult: oral airway required relaxation required
 Impossible

LMA: Size _____ Type _____ Atraumatic

Intubation

Pre-Oxygenation
 ETT size _____ Uncuffed
 Oral Nasal Via Trach
 Asleep Awake In Situ
 Air entry equal bilaterally
 Atraumatic
 RSI / cricoid pressure
 Non-standard tube: Rae DLT _____
 Alternate intubating technique: Elective Rescue
 Videolaryngoscope Lighted stylet
 Bronchoscope _____

Direct Laryngoscopy (circle grade)

Grade 1	Grade 2	Grade 3	Grade 4
			

First attempt, easy
 Some manipulation of larynx, tube or blade required
 Passed ETT "blind" or failed first attempt
 More than two attempts, or failed intubation

Figure 1: "Airway Management Template" Laryngeal mask (LMA); tracheostomy (Trach); endotracheal tube (ETT).

it is important to document clearly what type of intubating device was used, and whether it was used electively or as a rescue technique. An anesthetic record that reports the intubation as being “easy” without including the information that a videolaryngoscope was used to achieve it provides potentially misleading information to a future anesthesiologist. Figure 1 shows an example of an airway management template. Table 1 provides examples of intra-operative details that should be considered for inclusion on a modern anesthetic record. Finally, the attention required from the anesthesiologist during the emergence and transfer phase of care presents an obstacle to complete documentation. Table 2 lists suggested items for inclusion on a structured template for this important phase of anesthesia care.

Quality and accuracy of content

Though the required content of the anesthetic record may be easily determined, the literature suggests that there is much room for improvement by anesthesiologists in their ability to record those required items in a complete and accurate fashion. Even under prospective study conditions, Devitt found marked deficiencies in documentation by anesthesiologists using handwritten anesthetic records [17]. He reported a high rate of incompleteness, with fewer than 37% of records being considered complete. They also observed that abnormal physiological values were frequently omitted, averaged in with more normal values, or “smoothed” towards the upper or lower limit of the expected physiological range.

Tessler surveyed the opinions of anesthesiologists to determine the variables they felt to be most important to document on the anesthetic record [35]. His subsequent chart review found that many of the variables considered important were infrequently recorded. For example, estimated blood loss, though rated as essential or important information by the anesthesiologists, was recorded less than 24% of the time. These findings suggest that the barrier to accurate and complete anesthetic documentation is not fully explained by clinician apathy, and that a technology that facilitates accurate and complete documentation would be welcomed. Indeed, improved clinical documentation and improved data collection were rated as the top two motivating

Content item	Rationale
Verification of “nil per os” status	A historical feature that must be verified on the day of surgery
“Absence of peripheral nerve stretch verified”	A prompt to document the careful positioning and padding of extremities
Prompt for “Ultrasound Guidance” when used for central venous access	The use of this tool decreases risk and should be documented.
Accurate description of ventilatory modes over time, including documentation of tidal volume when pressure controlled ventilation is used	Ventilatory modes may be changed during the course of the anesthetic, a reality for which the anesthetic record must allow. In the case of a handwritten record, documentation may promote clinician awareness of this important physiological variable.
Airway pressure	Important physiologic variable
Fluid management summary box	Important clinical information which may be difficult to interpret from grid portion of record
Intra-operative laboratory results box	Promotes review of laboratory results and presents results and trends visually to the anesthesiologist.
Regional technique details box: includes prompts for needle type and sizes, precautions, drug types and doses; include absence or occurrence of bloody tap	Promotes completeness and serves as an easy reference for other health care professionals caring for the patient postoperatively (e.g. acute pain service, thrombosis team).

Table 1: Selected Content Items for Intra-operative Phase.

• Box indicating use (agents and doses) and timing of reversal agent
• Location of extubation
• Transfer location
• Monitors used in transfer
• Post-operative vital signs including level of consciousness
• Transfer of accountability

Table 2: Selected Content Items for Emergence, Transfer and Post-Operative Phase.

factors for installing AIMS in University departments of Anesthesia in the United States, and were also rated, in the same study, as the top two achievements after implementation [6]. Recent studies have substantiated that automated electronic records achieve more complete and accurate capture of physiological data [14-16,20,23,24,36]. It is important to remember that many essential content items are beyond the reach of automated capture. Management of the airway, invasive interventions, patient positioning, as well as the administration of drugs and fluids are but a few examples of data that require direct clinician input. The input of these variables can be handled in a variety of ways depending on the design of the electronic record. Reliance on free-text input by the clinician is associated with incomplete data collection [14,37]. In contrast, programs that focus on preventing omissions can create an awkward user interface unless engineered exceedingly carefully to mirror the clinician’s workflow.

Format

General considerations

The anesthesiologist, while not expected to be an expert typesetter or computer programmer, will be a more successful collaborator when aware of the relevant considerations. Some formatting issues apply equally to handwritten and electronic records. Chosen font should be simple (sans serif) and large enough to be read comfortably. Shading and bold lines can be used selectively to assist the reader to track visually across the page or screen and to distinguish clinically separate sections. Jargon should be avoided and use of abbreviations should be standardized according to one of the major English language medical dictionaries many of which are available online. The SI format for date (YYYY/MM/DD) and time is recommended, but consistency within the institution is of paramount importance. Many other details warrant attention and the reader is referred to a previously published article [2].

Structure

Anesthetic records (handwritten and electronic) utilize a mix of structured and unstructured data entry. A structured format presents a list of items or options and allows the user to select the relevant one(s). An unstructured format relies on free text entry, although the category may be prompted. The structured format has much to commend it and should be used wherever possible. When used in a handwritten record, it is legible and is associated with a higher degree of completeness compared to an unstructured format [14,37]. Prompting the anesthesiologist of the required items, the template-based form relies less heavily on the clinician’s spontaneous recollection of required items. Some types of information are not easily communicated through a structured format. The main drawback of the use of structured formats in handwritten records is the increased use of document space. The template lists many possible options, many or most of which will not be applicable to a singular patient. As a result, remaining space for unstructured input can be limited. When designing a handwritten record, therefore, the greatest challenge is to achieve a balance of

completeness and conciseness. A record that includes a structured input option for every possible data entry will be rendered useless due to its unwieldy size. Conversely, a single-page record requires much attention from the anesthesiologist to ensure that required information is documented in free-text.

The electronic record allows the elegant integration of structured and unstructured formats, with high completion rates particularly where essential data points are made mandatory [14]. Within a single content area, selection options can be hidden and accessed only as necessary, eliminating the visual clutter and “use of space” concerns inherent to the structured-format handwritten record. Ample space is available for the electronic input of narrative text when required.

User interface (“Human Engineering”)

Though content is the most critical element of a successful anesthetic record, significant effort should be directed toward engineering user-friendliness. The “user interface” describes how the user (the anesthesiologist) and the device (the anesthetic record) interact with each other. There are many shared interface considerations for the handwritten and electronic anesthetic record. For both media, each design choice carries its own set of benefits and limitations. In general, items should be grouped logically and separate sections should be visually distinct. Marco et al found that when the box for ASA status was placed near the beginning (rather than the end) of the handwritten preoperative form, it was less likely to be completed, showing that the logical design of a form is key to its successful use [37]. Where checkbox or drop-down lists are used, consideration should be given to placing more commonly selected items at the top, so that the user is infrequently required to skip over items. The record should be designed so that it could be easily completed during the span of a 30 minute procedure. The same record must also support complete and accurate documentation of a longer, more complex case. Not surprisingly, most studies have supported the electronic record as being more time efficient than the handwritten record [16,26,27].

The electronic record carries some unique human engineering considerations, though an in-depth discussion is beyond the scope of this article. Data which is captured automatically must be easily reviewable by the user for accuracy and completeness [12] and a simple method of correcting artifactual recordings must be in place. The design of the interface for the clinician-inputted data must ensure that the form aids, rather than hinders both the use of the document and the clinical care of the patient. Departments developing an electronic record should consider how the use of the record will interrelate with the clinical workflow of the anesthesiologist. Will data (such as surgical incision time or drug administration) be required to be inputted in “real time”? Will the program require sequential inputting of data, such that the user is unable to input a particular item until preceding items have been completed? Each decision requires a careful examination of its implications to ensure that the system’s capabilities ultimately match the users’ expectations and the clinical setting within which it will be used. While there is no such thing as a “plug and play” Anesthesia Information Management System, Sandberg suggests that departments considering adopting an AIMS beware that the most successful implementations involve systems that are highly customized to the anesthesia users [38]. He cautions that products that are designed to serve broad institutional needs are unlikely to be ideal for the Anesthesia application.

Media: handwritten vs. electronic records

As discussed earlier, the electronic record offers the advantages of

more complete, legible and accurate data collection compared to the handwritten record while at the same time freeing the anesthesiologist from the chore of physiologic data recording. It provides a more robust medico-legal document which is less subject to the biases of the anesthesiologist, and more importantly, possesses intrinsic features that may be used to improve patient safety (Table 3). Beyond the operating room, the electronic record is a ready database for research and quality assurance purposes. The AIMS has sophisticated managerial functions which allow it to be used for such diverse purposes as recording professional services (billing) and tracking supply utilization (medication and disposables). Those readers seeking an in-depth discussion of the AIMS are referred to several excellent previously-published articles [5,38-40].

In 2008, Halbeis’ survey study identified only 20 academic centres in the US that had an AIMS installed [6]. However, a further 41 were

Safety Feature	Explanation
Promotes the maintenance of normal physiological variables	The inability to “smooth” vital signs as with handwritten record may provide further motivation to the anesthesiologist to maintain normal vital signs.
Integration of AIMS with other patient information systems	Examples: allergy alerts, notification of abnormal laboratory results, access to other health consultants’ notes, access to full patient history.
Provision of prompts for specific actions	Examples: timing for antibiotic re-dosing
Improved legibility and accuracy	Provides a more accurate medical record for future reference for either medical or medico-legal purposes
Reduction in the time the anesthesiologist spends on clerical/recording tasks	Allows time and attention to be directed toward higher-order “managerial” roles

Table 3: Potential Safety Advantages of Anesthesia Information Management Systems (AIMS).

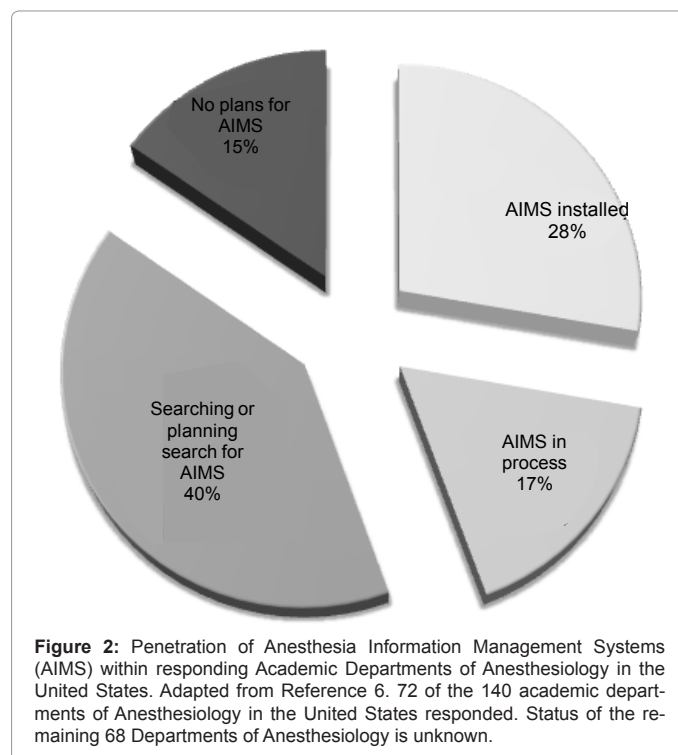


Figure 2: Penetration of Anesthesia Information Management Systems (AIMS) within responding Academic Departments of Anesthesiology in the United States. Adapted from Reference 6. 72 of the 140 academic departments of Anesthesiology in the United States responded. Status of the remaining 68 Departments of Anesthesiology is unknown.

Motivating Factors for Adopting AIMS†	Barriers to adoption of AIMS ‡
Improved clinical documentation	No clear return of investment
Improved data collection for quality improvement programs	High cost of AIMS
Improvement of patient care and safety	AIMS not key to/little value for hospital
Improved data collection for research	Fear of decreased revenue
Compliance with regulatory authorities	Fear of medico-legal exposure
Convenience for anesthesiologist	Systems are too complex or cumbersome

*Adapted from Reference 6 which reports results of a survey on the adoption of AIMS by academic Anesthesiology departments in the United States. Reasons are ordered in rank from most to least frequently-cited.

†Reasons for adopting AIMS were those reported by departments who had or were in the process of installing AIMS.

‡Barriers to adoption were those reported by all respondents (AIMS adopters and non-adopters).

Table 4: Reasons cited for and against adopting Anesthesia Information Management Systems (AIMS)*.

Feature	Handwritten Record	Electronic Record
Legibility	Frequently poor	Very good
Accuracy	Suboptimal- subject to clinician bias: "smoothing", averaging or omission of abnormal values	Excellent- must correct artifactual data and watch for missing data
Completeness	Suboptimal and difficult to control. Structured (template) format will improve legibility and completeness but constrained by space considerations	Excellent- user interface can prompt or require essential data points; some other data is completed automatically (e.g. patient information, surgeon's name) or captured (e.g. physiological variables)
Medico-legal Factors	Can be an asset if complete, legible and accurate. Bias remains problematic.	Favourable due to completeness and accuracy. Concerns about artifactual recordings have not been borne out. No evidence that the AIMS increases medico-legal exposure
Ease of Use	Simple. Ease of use depends on design of user interface	Well-designed system has the potential to be convenient and time-saving for the user
Cost	Inexpensive	Expensive to install and maintain. May reap some "Return on Investment" e.g. tracking drug-related costs and disposables.
Complexity	Simple	Requires a high initial and ongoing commitment to user training. Requires maintenance and technical support. Must be interfaced with other institutional systems
Value Adds	Limited	Myriad: convenient data base for research, quality assurance; seamless billing, archiving and communication applications. May have role in guiding care, e.g. user prompts.

Table 5: Comparison of Handwritten and Electronic Record.

either in the planning stages or in the midst of AIMS purchase and installation. This latter number represents at least 44% of all academic programs, perhaps more depending on the status of the 68 non-responding institutions. Figure 2 displays the status of AIMS in the 72 responding academic departments. Although precise figures do not exist, penetration in community departments is felt to be significantly lower. The fact that widespread adoption of electronic Anesthesia records has been slow in comparison to equivalent technology in

other areas of the hospital (e.g. radiology, pharmacy) [6] suggests that the potential difficulties are formidable and may counterbalance the advantages. Electronic records are perceived to be complex and costly to install and maintain [6,38]. The electronic anesthetic record must interface with the many other institutional electronic systems, such as those that handle laboratory results, surgical scheduling and electronic health records. Achieving compatibility with existing systems is a major stumbling block. Preventative maintenance and troubleshooting requires a significant investment of financial and human resources. A perception of the lack of a clear return on the investment is also cited as a major impediment to implementation [6] although achievable fiscal benefits do exist [40]. Table 4 highlights the reasons for and against implementing AIMS as cited by responding academic departments. By contrast, for all its faults and limitations, the handwritten record remains simple, reliable and inexpensive. Table 5 compares and contrasts the features of the two media options for anesthetic records.

Conclusions

The anesthetic record is a critical tool for the anesthesiologist with direct clinical as well as ancillary roles. Guidance provided by a variety of governing bodies should be supplemented by clinical knowledge to ensure adequate content of the anesthetic record, which will require updating over time. Handwritten records are hampered by inaccuracy, illegibility and incompleteness, but are simple, reliable and inexpensive. Electronic records have many theoretical advantages but available data suggests limited penetration due to the perception of high cost and complexity with little direct return on investment. Regardless of the media of the anesthetic record, anesthesiologists, at individual, departmental and professional societal levels must recognize the importance of this important medical document which has played an ever-expanding role in anesthetic practice for over 100 years.

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