

APSF Convenes Conference on Technology Training

by A. William Paulsen, MMSc, PhD, AA-C, and Robert C. Morell, MD

On September 18, 2013, in Phoenix, AZ, the Anesthesia Patient Safety Foundation convened a workshop to critically examine the importance of technology training in anesthesia. Dr. Robert Stoelting opened the conference with an introduction describing the need for anesthesia providers to be competent in their use of advanced medical equipment. Intrinsic to that competence is the assurance of training, education, and familiarity with these devices upon which we rely on a daily basis. To deny the importance of these basic tenets will most certainly result in "doing the same thing over and over again and expecting different results," a concept which Einstein

defined as "insanity." Following Dr. Stoelting's opening remarks, Dr. William Paulsen, chair of the APSF Committee on Technology (COT) and co-chair of the conference, reflected that the COT started to address technology training in 1996. Dr. Jeffrey Cooper, in 1984, published that lack of experience and unfamiliarity with equipment accounted for 63% of all critical incidents. In 1998, Dr. Robert Caplan published reports detailing how gas delivery systems are life support devices and catastrophic failures have occurred due to misuse. It is critical to recognize that training and competency for advanced medical equipment is important, substantiated by both direct and



Dr. William Paulsen, Chair of the APSF Committee on Technology, co-chairs the Technology Training conference.

indirect proof. Manufacturers have long noted that technology training is a perpetual problem with very low rates of participation. Such training is vital when either new equipment or technology is introduced or when a new individual is expected to use existing advanced medical technology.

Important principles include full participation in training, ability to understand device function and operation, ability to use the technology as often as necessary and often enough to maintain familiarity, knowledge of device safety features

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APSF Survey Results:

Drug-Induced Muscle Weakness in the Postoperative Period Safety Initiative

A recent APSF survey of anesthesia professionals on residual muscle relaxant-induced weakness in the postoperative period was a follow-up of the October 2011 APSF Board of Directors Workshop that addressed future patient safety initiatives (Table 1 on Page 70) by proposing the following 4 questions (http://www.apsf.org/newsletters/pdf/winter_2012.pdf).

See "Survey Results," Page 70



The Anesthesia Patient Safety Foundation announces

A NEW PROCEDURE FOR SUBMITTING GRANT APPLICATIONS

LETTER OF INTENT (LOI) PROCESS FOR APSF GRANT APPLICANTS IN 2014

In consideration for an invitation from APSF to submit a formal grant application (maximum award \$150,000 for a study conducted over a maximum of 2 years to begin January 1, 2015), applicants are being asked to initially submit an LOI for review by APSF.

- Deadline to submit an LOI is Monday, March 3, 2014 (5 PM EST).
- Invitations to submit a formal grant application based on the LOI will be sent electronically by APSF on Thursday, May 1, 2014.
- Deadline for submission of a completed grant application based on the LOI will be Friday, August 15, 2014 (5 PM EST).

For the latest information, please visit the [apsf.org](http://www.apsf.org) website or contact Steven Howard, MD, Chair, Scientific Evaluation Committee at howard@apsf.org.

CHANGES TO THE 2014-15 APSF GRANT PROGRAM

The APSF grant program is undergoing significant changes beginning with the next round of funding. A letter of intent (LOI) system will be utilized to replace the full proposal submission of years past. A 3-page letter of intent will be due on March 3, 2014 (5:00 PM EST), and a subset of these applications will be chosen for full grant submission. Applicants chosen for full proposal submission will be informed on May 1, 2014, with full proposals due on August 25, 2014 (5:00 PM EST). The LOI format will allow applicants to submit their proposed work in a shorter format without having to initially write a full proposal. This will also give the Scientific Evaluation Committee an opportunity to provide valuable feedback to those investigators who are invited to submit a full proposal.

The LOI/grant submission process will utilize new grant management software that has been designed to improve the reliability and ease of use for applicants, reviewers, and administrators. LOI submissions will be accepted via the [apsf.org](http://www.apsf.org) website.

—Steven Howard, MD

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NEWSLETTER

The Official Journal of the Anesthesia Patient Safety Foundation

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APSF Newsletter

guide for authors

The *APSF Newsletter* is the official journal of the Anesthesia Patient Safety Foundation. It is published 3 times per year, in June, October, and February. The *APSF Newsletter* is not a peer-reviewed publication, and decisions regarding content and acceptance of submissions for publication are the responsibility of the editors. Individuals and/or entities interested in submitting material for publication should contact the editors directly at Morell@apsf.org and/or Lee@apsf.org. Full-length original manuscripts such as those that would normally be submitted to peer review journals such as *Anesthesiology* or *Anesthesia & Analgesia* are generally not appropriate for publication in the *Newsletter* due to space limitations and the need for a peer-review process. Letters to the editor and occasional brief case reports are welcome and should be limited to 1500 words. Special invited articles, regarding patient safety issues and newsworthy articles, are often solicited by the editors. These articles should be limited to 2000 words. Ideas for such contributions

may also be directed to the editors. Commercial products are not advertised or endorsed by the *APSF Newsletter*; however, upon occasion, articles about certain novel and important technological advances may be submitted. In such instances the authors should have no commercial ties to, or financial interest in, the technology or commercial product. The editors will make decisions regarding publication on a case-by-case basis.

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All submissions should include author affiliations including institution, city, and state, and a statement regarding disclosure of financial interests, particularly in relation to the content of the article.

President's Report Highlights Accomplishments of 2013

by Robert K. Stoelting, MD

As president of the Anesthesia Patient Safety Foundation (APSF), it is my privilege to report annually on the activities of the foundation during the past calendar year. As in my previous annual reports, I believe it is important to recognize that the APSF, as an advocacy group, does not write standards. Recommendations developed and promulgated by the APSF are intended to assist professionals who are responsible for making health care decisions. Recommendations promulgated by the APSF focus on minimizing the risk to individual patients for rare adverse events rather than necessarily on practices that balance all aspects of population health quality and cost. The APSF does not intend for these recommendations to be standards, guidelines, or clinical requirements nor does application of these recommendations guarantee any specific outcome. Furthermore, these recommendations may be adopted, modified, or rejected according to clinical needs and restraints. The APSF recognizes that these recommendations are subject to revision as warranted by the evolution of medical knowledge, technology, and practice.

A highlight of the annual meeting of the American Society of Anesthesiologists in San Francisco in October 2013 was the Ellison C. Pierce, Jr., MD, Patient Safety Memorial lecture delivered by Alan F. Merry, MBChB. Dr. Merry's topic was "Toward Patient Safety in Anesthesia—Let the Journey Continue." This named lectureship continues to be part of the annual ASA meeting thus providing sustained recognition for the vision and contributions to anesthesia patient safety made by Dr. Pierce as the founding president of the APSF. The annual APSF Board of Directors Workshop held on October 12, 2013, was moderated by David M. Gaba, MD, and entitled "Should anesthesia incidents be investigated as they are in other high-risk industries?"

The APSF was pleased to congratulate Jeffrey B. Cooper, PhD for his well-deserved selection as the 2012 recipient of the prestigious ASA Distinguished Service Award. Dr. Cooper was a founding member of the APSF Executive Committee in 1985 and has continued to lead anesthesia patient safety efforts during his illustrious career (see p.56 of this issue).

Educational DVDs

The APSF is pleased to announce the availability of complimentary copies of the following educational DVDs (visit the APSF website for details, www.apsf.org):

- **Opioid-Induced Ventilatory Impairment (OIVI):** Time for a Change in the Monitoring Strategy for Postoperative PCA Patients (Executive Summary, 7 minutes)
- **Perioperative Visual Loss (POVL):** Risk Factors and Evolving Management Strategies (Executive Summary, 10 minutes)



Robert K. Stoelting, MD
APSF President

- APSF Presents **Simulated Informed Consent Scenarios for Patients at Risk for Perioperative Visual Loss (POVL)** (18 minutes)

The simulated informed consent scenarios are based on the conclusions of the September 11, 2012, APSF-sponsored multispecialty conference that "the remote risk of blindness should be part of the informed consent process" for patients at risk for POVL.

Residual Muscle Relaxant-Induced Weakness in the Postoperative Period: Is It a Patient Safety Issue?

The APSF conducted a survey of anesthesia professionals' opinions regarding the patient safety importance of residual muscle relaxant-induced weakness in the postoperative period. The results of this survey are reported starting on page 49 of this issue.

Anesthesia Professionals and the Use of Advanced Medical Technologies: Recommendations for Education, Training, and Documentation

The APSF sponsored a conference on Wednesday, September 18, 2013 (Royal Palms Resort and Spa, Phoenix, AZ), to address the safe use of advanced medical technology by anesthesia professionals. The conference engaged all stakeholders

(anesthesia professionals, technology manufacturers, accrediting and regulatory agencies, professional technology organizations, insurers, hospital administrators, risk managers) to discuss and refine the existing APSF Committee on Technology's Advanced Medical Technology Training document (<http://www.apsf.org/announcements.php?id=27>)

Using an audience response system, 60% of the 94 attendees described themselves as anesthesia professionals, 97% of the attendees believed the logic was compelling to require confirmation of competence before using advanced medical technology despite a paucity of supporting literature, 93% viewed standardization of technology as important for safety, 65% of the respondents viewed the "traditional in-service model" (occurs when equipment installed, voluntary, offered during clinical work hours) as "inadequate (cannot be fixed and needs to be replaced with new concepts/technology such as e-learning modules, hands on simulator sessions and individual downloadable apps), and 91% of attendees concluded the APSF should encourage anesthesia professional societies to promote adoption of training requirements on the use of advanced medical technology.

Patient Safety and the Perioperative Surgical Home (PSH)

The APSF will hold a consensus conference on this topic on Wednesday, September 3, 2014 (Royal Palms Resort and Spa, Phoenix, AZ). The APSF believes that the model envisioned by the PSH will present opportunities for patient safety innovations. The goals of this 1-day conference will include establishing a better understanding of the PSH concept and how its implementation could facilitate patient safety initiatives. Those interested in attending the conference are encouraged to contact Dr. Stoelting (stoelting@apsf.org) for registration information.

Research

The APSF Committee on Scientific Evaluation chaired by Steven K. Howard, MD, received 45 grant applications in 2013. In October 2013, the committee recommended funding the following 4 research awards totaling \$543,461 to begin in January 2014.

In addition, the APSF will continue its support of the APSF Safety Scientist Career Development Award (SSCDA) (\$150,000.00 over 2 years) beginning in July 2014. The APSF will also award a grant of up to \$200,000 to begin in

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APSF President Reflects on Patient Safety Initiatives for 2013

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July 2014 to evaluate the "implementation and performance" of the APSF Pre-Induction Patient Safety (PIPS) checklist.

The APSF is the largest private funding source for anesthesia patient safety research in the world. Since the inception of the APSF grant program 727 grant applications have been received by the APSF. When the first grants were funded in 1987, funding for anesthesia patient safety was virtually unknown. Since 1987, the APSF has awarded 100 grants for almost \$9 million. The impact of these research grants is more far-reaching than the absolute number of grants and total dollars, as APSF-sponsored research has led to other investigations and the development of a cadre of anesthesia patient safety investigators.

APSF Newsletter

The *APSF Newsletter* continues its role as a vehicle for rapid dissemination of anesthesia patient safety information with Robert C. Morell, MD, and Lorri A. Lee, MD, as co-editors. The *APSF Newsletter* is provided as a member benefit by the ASA, American Association of Nurse Anesthetists (AANA), American Association of Anesthesiologists Assistants (AAAA), American Society of Anesthesia Technologists and Technicians (ASATT), American Society of PeriAnesthesia Nurses (ASPAN), American Society of Dentist Anesthesiologists (ASDA), American Dental Society of Anesthesia (ADSA), and the American Association of Oral Maxillofacial Surgeons (AAOMS) with a resulting circulation of 107,515. In addition to the electronic version of the *APSF Newsletter*, a hardcopy is mailed to all members of the ASA, AANA, AAAA, ASPAN, and ASDA.

The "Question and Answers" and "Dear SIRS" (Safety Information Response System) columns in the *APSF Newsletter* provide rapid dissemination of safety issues related to anesthesia equipment in response to questions from readers. These columns are coordinated by Drs. A. William Paulsen (chair, APSF Committee on Technology) and Robert C. Morell (co-editor, *APSF Newsletter*). The value of industry to anesthesia patient safety is reflected by these columns.

Communication

The APSF website design and appearance (www.apsf.org) continues under the direction of APSF Executive Vice President George A. Schapiro. The APSF website includes a monthly poll question related to anesthesia patient safety issues. The poll question is coordinated by Timothy N. Harwood, MD, a member of the APSF Committee on Education and Training chaired by Richard C. Prielipp, MD. Online donations to APSF are possible via the website.

Sorin J. Brull, MD, continues as the Patient Safety Section editor for *Anesthesia & Analgesia*.

The APSF sponsored a panel entitled "Anesthetic Toxicity in Infants" at the May 2013 annual congress of the International Anesthesia Research Society. The panel was moderated by Richard C. Prielipp, MD, chair, APSF Committee on Education and Training.

Prevention and Management of Operating Room Fires

To date more than 6,000 individual requests for the complimentary copy of the Prevention and Management of Operating Room Fires DVD (http://www.apsf.org/resources_video.php) have been received. In an effort to increase awareness for the potential of surgical fires in at risk patients, the APSF published a "Fire Prevention Algorithm" in the Winter 2012 issue of the *APSF Newsletter* (<http://www.apsf.org/newsletters/html/2012/winter/index.htm>). The goal of the "APSF Fire Prevention Algorithm" to increase awareness of the risk of operating room fires was endorsed by ASA, AAAA, AANA, ASATT, American College of Surgeons, ASPAN, Association of periOperative Registered Nurses, ECRI Institute, Food and Drug Administration Safe Use Initiative, National Patient Safety Foundation, and The Joint Commission.

Medication Safety in the Operating Room

To date more than 2,000 individual requests for the complimentary copy of the 18-minute educational DVD entitled "Medication Safety in the Operating Room: Time for a New Paradigm" (http://www.apsf.org/resources_video2.php) have been received.

Financial Support

Financial support to the APSF from individuals, specialty and components societies, and corporate partners in 2013 has been most gratifying. This sustained level of financial support makes possible the undertaking of new safety initiatives, the continuation of existing safety initiatives, and funding for anesthesia patient safety research. The level of research support is particularly dependent on the level of financial support received.

Online Donations

The link for online donations to the APSF is <http://www.apsf.org/donate.php>. Contributions may also be mailed to the Anesthesia Patient Safety Foundation, 515 North Northwest Highway, Park Ridge, IL, 60068.

Concluding Thoughts

The APSF extends its condolences to the family, friends, and colleagues of Ephraim ("Rick") S.

Siker, MD, who passed away on June 21, 2013 (<http://www.apsf.org/newsletters/pdf/Fall2013.pdf>). Dr. Siker was a past president of the ASA and a founding member of the APSF Executive Committee, retiring from the APSF Board of Directors in 2003 after 18 years of service. Dr. Siker was a tireless advocate for patient safety, mixing his passion for the foundation's mission that "no patient shall be harmed by anesthesia" with wit and wisdom that only he could provide.

The APSF is also saddened to learn of the passing of Jerod Loeb, PhD, member of the APSF Board of Directors. Our condolences are extended to Dr. Loeb's family.

The APSF thanks retiring board directors, Patricia A. Kapur, MD, and Alexander A. Hannenberg, MD, and welcomes new directors, Daniel J. Cole, MD, and Jerry A. Cohen.

At the annual meeting of the APSF Board of Directors in October 2013, Steven R. Sanford, JD, was elected as a member-at-large to the APSF Executive Committee and Robert J. White, Covi-den, became vice president.

As in the previous annual report, I wish to reiterate the desire of the APSF Executive Committee to provide a broad-based consensus on anesthesia patient safety issues. We welcome the comments and suggestions from all those who participate in the common goal of making anesthesia a safe experience. There remains much still to accomplish and everyone's participation and contributions are important.

Best wishes for a prosperous and rewarding year 2014.

Robert K. Stoelting, MD
President

Vision

The vision of the Anesthesia Patient Safety Foundation is to ensure that no patient shall be harmed by anesthesia.



Mission

The APSF's Mission is to improve continually the safety of patients during anesthesia care by encouraging and conducting:

- safety research and education;
- patient safety programs and campaigns;
- national and international exchange of information and ideas.

Workshop Encourages Multidisciplinary Perspective

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and how to avoid the potential for harm, and, finally, the ability to recognize when a device is not functioning properly and be able to trouble-shoot to avoid harm.

- The majority of conference participants (74%) agreed that current advanced medical technology training is inadequate.
- 80% of respondents agreed that the typical low participation in new product training reflects the inherent flaws in the traditional "in-service training concept."
- 89% of conference attendees agreed that adoption of training requirements for advanced medical technology parallels the national discussion for patient safety and is a safety requirement on which "we" must deliver.
- Despite limited supporting literature, the conference participants overwhelmingly (97%) concluded that logic is compelling to require confirmation of competence before using unfamiliar and/or complex advanced medical technology that can directly impact patient care.
- Conference attendees rejected (79%) the proposal that the low incidence of equipment problems does not justify efforts directed toward advanced medical technology training and limited resources should be diverted to solving other safety problems.

Speakers at the conference represented all key areas including provider perspectives, industry/manufacture perspectives, institutional perspectives, training and educational perspectives, and regulatory perspectives. The speakers included Jeffrey M. Feldman, MD, MSE (division chief, General Anesthesia Children's Hospital of Philadelphia), Matthew B. Weinger, MD (professor, Anesthesiology & Medical Education, Vanderbilt University), Nikolaus Gravenstein, MD (professor of Anesthesiology, University of Florida), Michael A. Olympio, MD (professor of Anesthesiology, Wake Forest School of Medicine), David Schlotterbeck, MSEE (moderator, Chair, National Council for Healthcare Technology Safety), Timothy W. Vanderveen, PharmD, MS (vice president, Center for Safety and Clinical Excellence, CareFusion), Saliha K. Gref, JD (associate general counsel and chief compliance officer, Respiratory and Monitoring Solutions, Covidien), David Karchner (director of marketing, Perioperative Care, Dräger), Kevin G. Tissot (chief engineer-Anesthesia, Life Care Solutions, GE Healthcare), Steven J. Barker, MD, PhD (acting chief medical officer, Masimo; chair emeritus, Department of Anesthesia, University of Arizona School of Medicine), Carsten Bech-Jensen (senior clinical and service specialist, Marketing and Clinical Application, Anesthesia Care, Philips Healthcare), R. Michael Boyer, DO, MS (moderator, associate professor, Department of Anesthesiology, Northwestern University Feinberg School of Medicine), Nancy G. Pratt, RN, MS (chief quality and patient safety officer, St. Joseph's Health),



APSF partners with Industry to improve advanced medical technology training for anesthesia professionals. Panelists, left to right: Steven J. Barker, MD, PhD (Acting Chief Medical Officer, Masimo, Chair Emeritus, Department of Anesthesia, University of Arizona School of Medicine), Timothy W. Vanderveen, PharmD, MS (Vice President of the Center for Safety and Clinical Excellence, CareFusion), Saliha K. Gref, JD (Associate General Counsel and Chief Compliance Officer, Respiratory and Monitoring Solutions, Covidien), David Karchner (Director of Marketing, Perioperative Care, Dräger Medical), Kevin G. Tissot (Chief Engineer-Anesthesia, Life Care Solutions, GE Healthcare), and Carsten Bech-Jensen (Senior Clinical and Service Specialist, Marketing and Clinical Application, Anesthesia Care, Philips Healthcare). Foreground facing away, one of the authors of this article: Dr. A. William Paulsen, MMSc, PhD, AA-C (Chair of the APSF Committee on Technology).

Brian J. Thomas, JD (senior claims attorney, director of Risk Management, Preferred Physicians Mutual), Jerry Stonemetz, MD (past medical director of Anesthesia Services, Hospital Corporation of America), Bruce P. Halbert, PhD (consultant to APSF Executive Committee, Battelle Energy Alliance – Idaho National Laboratory Director, Nuclear Safety and Regulatory Research Division), David Gaba, MD (moderator, Professor of Anesthesia, Stanford University School of Medicine), Michael Argentieri (vice president, Market Development, ECRI Institute), Mary K. Logan, JD (president and CEO, Association for the Advancement of Medical Instrumentation), Patricia Adamski, RN, MS, MBA (director, Standards Interpretation Group, The Joint Commission), Julian M. Goldman, MD (medical director, Partners HealthCare, Biomedical Engineering Anesthesiology, Massachusetts General Hospital/Harvard Medical School), Daniel Hatlestad (clinical marketing manager, Perioperative Care, GE Healthcare), Jason R. Byrd, JD (director of Patient Safety, Hospital Engagement Network, Quality Division, Carolinas HealthCare System), Nathaniel M. Sims, MD (physician advisor, National Council for Healthcare Technology Safety), Anthony C. Easty, PhD, CCE-C, CCE (senior scientist, Baxter, Chair of Health Technology, University of Toronto), and Patricia Trbovich, PhD (academic research lead, HumanEra, University of Toronto).

- 93% of conference attendees agreed that when an anesthesia professional first joins an anesthesia group/practice, he/she should be required to demonstrate competence in the use of all advanced medical technology that will be used in his/her care of patients.
- Conference attendees (92%) overwhelmingly support the concept that the hospital privileging process include evaluation of training and competence in advanced medical technology before such a privilege be granted for physi-

cians and other practitioners providing a medical level of care.

- 94% of conference participants agreed that industry should standardize (especially interfaces) advanced medical technology similar to the automotive industry.
- An overwhelming 97% of respondents agreed that no amount of training (voluntary or mandatory) will obviate the need for highly usable medical device user interfaces.
- 99% of conference participants agree that manufacturers should be encouraged to provide web access to user manuals and training information.
- Conference attendees (95%) agreed that advanced medical equipment should record button-presses and other information that can be used to improve user interface design, device performance, and training.
- 91% of conference attendees agreed that inclusion of training in the pricing of advanced medical technology should be part of every proposal to avoid the temptation to accept a lower bid but without a training feature.
- 95% of conference attendees agreed that technology training should have standardized elements across vendors.
- Conference participants agreed (89%) that ongoing professional practice evaluation data collection should include data on training and competence of the practitioner being evaluated.
- Conference attendees (84%) agreed that Maintenance of Certification in Anesthesiology (MOCA) requirements should include training and competency assessment on the use of advanced medical technology.
- A majority (77%) of conference attendees agreed that mandatory components of training should include advanced trouble-shooting simulations.

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Conference Participants Seek Greater Use of Advanced Medical Technology Training

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- 99% of conference participants agreed that there is a role for readily accessible computerized interactive training tools (such as tablet apps) for training health care providers.
- Conference participants (75%) agreed that evaluative tests embedded in computerized interactive training tools are a good platform to electronically document competency and assign recertification if appropriate.
- 72% of participants felt that hands-on-in-service training should be replaced with computerized interactive training tools.
- 91% of participants agreed that the APSF should encourage anesthesia professional societies to promote adoption of training requirements on the use of advanced medical technology.

Discussion

Sixty percent of conference participants were anesthesia professionals and 20% were representing the medical device industry. Five percent were risk management, hospital administration, or regulatory agencies, while another 5% were health care professionals outside of anesthesia.

The majority of participants agreed that current in-service strategies are inadequate and low participation rates of clinicians are symptomatic of current flaws. Despite a lack of evidence to the contrary, 97% of participants felt that requiring practitioners to demonstrate their competence in using advanced

medical technologies to care for patients was essential and paralleled the national discussion on patient safety. Participants rejected the concern that the low incidence of equipment problems doesn't justify the "cost" of advanced technology training.

Participants overwhelmingly agreed that advanced medical technology should be added to the hospital privileging process and to deny the use of such technology for patient care to anyone who has not demonstrated proficiency, including anesthesia professionals who are new to a practice.

Conference participants supported the concept that industry should standardize their equipment, especially interfaces, that would permit a knowledgeable user of one brand of anesthesia machine to safely operate an unfamiliar machine from another manufacturer. The automobile industry has standardized cars such that a driver of a rental car can safely operate any manufacturer's rental vehicle even though they might not understand all of the technologic features. In addition, participants overwhelmingly agreed that no amount of training can obviate the need for a highly functional user interface.

Ninety-nine percent of participants want to have web access to equipment user manuals for emergency purposes and to have access to training materials. The vast majority of attendees would like to see equipment record button presses and other information to improve user interface design, device performance, and training, and participants (95%) would like to see standard elements across vendors in training programs.

Eighty-four percent of the participants believe that MOCA should include training and assessment of competency in advanced medical technology, including device troubleshooting simulations. Conference participants agree (99%) that there is a role for readily accessible computerized interactive training tools, but they still want the assessment to include direct hands-on demonstration of the proper use. A choice of media would provide the best chance of reaching many anesthesia professionals with different learning styles and outside commitments, whether it is interactive web-based, an application for your television or phone, video, or print material.

Ninety-one percent of participants would like the APSF to encourage anesthesia professional societies to promote adoption of training requirements on the use of advanced medical technology. In response to this conference, the emerging consensus, and the need to advance patient safety by the implementation of technology training initiatives, the APSF and the APSF Committee on Technology are currently working toward developing recommendations to these ends. These recommendations will appear in a future issue of the *APSF Newsletter*.

Dr. Paulsen is professor of Biomedical Engineering and director of the Anesthesiologist Assistant Program in the School of Health Sciences at Quinnipiac University, and chair of the APSF Committee on Technology. Dr. Morell is a private practice anesthesiologist in Niceville, Florida, co-editor of this newsletter, and member of the APSF Board of Directors.

Do You Really Know Your Technology?

by Jeffrey B. Cooper, PhD

A few years ago, I went to a car dealer to buy a new hybrid electric car. I didn't know how to start it. I was a bit disoriented and a tad embarrassed. I'm not sure I would have figured it out if the salesman hadn't told me (I'm an engineer so I'd like to think I could). It didn't take much—there's no key and thus no place to insert one. Perhaps if someone gave me the fob and said, "Here's the key, there's no hole to put it in, take it for a spin," I might have instinctively put my foot on the brake and pushed the button marked "POWER." If you don't put your foot on the brake, it will only turn on the auxiliary power; it won't power up the engine or engage the battery driven motor. Once I was shown how to start it, I still wasn't sure how to drive it away; the gearshift is more like a joystick. I got the gist of it but didn't know what the "B" symbol meant (engine braking to be used to downshift to maintain a safe speed on a steep downhill). When it came to learning some of the cool features, like the hands-free, voice-activated phone that connects via Bluetooth to my cell phone, once again I needed instruction. This is an important safety fea-

ture. I could have driven the car without it but, had I not enabled this system, I wouldn't have been able to use my cell phone as safely.

This situation is similar to the current world of anesthesia technology. In the old days, if you were an anesthesia professional with the usual training, you could just walk up to a new anesthesia machine, monitor, or just about any device and figure out how to use it in its basic mode. You might even figure out some special features. A few decades ago, it was pretty easy to understand how it all worked, at least I thought so given my engineering background. Yet, when trying to teach residents about the basic concepts of how an anesthesia machine works, I was always surprised that it was impenetrable for many. I can only imagine how difficult it is for most providers to use, not to mention, understand the inner workings of new complex machines by themselves. How much can we possibly expect people, few of whom have backgrounds in physics or engineering, to understand how a BIS monitor arrives at the displayed value, how algorithms that generate non-invasive blood pressure measurements interpret the signals and decide



Joystick" gearshift on 2010 Prius. What is the "B" for?

what numbers to display, or what hazards lurk when using some new airway device? The answer is "not much." Yet, many anesthesia professionals still expect to be able to do that. I'd call that hubris. It's dangerous. How can we make it safer?

Anesthesia is one of the most technology-dependent specialties. The modern anesthesia professional must have at least basic competence to use at least twice as many devices as a decade ago; devices which are far more complex. We are similarly challenged with "techno-overload" in our everyday life, where

**See "Do You Know Technology?"
Next Page**

Competency Necessary for Complex Technology

"Do You Know Technology?" From Preceding Page

we have choices regarding which technologies we choose to buy and use, unlike the clinical arena. But these new devices are not the only additional elements of modern anesthesia. There are also a vastly increased number of drugs, procedures, regulations, patient-centered care requirements and production pressure, and a demand to know much more about the system within which they all must inter-operate. This situation creates more ways in which failures can occur. In the language of human factors, these are each "latent conditions" or "latent failures," lurking to trigger, enable, exacerbate, or obscure the evolution of an adverse event. You, the anesthesia professional, must not be complacent about this additional risk under which you are operating. To do so is to tempt fate. While there is no magic cure, surely the more you know about the technology the more you can help either prevent an event from evolving or improve your chances of stopping it once it has started on a path of potential destruction.

The opening paragraph might lead you to ask, "Do you need to know how a car works in order to drive it?" The answer is no. Almost anyone with normal intelligence and basic physical abilities can learn to drive a car, even quite competently, without having a clue about what goes on inside. But, how much do you need to know to drive it safely, or at least how much do you have to learn about the features and hazards to stay out of trouble or to get out of trouble? Take the key fob for instance. What if it malfunctions? Would you know how to get into the car and start it? If you weren't shown what to do or don't read the manual, I doubt that 20% of people could get into the car, and only 1% could start it (check online to find out the trick). What about the navigation system? If you haven't used one a lot, you might not figure it out so quickly or perhaps not at all. If you are lost and in a hurry to get someplace, it might not be of much use. Perhaps more important, while not recommended, it's easy to be lured into trying to program it while you are stopped at a light. You can easily get distracted and lose situational awareness. A few years ago there was a widely publicized report of airline pilots becoming distracted with a computer program for over an hour, missing the airport entirely, proof that it can happen even to well-trained professionals. If you're in a rainstorm, lost at night, or otherwise at higher risk, the risk of a distraction-induced accident increases. Sure, you are not supposed to try to use this feature unless you are stopped on the side of the road, but in a pinch, you'll be tempted to try.

For all of these situations, there are analogies to the challenges and hazards of modern anesthesia technologies. Anesthesia machines are now essentially computers, as are most devices used in the operating room. They have so many features, just like any kind of software, that you'd have to be very committed to learning

how to use all of them. Trying to do that in the midst of a problem isn't wise. Opportunities for distraction now abound, exacerbated perhaps by electronic record keeping. AIMS may be a great tool for many reasons, but don't try to learn how to use it for the first time during a real procedure. And don't get stuck exploring its features when a challenging moment arises. What makes the situation worse in anesthesia is that, typically, the human factors design of anesthesia equipment is much less user friendly than that of a car. That just makes it easier to get trapped into not knowing how to use some feature when you need it or trying to use a device incorrectly.

So, what is the minimum you need to know about anesthesia technology to use it effectively and safely? Every health care provider should take responsibility to learn how to use a device and practice using its features before they first use it on a patient. That may sound obvious. But, there are few, if any requirements for it, and there isn't always time set aside in busy practices to really get to know a device before you first use it. That's a situation that needs to change and soon.

This idea was the underlying theme of the recent APSF workshop and the report that has followed (see page 49 and following). Should there be requirements to require training and/or demonstrate competence on anesthesia devices? It's required in almost all disciplines that impact on public safety, e.g., aviation, nuclear power, chemical production, and even many trades. Why not in anesthesia? Why is it acceptable for any clinician to decide for himself or herself that they know enough to use a device without training or, even if they get some training, that they are competent to use it? The Anesthesia Patient Safety Foundation took a position on this in 2009. Here's what we said:

"Although existing literature does not describe frequent adverse anesthesia events owing to the anesthesia professional's lack of understanding of equipment, the APSF believes the logic is compelling to require confirmation of competency before using unfamiliar and/or complex anesthesia equipment that can directly affect patient safety. In this regard, the APSF believes that each facility should develop a required, formal process to assure that anesthesia professionals have received appropriate training and/or demonstrated competence in the use of such medical devices. Manufacturers should refine and initially offer this training. This required process for administering training and/or for demonstrating competence should be efficient, timely, and pertinent in addressing new critical features and relevant failure modes. The most effective manner to successfully accomplish this training and testing is not known and requires deliberate investigation." (http://www.apsf.org/resource_center/newsletter/2008/winter/03_formal_training.htm)

Until there are such requirements, you, the individual provider, can adopt the spirit of this statement. Above all, know your limits. When my wife drove

our car for the first time, I tried to show her how to use the "B" control on the joystick. At the time, we were going down a steep hill. She knew she couldn't do that without looking down for the joystick and its markings and said, "I can't do that now." That was the right move (she's wiser than I am). The engine braking is nice and saves fuel, but is not necessary for safe operation. My wife knew she wasn't comfortable with the joystick; its use is not obvious and requires that one look down to find it. That's not the thing to be doing while you are driving, especially on a winding hill. Fortunately, she had better sense than I did. I hope you do, too. Don't try to figure out new features during patient care. Find a better time before you need the feature.

How much do you need to understand about how a measurement is made to use it safely and effectively? I suspect more than most people generally know. I doubt that most anesthesia providers today really understand how a non-invasive blood pressure monitor determines the blood pressure it displays. More importantly, many likely don't know all (or even most) of the ways that measurement can be fooled as a result of the way it is made. There are lots of ways that can happen. Depth of anesthesia is another example as is the more common measurement, pulse oximetry. With both, there are plenty of ways to get fooled and do the wrong thing based on misleading information. In typical use, this isn't a problem. In the unusual patient or unusual circumstance, it can be. Having at least some basic understanding of the basis for the number you are using to guide care can be life saving.

Where are you going to get the training you need? There are several good textbooks to help, but that's just a start and not likely to help most of you since most adults learn experientially. There are various ways to get training, but not nearly enough. I hope that one result of the APSF workshop on technology education will be to motivate more training programs to improve technology training, especially on-line and via simulation. Practice and experience are great teachers.

I bought the car. I adapted to it quickly. I've learned almost all the cool features. The real test will come when it doesn't start or breaks down somewhere. Will I have a chance of getting it going without calling a service truck? And, when you confront a new situation with your latest anesthesia technology, how well prepared will you be to cope? Improve your chances. Read a book. Take a workshop. Ask your colleagues. Please don't fail to act.

Jeffrey B. Cooper, PhD is Executive Vice President, APSF, Professor of Anaesthesia, Harvard Medical School and Executive Director of the Center for Medical Simulation, Boston, MA.

APSF Executive Vice President Jeffrey B. Cooper, PhD Awarded the 2012 Distinguished Service Award by the ASA

by David Gaba, MD

APSF Executive Vice President Jeffrey B. Cooper, PhD, has been awarded the 2012 Distinguished Service Award by the American Society of Anesthesiologists. This award is the highest tribute the Society can pay to an ASA member. It may be given for outstanding clinical, educational, or scientific achievement, contribution to the specialty, and/or exemplary service to the Society. Dr. Cooper was elected to receive this award for achievements in all these areas, save only for clinical work. Dr. Cooper is the first non-clinician to receive the Society's highest award.

Jeffrey B. Cooper, PhD, is the founder and executive director of the Center for Medical Simulation, which is dedicated to the use of simulation in health care as a means to improve the process of education and training and to avoid risk to patients. He is also professor of Anesthesia at Harvard Medical School. He received his BS in Chemical Engineering and MS in Biomedical Engineering from Drexel University in 1968 and 1970, respectively, and completed a PhD in Chemical Engineering at the University of Missouri in 1972.

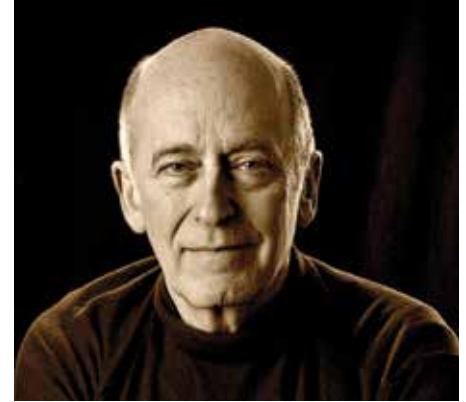
Dr. Cooper joined the Bioengineering Unit in the Department of Anesthesia and Critical Care at Massachusetts General Hospital, where he had a great impact on anesthesia patient safety in the institution. He was involved in many threads of research to improve safety, including the development of one of the first microprocessor-based medical technologies, the Boston Anesthesia System, the conceptual forerunner of today's most advanced anesthesia workstations. Perhaps his most influential line of research was to lead a team that used the aviation-inspired critical incident analysis technique to understand the causes of anesthesia-related mishaps and injuries. A seminal publication from the group in 1978, with Cooper as first author, provided important data on the human factors of how and why anesthetic mishaps occurred. This was the first of a series of papers on the topic; publications that not only illuminated these issues in an entirely new way, but also inspired a whole generation of new investigations and investigators addressing anesthesia patient safety. It is largely for this work that Dr. Cooper is widely regarded as the "father of patient safety research."

However, Dr. Cooper's contribution to patient safety and to the ASA were not confined to research. He was a lead member along with Dr. John Eichhorn and others of the group that created the first safety-related standard for anesthesia, the 1985 Harvard Anesthesia Monitoring Standards, described in a 1986 paper in JAMA, which became the basis for monitoring standards adopted by the ASA. In 1984, Cooper joined with

other Harvard colleagues including Drs. Ellison C. Pierce, Jr., and Richard Kitz, to convene the International Symposium on the Prevention of Anesthesia Mortality and Morbidity, which constituted the first public examination of what was soon to be known as "anesthesia patient safety." Out of this was born the idea for the Anesthesia Patient Safety Foundation (APSF), which was launched in 1985. Dr. Cooper was a major force in the creation of the APSF, and is widely considered the scientific heart of the organization. He has served continuously on the APSF Executive Committee since its inception (the only remaining founder on the Committee), and for 13 years was chairman of its Committee on Scientific Evaluation—essentially the study section for APSF patient safety grants (whose 100 awards from 1987 to 2013 total approximately \$9 million). Since 2003 he has served as one of two APSF executive vice presidents. It was also due to Dr. Cooper's persistent insistence that APSF became a truly pan-professional organization with Executive Committee members or Committee chairs coming from the ranks of MDs, CRNAs, Anesthesiologist Assistants, and PhDs.

Dr. Cooper influenced strongly the creation of the National Patient Safety Foundation and founded its grant program, which he directed for 8 years. At various times he served on the NPSF's Board of Directors, Board of Governors, and Executive Committee. Thus, it can be fairly said that Cooper is the father of "patient safety" as both a research and organizational topic, for all of health care, not just anesthesia. In fact, Dr. Atul Gawande, writing about safety in surgery in the *New Yorker* magazine (and reprinted in his book *Complications: A Surgeon's Notes on an Imperfect Science*) highlighted Cooper's work, and indicated ruefully that, at the time of the publication, "Surgery, like most of medicine, awaits its Jeff Cooper." It is to a substantial degree through the work of Dr. Cooper that the concept of patient safety as something to be studied and sought in its own right, rather than just being a side-effect of clinicians doing their jobs properly, has been correctly attributed to the field of anesthesiology; a fact that itself has done a huge service to the ASA.

Dr. Cooper has also played a major role in the diffusion and innovation of health care simulation. Through the APSF he was exposed to early efforts in simulation in the mid-1980s, creating the Harvard Anesthesia Simulation Project in 1992. This brought together the (then) 5 anesthesia teaching programs in the Harvard system in a project for faculty to learn to conduct crisis-resource management types of simulation training for residents, anesthesiologists, and nurse anesthetists, under the tutelage of Dr. David Gaba and colleagues



Jeffrey B. Cooper, PhD, APSF Executive Vice President

from Stanford and using their group's pre-commercial simulator. This led to the 1994 founding of the Boston Anesthesia Simulation Center—the first dedicated health care simulation center in the world. BASC later morphed into the world-renowned Center for Medical Simulation. Among the more innovative programs Dr. Cooper created or co-developed are the Institute for Medical Simulation, live interactive simulation video-conferencing, and the novel Healthcare Adventures (a program for training health care administrators and leaders in teamwork via realistic simulation). Dr. Cooper is a founding and current member of the ASA's Simulation Editorial Board and a member of the American Board of Anesthesiology's OSCE Development Advisory Panel.

In addition to the ASA's Distinguished Service Award, Dr. Cooper has received numerous honors for his work in patient safety, including the 2003 John M. Eisenberg Award for Lifetime Achievement in Patient Safety from the National Quality Forum and the Joint Commission on Accreditation of Healthcare Organizations and the 2004 Lifetime Achievement Award from the American Academy of Clinical Engineering. In 2009 the Department of Anesthesia and Critical Care of the Massachusetts General Hospital established the Jeffrey B. Cooper Patient Safety award in his honor. The ASA chose him to deliver the 2011 Wright Memorial Lecture.

The ASA, the APSF, the field of anesthesiology, and indeed health care as a whole are all extremely proud and grateful that we "did have our Jeff Cooper." He is rightly recognized with the ASA's highest award.

Dr. Gaba is Associate Dean for Immersive and Simulation-based Learning, Professor of Anesthesia at Stanford University School of Medicine, Director of the Patient Simulation Center for Innovation at the Veterans Administration Palo Alto Health Care System and member of the APSF Executive Committee.

Four APSF Grants Awarded for 2014

by Steven K. Howard, MD

The APSF's mission statement explicitly includes the goal to improve continually the safety of patients during anesthesia care by encouraging and conducting safety research and education. Since 1987, almost \$9 million has been provided to investigators for patient safety research and the field of anesthesiology continues to be a shining example in health care in this area. In 2013, the APSF investigator-initiated grant program had the second greatest number of grant submissions in its 28-year history—a total of 45. We are pleased that there continues to be such an enthusiastic interest in the study of patient safety.

Over the summer, members of the Scientific Evaluation Committee (SEC) provided reviews of this year's grant submissions and from these reviews a subset was chosen for further discussion during a convened meeting of the SEC on October 12, 2013, at the ASA National Meeting in San Francisco, CA. Of the 8 finalists, 4 were recommended to and approved by the APSF Executive Committee for funding. The principal investigators of this year's APSF grant awardees provided the following description of their proposed work:



Scott C. Watkins, MD

Vanderbilt University,
Department of Anesthesiology

Dr. Watkins' submission is titled *"The Effect of Technical and Non-Technical Decision Support Tools on Team Performance in Simulated Perioperative Pediatric Crises."*

Background: During critical events, clinicians routinely deviate from evidence-based standards and omit critical actions when they depend upon memory alone. Reasons for this are thought to be multi-factorial in nature including decay in techni-

cal skills (TS) and knowledge over time and the negative influence of stress on performance during high-stakes events. There is also increasing evidence that failures in team-based non-technical skills (NTS) including inadequate leadership, failing to assign roles, poor task distribution, inadequate planning, and broken communication, contribute to poor adherence to guidelines and treatment algorithms by clinicians. These deficits in NTS lead to failures in the transfer of medical knowledge into appropriate clinical actions.

Efforts to improve clinician performance with the use of cognitive aids containing reminders of TS have yielded mixed results with some demonstrating improved, but not perfect, adherence to guidelines and others demonstrating no change and even potential harm. To understand the gap in team performance in critical events, research has turned towards assessing the impact of human factors and NTS on performance, such as using alternative methods of delivering information to providers and incorporating electronic prompts and real-time feedback into cognitive aids. The management of critical events requires clinicians to utilize both TS and NTS; thus measures aimed at improving clinician performance, such as cognitive aids or decision support tools, should focus on both skill sets.

Aims: The aim of this study is to assess the impact of different versions of an electronic decision support tool (e-DST) on team performance as compared to memory alone. The 3 versions of the e-DST include 1) prompts for TS only, 2) prompts for NTS only, and 3) prompts for both TS and NTS. The performance of pediatric operating room teams in the management of 4 *in situ* simulations of perioperative emergencies using the 3 versions of the e-DST and 1 using memory alone will be assessed by adherence to evidence based guidelines and by the Mayo High Performance Teamwork Scale (MHPTS). The inter-disciplinary operating room teams will consist of personnel from anesthesia, surgery, nursing, and allied health services. We hypothesize that the e-DST that emphasizes both non-technical skills (NTS) and technical skills (TS) will significantly improve team performance as measured by adherence to evidence based guidelines and the MHPTS.

Implications: The work described in this proposal will assess the impact of non-technical skills (NTS) on inter-disciplinary team performance in simulated events as defined by adherence to evidence-based guidelines. Furthermore, it will allow us to refine the way DSTs are designed and

improve our understanding of how to educate and train interdisciplinary medical teams for high-stakes events. It will explore the impact of NTS on team performance as guided by a clinical decision support tool. The e-DST implemented in this study is also designed to aid teams in accurately documenting what occurred during the event and to allow video capture of team performance for improved post-event debriefing.

Funding: \$149,892 (January 1, 2014-August 31, 2015). This grant was designated as the APSF/ASA President's Research Award. Dr. Watkins is also the recipient of the Ellison C. "Jeep" Pierce, Jr., MD, Merit Award which provides an additional unrestricted amount of \$5,000.



Karthik Raghunathan, MD, MPH

Duke University Medical Center,
Department of Anesthesiology

Dr. Raghunathan's project is titled *"Comparative Safety of Different Types of IV Fluids for Resuscitation in the OR and ICU: An Applied Pharmacoepidemiologic Approach."*

Background: Intravenous (IV) fluids are used routinely to maintain euvolemia and to correct overt or presumed hypovolemia during major surgical procedures in operating rooms (ORs) and in intensive care units (ICUs). Among ICU populations, meta-analyses of "crystalloid versus colloid fluid" trials suggest equipoise in efficacy but certain colloids (hydroxyethyl starches) have been associated with harm. However in ORs, the use of colloid solutions has been associated with improved outcomes in moderate and high-risk surgical patients (contrasted against conventional

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Grant Recipients Chosen from 45 Total Submissions

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crystalloid therapy). More recently, studies have linked safety outcomes to the chloride content of commonly used solutions. When compared with chloride restrictive ("physiologic") balanced fluids, resuscitation with chloride liberal solutions (such as isotonic saline) appears to be associated with adverse consequences. Hence, fluids may be categorized along distinct axes with specific patterns of exposure in the OR and ICU potentially leading to different clinical safety outcomes. Currently, there is a natural "quasi-experiment" in progress as patterns of IV fluid use vary influenced by institutional or physician preferences. With such significant unwarranted variability, patients with similar clinical conditions may receive different qualitative and quantitative exposures making a pharmacoepidemiologic study of fluids feasible and desirable.

Aims: Using the nation's largest inpatient drug utilization database (maintained by Premier Inc., Charlotte, NC), we propose to study the comparative safety of different types of IV fluids used in ORs and ICUs. As varying combinations of fluids are typically used, exposure may be defined based on the relative proportions of balanced fluids and/or colloids used on the day-of-surgery and in the ICU. Contrasting fluids primarily based on their chloride content, we will test the hypotheses that exposure to increasing proportions of "chloride liberal" fluids (e.g., isotonic saline) results in greater in-hospital mortality, morbidities (renal failure, infections, bleeding), and higher treatment costs when compared to the use of larger proportions of balanced fluids. Further, we will analyze heterogeneity of effects across different surgical procedures and patient populations. Premier Inc.'s large quality-assured database contains a prospectively collected itemized date-stamped log of patient-level charges including granular data on patient and hospital demographics, comorbidities and co-treatments (such as fluid type and amount), co-medications, diagnostic tests, and therapeutic services from over 500,000 patients across hundreds of acute care facilities nationwide. We plan to conduct propensity-score matched analyses creating comparable subgroups that differ in fluid exposures. In addition, as fluid choice is often influenced by where care is received rather than on specific patient or procedural characteristics, there is potential for analysis based on hospital-preference for specific fluids that emulates "random" treatment allocation. Such methods estimate associations while minimizing bias, a major limitation

when using such secondary data. Finally, we will use network meta-analysis to combine estimates from observational data with other studies in the literature.

Implications: Fluid choice during major surgery and in ICUs may have enormous public health implications if the outcomes associated with commonly used combinations of fluids vary significantly. Our proposed study will re-orient the fluid debate using representative real-world national data and results will complement and inform future randomized trials.

Funding: \$94,680.30 (January 1, 2014-December 31, 2015). This grant was designated as the APSF/ASA Endowed Research Award.



Karl Hammermeister, MD

University of Colorado School of Medicine/Colorado Health Outcomes Program

Dr. Hammermeister's grant is titled "*Neuromuscular Blockade and Perioperative Outcomes.*"

Background: Residual postoperative neuromuscular blockade (NMB) is common with a reported incidence of between 4 and 50%. Murphy and Brull concluded in a recent review, "... residual neuromuscular block is an important patient safety issue and that neuromuscular management affects postoperative outcome." In 2012, Grosse-Sundrup et al., reported a significantly increased risk of reintubation with return to the intensive care unit within 7 days of surgery in patients who received an intermediate acting NMB agent matched to an equal number who did not by propensity score. Qualitative monitoring of neuromuscular transmission did not decrease this risk, and neostigmine reversal increased the risk of reintubation. Cholinesterase inhibitors, such as neostigmine, are commonly used to reverse NMB at the conclusion of surgery; however, they have

significant side effects. More importantly, they may actually increase NMB by creating very high concentrations of acetylcholine at the neuromuscular junction, which has an antagonistic effect.

Aims: The specific aim of this proposal is to test the primary hypothesis that intraoperative administration of a non-depolarizing NMB agent is associated with an increase in one or more of the following respiratory complications: failure to wean from the ventilator within 48 hours following surgery, reintubation within 30 days following surgery, or postoperative pneumonia within 30 days following surgery. We will also examine the effects of NMB on 30-day postoperative non-respiratory complications, all-cause mortality, and length of stay.

To accomplish this, we will analyze an existing data set containing patient-related risk factors, operative data, 30-day mortality and morbidity, and late survival on more than 19,000 major surgical procedures performed in VA medical centers between 1/1/2001 and 9/30/2005. We have merged this data set as part of an ongoing study of intraoperative predictors of adverse outcomes. This data set comes from 3 sources: 1) preoperative, intraoperative, and outcomes data from the VA Surgical Quality Improvement Program (VASQIP); 2) intraoperative data from anesthesia information monitoring systems (AIMS) from 4 VA medical centers; and 3) long-term vital status data from the VHA's vital status files. The VASQIP collects a standardized set of risk and outcomes data for the majority of major surgical operations performed in the VHA health care system as part of its ongoing quality assessment and improvement programs in surgery. We will use both propensity matching and multivariable risk-adjustment to minimize the inevitable selection bias that occurs in an observational study like this; therefore, the results cannot be considered to definitively demonstrate or exclude a causal relationship between NMB and adverse surgical outcomes

Implications: If this study shows a relationship between NMB and adverse postoperative outcomes, it should lead to the following: a greater caution in the use of intraoperative NMB, the development of better and wider application of postoperative monitoring for residual NMB, serve as a stimulus for a randomized trial comparing the common use of cholinesterase inhibitors and NMB that are reversed by other mechanisms.

Funding: \$148,802 (January 1, 2014-June 30, 2015). The funding was made possible by a grant from Covidien and is designated the APSF/Covidien Research Award.

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APSF Looks for Well-designed Studies of Safety-Related Clinical Research as Well as Research on Education and Training in Patient Safety

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Deborah Culley, MD

Brigham and Women's Hospital, Harvard Medical School, Department of Anesthesiology, Perioperative and Pain Medicine

Dr. Culley's grant is titled *“Preoperative Cognitive Status in Elderly Surgical Patients: Feasibility of Routine Screening and Utility for Predicting Morbidity.”*

Background: Anesthesiologists have been at the forefront of preoperative evaluation and patient safety initiatives. Thus, it is surprising that the function of one of the most vital organs—the brain—has been largely neglected. There are multiple reasons why preoperative cognitive screening in elders might be valuable. Elders have more surgical procedures than middle-aged adults; a high prevalence of undetected cognitive impairment; and high rates of postoperative morbidity and mortality. Pre-existing cognitive impairment is a known risk factor for postoperative cognitive morbidity such as delirium, which is associated with longer length of hospital stay, a higher likelihood of discharge to a place other than home, and greater 1-year mortality. Equally important but much less well recognized is that pre-existing cognitive impairment may be an independent predictor of serious in-hospital non-cognitive morbidity such as in-hospital falls. This suggests that poor preoperative cognitive function has major quality and safety implications and is likely to be an important, but largely unrecognized, determinant of morbidity and mortality and cost of care for geriatric surgical patients. The goal of this study, therefore, is to cognitively stratify elective geriatric

surgical patients preoperatively and to determine whether cognitive status predicts adverse cognitive or non-cognitive events.

Aims: Our overriding hypotheses are that cognitive impairment is 1) common in elders presenting for elective orthopedic surgery and better identified with a brief structured cognitive screen than standard practice; and 2) an independent predictor of adverse postoperative events. In addition, we will test whether it is feasible to implement routine structured preoperative cognitive screening of elders in a busy preoperative clinic. Accordingly, based on preliminary data and a power analysis, we will recruit and preoperatively cognitively stratify 211 patients 65 years of age or older who are scheduled for lower extremity joint replacement surgery. Cognitive screening will be performed with a standard and widely accepted instrument that, in a pilot study, took 3 min or less to administer and proved reliable and easy to score. The primary cognitive and non-cognitive outcomes will be, respectively, delirium and discharge to a place other than home.

Implications: This work has considerable clinical implications. The ability to identify and risk stratify patients with pre-existing cognitive impairment may improve the quality of shared decision making between patient/family and physician; influence decisions about appropriateness of surgery and anesthetic management; and/or optimize allocation of scarce perioperative resources known to improve outcomes (e.g., postoperative geriatric care units). Indeed, assuming preoperative cognitive impairment is common, routine preoperative cognitive screening promises to be an excellent low-cost, patient centered, high impact proposition for enhancing surgical outcomes.

Funding: \$149,997 (January 1, 2014-December 31, 2015).

Finally, the members of the SEC would like to thank all of the investigators who submitted their proposals to the APSF for this grant cycle. We continue to encourage submission of well-designed studies of safety-related clinical research as well as research on education and training in patient safety. It is through the mechanism of this research that we continue to strive for the vision that “that no patient shall be harmed by anesthesia.”

Dr. Howard is Staff Anesthesiologist at the VA Palo Alto HCS and Associate Professor of Anesthesia Stanford University School of Medicine as well as Chair of the APSF Committee on Scientific Evaluation.

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Dr. Alan F. Merry Delivers the ASA/APSF Ellison C. Pierce, Jr., MD, Memorial Lecture on Patient Safety

by Lorri A. Lee, MD

Alan F. Merry, MB, ChB, FANZCA, FRCA, Head of the School of Medicine, Faculty of Medical and Health Sciences, University of Auckland, New Zealand, delivered the ASA/APSF Ellison C. Pierce, Jr. Patient Safety Memorial Lecture at the annual Anesthesiology 2013 meeting on Oct 12, 2013, in San Francisco, CA, to a room full of anesthesiologists interested in patient safety. This annual lecture, jointly sponsored by the APSF and ASA, was created to recognize and honor the memory of the founding president of APSF and past president of ASA (1984), Ellison C. (Jeep) Pierce, Jr. MD. Dr. Pierce's foresight and passion for patient safety and his position in the ASA enabled the establishment of the APSF and set the course for anesthesiology to become the leader in patient safety. Dr. Merry was selected as this year's speaker because of his numerous contributions to patient safety worldwide on simulation training, research in human factors and teamwork, and advancement of patient safety in developing countries.¹

Dr. Merry's presentation was entitled "Toward Patient Safety in Anesthesia—Let the Journey Continue." He paid tribute to many patient safety leaders in anesthesiology during his opening comments including Drs. Ellison C. Pierce, Robert K. Stoelting, John H. Eichhorn, and Jeffrey B. Cooper. He provided data on the unsustainable trends in health care expenditures, particularly in the United States, and noted that 60% of all operations are done on 15% of the world population. Not surprisingly, anesthesia mortality varies from 1/150 in Togo to 1/56,000 persons in Australia. Dr. Merry commented that the current high mortality rates in developing countries are reminiscent of the course of health care in the United States from 1948-1952 where mortality was estimated at 1/2680 to 1985-1986 at 1/185,000 persons. He noted that the greatest challenges lie in low income countries.

Dr. Merry pointed out that despite the high cost of health care in the developed nations, perioperative complications remain high as demonstrated by the recent study in the United Kingdom on major airway complications that found that most cases involved some degree of poor management.² He provided several other examples of recent studies in developed countries showing high rates of complications in patients over 70 years of age and high stroke rates in patients having aortic valve replacements. He appealed to anesthesiologists to look beyond the recovery room and focus on the whole patient experience. He believes we should strive for disability-free outcomes and that anesthesiologists can successfully impact the entire perioperative period. He reiterated the 6 aims for the 21st century health care system published in the Institute of Medi-



Dr. Robert K. Stoelting, APSF president with Dr. Alan F. Merry, the 2013 ASA / APSF Ellison C. Pierce, Jr., MD, Patient Safety Memorial Lecturer.

cine's 2001 report that include provision of health care that is safe, timely, effective, efficient, equitable, and patient-centered.³

He ended his presentation by discussing systems errors and paid tribute to Drs. James Reason and David Gaba for their body of work in this area. He noted that experts make errors; errors are typically not a result of carelessness; deterrence is useless; and that prevention of errors should focus on the process and not the outcome. He acknowledged in some rarer instances, violations occur when a health care provider knowingly does the wrong thing or actively decides not to engage in safe practices. However, he is encouraged by the teamwork initiatives that have recently been successfully launched such as rapid response teams and surgical safety checklists that require engagement of health care providers to be effective. Dr. Merry noted that enabling all members of the team to effectively speak up such as use of the 2 challenge rule would enhance team behavior. He believes the focus should be on the team and not

the individual—with the goal of improving outcomes for our patients.

Dr. Lee is Professor of Anesthesiology and Neurosurgery at Vanderbilt University Medical Center and Co-editor of the APSF Newsletter and member of the APSF Executive Committee.

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3. National Research Council. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: The National Academies Press, 2001.

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Annually, the APSF Scientific Evaluation Committee (SEC) considers the addition of new members to participate in the review of clinical and educational patient safety grants. Applicants for SEC membership should be experienced patient safety researchers with a track record of funding and peer-reviewed publication. The SEC is particularly interested in applicants with safety related expertise in informatics, simulation, or the responsible conduct of research. Interested applicants should submit their curriculum vitae and a cover letter explaining interest and qualifications to Dr. Steven K. Howard at howard@apsf.org.

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Many Abstracts Focus on Patient Safety at the 2013 ASA Annual Meeting

by Torin D. Shear, MD, Steven B. Greenberg, MD, Glenn S. Murphy, MD

Over 1,500 abstracts were presented at the 2013 American Society of Anesthesiologists Annual Meeting in San Francisco, CA. As in previous years, a number of these abstracts examined issues directly related to patient safety. This brief review will highlight several abstracts discussed at the meeting.

Perioperative Complications

Several abstracts focused on perioperative complications. Dr. Teng studied endotracheal tube cuff pressures and postoperative complications, noting that 58% of the time, the cuff pressure was outside the recommended range of 10-30 cm H₂O. In addition, cuff pressures greater than 30 cm H₂O were associated with increased bloody expectorant (A1113). Voscopoulos et al. evaluated a new protocol to identify patients at risk for opioid-induced respiratory depression. Using an impedance-based device, minute ventilation (MV) was measured in postoperative patients. In patients with a MV of less than 80% predicted, opioid administration may lead to potentially dangerous respiratory depression. Measuring minute ventilation in the PACU may help risk stratify patients and prevent opioid induced pulmonary morbidity (A3041). Pulmonary complications were also evaluated by Schumann et al.; specifically patients undergoing bariatric surgery were retrospectively analyzed. Those patients with metabolic syndrome (obesity, hyperlipidemia, hypertension, impaired glucose tolerance) were found to be at increased risk of multiple pulmonary complications (pneumonia, atelectasis, ARDS, pleural effusion, respiratory failure) (BOC05). The incidence and duration of postoperative hypoxemia was prospectively studied by Shahinyan. Analysis of 159 patients revealed that hypoxemia was surprisingly common among elective surgical patients with 15% of patients having a saturation of less than 85% for more than one hour (BOC12).

Cardiovascular events remain a major source of morbidity in the postanesthetic care unit (PACU). A retrospective analysis of 107,671 patients was performed by Bondoc et al. as part of a quality assurance database. The overall PACU complication rate was 14.8% with postoperative nausea and vomiting as the most common complication (5.5%) and cardiovascular complications as the second most common (2.5%) (A3034).

Several abstracts focused on an association between hypothermia and perioperative morbidity. Sun et al. evaluated a perioperative database registry of 51,274 non-cardiac surgical patients to assess the effect of intraoperative hypothermia on hospital length of stay. Hypothermia less than 34.5 °C was independently associated with increase length of stay (A1272); and 5% of patients were noted to have a core temperature less than 35 °C for more than 1 hour (A1267).

Pimental performed an analysis to better delineate local risk for perioperative ocular injury at Brigham and Women's Hospital. In this population, eye injury was rare and associated only with general anesthesia and cases longer than 90 minutes (A4107). Choi and colleagues randomized 66 patients to receive balanced anesthesia or total intravenous anesthesia (TIVA) with propofol. The authors evaluated intraocular pressure (IOP) in patients undergoing robotic radical prostatectomy. Increases in IOP were prevented by the use of TIVA despite steep Trendelenburg and pneumoperitoneum (A5007).

Transfusion Medicine

Consistent with prior literature, abstracts from the ASA suggest that perioperative transfusion is associated with significant morbidity. Basora and colleagues prospectively studied 1331 patients presenting for knee arthroplasty. Transfusion of blood was found to be an independent predictor of deep prosthetic joint infection (odds ratio 4.5) (A2268). In a study by Frank et al., patients refusing blood transfusions were compared with those accepting allogeneic blood transfusions. Although mortality and morbidity were similar between cohorts, those refusing transfusion were observed to have a lower infection rate (A2190). In a separate retrospective analysis of patients with non-small cell lung cancer, Cata et al. found a reduced overall survival among patient receiving blood transfusions (A2227). While there are limitations to the presented data, the findings are consistent with a growing body of literature supporting an increase in morbidity and mortality with blood transfusion.

In addition, several abstracts evaluated risk factors that may increase the rate of transfusion. Panjasawatwong et al. studied the effect of hypothermia on red blood cell transfusion in 51,274 patients. Hypothermia was significantly associated with blood transfusion in an incremental fashion, suggesting that the maintenance of nor-

mothermia may reduce the need for blood transfusion and the concomitant risks (A2230). Following recommendations from the Society of Cardiovascular Anesthesiologists and Society of Thoracic Surgeons, Brooker et al. evaluated the implementation of a multimodal blood conservation strategy in a community hospital setting. The institution of this strategy decreased transfusion rates in cardiac surgical patients. PRBC transfusion decreased from 1.7 units/patient/year to 0.33 units/patient/year ($p < 0.04$) (A2194).

Safety and Communication

Iatrogenic harm is a major threat to patient safety and the investigation of methods of attenuating this risk was again an important topic at the 2013 ASA. Nosocomial infection can result from poor hand hygiene and several abstracts focused on this issue. Parks and colleagues from the University of Wisconsin collected behavioral and hygiene data as part of a quality improvement database. The study noted that compliance with hand hygiene by members of an acute pain service improved significantly when personal sanitizing gel dispensing devices were worn compared to communal devices on the wall (A2309). It is clearly important to improve hand hygiene in an attempt to decrease hospital-acquired infections. On the other "hand," Cole and colleagues discovered the potential for bacterial contamination of the hand sanitizer devices. Dispensers were sampled with and without routine cleaning of the dispenser. Cleaning of the dispenser in between surgical cases may reduce pathogen load and should be considered as part of a routine room turnover protocol (A2307).

Communication also plays a major role in medical error and patient safety. Handoff communication among anesthesia personnel was a major topic in the 2013 abstracts. Investigators from Wayne State University studied intraoperative communication between anesthesia providers. Only 7.4% of responders stated that "they have never had a complication" due to poor handover communication (A4210). McLaren instituted a standardized handoff at the University of Kansas and found improved thoroughness and delivery of handoffs without prolonging the time spent in handoff communication (A4304). A similar study by Mason and colleagues scored patient information transfer in groups with and without a standardized handoff among obstetric anesthesia

APSF Workshop Explores Whether Investigations into Anesthesia Incidents Should Be Conducted Similar to Mass Transportation or Nuclear Power Incidents

by David M. Gaba, MD, and Lorri A. Lee, MD

The dramatic improvement in the airline industry safety record has been attributed in part to changes in practice introduced as a result of investigations of accidents by an independent third party, the National Transportation and Safety Board (NTSB). Would this model work in health care for high severity iatrogenic injuries? This question has frequently been asked over the last few decades, but the idea has never gained traction. The APSF organized a workshop focused on this topic with speakers from multiple disciplines including experts in health care system safety, the NTSB, and the medico-legal profession. Robert K. Stoelting, APSF president, and David M. Gaba, MD, associate dean for Immersive and Simulation-based Learning, professor of Anesthesia at Stanford University School of Medicine, director of the Patient Simulation Center for Innovation at the Veterans Administration Palo Alto Health Care System, and member of the APSF Executive Committee, opened the APSF Board of Directors Workshop at the Anesthesiology 2013 Annual Meeting in San Francisco, CA, by posing the question "Should anesthesia incidents be investigated as they are in other high-risk industries?"

Charles R. Denham, MD, the editor-in-chief, of the *Journal of Patient Safety* and the chair of the Global Patient Safety Forum, noted that because the database of health care accidents is sparsely populated, we should consider fast-tracking specific patient safety events and generating "Red Cover Reports" so that health care systems can learn from each other's errors. This process would challenge the current risk management policies of institutions that prevent sharing of information nationally. He believes that we should use methodology similar to the NTSB to eliminate the more than 30 deaths per hour that are estimated to occur in U.S. hospitals. Dr. Denham published an article in 2012 with actor Dennis Quaid and famous airline pilots and authors "Sully" Sullenberger and John Nance in the *Journal of Patient Safety* making these points.

The Honorable Mark R. Rosekind, PhD, member of the NTSB and one of the world's foremost human fatigue experts, was unable to attend the meeting in person (because of the temporary government shutdown last October), but provided his slides that Dr. Gaba kindly presented. The 2 major goals of the NTSB are to determine the probable cause of transportation accidents and to make recommendations aimed at preventing their recurrence. The NTSB was created in 1967 and has investigated over 132,000 accidents and has generated more than 13,500 safety recommendations.



Dr. David Gaba, Dr. Charles Denham, Dr. John Eichhorn, Mr. David Epperson, Dr. Richard Cook, and Dr. Matt Weinger were speakers at the APSF Workshop examining the concept of an accident investigation team.

Although the NTSB is credited with making significant advances in safety in the transportation industry, it does not have the authority to regulate or enforce its recommendations. It oversees transportation accidents in the aviation, marine, highway, railroad, pipeline, and hazardous materials industries. Dr. Rosekind noted in his slides that the major strengths of the NTSB are its rigorous investigations, independence, transparency, use of a formalized structure and process, and the people involved who bring their expertise and passion to the organization.

Richard I. Cook, MD, professor of Healthcare System Safety and chief of the Patient Safety Division at the Royal Institute of Technology in Stockholm, Sweden, who is recognized world-wide for his research in human performance, complex systems failures, and medical accident investigation provided his insights on the possibility of investigating medical or anesthesia events as in other high-risk industries. Cook stated

"Experience in medical settings shows that high quality, independent accident investigation is possible and can provide valuable insights into the genesis and aftermath of accidents. We conclude that there are 3 important criteria that need to be met to achieve high quality results. First, the investigation must be independent of all the stake-

holders. These include the practitioners involved and their affiliated organizations; the health care facility, its management, and its owners; the regulators and authorities governmental and non-governmental; and the patient representatives. Stakeholder independence is critical to the conduct and credibility of the investigation. Second, the investigation requires high level technical competence. The investigators and their support staff must be experts in the areas involved and have access to high quality tools and methods for forensic examination of the setting, technologies, and physical data. They must be skilled at interviewing all those involved in the situation at hand. They must be able to critically analyze complex data and to write and present their findings in clear, unambiguous terms. Third, the investigation must begin immediately. In contrast to transportation accidents, medical accidents take place under a wide variety of circumstances, leave little forensic evidence for examination, and rarely halt work in the effected facilities. The investigating team must be able to appear at the site, secure forensic materials, and begin debriefing participants within a day, preferably within

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NTSB Model Would Face Many Barriers and Pitfalls

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hours. There are substantial technical, social, and legal obstacles to high quality investigations. Our research, however, shows that these are not insurmountable.”

John H. Eichhorn, MD, professor of Anesthesiology and Provost’s Distinguished Service professor at the College of Medicine, University of Kentucky Medical Center and a consultant to the APSF Executive Committee believes that a specialized anesthesia accident investigation by an independent party is a good idea, but enormous pitfalls would make it impossible to carry out. He noted that members of the APSF had proposed this idea as early as 1990, but that logistical, personnel, financial, and medico-legal constraints would prohibit its success. Organizing a team of highly qualified experts who would be readily available to travel on a moment’s notice to an anesthesia incident site would require significant financial resources and it would be unclear who would own the findings and recommendations from the investigation.

David C. Epperson, JD, of the law firm Epperson and Owens in Salt Lake City, UT, brought the expertise of a liability law defense lawyer in both health care and aviation. He suggested that the NTSB process has access to all the participants and parties to an accident, something that would be difficult to achieve in health care. He indicated that even to contemplate a health care investigation system would require certain legal protections. The Patient Safety and Quality Improvement Act of 2005 conveys some protection to “patient safety organizations,” but the strength of these protections has not yet been tested in court. Although it is not admissible in court as proof of causation, the final report and analysis of the NTSB is a public document that can breed lawsuits in aviation. Would not the same be even more true in health care? Mr. Epperson noted that in his opinion even the NTSB’s analysts sometimes “get it wrong,” with direct experience on his part with aviation accidents where the defense has proof of a different proximate cause than that indicated by the NTSB.

A spirited discussion and question and answer period ensued and was moderated by Matthew B. Weinger, MD, APSF secretary and Norman Ty Smith chair in Patient Safety and Medical Simula-

tion and professor of Anesthesiology, Biomedical Informatics, and Medical Education, Vanderbilt University School of Medicine, and Dr. Jeffrey Cooper, APSF executive vice president and professor of Anesthesia, Harvard Medical School.

Some suggested that currently the local “root cause analyses” are often not performed very well and that attention should be focused on making the local investigations more solid. Others suggested that a federal agency would not be appropriate but a private organization using the same methods might be applicable. One comment was that investigations should focus on the positive learning from what was done right as well as the critique of negative aspects.

In summary, the panel aired many of the key issues about the desire for better processes to extract the maximum organizational learning of the health care system from the analyses of adverse events. Many panelists, and many in the audience embraced the ideal of an investigating body that combines independence, technical competence, a focus on safety and learning, and the ability to execute rapid-startup of investigations using a similar methodology to that used by the NTSB. However, the barriers and pitfalls of such a system seem daunting, particularly the medico-legal issues, the ability to obtain full participation of all parties in a rapid fashion, and the high cost and complexity. The opportunity cost is also high—would the same effort and investment yield more patient safety if it was devoted to addressing problems that we have already identified by other means but have yet to solve? The goal of independent expert analysis remains enticing, but may remain elusive for the foreseeable future.

Dr. Gaba is Associate Dean for Immersive and Simulation-based Learning, Professor of Anesthesia at Stanford University School of Medicine, Director of the Patient Simulation Center for Innovation at the Veterans Administration Palo Alto Health Care System and member of the APSF Executive Committee.

Dr. Lee is Professor of Anesthesiology and Neurosurgery at Vanderbilt University Medical Center and Co-editor of the APSF Newsletter and member of the APSF Executive Committee.

Abstracts Address NMB

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providers. Standardizing the handoff significantly improved information transfer scores (A5009). Dr. Agarwala and colleagues instituted a checklist to aid patient information transfer. Utilization of this checklist for patient handoffs improved both the transfer of information and retention by anesthesia care providers (BOC03).

Neuromuscular Blockade: Too Much or Too Little

Residual neuromuscular block in the postoperative period is an important patient safety issue. Galarneau and colleagues found that a lower train-of-four at extubation resulted in a higher incidence of complications and health care resource utilization perioperatively including increased nurse-patient interventions and increased nurse staffing (A1053). As awareness of residual neuromuscular block and its risk has increased, the issue of inadequate block for good surgical conditions has been raised (A1054, A1055, A1052). From the surgical perspective, there are potential problems associated with inadequate depth of muscle relaxation such as poor closure that could lead to incisional hernia. Finally, Todd et al. described the successful implementation of quantitative monitoring in an academic setting along with a potential reduction in “relaxant-related reintubation” (A5010).

This brief review summarized only a small number of abstracts on patient safety presented at the 2013 Annual Meeting. This is not an endorsement of the methods, results, or conclusions of any particular abstract. To view other abstracts on patient safety, or to obtain further information on the abstracts discussed in this review, please visit the Anesthesiology website at www.anesthesiology.org.

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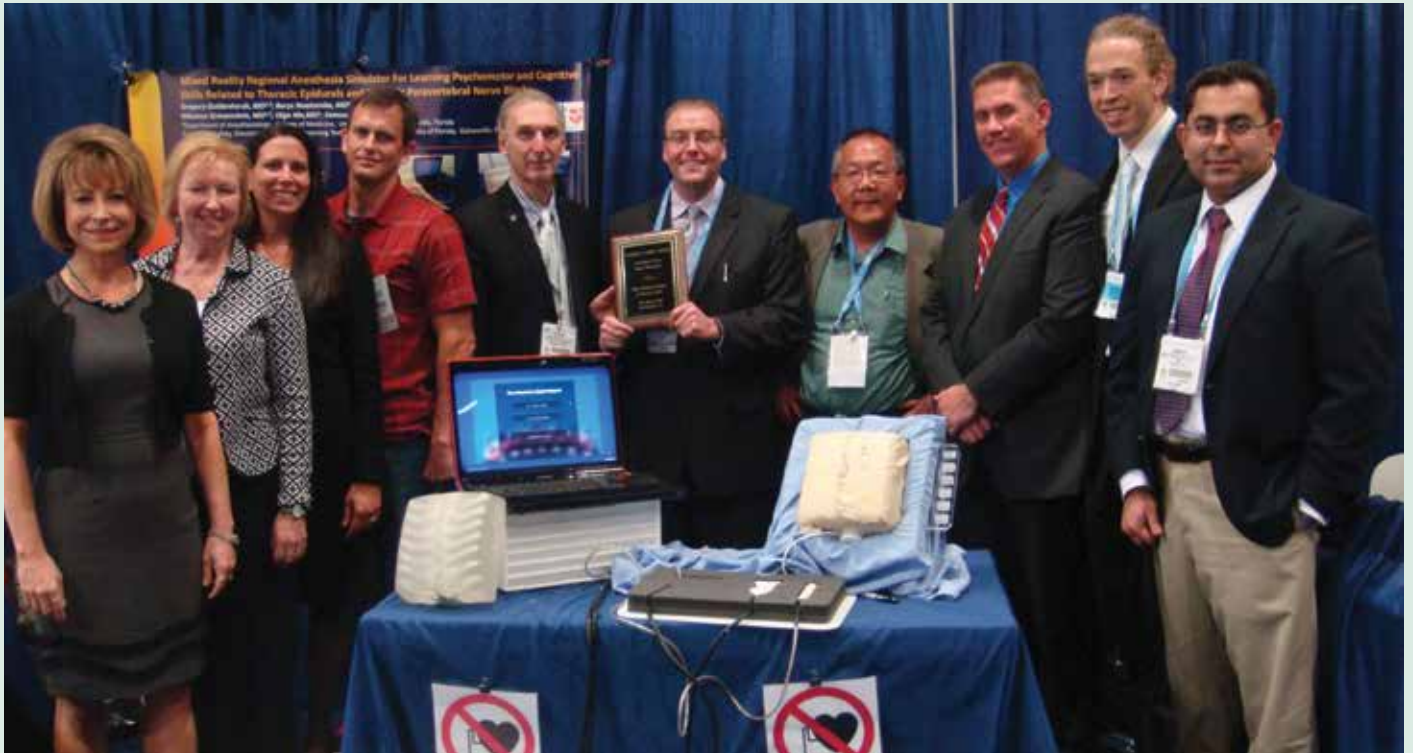
Dr. Greenberg is Director of Critical Care Services, Evanston Hospital; Co-Director for Resident Education at the Department of Anesthesia, NorthShore University HealthSystem; Clinical Assistant Professor, Department of Anesthesiology Critical Care, University of Chicago; and a member of the APSF Editorial Board.

Dr. Murphy is Director of Cardiac Anesthesia, NorthShore University HealthSystem; Clinical Professor, Department of Anesthesia/Critical Care at the University of Chicago; and a member of the APSF Editorial Board.

The APSF Committee on Education & Training awards the **Ellison C. Pierce Research Award** for Best Scientific Exhibit at the ASA 2013 Annual Meeting in San Francisco, CA. Dr. Richard Prielipp, APSF Committee Chair, presents the award to Dr. Greg Goldenhersh of the University of Florida for the exhibit:

Mixed Reality Regional Anesthesia Simulator for Learning Psychomotor and Cognitive Skills Related to Thoracic Epidural, Thoracic Costal, and Thoracic Paravertebral Nerve Blocks [exhibit # SO8].

This exhibit highlights a 3D anatomic reconstruction of bony and soft tissue elements of the spine while tracking a user (student) directed physical Tuohy needle. Mock ultrasound provides guidance and feedback as the needle tip is localized in 3D space with real-time visualization technology. Learner feedback is visual, tactile, and auditory.



Pictured in photo are members of the APSF Committee on Education and Training () and authors of the patient safety exhibit from the University of Florida (†) (left to right) are: Tricia Meyer, Pharm D*, Deb Lawson, AA-C*, Maria Van Pelt, CRNA*, MS, MSN, Barys Ihnatsenka, MD†, Richard Prielipp, MD, MBA, FCCM*, Greg Goldenhersh, MD†, Sem Lampotang, PhD†, John O'Donnell, CRNA, DrPH*, Drew Gonsalves, BS-ME†, and Sandeep Markan, MD*. (Not pictured but present at the exhibit, David Lizdas, BS†).*

Patient Safety Theme at ASA Meeting Echoed in Exhibits

by John H. Eichhorn, MD

Patient safety was featured as a significant elemental theme of the entire American Society of Anesthesiologists (ASA) Annual Meeting in October in San Francisco. Both the Scientific and the Commercial Exhibits at the meeting also contained strong safety components. New and recurrent patient safety concerns were presented throughout the Exhibits along with proposed technical and educational safety improvement strategies.

Scientific Exhibits Span Wide Spectrum of Safety Topics

High-fidelity simulator training as a teaching tool and a mechanism for practice improvement has often figured prominently in patient safety programs. This year's APSF E.C. Pierce Award winner for the best safety-related scientific exhibit went to a

team from the University of Florida for a new and remarkable tool to teach placement of thoracic epidural catheters and blocks. A spine fabricated by 3-D printing from actual patient CT scans was encased in gel, giving a soft-tissue model that provides a realistic-feeling "back" for the simulated block placement. There is continuous ultrasound going and the Tuohy needle has trackers in it so that a high-resolution 3-D virtual image of both the anatomy and the needle path are together displayed on a large video screen in real time above the mannequin. The computer-controlled image can be rotated and angled to show multiple views and orientations, allowing the "student" to see and understand anatomic features of this block placement in ways not before possible, with the goal of rapid and maximally safe mastery of this challenging regional anesthetic procedure.

Two Scientific Exhibits concerned fires in the OR. A very engaging and emphatic exhibit was presented by a team from the University of Oklahoma. It was based on a real incident in an outpatient OR where construction in an adjacent space led to an electrical fire that sent copious thick smoke into an OR suite containing pre-op, anesthetized, and post-op patients; electric power, including some of the emergency back-up, failed. Hurried evacuation was conducted, without injuries, but possibly less efficiently than desired. After the debriefing, an educational video ("wrong-way, right-way") was developed to teach both effective OR evacuation protocols and fire prevention in general (on YouTube as "Fire Safety, OUmedicine"). Another exhibit, from Robert Wood Johnson University Hospital, concerned patients set on

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Non-Invasive Cardiac Output Monitoring Devices Featured at ASA Exhibits

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fire during MAC procedures on the upper body when there is open delivery (nasal cannulae or mask) of supplemental O₂ under a drape over the face (a recent topic of articles and editorials in the national anesthesiology literature). Inappropriate electrocautery use in the O₂-enriched surgical field atmosphere ignites a sponge, towel, or drape (or even residual alcohol-based skin prep solution), thus burning the patient, often severely. The presenters showed a modification of a previously presented face mask for the patient that is fashioned from a clear plastic face shield often worn by surgeons in the OR. The unit functions to prevent the supplemental O₂ from pooling under the drapes and leaking into the surgical field.

An exhibit essentially dealing with human factors but with great safety implications was presented by a team from the University of North Carolina. A retrospective case analysis revealed that established guidelines for treatment (of PONV in the study example) were often not followed in real-life practice. The conclusion was that there is “significant deviation from existing guidelines,” and the more generalized patient safety implications when the findings are extrapolated are obvious.

Finally, a high-tech approach to the risk of damage from excessive pressure to skin or nerves was presented by a team from Boston University. The wireless disposable thin-film sensors that are applied to a patient’s vulnerable anatomic points measure pressure on the skin and are monitored remotely by telemetry, with alarm thresholds appropriate to the situation. Whether in the OR, ICU, or chronic care, excessive force over time on so-called “pressure points” can cause injury. In the OR, the goal of the technology is to help prevent positioning injuries.

Commercial/Technical Exhibits Include Multiple Safety Themes

In the Commercial Exhibits, many familiar safety themes were presented as they have been in recent years, but there were several new ideas and new twists that attracted attention. Also, it appeared that the trend to more and more international exhibitors with products for sale in the U.S. continued even further this year.

The recurrent themes included information management technology systems that facilitate statistics and data mining designed to help promote quality and safety of care. Some systems touted cloud data storage as an advantage, but without presentation of specific details of any special security features related to potential HIPAA privacy concerns. Exhibits of simulators using high-fidelity patient mannequins as clinical teaching tools revealed several ever-more-realistic interactive features that help bring the simulation experience closer and closer to capturing

almost frighteningly realistic presentations. Likewise, a “medical skills trainer” system of “virtual patients” that are synthetic models based on actual anatomy from the Visible Human Project is likely most suited to training for surgical endoscopy, but may well have potential applications for training in various anesthesia procedures. Ultrasound as a tool for regional anesthesia block placement (as well as other potential uses) was widely displayed throughout the vast exhibit hall, although somewhat less so that last year. Likewise, various systems for intraoperative medication safety with bar-code readers and label printers were shown, but not as many as in prior years.

Noninvasive cardiac output measurement devices were more prominently featured than in prior years. One model involves the placement of 4 special sensor electrodes (2 on the chest and one on each carotid artery) that sense the change in red blood cell orientation caused by contraction of the left ventricle—from which a computer can derive stroke volume and then cardiac output by extrapolation, with both displayed continuously. A new device for continuous noninvasive blood pressure monitoring that produces a real-time waveform appearing like that of an intra-arterial catheter pressure tracing involves 2 mini-cuffs on 2 adjacent fingers. A cuff stays inflated enough to plethysmographically sense arterial pressure, and the function shifts to the other finger every 30-60 minutes in order to prevent any potential deleterious effect to a finger distal to a cuff. The manufacturer, from Austria, suggested that, eventually, this device also will calculate and display continuous cardiac output and systemic vascular resistance in real time.

“Thermal management system” is the modern term for a patient warming device. The usual competing claims for different traditional whole-body types were prominent. In addition, one company displayed “dry” IV infusion fluid warmers that have a plastic foam sheath containing a heating element that encircles the normal IV tubing all the way to the IV catheter in the patient, avoiding the need for any additional disposable supplies to facilitate fluid warming and preventing any cooling of the IV infusion in the last tubing segment.

The activated charcoal filter device intended to remove residual potent volatile anesthetic from an anesthesia machine and circuit during or prior to any concern about triggering agents for malignant hyperthermia has had its color changed to bright orange from gray. This is intended to help remind users to remove it after the case for which it was used.

Many Monitoring Modalities

New variants in patient monitoring technologies with safety implications were seen in multiple exhibits. Several of the cerebral oxygen monitors emphasized their potential value during general

anesthetics in the beach-chair position, such as for shoulder arthroscopy. The orthostatic pressure-head consideration and also the surgeon’s common request for deliberate hypotension to limit vision-obscuring bleeding in the joint space have been associated with cerebral hypoperfusion injuries in such patients. An entirely different type of new monitor gives a continuous real-time reading of the gas pressure in the endotracheal tube cuff during general anesthesia, purported to help prevent tracheal mucosal injury/pressure necrosis. Another new monitor for patients having surgery in the prone position is a specialized headrest that contains a digital camera attached to a 4.3 inch LCD monitor that clamps to an IV pole and displays a continuous picture of the patient’s eyes from below, assisting in preventing direct trauma to the eyes and possibly also excessive pressure or edema associated with potential vision loss during very long head-down prone cases with major blood loss. Further, a different company stressed the potential value of having an alternative to putting the pulse oximeter sensor on an extremity – a new sensor that is a low-pressure (painless) spring clamp on to the nasal ala, the lateral wall of the nostril. The manufacturer states that problems of limb peripheral vasoconstriction, access, or movement are thus eliminated, and that response times to changes in hemoglobin saturation are faster than with the traditional fingertip oximeter probes.

Regarding monitoring of patients who are not under general anesthesia, a new product responsive to the guideline that all patients having moderate or deep sedation for procedures should have qualitative monitoring for the presence of expired CO₂ as a ventilation monitor, one company offered a facemask with a built-in port for connection to a capnograph sampling line. Considering a similar safety issue for post-op patients receiving IV opioids and at risk for ventilatory compromise, one exhibitor presented a new “respiratory motion monitor” involving a strip of electrodes/sensors placed on the patient’s chest that not only measures respiratory rate, but can be calibrated to also display continuous real-time tidal volume and minute ventilation. Company promotional material cited data showing that the device accurately reflected changes seen with each dose of narcotic in a given patient.

Always the Airway

As always, reflecting the fact that airway manipulation issues remain some of the most vexing “unsolved” patient safety challenges, airway tools figured significantly in the commercial exhibits having patient safety implications. Various pieces of airway equipment involving video in a wide variety of permutations and combinations were prominently featured. One, a new

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Google Glasses May Enter Operating Room Arena

"ASA Exhibits," From Preceding Page

"VLM" (video laryngeal mask) device from Spain, seemed to attract extra attention from attendees. It is an intubating supraglottic mask that is also on a reusable curved handle that has a video camera in it and small screen on it, allowing gas delivery and ventilation during video imaging of the larynx through the mask showing the ET being guided into the trachea. There are also integral tubes for suction of airway secretions and also gastric aspiration. The manufacturer also recommends it for "staged extubation," particularly in morbidly obese patients, where the video mask would be inserted and then the ET withdrawn from the larynx into the pharynx under video imaging, allowing inspection of the airway and also additional time with some airway support from the supraglottic mask as the patient emerges. Another manufacturer, from England, offered a standard-looking laryngoscope handle claimed to contain a rechargeable battery that can last up to one year. One company displayed a video laryngo/bronchoscope with a video chip in the tip—rather than in the handle at the proximal end of a fiberoptic bundle—thus giving a bigger picture with a wider field of view in the airway. Further, one other exhibitor showed a flexible light-wand with an attached video camera that transmits its image wirelessly to a 7-inch video screen clamped to the IV pole or equivalent. The wand is completely covered with a disposable impermeable plastic sheath so it does not need cleaning between uses. Directing the wand into the larynx under direct video image allows the previously loaded ET to be advanced off the wand easily into the trachea. Finally, a new ET introducer (that can be used in conjunction with a standard video laryngoscope or without) has a telescoping plastic stylet inside a bendable cannula. The cannula is directed "around

the corner" into the airway and the internal stylet is then advanced with the operator's thumb out of the cannula into the trachea, after which the ET is advanced down over the apparatus, completing the intubation.

Focus on the Future

Possibly the most futuristic exhibit at the meeting was an interactive monitoring system for the OR based on Google Glasses. Still a prototype and not commercially available, the glasses mesh with an information management system that captures all the clinical vital signs and information, which are then projected inside the glasses on to what looks like a miniature monitor screen, constantly within the operator's field of vision. The glasses will have a microphone allowing recording of spoken notes and also a camera to allow recording video of what the operator is seeing. Eventually, the glasses will become a command center for an automated anesthesia system, where, for example, the concentration of delivered volatile anesthetic could be increased or decreased by simply speaking a command that will be "heard" by the glasses and transmitted wirelessly to the anesthesia machine. The presentation focused on the technology of the glasses, but it is easy to imagine this anesthesia system also incorporating "smart" technology.

As a "smart" follow-on, last but far from least is the apparent arrival of the long-anticipated era of commercially available user-friendly algorithm-driven "decision support" software for anesthesia practice. Cleveland Clinic has partnered with 3 commercial firms to market an anesthesia information management system (AIMS) that incorporates software that automatically provides "advanced clinical guidance" through its "decision support system" to anesthesia professionals using



Figure 1. Google Glasses.
<http://www.google.com/glass/start/what-it-does/>

the product. Inspired originally by the example of the autopilot and its component alarms in an airplane, this AIMS processes all the input of vital signs and events with the goal of analyzing the progress of the anesthetic and providing the earliest possible warning of any untoward trends by issuing a "tap on the shoulder" in the form of an advisory alarm and also specific recommended remedies that go beyond "generic tips" or simply a checklist. The overall AIMS also promotes remote simultaneous monitoring of many care locations, implied to enhance supervision, efficiency, and patient safety. The ultimate goal is to extend the technology "throughout the acute care environment," according to the company.

Overall, patient safety themes among both types of exhibits well reflected the focus of the 2013 ASA Annual Meeting. This emphasizes ongoing efforts that both have yielded success in improving anesthesia patient safety and also demonstrate challenges yet remaining.

Dr. Eichhorn, Professor of Anesthesiology at the University of Kentucky, founded the APSF Newsletter in 1985 and was its Editor until 2002. He remains on the Editorial Board and serves as a senior consultant to the APSF Executive Committee.



APSF Announces Availability of Recently Released Educational DVDs

Visit the APSF website (www.apsf.org) to view the following DVDs and request a complimentary copy.

- Opioid-Induced Ventilatory Impairment (OIVI): Time for a Change in the Monitoring Strategy for Postoperative PCA Patients (7 minutes)
- Perioperative Visual Loss (POVL): Risk Factors and Evolving Management Strategies (10 minutes)
- APSF Presents Simulated Informed Consent Scenarios for Patients at Risk for Perioperative Visual Loss (POVL) Due to Ischemic Optic Neuropathy (18 minutes)

Status of APSF Drug-Induced Muscle Weakness in the Postoperative Period Safety Initiative and Survey Results

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Responses to Questions Posed at 2011 Workshop

1. Do we have evidence/agreement for the etiology of the problem?
2. Do we have evidence/agreement for the solution of the problem?
3. Does anesthesia have control/influence over introducing the solution to the problem?
4. Do we have a way to measure the incidence for baseline and post-intervention data?

At this conference, Sorin J. Brull, MD, addressed “Residual effects of neuromuscular blockers into the postoperative period” as a future APSF safety initiative and proposed the following responses to the 4 questions posed (<http://www.apsf.org/initiatives.php?id=11>)

Table 1. Future Patient Safety Initiative

Patient Safety Issue	Do we have evidence/agreement for the etiology of the problem?	Do we have evidence/agreement for the solution to the problem?	Does anesthesia have control/influence over introducing the solution to the problem?	Do we have a way to measure the incidence for baseline and post-intervention data?
Medication Safety in the OR	YES	INCONCLUSIVE	YES	YES
Hand-offs	YES	YES	YES	YES
Cerebral Ischemia and Cerebral Perfusion Pressure	YES	INCONCLUSIVE	YES	INCONCLUSIVE
Residual Neuromuscular Blockade	YES	YES	YES	YES
Fire Safety in the OR	YES	YES	YES	NO
Ischemic Optic Neuropathy	YES	YES	YES	YES

APSF Newsletter Winter 2012;26:45-46. http://www.apsf.org/newsletters/pdf/winter_2012.pdf.

1. Do we have evidence/agreement for the etiology of the problem? YES

We have reports of residual neuromuscular block (residual “curarization”) for over 3 decades (Viby-Mogensen, 1979). The etiology is likely multi-factorial: use of non-depolarizing muscle relaxant agents, lack of intraoperative objective monitoring, and reliance on subjective assessment (visual or tactile means) or clinical tests (head-lift, grip strength, tidal volume, etc) to judge adequacy of pharmacologic reversal prior to tracheal extubation. Recent meta-analysis revealed an incidence of residual paralysis in the PACU of 41% (Naguib, 2007).

2. Do we have evidence/agreement for the solution of the problem? YES

We have many reports that postoperative pulmonary complications continue to occur in patients who experience residual postoperative weakness (Moller, 1990; Pedersen, 1992; Berg, 1997). Patients experience significant delays in meeting PACU and hospital discharge criteria (Murphy, 2004). And we have reports that have documented that appropriate antagonism of neuromuscular block decreases 24-hr morbidity and mortality (Arbous, 2005).

With this background, APSF sponsored a panel on monitoring neuromuscular blockade at the 2012 New York Society of Anesthesiologists Postgraduate Assembly (<http://www.apsf.org/newsletters/pdf/spring2013.pdf>) and most recently conducted a survey to determine the opinions of anesthesia professionals with respect to “Residual Muscle Relaxant-Induced Weakness in the Postoperative Period: Is it a Patient Safety Issue?”

The announcement of the survey with the link to access the survey was sent to a random sam-

pling of 25% of the active members (including residents and students in training) of the American Society of Anesthesiologists (ASA), American Association of Nurse Anesthetists (AANA) and American Academy of Anesthesiologist Assistants (AAAA) with a follow-up email 14 days after sending the initial announcement. Email announcements were sent to 21,482 anesthesia professionals and 3,182 recipients opened the link to take the survey for a response rate of 14.9% (Figure 1). Nearly 60% of the respondents had been in clinical practice more than 10 years and

3. Does anesthesia have control/influence over introducing the solution to the problem? YES

In recent U.S. and European surveys, the majority of anesthesiologists (50-65%) believe that postoperative residual weakness is extremely rare (<1%), when in fact the incidence is 41% (Naguib, 2010). For the past decade, studies have shown that perioperative objective neuromuscular monitoring decreases the incidence of postoperative weakness (Mortensen, 1995; Gatke, 2002; Baillard, 2000, 2005; Murphy, 2011).

4. Do we have a way to measure the incidence for baseline and post-intervention data? YES

The currently available neuromuscular monitors (Merck TOF-Watch, GE Healthcare E-NMT, and the Draeger NMT SmartPod) provide objective data on the state of neuromuscular recovery and should be used routinely (Brull, 2010; Murphy, 2011).

72% characterized their clinical practice as the “team model” or a “combination of “solo practitioner and team model.”

The view as to the frequency of muscle weakness in the PACU due to residual neuromuscular blockade was mixed (Figure 2) but 82% disagreed that a TOF ratio >0.7 confirmed the absence of significant drug-induced neuromuscular weakness in the PACU (Figure 3), and nearly 80% agreed that

See “Survey Results,” Next Page

Ninety Percent of Respondents Agree on Need for Routine Intraop Monitoring of NMB

"Survey Results," From Preceding Page

normal respiratory function may not be present in the PACU until the TOF ratio is equal to or >0.9 (Figure 4). The vast majority of respondents (85%) agreed there was an association between residual neuromuscular blockade and pulmonary complications in the first 24 hours postoperatively (Figure 5) and that appropriate antagonism of neuromuscular blockade would decrease the 24-hour major postoperative morbidity and mortality.

Ninety per cent of the respondents agreed that objective functional monitoring (twitch measurement) should be utilized routinely intraoperatively for patients receiving nondepolarizing neuromuscular blocking drugs prior to transfer to the PACU (Figure 6). Consistent with this view nearly 80% of the survey responses supported the statement that "APSF should encourage professional associations (ASA, AANA, AAAA) to consider adding "Monitoring Neuromuscular

Function" to their "standards/recommendations" for the intraoperative care of those patients receiving neuromuscular blocking drugs.

Robert K. Stoelting, MD
President, APSF

APSF thanks Lorraine Jordan, CRNA, PhD, AANA Senior Director of Research and AANA Foundation Executive Director, for creation of the graphics depicting the survey responses.

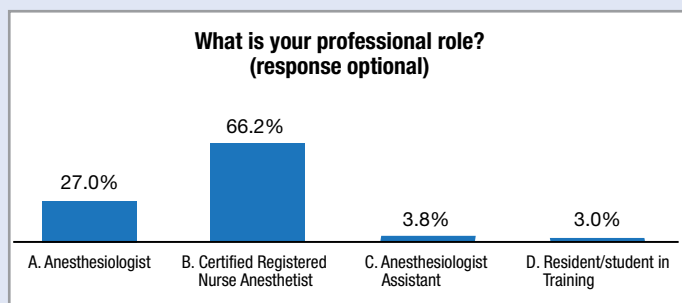


Figure 1

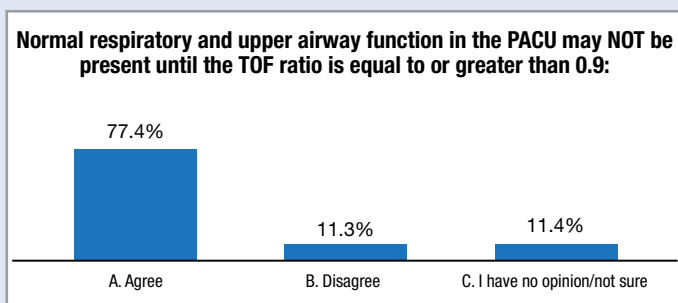


Figure 4

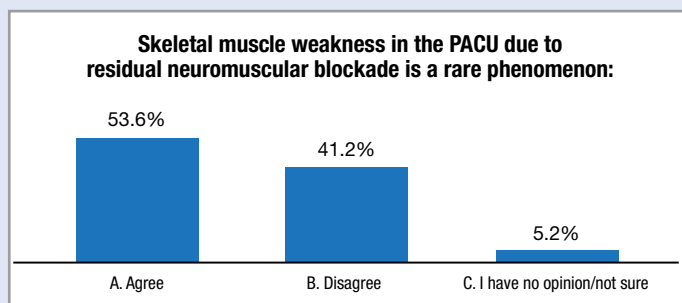


Figure 2

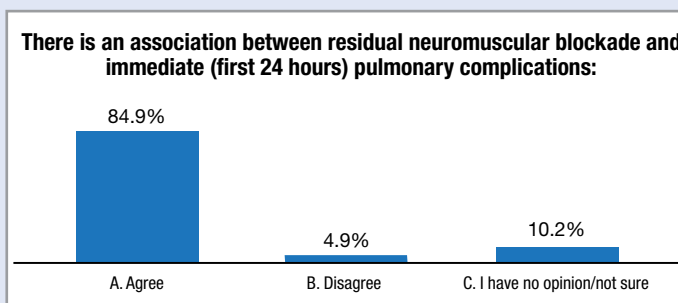


Figure 5

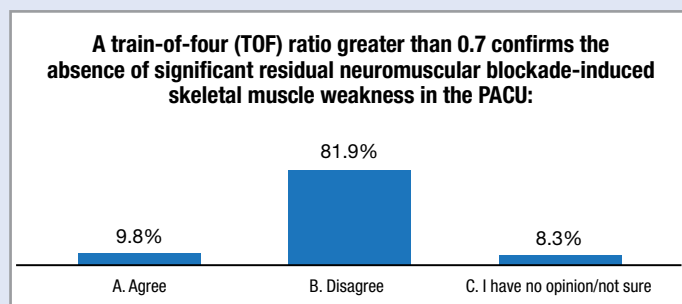


Figure 3

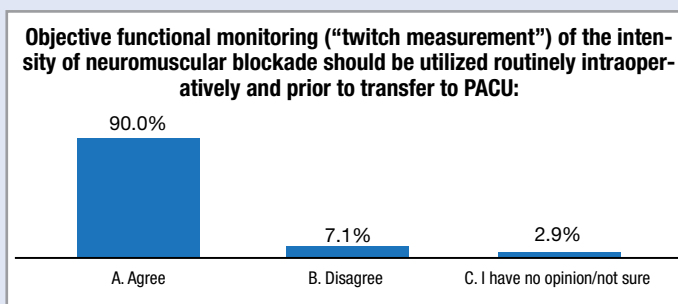


Figure 6

Figures 1-6: Responses from 3,182 out of 21,482 randomly sampled anesthesia professionals from the APSF Survey "Residual Muscle Relaxant-Induced Weakness in the Postoperative Period: Is it a Patient Safety Issue?"

Letter to the Editor:

Sioux Falls Team Implements High-Alert Label to Prevent Look-Alike Error

The FDA approved a new formulation of bupivacaine called Exparel™ in Fall 2011. Exparel™ is a liposome injectable suspension of bupivacaine used to infiltrate surgical sites to provide up to 72 hours of local anesthesia. The potential benefits of this new analgesic compared to other analgesics for postsurgical analgesia include that it is not a narcotic, can decrease narcotic use, can decrease the potential for drug interactions, and it has the convenience of being a single administration medication. The decreased use of narcotics may also result in reduced side effects (e.g., dizziness), which may translate to reduced incidences of falls after surgery. However, even though Exparel™ has many innovative benefits, some of the characteristics result in 2 distinct medication safety challenges that should be considered by facilities using the product.

One of the major medication safety challenges related to Exparel™ is its potential for a look-alike error. Since Exparel™ is a liposome suspension, it has a milky-white emulsion appearance much like propofol. Exparel™ and propofol are both used in the operating room and come in glass vials of similar sizes. Therefore, it is very likely that one drug could accidentally be selected with the intent of selecting the other. Propofol has a different indication and route of administration than Exparel™ in that it is used for sedation and administered intravenously. Exparel™, however, is infiltrated into the surgical site. Selecting the inappropriate product can result in a sentinel event such as fatality. This is especially true in the event Exparel™ is administered intravenously.

To prevent a look-alike error related to Exparel™ and propofol, our facility has implemented several processes. First, the 2 agents are stored in 2 separate locations within the pharmacy. This is easy to do as Exparel™ is stored in the refrigerator and propofol is stored at room temperature on IV shelves and in medication carousels.

However, Exparel™ is stable at room temperature for 30 days. Due to Exparel's stability at room temperature, it is commonly filled in medication dispensing units (e.g., Pyxis units) within the surgical area. Therefore, both propofol and Exparel™ can be retrieved from the same medication dispensing unit. The second safety measure we have in place is to avoid accidentally pulling the wrong medication from the dispensing unit. A Pyxis Clinical Alert has been programmed within the Pyxis unit that states, "Confirm removing of Exparel™ for SQ infiltration at surgical site." This alert brings to the user's attention that they are selecting Exparel™ and reminds them of the appropriate route of administration. There is still potential for a user to select the wrong drug if both agents are stored in an open access drawer (e.g., a matrix drawer within a Pyxis unit). To avoid the potential for error, Exparel™ is not stored in these drawers and can only be accessed in a carousel (pie) drawer within the Pyxis unit so the user only has access to Exparel™ when pulling the medication from the Pyxis unit. Another safety measure that was

implemented to help differentiate Exparel vials from propofol was the addition of a "High Alert" shrink wrap seal covering the cap of the Exparel™. Finally, there is always the potential for user error. To help counteract user error, we educated pharmacy and surgical staff on Exparel™ regarding the potential for a look-alike error, the consequences of an error, and the procedures to follow to avoid an error.

The second major medication safety challenge involving Exparel™ is that it is a high-risk medication. Exparel™ is a long-acting formulation of bupivacaine which results in plasma levels for a duration of 96 hours. No formulation of bupivacaine should be administered within 96 hours of Exparel™, due to potential risks of a significant overdose and systemic side effects. However, it can be difficult to identify whether a patient was given Exparel™, and when it was administered. Often, patients receive Exparel™ during a same-day procedure and have no way to identify that they received this agent. This is an issue since no one outside the surgical facility will be aware that Exparel™ was administered to the patient and the patient could potentially receive additional bupivacaine if he/she receives medical care within the 96-hour period.

To properly identify each patient who has received Exparel™ in a standardized process is not an easy task. Our facility wanted a "fool-proof" process that would identify each patient that received Exparel™ when it was administered. Due to the complexity of many patients quickly leaving the surgical facility, we needed an identifier that would follow the patient once they left our facility. We decided to utilize the Exparel™ wristband produced by the manufacturer of Exparel™. The wristband has the Exparel™ name preprinted on the band and a location to write in the date/time it was administered. This wristband is placed on the same arm as the patient's identification band. This helps surgical and post-op staff identify that the patient received Exparel™ and prompts them to educate the patient on the necessity of wearing the wristband for a full 96 hours after their procedure. It is our process that anyone wearing an Exparel™ wristband in our facility is verbally educated on the medication, instructed to wear the wristband for a full 96 hours, and informed on the potential adverse events that could occur if additional bupivacaine is administered during the 96 hour time period. Patients also receive standardized discharge instructions with this same information.

The only way the wristband procedure can be a success is if it is a reliable process that can be done on every patient who receives Exparel™. To assure a wristband is placed on each patient that receives Exparel™, the vials are specially processed before ever leaving the pharmacy. Each vial has an Exparel™ wristband attached to it with 2 "High Risk" shrink-wrap labels. This process assures a wristband is readily available at each administration and performs a double duty of further identifying



Figure 1. "High-Alert" labeling to prevent look-alike error.

the vial contains Exparel™ to prevent a look-alike error (see Figure 1). In the event that a wristband would fall off the vial or a wristband needed to be removed temporarily from the patient, the surgical staff has access to additional Exparel™ wristbands that are stored in the automated dispensing device.

Exparel™ is a novel anesthetic that provides long-acting pain relief and may help decrease the use of narcotics. However, its use is not without caution. Exparel™ has the potential to cause sentinel events via look-alike medication errors, especially with propofol. It is also a high risk medication due to plasma levels of bupivacaine persisting for 96 hours. Therefore, no additional bupivacaine is to be administered during this time period without significant risk of adverse events. To safely use Exparel™ within our facility, many standardized processes were implemented prior to its use in the operating room to avoid medication safety events.

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All authors have no disclosures to report.

Letter to the Editor:

Guidelines for Insertion of an Intrathecal/Spinal Catheter Following Unintended Dural Puncture

To the Editor:

Post-dural puncture headache (PDPH) was first described in 1898, a few hours after the first successful spinal anesthetic by August Bier. Over 100 years later, it is still a problem and little consensus exists on managing it.¹ The risk of puncturing the dura inadvertently is between 0.2 and 4%.²⁻³

Data obtained from the American Society of Anesthesiologists closed claims analysis project show that this is the third most common reason for litigation in obstetric anesthesia in the USA.⁴

Intrathecal placement of an epidural catheter after unintended dural puncture has become increasingly common. Reasons cited for intrathecal catheter insertion are to prevent another unintended dural puncture, ensure excellent analgesia for normal labor, instrumental, or operative delivery, and to reduce the incidence and severity of postdural puncture headache.

There are safety concerns with the use of intrathecal catheters including the potential for high block, meningitis, and inappropriate drug administration.

In our institution we have a mix of residents, CRNAs, and SRNAs. Our policy is to thread the epidural catheter intrathecally following an unintended dural puncture during the placement of an obstetric epidural. Unfortunately, in the midnight hours a parturient with an intrathecal catheter was taken to the OR for an emergent Caesarean section and due to a breach in communication was administered a large volume of local anesthetic. The high block was detected immediately and an emergent Caesarean section was performed with no adverse outcome to mother or baby. Following this incident we implemented the guidelines in Figure 1, so as to avoid future errors.

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Intrathecal Catheter Protocol

Catheter placement: After accidental dural puncture, thread the epidural catheter so that 3-5 cm of the catheter is in the subarachnoid space.



1. **Label the catheter:** Label the catheter at the injection port and remove any other possible ports of injection such as 3-way stop cocks.



2. **Label the pump:** Cover the pump with a bag and place a warning label on the bag.



3. **Place a sign board outside the patient's room:** Place the laminated "Caution Intrathecal Catheter" sign outside the patient's door under the door number.



4. **Communicate:** Notify the bedside nurse, the charge nurse and the OB team of the presence of an intrathecal catheter. Note in **RED** on the board in the OB lounge and the nurse's station. Notify anesthesia during hand-off.

Charting: Write across the top of the OB Anesthesia record in large letters "INTRATHECAL CATHETER."

After delivery:

1. Disconnect the pump from the catheter, cap the catheter, and secure with tape.
2. Catheter should be left *in situ* for **24 hours** following placement. Time of removal must be communicated during hand-off.

Figure 1. Intrathecal Catheter Protocol.



The Anesthesia Patient Safety Foundation Sponsored Conference

Wednesday, September 3, 2014
Royal Palms Resort and Spa, Phoenix, AZ

Patient Safety Opportunities and the Perioperative Surgical Home

The Anesthesia Patient Safety Foundation (APSF) believes that the model envisioned by the Perioperative Surgical Home (PSH) will present opportunities for patient safety innovations. The goals of this 1-day conference will include establishing a better understanding of the PSH concept and how its implementation could facilitate patient safety initiatives.

Contact Stoelting@apsf.org for registration information.

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Julie M. Brightwell, RN.....*The Doctors Company*

Stephanie Musho.....*WelchAllyn*

Abe Abramovich

Robert K. Stoelting, MD

Letter to the Editor:

Rivastigmine (Exelon) Patch May Complicate Use of Neuromuscular Blocking Drugs

To the Editor:

We would like to present a situation that may impact patient safety. Rivastigmine (Exelon) is a drug used to treat Alzheimer's disease. It is an acetylcholinesterase inhibitor (AChI) designed to increase acetylcholine (ACh) in the central nervous system and improve memory. It was first approved in 2006 and a higher dose was approved in 2012 to treat mild to moderate Alzheimer's disease.^{1,2} The drug is available in an oral form and, most concerning for anesthesiologists, a "skin colored" patch (transdermal delivery system). The patch is left in place for up to 24 hours and the pathophysiologic memory loss of Alzheimer's might preclude anesthesia providers from learning of its presence.

The effect of AChI on neuromuscular blocking (NMB) drugs used in anesthesia is well described.³ Specifically, the resultant increased ACh from the inhibition of acetylcholinesterase can result in a resistance to nondepolarizing NMBs and sensitivity to depolarizing (succinylcholine) NMBs. The presence of AChI can dramatically affect both the dosing and monitoring of NMBs as well as their subsequent reversal, but the most pressing safety concern is the potential for unexpected patient movement if this drug interaction initially goes unrecognized.

Today, many patients with Alzheimer's disease present for surgery. A high index of suspicion for AChI from an oral or transdermal source should be suspected and sought. If time permits, a rivastigmine patch should be removed at least 24 hours before any anticipated general anesthetic, but the effects of residual AChI should still be anticipated and tracked with neuromuscular monitoring. Other considerations for patients on AChI include a preference for regional anesthesia or the avoidance of NMBs if possible.



Figure 1. Rivastigmine, an acetylcholinesterase inhibitor, may be administered orally or as a transdermal patch (photo) for treatment of Alzheimer's disease and may interfere with neuromuscular blocking drugs.

In summary, our profession has already learned from the fentanyl patch that transdermal delivery systems can profoundly alter anesthetic requirements and plans. The rivastigmine patch presents a new and unique safety threat because it specifically affects medicines that could affect patient movement, and it might be difficult in some urgent settings to even discern its presence.

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APSF NEWSLETTER Winter 2013-14

NEW PROCESS



The Anesthesia Patient Safety Foundation

ANNOUNCES A NEW PROCEDURE FOR SUBMITTING GRANT APPLICATIONS

LETTER OF INTENT (LOI) PROCESS FOR APSF GRANT APPLICANTS IN 2014

In consideration for an invitation from APSF to submit a formal grant application (maximum award \$150,000 for a study conducted over a maximum of 2 years to begin January 1, 2015), applicants are being asked to initially submit an LOI for review by APSF.

- Deadline to submit an LOI is Monday, March 3, 2014 (5 PM EST).
- Invitations to submit a formal grant application based on the LOI will be sent electronically by APSF on Thursday, May 1, 2014.
- Deadline for submission of a completed grant application based on the LOI will be Friday, August 15, 2014 (5 PM EST).

For the latest information, please visit the apsf.org website or contact Steven Howard, MD, Chair, Scientific Evaluation Committee at howard@apsf.org.

In this issue:

APSF Convenes Conference on Technology Training

Status of APSF Drug-Induced Muscle Weakness in the Postoperative Period Safety Initiative and Survey Results

President's Report Highlights Accomplishments of 2013

Four APSF Grants Awarded for 2014