

IV. DATA SHARING

SHARING DATA WITH HOSPITAL INFORMATION SYSTEMS

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As noted earlier, medical centers, stand-alone hospitals, and ambulatory facilities have accelerated the implementation of electronic medical records (EMRs). This activity was stimulated by the passage of the Health Information Technology for Economic and Clinical Health (HITECH) act in 2009.¹ National quality efforts such as the Surgical Care Improvement Program (SCIP) demand various metrics, some of which can be abstracted from the anesthesiology record.² The Medicare Hospital Inpatient Prospective Payment System requires hospitals to report a subset of SCIP quality metrics or face financial penalties.³

All aspects of anesthesia services, including surgical, critical care, and pain management cases must be considered when developing the EMR integration plan for anesthesia services. The anesthesia team is responsible for championing the most complete transfer of data to and from the EMR. Table IV-1 describes a list of data elements that are ideally received by the anesthesia information management system (AIMS) from other systems. Later we address data elements that are ideally provided by the AIMS to other systems.

Table IV-1. Data Elements to be Received by an Anesthesia Information Management System (AIMS) From Hospital Systems

Category of AIMS Data	Specific Data Points Collected from Other Systems
Patient Information	Name, date of birth, medical record number, encounter ID
Preoperative Evaluation	Patient demographics (height, weight, recent vital signs)
	History and physical from recent visits
	Past anesthetics at this hospital, with flags for exceptional incidents (eg, difficult intubation)
	Drug allergies
	Medications: current schedule for inpatients,

	prescription list for outpatients
	Cardiac studies, including electrocardiograms, stress testing, echocardiograms
	Chest x-ray or chest computed tomography images and reports
	Preoperative laboratory studies
Perioperative Data	Perioperative laboratories (eg, arterial blood gas reports)

Note that several items in Table IV-1 are present in prior case files stored in the AIMS. It is up to the anesthesiologist to decide whether these data should be preferentially imported from prior case files or from outside systems.

Several benefits arise when transferring information between the AIMS and the EMR. First, care can be delivered more efficiently by reducing the amount of repetitive data entry required. Second, errors can be avoided related to manual entry of patient demographics and laboratory data. Finally, future care is improved with a longitudinal record of a patient's hospital stay, including the time under the care of anesthesiologists.

Using AIMS as a Module Within an EMR

Several vendors are promoting AIMS that run as modules of an enterprise-wide EMR. The major advertised benefit is that these AIMS already transfer data to and from the EMR without the need for additional software development. However, an AIMS module may not be fully integrated with the host EMR. Potential customers need evidence that the AIMS module properly retrieves preoperative data and transfers postoperative summaries to the EMR. AIMS software modules written independently of the core EMR have the same issues seen with

standalone AIMS, where different abstractions and data dictionaries make data transfer awkward.

Specific Types of Systems Commonly Interfaced With an AIMS

Admission, discharge, and transfer interface

All major health care facilities have an admission, discharge and transfer (ADT) system for registering patient demographic and encounters with the facility. All ADT systems contain demographic and some financial data for patients. Inpatient facilities will also have patient location and transfer data within the facility. In some cases, the ADT system is integrated into the EMR product. The primary patient identifier is a medical record number (MRN), while the primary visit identifier is a visit or encounter number. Ambulatory surgery is often handled differently than inpatient surgical procedures.

There are two common reasons to copy ADT data into an AIMS. In the most common scenario, the anesthesiologist starts a case by looking up a patient using an MRN or some combination of demographics. The AIMS sends a query to the ADT system and returns a list of matching results. The anesthesiologist picks the correct result, and the patient's demographics are imported into the AIMS.

The second reason involves importing scheduled case data into the AIMS. The AIMS system performs a query against the ADT for inpatients and outpatients expected to arrive for a procedure that day. This information is temporarily stored within the AIMS so that when the anesthesiologist starts a new case, the patient's name can be quickly selected from a list of scheduled cases for that room.

The most common interface technology is Health Level Seven (HL7), which defines a protocol for making the queries described earlier.

Laboratory information system interface

Preoperative laboratory values are part of the anesthesia preoperative evaluation, and intraoperative laboratory values are an integral part of the anesthesia record. These data can be pulled from the hospital laboratory information system (LIS).

Pulling this information into the AIMS requires matching the concepts used to represent laboratory values in the AIMS with those used in LIS result reports. It is best to pick a short list of frequently imported laboratory results and develop a mapping system from the LIS to the AIMS. Sometimes customized interface software is required to collect laboratory data from the LIS and populate an AIMS database table with the information. It is important that the patient's MRN and/or encounter number be used to query for laboratory data so that studies from other visits or other patients are not accidentally imported into the record. Furthermore, a software interface to prompt the anesthesiologist to review and possibly reject the collected laboratory values before copying them into the anesthesia record should be functional. This allows the anesthesiologist to correct for mistakes, such as a venous blood gas that was processed as an arterial blood gas, or to ignore spurious laboratory values, such as hyperkalemia due to hemolysis.

A common starting list of studies to import includes the arterial blood case panel, complete blood count, chemistry panel, and coagulation panel. Point-of-care testing for pregnancy status, glucose, electrolytes, blood gases, and coagulation parameters should be interfaced through the LIS whenever possible.

Patient tracking system interface

An acute care patient may be transferred between multiple hospital locations in a span of hours for various tests and procedures, making the patient difficult to find. Several hospitals are implementing tracking systems that collect data from both physical sensors and information systems. There is a further need to determine where a patient is located within the perioperative process. The limited space resolution of patient ID bands and the role that a particular location may play (holding area vs recovery location) provide areas of ambiguity for most enterprise patient tracking systems, which a perioperative system or AIMS can handle more effectively. For example, the AIMS can provide data on when a patient enters the holding area, enters and exits the operating room, specific surgical milestones within the operating room, and which postanesthesia care unit bed they occupying. Intelligent algorithms based on historical data and Bayesian theory have been shown to provide accurate estimates of remaining time in surgical procedures, even when the patient has exceeded the allotted time interval.⁴

Medical history information

It is crucial for anesthesiologists to have a correct and complete set of preoperative data for every case to avoid procedure delays and cancellations. Pulling preoperative information from the EMR regarding prior patient visits can improve the accuracy and efficiency of the anesthesiologist's preoperative evaluation.

Medical history data are more difficult to integrate than ADT or laboratory data because there are few standard methods for storing and exchanging the data. For problem list data, the data dictionaries may be standardized according to the nomenclatures specified in the

International Classification of Diseases, 9th revision (ICD-9), the 10th revision (ICD-10), and the Systemized Nomenclature for Medicine coding systems. To create practical solutions in the absence of industry-wide adoption of standard data definitions, the most straightforward approach to import EMR information into an AIMS is to identify the specific data points of interest (eg, problem list, recent vital signs, height, and weight) and develop a local protocol for transferring the information (eg, a formatted text file).

Interface Techniques

Exporting key elements of an anesthesia encounter

Following completion of AIMS documentation of an anesthetic, the hospital EMR should receive a summary of the anesthetic procedure. Tables IV-2 and IV-3 show sample lists of values to export. Additionally, it is reasonable to transmit an image file of the complete AIMS record and portions of perioperative documentation that may be handwritten, such as consent forms.

Table IV-2. Categories of Data Elements to be Transferred to an Enterprise Electronic Medical Record by an Anesthesia Information Management System

Category of AIMS Data	Specific Data Points Provided to Other Systems
Patient Events	Time patient arrives in holding, arrives in the operating room (OR), procedure starts, patient leaves OR, patient leaves recovery area
Quality Compliance	Documentation of central line–associated bloodstream infection prevention guidelines
	Documentation of patient warming
	Documentation of timely antibiotic administration
Billing Data	Anesthesia techniques and modifiers
	Anesthesia times
	Surgical procedure performed (often Current

	Procedural Terminology coded)
	Postoperative analgesic procedures performed
	Attending attestations and electronic signatures
Postoperative Evaluation	Postoperative findings and complications

Table IV-3. Fields From an Anesthesia Information Management System (AIMS) to be Transferred to an Enterprise Electronic Medical Record (EMR) by the AIMS

Field	Comments
Medical Record Number and Visit/Encounter Number	Links summary to correct EMR encounter
Height and Weight	
American Society of Anesthesiologists Physical Status	
Emergency Status	
Procedure Description	Text entered by anesthesiologist
Surgical Current Procedural Terminology (CPT) Code(s)	Selected by anesthesiologist as preliminary CPT coding to be verified later by certified coder
Anesthesia Technique	General, monitored anesthesia care, etc.
Patient Position	Supine, left lateral decubitus, etc.
Attending Anesthesiologist(s)	Relief times to be indicated
Resident/Certified Registered Nurse Anesthetist	Relief times to be indicated
Electronic Signature Indicators	For all anesthesia care team members
Anesthesia Start/End	
Procedure Start/End	
Drugs and Fluids	Array of drug/fluid name, amount, and time administered

Techniques of Transmitting Data

This section presents an accessible technical description of the issues involved in creating interfaces among systems. Larger institutions will have an interfaces group within the information technology (IT) department that manages an enterprise interface engine. This may be thought of as a traffic management system that directs messages from the source to the interested parties. Smaller institutions may hire a software consulting firm to build one-off interfaces using HL7 messages or text files to transfer information between the AIMS and other information systems.

Pushing data versus pulling data

There are two possibilities for transferring data among the AIMS, the enterprise EMR, and other systems. First, data can be pushed on a scheduled or triggered basis from the source system to the target system. Second, the target system can pull data directly from the production databases of the source system or a recent copy of the source system's databases.

Pushing data is almost always implemented as an HL7 message or a formatted text file transfer. HL7 messages are a standardized way for specific healthcare concepts to be transferred between independent systems and are most widely used in integration projects.⁵ Nearly every large health care organization will have an IT resource that is knowledgeable regarding HL7 messaging.

Formatted text messaging follows typical formats, such as comma-delimited data fields of known lengths. These messages must be negotiated with the IT department because no universal standards exist. International implementers need to be cognizant of the different

character encodings in use around the world, such as ISO-8859-1 in English and some European languages.

Data pushing is best for situations where it is known in advance what data are going to be required. For example, the list of expected anesthesia patients can be pushed early in the morning from the surgical scheduling database.

Data pulling is best when a small amount of information is needed on demand from a large database. For example, an anesthesiologist can type in the MRN for a patient and have the AIMS acquire the remainder of the patient's demographics.

SHARING DATA (AIMS) WITH NATIONAL REPOSITORIES

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Data Sharing Comes in All Shapes and Sizes

Anesthesiology generates substantial amounts of data, much of which is already shared in some fashion. Although software is constantly evolving, sources of anesthesia data can be broadly sorted as follows:

- Administrative data includes billing records, times, dates, and overall activity. Most practices are already sharing this data with the company that does the billing, and it is possible that this vendor is already aggregating that data across many of its clients. They may be using this for their own internal purposes or sharing it in a deidentified fashion with others, such as the Medical Group Management Association (MGMA). Administrative data are also aggregated (and sometimes shared) by the recipient of the electronic billing, whether private insurance companies or the Center for Medicare and Medicaid Services (CMS). Deidentified Part B (provider) Medicare data are aggregated every year into a master file that is publicly available.
- Hospital data consist of the anesthesia-relevant information that is routinely captured by the

health care facility's IT. This includes patient demographic information (eg, age, gender, ZIP code), patient risk factor information (eg, preexisting diagnostic codes, laboratory values), and some outcome information (eg, length of stay, discharge disposition, postoperative laboratory values, and new diagnostic or complication codes). The potential for these data to be shared by the facility with anyone—including anesthesia practices—depends on institutional philosophy and the sophistication of its IT platform. In hospitals with very advanced systems, all EMR data are dumped into a common internal repository that is then mined for a variety of business, quality management, and research purposes. In less advanced systems, this information exists in a variety of isolated software silos, making both internal analysis and external reporting much more challenging.

- AIMS data are available in about 20% of anesthesia practices. AIMS are based on electronic capture of every vital sign, medication dose, and event whenever an anesthetic is given. Older AIMS store these data only within their own software; new generation AIMS contribute to the facility's overall electronic record. An AIMS record represents a large amount of very granular data about anesthesia processes but must be linked to patient risk factors and outcomes before it can be meaningfully interpreted. Academic centers using AIMS can participate in the Multicenter Perioperative Outcomes Group (MPOG), which pools data from multiple AIMS platforms into a common format for research purposes.
- Quality management (QM) data (eg, postoperative patient outcomes) are seldom available for national submission. Many groups have a process for contacting patients 24 to 48 hours after a procedure to determine the occurrence of complications. Anesthesia groups may handle this information in a variety of ways, including (a) not capturing these data electronically, (b) capturing the data but not linking to the original patient data or anesthesia record, and (c)

capturing and linking the data but not reporting them outside the practice. There are no uniform definitions for QM outcomes and no dominant vendors of supporting software.

A variety of national anesthesia data registries already exist. They fall into the following broad categories:

Government and Quasi-Governmental Registries: As mentioned earlier, the CMS already collects and publishes anesthesia administrative data. The Agency for Healthcare Research and Quality (AHRQ) manages the Physician Quality Reporting Initiative (PQRI), which collects a number of anesthesia data points from surgical cases. AHRQ also certifies patient safety organizations to encourage national capture of untoward incidents and is working toward a “registry of registries” that will aggregate this information across multiple specialties and disciplines. The Joint Commission collects sentinel event and complication rate information from almost all hospitals in a variety of formats.

Research Registries: There are almost as many disease-specific registries in existence as there are diseases. Notable examples in anesthesia include the Malignant Hyperthermia Society of the United States Registry and the Closed Claims Project’s Post-Operative Visual Loss (POVL) Registry. Contribution of cases to these registries is voluntary. The percentage of cases reported to a registry (out of all occurrences) is usually not known, limiting the ability to generalize from the cases collected. For example, information in the registry alone cannot be used to determine whether POVL is a common problem or a rare occurrence.

Commercial Registries: Many software contractors, such as anesthesia billing companies, trap data as they are moving it from place to place, creating their own proprietary registries from groups and facilities using their software. Data in these registries are generally deidentified and

only used in the aggregate, but the existence and use of these kinds of repositories are seldom visible to the frontline clinician. More obvious (and even more commercial) are the development of registries related to the use of certain products (eg, hip implants of a certain brand) or medications (eg, postapproval or Phase IV surveillance registries for new drugs).

The National Anesthesia Clinical Outcomes Registry (NACOR): NACOR is the product of the Anesthesia Quality Institute (AQI)—a patient safety organization funded by the American Society of Anesthesiologists (ASA)—and exists to gather data from anesthesia practices nationwide. These data are used at the local level to improve quality and efficiency in participating practices and at the national level to provide an evidence base for ASA’s educational and advocacy efforts. Participation in NACOR is open to any anesthesia group in the United States.

Rules for Sharing Identifiable Data

Most data contributors (individuals, group practices, and healthcare facilities) would prefer to deal only in deidentified information. Most registry operators feel this way as well. Although specific cases are rare, every registry’s fear is that data will leak out (or be lost to a hacker) in an embarrassing way and will identify patients, groups, or facilities. Fear of potential data leakage is a barrier that prevents groups from contributing data to national efforts. Identifiable data is also problematic because it could be used for public reporting, which many anesthesiologists are not likely to support.

The downside of deidentified data is that it is hard to expand the data on individual patients (for instance, follow-up information on specific cases) and very difficult to link data

from a registry with deidentified information to data from other registries. This is problematic in anesthesia because our profession tends to have very good intraoperative process data (from AIMS platforms, for example) that will only be meaningful if it can be linked to long-term outcomes, such as those that exist in surgical registries. Therefore, many registries need to collect identifiers to fulfill their function and maximize their usefulness.

The Health Insurance Portability and Accountability Act (HIPAA) of 1996 included strong protections for the confidentiality of medical data. Clinical information that includes patient identifiers may only be shared for certain specified purposes or with the prospective permission of the patient. This rule has had an enormous impact on clinical research in the United States and has limited some research registry projects. Using identifiable data for QM purposes (as the AQI does) is permitted under HIPAA, but the health care organization contributing the data must have a legal agreement in place with the recipient that clearly spells out their mutual responsibilities for protecting the data and their uses. These be business associate agreements or data sharing agreements, depending on the entities and the purposes for which the data will be used. Examples of this sort of legal paperwork are available by request from the AQI.

AIMS Data

AIMS generate large amounts of process data from anesthesia cases. These data have tremendous potential for business, quality management, and academics when linked to risk-adjusted outcomes. An example is the recent study examining the risk of cancer recurrence based on general vs regional anesthesia that was produced by the Outcomes Research Group at the Cleveland Clinic.⁶ To be most effective, AIMS data should be connected to other internal data before sharing outside the institution. The most advanced AIMS are more than anesthesia record-keeping systems: They are integrated parts of the hospital's EMR. In an efficient system, data from the AIMS are deposited in an internal database with all other elements of the electronic record, creating a repository within the institutional firewall that can be used for a variety of purposes. Patient risk factors are readily available (ICD-9 diagnostic codes and selected laboratory values) as well as in-hospital or in-system outcomes (length of stay in intensive care or the hospital, discharge disposition, complication or new diagnostic codes, postoperative laboratory values).

The goal of the MPOG is to assemble AIMS data from multiple institutions to leverage this kind of data aggregation even further. MPOG has made great progress on the technical side, creating a common anesthesia record that can absorb data from half a dozen different AIMS platforms. This is an important accomplishment and a necessary step toward national anesthesia data collection. What has proven harder for MPOG is linking these data to relevant patient outcomes, because most anesthesia groups (and most AIMS) do not capture this information. This is why internal linkage to other elements of the hospital EMR is so critical and why

anesthesia groups need to place increasing emphasis on measuring patient outcomes after surgery and recording this information in an accessible, linkable electronic format.

In the utopian future state of anesthesia IT, anesthesia groups will use a number of different front-end systems to gather preoperative information, record intraoperative data and processes, and capture postoperative outcomes. These front ends may be parts of an AIMS, parts of the hospital EMR, offshoots of billing systems, or stand-alone anesthesia QM programs. All of these front ends systems will contribute their data to a central repository, maintained by the hospital or health care system. The central repository, rather than the individual front end systems, will become the source for internal business, QM and research requests, and any desired external reporting. Because all relevant case data are linked in the repository, external reports can be constructed and transmitted using only deidentified data. This will greatly lower the barrier to national aggregation, while still allowing the necessary connection of risk factors, processes, and outcomes.

BENEFITS OF SHARING DATA

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This chapter highlights the potential advantages that anesthesiologists and anesthesia groups may derive from sharing their patient-level data with reputable national electronic data warehouses, with a view toward the rapidly changing environment anesthesiologists and anesthesia groups are facing. Examples of such changes are the emergence of national perioperative anesthesia data warehouses, the Health Care Reform Act of 2010, and the accelerating adoption of EMRs by practices and health care facilities.

Data Sharing Concerns

Sharing practice data with individuals or entities other than within a group of anesthesiologists has been difficult to justify; examples and anecdotes abound wherein a well-meaning anesthesiologist provided such practice data, say to the hospital administrator, only to have that same data be used against the group, for example in contract negotiations. Moreover, sharing detailed economic data, such as negotiated prices for service, though perhaps desirable from a practice's viewpoint, is seen as anticompetitive and not allowed by law.

It has further been difficult to conceptualize how such data sharing might be advantageous; large-scale electronic databases of interest and use to anesthesiologists have been largely absent or exist for the advancement of very narrowly focused problems such as postoperative vision loss,⁷ malignant hyperthermia,⁸ or pediatric cardiac arrest.⁹ Others—such as ASA’s Closed Claims Database, the Society for Thoracic Surgery (STS), database and the National Surgical Quality Program database—are neither sufficiently comprehensive nor accessible enough to impact the everyday practice of most anesthesiologists. Although these organized database efforts are of high quality, they are expensive to maintain and require substantial data collection and analysis resources on the part of sponsoring organizations. Important information is gleaned from such databases, to which many individual practitioners and groups contribute, but reports are generally in the form of published articles aimed at broad dissemination rather than feedback to individual practitioners and their groups.

National Anesthesia Data Warehouses

Enter new data warehouses, such as the MPOG or the AQI that are on track to bring together patient and practitioner data from potentially millions of cases, dedicated to the practice of anesthesiology in the perioperative period and beyond.¹⁰

Although the AQI is supported by the ASA, it is separately incorporated and directed. AQI envisions that it will become “the primary source of information for quality improvement in the clinical practice of anesthesiology” (www.aqihq.org). AQI is developing an ongoing registry of case data that helps anesthesiologists assess and improve patient care. This data warehouse, the NACOR, is at the center of data flow into and out of the AQI. The AQI is organizing the

registry for anesthesiology practice groups to submit their case information and to receive the data they find useful for improving the quality of care. Before data are uploaded to NACOR, they are deidentified. Direct patient identifiers will not enter the registry, and facilities and providers will assign their own codes. The AQI web site states that “nothing published by the AQI will ever directly identify a patient, provider, or facility without their express permission.”

At present the AQI is in the process of gathering data, with more than 250,000 cases in the registry representing 150 facilities and nearly 2,000 providers; the AQI published its first executive summary in 2010; it is available to AQI participants and members. The AQI’s goal is to eventually provide anesthesiologists access to patient safety and quality management data so as to better be able to meet regulatory reporting, credentialing and performance improvement requirements.

The AQI is recognized as an emerging force in perioperative safety. It is designated as a [Patient Safety Organization](#) by the US Department of Health and Human Services and has memberships in the [National Quality Forum](#) and the MPOG).

The MPOG was formed “to promote multiinstitutional collaboration on outcomes research to advance knowledge and improve patient care in perioperative medicine” (<http://mpog.med.umich.edu/>) and is made up of institutions whose practices employ AIMS. The group, headquartered at University of Michigan, has developed a database structure capable of accepting data from multiple AIMS vendors and other perioperative systems. Data are deidentified and uploaded for the purpose of conducting outcomes research on a large nationwide data sample. MPOG’s primary goal is to take advantage of pooled high resolution AIMS data so that member institutions can conduct research on large sets of perioperative data and effectively answer questions not amenable to a single-institution approach. Resources exist

to facilitate statistical analysis and collaboration in outcomes research by faculty from multiple academic institutions. Any member of the MPOG, if they so desire, can have AIMS data exported to the AQI via the MPOG. As a special status member of the MPOG, the AQI may also conduct research using the MPOG dataset under the same conditions as any other MPOG member.

These new organizational structures emphasize electronic data collection via the facility's EMR or AIMS. They also espouse a fairly open two-way flow of information, with practices having access to others' deidentified data in the form of flow of information from the database back to groups in need of information. For the first time, the specialty of anesthesiology and each practitioner have a solid opportunity to benefit from each others' patient-level data, whether for benchmarking support, risk adjustment of outcomes, credentialing, maintenance of certification, or risk management, to say nothing of the opportunities for collaborative, epidemiologic research from data collected routinely in the process of care.

Health Care Reform

The 2010 Patient Protection and Healthcare Reform Act effects two major changes beginning in 2014. First, everyone must have health insurance or pay a fine; this requirement is known as the individual mandate. Also, the law mandates state-based insurance exchanges as conduits for offering private coverage options for people who currently are not provided insurance by their employers or the government. Insurance exchanges will provide subsidies for Americans with low to middle incomes. The most popular new health benefits and consumer protections intended by this new law include guaranteed coverage for people with preexisting

conditions, prevention of capricious loss of existing health insurance, elimination of lifetime coverage limits, free preventive care, and limits on out-of-pocket expenses (www.aarp.org).

Medicare payments to physicians providing primary care in areas with doctor shortages will increase. Medicaid payments may increase in certain situations, and more health professionals will receive Medicare payments for the quality of care they provide rather than the quantity of service; this is meant to lower costs while improving care and will likely also be adopted by private insurers.

The latter provisions of the act furnish the best argument for anesthesiologists to acquire electronic health record and quality data reporting systems. It is not difficult to see that without electronic access to data and reports, some potential benefits of the new law may be lost.

American Recovery and Reinvestment Act-HITECH

The American Recovery and Reinvestment Act of 2009, also known as the stimulus, contains sweeping new health information technology provisions collectively referred to as HITECH. HITECH's purpose is to fund and incentivize an interoperable network of paperless electronic health records (EHRs). This law makes available more than \$30 billion in federal funds (\$17.7 billion for Medicare and \$12.4 billion in Medicaid incentives) to individuals, group practices, and health care facilities as early as 2011. It provides substantial up-front funding, estimated at approximately 50% of the cost of deploying an EHR system; furthermore, beginning with 2015 it also penalizes practices that do not have a certified EHR system by up to 5% of Medicare payments (as discussed earlier). To be eligible for federal HITECH funding, practices must not only have a working EHR system but also undergo certification for meaningful use

(MU). To be eligible for the maximum incentives provided by the law, a certified EHR system must be in place and used at the point of care by October 2012. Certification for MU entails demonstration of 15-20 key features during a 90-day period, including drug compatibility checking, allergy cross checking, formulary access, importing laboratory data, recording vital signs, recent smoking status record, CMS quality measure reporting, patient-specific education materials, and clinical decision support. While this is only a partial list of required MU criteria, it is easy to appreciate that anesthesiologists can participate substantively in demonstrating MU for the criteria listed herein, at least in the perioperative setting.

Because of the powerful incentives for EHR adoption, coupled with increasingly onerous disincentives over time that are set up within HITECH, anesthesiology practices will likely see accelerated EHR installations at their facilities. There will be pressure to adopt compatible and certifiable AIMS as well, with the expectation that data from interoperable information systems are freely available to local health care leadership, insurers, regulators, and patients. Even now, AIMS users find it convenient to report PQRI codes electronically and back up SCIP performance data such as antibiotics timing and intraoperative thermal management. Sharing patient-level data for benchmarking, quality reporting, risk management, and credentialing will become more necessary, and barring an alternative, facility administrations, medical oversight bodies, and insurers, given the existence of electronically accessible data, might well feel empowered to extract raw information without practitioners' input.

Benchmarking for Quality

All too often one hears members of quality improvement groups in anesthesiology lament the lack of nationally applicable and practitioner-relevant benchmarks for complication rates and other events associated with anesthetic and pain management. When combining the search terms “anesthesiology” and “benchmarking” in the PubMed database, the results are sparse and largely confined to the critical care environment and clinical productivity.^{11,12} Nevertheless, some excellent work has been published from a large single-institution AIMS database (Michigan). Although this and other work can certainly assist in gauging a group’s performance, practice settings vary across the country and experience from a single institution may not reflect the population of anesthesia practices across the country. For example, Kheterpal and colleagues¹³ report raw incidence of cardiac arrest, myocardial infarction, and cardiac dysrhythmia from a National Surgical Quality Improvement Program (NSQIP) set of more than 8,000 patients. Thus, one might conclude that a good benchmark to look at is an incidence of 0.43% for cardiac arrest, 2.5% for myocardial infarction, and 0.45% for new cardiac dysrhythmia. This information, while seemingly useful for quality improvement committees, is limited by the fact that only general, vascular, and urologic surgical patients were abstracted by NSQIP and that all data are from the University of Michigan’s practice. Even when a large national dataset is involved, as with the same group’s paper on acute postoperative kidney failure that was based on more than 75,000 patients from the NSQIP participant use data file,¹⁴ quality improvement committees would be hard pressed to use such benchmarks for individual practitioners, even if their practice was similar to the profile of the report by Kheterpal and colleagues. Consider that the renal failure data, with an incidence of 1%, applied only to general surgical patients and excluded outpatients

or patients with preexisting renal failure. Of even greater importance to fair-minded quality review panels is the number of identifiable risk factors, as elegantly demonstrated by the Michigan group, that make the occurrence of these adverse outcomes much more likely. Benchmarking therefore requires meaningful *risk adjustment* that is difficult to accomplish without access to large-scale clinical data, both from the individual physician's practice and from the comparative dataset. One need only keep in mind that even the raw incidence of myocardial infarction in the aforementioned study was based on only 21 patients with this complication.

Physician practice benchmarking therefore requires an extremely thoughtful approach with extensive access to data from comparable practices and a commitment to meaningful risk adjustment for each major outcome to be benchmarked. With powerful professional alliances such as the AQR, care quality outcomes are more likely to be reported using appropriate measures adjusted for medical and surgical complexity than if this process is left to government agencies.

Risk Adjustment

With the general public's expectation of freely available information regarding the outcomes of individual practitioners as well as health care institutions, risk adjustment has become an increasingly hot topic. Raw data are extremely difficult to interpret and would both mislead the general public and give unfair advantage to some industry segments. It is therefore imperative that outcomes be risk adjusted. Organizations expecting to collect data from a large population of practices and practitioners must therefore commit to offer a validated method for risk adjustment of the outcome(s) that will be reported back to the contributor groups or, if necessary, to regulators and payors. From the early days of anesthesia practice, anesthesiologists

have sought to assess risk, such as with the ASA Physical Status Classification. Risk assessment methods abound in the anesthesiology literature and include outcomes such as postoperative nausea and vomiting,^{15,16} cardiac complications,¹³ renal failure,¹⁴ and patient satisfaction.¹⁷ Hospitals currently use severity-of-illness scores and administrative coding to identify comorbidity to CMS and other payors, taking advantage of higher payment for patients who are more medically complex.

Anesthesiologists can contribute to the accurate identification of medical comorbidity and prediction of medical risk for surgical patients. Stonemetz et al¹⁸ have shown that when anesthesiologists identify the status of preoperative illnesses in surgical patients, the effect on coding medical complexity is favorable. Recently, Sessler et al¹⁹ reported a broadly applicable risk stratification system that was derived from the MEDPAR inpatient national dataset and successfully validated against a large institutional perioperative database. Sharing patient-level data therefore may allow anesthesiologists to have a further role in shaping risk adjustment strategies that are based on data specific to the perioperative environment.

Credentialing and Certification Support

Credentialing and re-credentialing procedures increasingly require the assessment of practice data. For example, The Joint Commission now requires health care facilities to have specific processes in place that examine the practices of physicians at regular intervals. Ongoing professional practice evaluations (OPPEs) are to be conducted at 6-month intervals and have the character of screening activities. Anesthesia groups have found their AIMS to be excellent source of data for OPPE, noting that such data can be obtained at minimal incremental cost.²⁰

OPPE data then can provide the basis for conducting a more focused professional practice evaluation (FPPE), also required by The Joint Commission. Other information relevant to credentialing decisions might involve the volume of procedures and patients.

Routine reports from national anesthesia data warehouses such as AQI may eventually replace institution-based OPPE reporting for anesthesiologists. Because the data structure exists for a variety of practice parameters and outcomes at registries such as NACOR, practices could choose the parameters they wish to use for OPPE and perhaps modify them based on performance gap trends.

Demonstration of continuing competence is increasingly demanded by licensing boards, facilities, and patients. The American Board of Anesthesiology requires a 4-part Maintenance of Certification in Anesthesiology (MOCA) process for diplomats with time-limited certificates dated after the year 1999. Part IV of this process is the Practice Performance Assessment and Improvement, which requires evaluation of case data and demonstration of improvement over time. National anesthesia data warehouses may be able to assist practitioners in the process of completing their MOCA.

Risk Management

Managing liability risk for malpractice claims has been one of the important aspects in practice operations. Financial liability in anesthesia can be substantial, not to mention the devastating effects on individual practitioners and, potentially, the reputation of the entire group. The best defenses against these threats are proactive monitoring and preventive intervention. However, among a group of colleagues it is very difficult to identify practice patterns that might

lead to higher liability. Reports from organizations such as AQR, with many hundreds of data points for the individual practitioner and hundreds of thousands of benchmarking data, might make it easier to spot troublesome trends; moreover, such reports might be perceived as more objective than the opinion of a surgeon, colleague, or department head.

Collaborative Database Research

The cost of prospective randomized clinical trials (RCTs) is becoming prohibitive. This is especially true for conditions with a low incidence or prevalence. Although RCTs will likely remain the gold standard for inferring causality and ultimately promoting practice change, observational data from hundreds of thousands of patients can be helpful in identifying the RCTs to be conducted and the questions they should ask. Examples of clinical problems that likely benefit from such population database research are perioperative visual loss, epidural hematoma, the correlation of postoperative mortality and major morbidity with anesthetic state, vital signs, and incident interventions. MPOG and AQR are poised to open a plethora of opportunities to elucidate perioperative conditions that heretofore defied closer scrutiny.

Summary

The landscape of perioperative health care data management is changing, driven by new legislation, public demand for greater accountability, and IT advances. Anesthesiologists even now see some of their patient-level data migrate to the CMS, The Joint Commission, insurers, surgical national quality organizations, and in some cases, IT vendors. The advent of large-scale

reputable anesthesia data warehouses brings both opportunity and risk for anesthesia practices. Sharing of patient-level data must be done in accordance with federal patient privacy laws, safeguard against unintended consequences, and operate under the expectation that useful and fair reporting can result, including with appropriate adjustments for medical complexity and surgical risk. When this can be accomplished, practices stand to gain in many areas, including quality management, credentialing, certification, performance improvement, and practice management.

PITFALLS OF DATA SHARING

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The source of much of the anesthesia-related observations were extractions and groupings from a series of articles in the May 2010 *ASA Newsletter* by RE Johnstone, MD, MBA²¹; LG Glance, MD²²; RP Dutton, MD, MBA²³; and PG Duke, MD²⁴ (*ASA Newsletter* 2010; 74). We thank them for their permission to include their work in this chapter.

The sharing of clinical outcomes and data is not a new concept, but early anesthesia specialty studies generally had a single focus in a limited number of institutions even though they involved large numbers of patients and sometimes generated secondary inquiries. In 1954, Beecher and Todd published a study of mortality in 599,548 anesthesia cases in 10 institutions in an era when mortality was much higher than today.²⁵ From 1959 through 1962, the National Institutes of Health funded the National Halothane Study, which evaluated 850,000 halothane anesthetics from 34 facilities. Although the study concluded that halothane hepatitis was rare, it noted that mortality ranged from 0.27% to 6.4% among the various institutions; however, the study was not designed to answer the secondary question that it generated.²⁶ The two early studies noted above provide a glimpse of the factors that drive contemporary efforts to understand and quantify our professional world and its challenges.²¹

The AQI is early in the process of developing NACOR's infrastructure and methodology to address the deficit of lack of quantification and understanding within anesthesiology. A number of concerns exist regarding the sharing of clinical data in registries. Some are valid, and others are not material to this specific circumstance. One must discern between the sharing of data generically and those specific to clinical outcomes. The concerns fall into general categories of risk adjustment, administrative versus clinical data, competitive advantage, full reporting, confidentiality, practice diversity, liability, accuracy and relative applicability, and nontraditional medical terms and abbreviations.

Risk Adjustment

One major hurdle to accurate assessment and interpretation is risk adjustment as one transitions from data to information and then to knowledge. Although the National Halothane Study may have found different outcomes in identical populations, there was a high likelihood that many of the differences reflected dissimilar patient populations. One of the more compelling criticisms of a recent study funded by the American Association of Nurse Anesthetists was a lack of risk adjustment, as they concluded that opting out of the medically directed mode of practice was not associated with higher mortality rates.²⁷ The reality is that anesthetists in nondirected cases tend to be in rural or ambulatory locations with less complex cases and healthier patients. Nurse anesthetists in independent practice at tertiary or regional facilities are nonexistent. Shared information may lack the data points that permit risk adjustment, needed in addition to those points that will become the primary focus of an investigation. This means that the database must be comprehensive and detailed to formulate valid conclusions.

Administrative Data

The concerns

The ability to risk adjust is closely linked to the controversy over using existing claims-based administrative data versus clinical data. In the May 2010 issue of the *ASA Newsletter*, Drs Glance and Dutton^{22,23} presented the pros and cons of this matter. Administrative data, based on ICD-9 codes, are less expensive and available from existing billing software in the vast majority of practices. Dr Glance noted that to produce benchmarks that facilitate true adaptive learning, it is essential to evaluate actual differences in outcome in the context of patient case mix and severity of disease across facilities, which would be based on clinical data. Otherwise, apparent differences based on administrative data may be more reflective of skill and completeness in coding practices, which could lead to faulty conclusions that could do more harm than good if changes in practice were based on a flawed premise.²² Glance observed that administrative databases did not always capture severity of illness and were not reliable in identifying the preexisting illnesses upon which risk adjustment is based.

A study by Lee et al²⁸ found that 55% to 75% of 3 preexisting illnesses were missed, which skewed their relative performance. The same concerns apply to situations when entities such as the AHRQ use administrative databases to assess clinical outcomes. For instance, Romano et al²⁹ found that ICD-9–based analysis of AHRQ markers missed 44% to 80% of 4 major complications because it attempted to use data for a purpose for which they were not intended. The implications of such data may or may not translate to accurate conclusions and changes in patient care strategies.

The merits

Does this mean that administrative data has no value? Dr Dutton (Executive Director, AQI) points out that certain basic administrative data have value, such as case type and length, which he views as the foundation to an all-inclusive registry.²³ Because electronic systems are limited to approximately 10% of locations and 20% of cases, the majority of ASA members would be unable to submit clinical data. The NSQIP exemplifies the current model for the acquisition of clinical data, in which trained abstractors manually analyze charts looking for specific entries. The result is a highly accurate database that is poised to achieve policy objectives, but at a high cost (more than \$100,000 per facility) and relatively low volume (estimated at 10% of the data in 10% of the cases in 5% of US facilities).

As more systems evolve into the electronic column, the administrative contributors of today will become the clinical contributors of tomorrow. Thus, AQI's strategy of recruiting participants at whatever level of information they can provide over more selective but smaller groups that have a higher barrier to entry will provide a larger pool in the future. AQI's strategy and goal of compiling a comprehensive digital database that directly scans electronic records, AIMS, QM programs, and any other digital information to collect as much information as possible from every case in every practice minimize this vulnerability in the long term. Dr Peggy Duke articulated the ultimate goal of AQI data: "... provide trending for cause and effect, highlight the relationship between processes and patient outcomes, and provide insight into specific areas for improvement. As AQI matures, data will aid development of outcomes-based performance measures sent directly to CMS...."²⁴

Political Objective and Public Reporting

Although risk adjustment is important, analyzing data to prove a predetermined political objective may bias the outcome. This may occur when unflattering data are incomplete, suppressed, or manipulated/edited; in extreme unethical situations, these could lead to fabricated data. Public reporting confers many of the same issues and pressures, which are compounded when data are used in a manner for which they were not intended. This is why the AQI is focused on individual feedback with peer benchmarks for self-improvement.

Competitive Advantage

Large anesthesia groups, hospital systems (regional or national), and billing entities with aggregate data may have a competitive advantage over solo and small group practices. While median anesthesia groups average around 16.2 physician full-time equivalents (FTEs) and cover 3 facilities according to the MGMA,³⁰ the 90th percentile group averages 57.6 FTEs and covers 14 facilities. Billing and practice management companies cover a magnitude of practices with an unknown degree of regionalism (a potential concern) and up to several thousand anesthesiologists and anesthesiologists. In a metropolitan area, a large multisite group can compare facilities and anesthesia practice centers unless they are under a contractual confidentiality agreement that requires a written release. They also are likely to have standardized terminology and methodology that captures and defines events in a similar manner.

Although one might think that regional hospital systems would have standardized terminology and methodology, this is not always true; however, the overarching leadership team

may have a different mental model for operations. Depending on the level of competitiveness and overlap in the local market, both the anesthesia and hospital leadership may be reluctant to share data they feel will dilute or negate their edge. National hospital systems are likely to have a mixture of highly standardized processes in some areas and highly divergent processes in others, resulting in variable contributions to protect their diverse databases and thus preserving their competitive advantage.

Local, regional, and national billing and practice management companies bring another facet to a competitive advantage. An intangible element of building a business is maintaining a competitive advantage in an area such as lower costs, so that the bottom line savings/performance accrued to the entity's benefit. As the paradigm shifts, clinical outcomes demonstration will become one of the value-added expectations and deliverables.

Full Reporting

Full reporting is closely related to competitive advantage. In each of the scenarios above, the reporting of less than desirable outcomes may reflect poorly on that particular site, entity, or organization; pressure will develop to report the positive outcomes, sites, and divisions while suppressing the sources of negative data points. This may not be a prominent characteristic of initial or early reporting, but the inverse of the Hawthorne effect may manifest itself as bad or suboptimal performance that may be difficult to identify in local and regional situations until it has financial or competitive implications. National hospitals and billing companies should compare the number of units in the report, and database managers must become adept at identifying only segments of previously reported entities.

Early efforts were focused; currently, quantification of perceptions through data analysis is voluntary for the most part, but it will gradually become mandatory at the federal level. Voluntary participants are motivated to collect and report the data in a comprehensive manner. Mandatory participants, however, do not necessarily share that same zeal and commitment. This fear/reality will eventually impact the compliance of data submission and in some cases the integrity and amount of the data, as disinterested parties fill in the blanks and boxes. This is one reason that the AQI will focus on the direct collection of accurate and comprehensive digital data.

Confidentiality

Confidentiality is a double-edged sword; it has HIPAA implications, with maintenance of patient privacy a prerequisite for entity participation. Privacy was traditionally guaranteed by maintaining health information confidentiality through mechanisms such as releasing data in the aggregate or removing identifying information. In instances where a researcher requires more data points than received, he or she may want a review of the patient record to complete a valid analysis of a particular research objective. “Privacy risk assessments need to have regard to the whole data environment, not merely the quality of the dataset to be released in isolation. As sources of data proliferate, issues of privacy protection are increasingly problematic...”³¹ The hurdles are overwhelming and must be addressed: They represent a moving target.

Specialty Diversity

Specialty diversity is a problem with generic databases because most of the current PQRI measures are for nonhospital-based specialties, and multiple entities are assessing quality measures for varying purposes and objectives. The Physician Consortium for Performance Improvement has convened 43 workgroups that have developed 270 measures. However, only three = are applicable to anesthesiologists. This limitation provides one of the justifications for the development of the AQI. The ASA Committee on Information Management (CIM) developed standardized definitions for terms to be used in ASA databases, a process that was much less straightforward than one might expect. The hurdles on a multispecialty level are even more complex and compounded as multiple specialties and facilities submit data.

Liability

Liability concerns emerge if the database is subject to discovery and if individual confidentiality is breached. Because QM programs are potential sources of data, otherwise protected conclusion access by a back-door approach is possible. Although this concern is justified, data are already available from the patient medical records; theoretically, it is possible that trial lawyers could perform blind searches with certain keywords associated with patient injuries. Databases structured with safeguards to prevent such intrusions should be an important priority. Precedent exists with the voluntary, nonpunitive reporting by medical witnesses in an internal medicine initiative in New York, which is similar to the near-miss registries in the airline industry.³²

Nontraditional Medical Terms and Abbreviations

The use of nontraditional medical terms and abbreviations limits the utility of databases for research. With worldwide submissions, the procedures and terminology may contain subtle differences between regions and nations. This is why attention and detail must be given to terms and definitions.³³ For instance, the CIM had to reconcile a number of definitions between existing databases for seemingly obvious events such as death.

Conclusions

Although many potential pitfalls exist in the sharing of medical data, so does enormous upside potential to improve clinical practice patterns and provide a system that could deliver on the promise of higher quality of care at a lower price with high patient and physician satisfaction. However, that will not occur on its own or in a vacuum: It will be based on best as well as worst practices. Such analysis will require massive amounts of data to make the transition from data to information to knowledge. We have discussed some of the pitfalls and some of the potential solutions. We probably missed some current pitfalls, and new ones will certainly develop in the future. We must identify the vulnerabilities and counterstrategies to deal with them because we as a profession must make this journey, which like all begins with a first step; the AQI represents anesthesiology's first organized step in our professional journey.

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