Medical Informatics and Opportunity for Anesthesiologists

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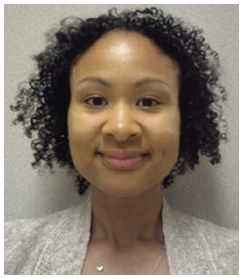
This is the fifth year that we are organizing the anesthesia symposium/debate during the annual meeting of the Chinese Society of Anesthesiologists. The member of the symposium consists a team from China lead by Dr. Buwei Yu, the immediate past president of the Chinese Society of Anesthesiologists (CSA, http://www.csaol.cn) and a team from US lead Dr. Lee Fleisher, the current president of the Association of University of Anesthesiologists (AUA, http://www.auahq.org/). The first symposium was held in Shanghai with the focus on providing anesthesia in day surgical centers and out of operating room settings. The second symposium was held in Beijing with the focus on evidence based anesthesiology. The third symposium was held in Jinan with the focus on anesthesia simulation and education. Last year, the symposium was held in Chongqing with the focus on modes of safe anesthesia delivery in the US vs. China.

With the rapid development of medical informatics and its significant impact on the future of anesthesiology, the leaders of this symposium believe that a joint symposium focusing on medical informatics and the opportunity for anesthesiologists is timely. Over the last decade, anesthesia related morbidity and mortality have decreased dramatically due in part to the advancement of anesthesiology, modern informatics, and monitoring technology.[1,2] Anesthesiology remains among the top leaders of patient safety and serves as a model for other specialties.[1,2] However, challenge remains to improve perioperative outcome which is one of the top priorities for anesthesiology. To achieve the goal to improve outcome, medical informatics is the backbone of this task despite that many obstacles remain to be overcome. There is no doubt that anesthesiologists are grasping this great opportunity and playing a leadership role in developing, implanting and researching medical informatics to improve patient care and outcome. Here are some of the major points that the team from the US side is going to present, discuss, and debate during the symposium with the focus on "Medical informatics and opportunity for Anesthesiologists" in the afternoon of September 20th, 2013in Tianjin.

Telemedicine in the ICU

Meghan Lane-Fall, MD, MSHP



Telemedicine is the practice of providing clinical care from remote locations. Telemedicine has its roots in the 20th century, when physicians offered remote support via telephone or radio. The field truly began to flourish, however, in the late 20th century.[3] Advances in medical informatics (including electronic health records and clinical decision support), audiovisual technology, and Internet connectivity have transformed the physician's ability to deliver medical care from afar. Dermatologists, ophthalmologists, pathologists, radiologists and surgeons are among the specialists able to provide care remotely to distant locations and areas with a scarcity of physicians.[3]Scarcity of specialists has also driven the use of telemedicine in critical care.

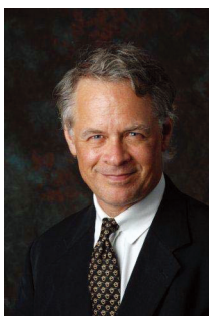
Telemedicine offers an opportunity for intensivists to provide remote consultations for critically ill patients.[4] Medical informatics is at the heart of the intensivist's ability to provide remote critical care safely and efficiently.

For example, electronic progress notes provide much-needed context to appropriately interpret laboratory studies and vital sign trends. Clinical decision support algorithms aggregate information that the physician may then use to make decisions about therapeutic alternatives. Smart alarms can alert the physician to emerging trends in vital sign or laboratory data that may precede clinical deterioration.

Although medical informatics has enabled the practice of ICU telemedicine, there are still obstacles that must be overcome to realize the full potential of informatics. Research is needed to determine how to optimize technical acceptability and health systems interfaces [5] and how to improve the acceptance of telemedicine, which is crucial to its ability to improve outcomes.[6] As critical care providers, consultants accustomed to working in multidisciplinary teams, and as specialists who have embraced technological advances in medicine, anesthesiologists are uniquely equipped to guide research and development of systems that can realize the full potential of telemedicine in the care of critically ill patients.

Anesthesiologists as Leaders in Biomedical Informatics

C. William Hanson, MD



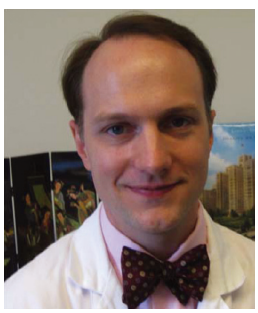
Biomedical informatics is a growing field, encompassing abroad span from pure research on data from patient populations and genes to the development of applications (i.e. electronic record systems)and, increasingly, 'apps' for mobile devices. Much of the initial development of medical databases and applications was done at academic institutions. Many of today's commercial electronic records, for example, were created by medical school faculty as an adjunct to direct patient care and only subsequently commercialized. Medical providers, medical researchers, traditional medical software vendors and an increasing variety of non-traditional players such as phone vendors and companies are now engaged in innovation in healthcare informatics.

The American Medical Informatics Association has, through its American College of Medical Informatics, defined the core content for a subspecialty track in clinical informatics which will eventually be administered by the (American) Accreditation Council for Graduate Medical Education. Masters programs in biomedical informatics are also increasingly prevalent. As a result, there are an increasing variety of avenues for anesthesiologists seeking advanced training in biomedical informatics.

Anesthesiologists are well positioned to become leaders in biomedical informatics. Inherently data-oriented and technologically savvy, anesthesiologists have published on the deployment of anesthesia information management systems (AIMS),[7-10] and the use of these systems for alerting,[11,12] optimization,[13,14] and professional evaluation.[15] Anesthesia based intensivists developed the first intensive care telemedicine suite at the University of Pennsylvania.[16] And the anesthesia community has taken a lead in the development and use of perioperative databases as Dr. Fleisher will describe below.

Electronic Anesthesia Records: Obstacles and Limitations

Joshua H. Atkins, MD, PhD



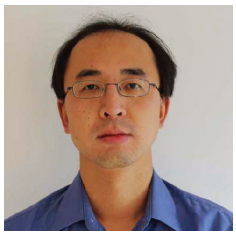
AIMS are assumed to afford broad benefits to perioperative patient care. AIMS may save money by streamlining data transfer for billing, reduced transcription errors, and eliminating the need for review and manual transcription by office staff. AIMS may be more accurate. Precise time-stamps of events are recorded for later review. Vital signs are recorded in real-time and more accurately reflect the onset and resolution of changes such as pronounced hypotension, arrhythmia, or hypoxemia while the anesthesiologist focuses on diagnosis and treatment. Templates for procedure and airway notes provide the opportunity for comprehensive, legible entries that may provide more details and standardization that the typical variability seen in handwritten notes. Electronic archiving of data should

facilitate reliable remote access to the record by future providers in emergent or other circumstances where pertinent information related to airway management, anesthetic dosing, or procedures is recorded. AIMS will provide enhanced safety and opportunities for quality improvement. Advanced systems may offer the ability to send alerts to supervisors regarding changes in patient condition based on pre-defined thresholds such as sustained hypotension or tachycardia. Automated warnings (so-called clinical decision support) can prompt anesthesia providers regarding known allergies to entered medications, the need to re-dose antibiotics, and reduplicative administration of drugs. Software can be designed to mandate entry of data for quality control such as perioperative beta-blocker therapy and temperature maintenance. Archived data can be pooled and reviewed for quality improvement and clinical research. One example is the Anesthesia Quality Institute (AQI) created in partnership with the American Society of Anesthesiologists. [17]

The promises from the AIMS do not always reflect the reality and are seldom realized immediately.[8] Clinicians are generally skeptical of and resistant to change. Implementation of a new system is expensive and requires appropriate technological support and new equipment.[9] The selected system may be excellent for anesthesia yet not offer all of the features needed throughout the hospital and outpatient clinic. [18] Multiple platforms may be necessary. Different technology platforms are frequently not capable of data sharing and many systems are designed for the ward or office use and not the dynamic environment of the operating room. Anticipated clinical efficiencies may not be realized. Hospital and physician payments may actually decrease as efficiency slows during the learning process. Patients may react poorly to a clinician focused on computer data entry and this may lead to reduced patient satisfaction with care. Template, pre-generated notes may be used reflexively and not properly edited to reflect the details unique to the situation documented. For example a difficult airway requiring multiple laryngoscopies and esophageal intubation is entered as the un-edited template default of "easy mask, with a Grade I view, and single routine laryngoscopy". Artifactual data (low blood pressure, arrhythmia) may be recorded and if not deleted will become part of the permanent record. Clinical decision support systems may not be relevant to the OR (e.g. a warning not to administer fentanyl for allergy to hydrocodone). Warning fatigue may develop further diminishing the effectiveness of built-in error prevention alerts. Similarly, clinicians may assume vital sign data is being record and stop looking at the record only to realize a system failure much later. Systems may not contain the requisite flexibility to adapt to unusual circumstances thereby costing clinicians time to develop a work around. Trouble shooting a system or tedious effort for data may actually distract from patient care. This may be especially true in emergency situations or in high-throughput clinical settings such as the GI endoscopy or delivery suites. Analysis of large amounts of pooled clinical data (such as Anesthesia Quality Institute) is challenging and full of pitfalls including data validation (e.g. automated exclusion of inaccurate data). Methods to encourage adoption of AIMS are varied. In the United States financial incentives have been the primary mechanism to date. For example, as part of "Obamacare" special payments were offered to some physician groups and hospitals to pay for electronic health records. Private and government insurers have also begun to link payment to central reporting of patient care data such as administration of prophylactic antibiotics and maintenance of normothermia. Due to the large amount of patient data that must be reported use of AIMS becomes necessary for most centers. Other strategies for introduction would be to demonstrate ease of use to clinicians such that the clinical workload could be more readily accomplished or improved documentation for medico-legal or quality improvement applications. State and national medical societies and health system leadership can be instrumental in making the transition to AIMS acceptable for the local practitioners. Anesth esiologists, in light of large experience with advanced technology and complex work environments, may be well-positioned to lead their hospital or health system in the evaluation and selection of electronic health record systems for use elsewhere in the hospital and clinic.

Informatics Research in Anesthesiology -a Discussion

Jiabin Liu, MD, PhD



A wealth of health information data has been collected constantly from various sources across various specialties, including Anesthesiology. The popularity of electronic medical recording system in Anesthesiology further boosts the amount of data source. The technical advancement of computation power, and data storage and sharing provides us with even greater opportunities of accessing massive amount of information, with great potential for biomedical informatics research. However, there are still many challenges to apply the existing information to benefit our current and future clinical practice. The data structure has to be easy access and search-able, while maintaining the data quality of complex medical information.[19] The database infrastructure should also be flexible for future adjustment to accommodate novel variables. More importantly, the database has to be user-friendly to clinicians with limited training in statistics and computer sciences.[20]

American College of Surgeons National Surgical Quality Improvement Program (NSQIP, http://site.acsnsqip.org) is a leading national outcomes-based program to measure and improve surgical quality. NSQIP provides services to participating hospitals to decrease complications and reduce health care costs. The database collects information since 2005. There are over 136 variables in the database, including patient demographic information, pre-existing condition, intra-operative events, and 30-day post-operative complications. Using the NSQIP database as an example, our lecture will focus on the history of NSQIP program, the data collection process, database infrastructure, and its potential applications for anesthesia informatics research.

Big Data and Perioperative Care

Lee Fleisher, MD

Big data has become the buzzword today in order to develop predictive analytics for decision-makers. It is becoming increasingly common in business decisions such as predicting buying trends and offering individuals

targeted advertisements in the United States. The driver behind the use of big data is the marked improvement in both computing power and reduction in the costs of data storage which has occurred over the past 40 years. Additionally, there are new statistical tools to analyze large datasets which enhances the ability to demonstrate strong associations which account for confounding variables. Examples of these tools include logistic regression, propensity scores and matching techniques. In the United States and several other countries, the availability of discharge billing data (eg. Medicare, state hospital discharge data) has allowed investigators to develop models which demonstrate associations between preoperative risk factors, type of anesthesia or postoperative analgesia and death or specific complications. One of the major advantages of these types of analysis is the ability to observe what is occurring in real-world situations, the power of extremely large numbers of patients. The limitations include the fact that much of the data is not very granular (it usually only includes diagnoses and rarely specific laboratory data or details of the diagnosis), the type of anesthesia and analgesia is only rarely captured and the incidence of postoperative complications depends on the quality of the surveillance. One recent example from our group is the analysis of New York State Hospital Discharge data using logistic regression to demonstrate that regional anesthesia is associated with a lower odds of inpatient mortality and pulmonary complications among all hip fracture patients compared with general anesthesia.[21] By combining Medicare billing data with chart abstract, the influence of specific risk factors such as obesity on surgical outcomes can also be assessed.[22]

The recent development of large perioperative databases also offers other opportunities to demonstrate associations with more granular data. Dr. Liu has discussed above the National Surgical Quality Improvement Project of the American College of Surgeons. The Anesthesia Quality Institute has data from anesthesia practices throughout the United States and the Multi-center Perioperative Outcomes Group has data from AIMS systems. Combining the aggregated data from AIMS systems with the quality assurance databases, Medicare data or NSQIP data

allows very sophisticated relationships to be assessed. For example, a recent analysis of 62,450 patients undergoing perioperative epidural catheterizations developed hematoma requiring surgical evacuation.[23] They were able to determine that frequency of epidural hematoma requiring laminectomy after epidural catheter placement for perioperative anesthesia/analgesia was 1 event per 22,189 placements to 1 event per 4330 placements. Risk was significantly lower in obstetric epidurals.

Given the availability of large data and the power of newer computers the key will be to ensure that appropriate analyses are being performed and that the conclusions from such analyses are accurate. These analyses can show important associations but must be followed by interventional trials to demonstrate that intervening or changing care will result in improved outcomes.

Acknowledgement: Dr. Liu thanks the technical support from Jingyuan Ma and acknowledges the support from NIH K08 (K08-GM-093115) and the Department of Anesthesiology and Critical Care at the University of Pennsylvania

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