

Canister Fires Become A Hot Safety Concern

by Michael A. Olympio, MD,
and Robert C. Morell, MD

Reports of fire and/or extreme heat occurring in the carbon dioxide absorber portion of the anesthesia circle system have come to the attention of the APSF. An October communication received from an anesthesiologist described canister overheating and a burning expiratory valve. Rapid communications and discussions revealed the existence of other, extremely rare, but similar occurrences. Input from the ASA Committee on Equipment and Facilities and from the FDA Center for Devices and Radiologic Health revealed 3-4 other reports. While the exact etiology of these "canister fires" is not known, the mechanism appears to be related to chemical interactions between desiccated CO₂ absorbent and potent inhaled anesthetic agents. The ECRI has also received reports of this dangerous phenomenon and has identified some common elements in 4 fires that were reported to them over the past few years. These common elements include the use of barium hydroxide containing CO₂ absorbent, desiccation of the absorbent, and the use of sevoflurane.

Abbott Laboratories issued a "Dear Health Care Professional" letter on November 17, 2003, calling attention to these rare, isolated reports.¹ In their letter a number of suggestions are described that might limit the risk of canister fires. These include

1. If you suspect that the CO₂ absorber may be desiccated because it has not been used for an extended period of time, it should be replaced.
2. Shut off the anesthesia machine (and fresh gas flow) after any case, when an extended period of non-use is anticipated.

3. Turn off the vaporizers when not in use.
4. Verify the integrity of the packaging of new CO₂ absorbents prior to use.
5. Periodically monitor the temperature of the CO₂ absorbent canisters.
6. Monitor the correlation between the sevoflurane vaporizer setting and the inspired sevoflurane concentration. An unusually delayed rise or unexpected decline of inspired sevoflurane concentration compared to the vaporizer setting may be associated with excessive heating of the CO₂ absorbent canister.

Abbott also pointed out that the color indicator of CO₂ absorbents does not necessarily change as a result of desiccation. If excessive heat is detected the patient should be disconnected from the anesthesia circuit, fresh gas flow to the circuit should be shut off, and the CO₂ absorbent should be replaced. The patient should also be monitored for carbon monoxide exposure and the potential for chemical thermal injury. Clinical findings associated with these events can include

1. Failed inhalation induction or inadequate anesthesia with sevoflurane.
2. Clinical signs of airway irritation.
3. Oxygen desaturation, increased airway pressure, and difficulty with ventilation.
4. Severe airway edema and erythema.
5. Elevated carboxyhemoglobin levels.

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Ellison C. (Jeep) Pierce, Jr., MD, Retires From APSF

The APSF and ASA Meetings held this past October in San Francisco witnessed a landmark event, the retirement of Ellison C. (Jeep) Pierce, Jr., MD, from his position as Executive Director of the Anesthesia Patient Safety Foundation. Jeep is truly the father of patient safety, both in the United States and abroad. His dedication, persistence, enthusiasm, and hard work led to the formation of the Anesthesia Patient Safety Foundation, which served as the model for the National Patient Safety Foundation and numerous similar international organizations. The celebrations held in Jeep's honor were bitter-sweet, sweet with the love and admiration that so many hold for this amazing man and his accomplishments, and sad with the knowledge that he is now retiring from the APSF. Jeep has served as a role model and mentor for many anesthesiologists and leaders in the field of patient safety; his influence has been and continues to be enormous. Like so many men of greatness, Jeep's contributions will continue to be recognized, recounted, and rediscovered, long after his retirement. Please join with the Executive Committee and the Board of Directors of the APSF in wishing Jeep a long and happy retirement, replete with the knowledge of the lives he has touched and the lives he has saved.



Dr. Staelting (left) honors Dr. Pierce with a plaque at the APSF Board of Directors Meeting.

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President Reports on State of APSF

2003 Replete With APSF Successes

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. I am pleased to report that 2003 has been a year of successes and achievements as the APSF strives to fulfill our mission that no patient shall be harmed by anesthesia.

Administrative Reorganization

Ellison C. Pierce, Jr., MD, retired as Executive Director on December 31, 2003. Dr. Pierce was the moving force and vision for the formation of the APSF in 1985, serving as the first president of APSF, and since 1997, as the Executive Director. His contributions and accomplishments to anesthesia patient safety were recognized by special presentations during the annual meeting of the APSF Board of Directors in San Francisco this past October. Anesthesia is a safer experience because of the tireless efforts of Dr. Pierce. His colleagues and patients thank him. We extend to Jeep and his family our best wishes for a pleasant and rewarding retirement.

The transition for moving the APSF office to Indianapolis from Boston and Pittsburgh began in July 2003. Deanna Walker began her new duties as Administrative Assistant for APSF in the Indianapolis office in July 2003. Contact information for the Indianapolis office is detailed in the *APSF Newsletter* and on the APSF Website.

Executive Vice Presidents

The APSF Board of Directors approved changes to the Bylaws at the annual meeting in October 2003 that included the provision for more than one Executive Vice President position. In view of the consolidation of the office of President and Executive Director into a single position, it was recognized that program development and corporate development would benefit from the efforts of a dedicated officer position. In this regard, Dr. Jeffrey B. Cooper and Mr. George A. Schapiro were elected to the offices of Executive Vice President by the APSF Board of Directors in October 2003. All other offices, including the office of Vice President, remain unchanged.

Data Dictionary Task Force

The Data Dictionary Task Force (DDTF) chaired by Terri G. Monk, MD, from the University of Florida has succeeded in accomplishing the "impossible" by creating the beginnings of a set of common anesthesia terms for use with anesthesia information systems (AIMS). The APSF DDTF is an international effort with collaboration from the American Society of Anesthesiologists and its Committee on Performance and Outcomes Measure-

ment, the Canadian Anesthesiologists' Society, and the National Health Service Information Authority in the United Kingdom. In October 2003, the APSF and the Systematized Nomenclature of Medicine (SNOMED) International Organization announced a 5-year collaboration agreement to utilize the DDTF to enhance the anesthesia content currently available in SNOMED Clinical Terms. The new concepts will be integrated into the SNOMED CT Core content and be available through the National Library of Medicine's Unified Medical Language System (UMLS).

The success of the DDTF was greatly enhanced by the efforts of Dr. Iain C. Sanderson from Duke University who chaired the DDTF Working Group. Dr. Sanderson developed the software for Distributed Anesthesia Terms and Mapping System (DATAMS) that permits cross-compatibility of terms used by manufacturers of AIMS. Global corporate sponsors of the DDTF include a number of the AIMS suppliers, GE Medical Systems, Deio, Philips Medical Systems, Siemens Medical Systems, Draeger Medical, eko systems, Picis, Inc., and Cerner Corporation.

The APSF is committed to encouraging the adoption of AIMS as a key to providing better anesthesia care, collection of data that will contribute to development of best anesthesia practices, and improved anesthesia patient safety. The APSF believes that the development of standardized clinical terminology will support documentation in the operating room, and thus improve data collection and analysis to reduce anesthetic errors.

American Association of Nurse Anesthetists

I am pleased that a continuing dialogue has been established with the American Association of Nurse Anesthetists (AANA) and the APSF Executive Committee to discuss common areas of interest in anesthesia patient safety. In an effort to ensure communication and sharing of anesthesia patient safety information, selected articles from the *APSF Newsletter* may be reprinted in the AANA NewsBulletin. The *APSF Newsletter* editorial board includes Rodney C. Lester, PhD, CRNA, and encourages patient safety articles from all those who participate in anesthesia care.

High Reliability Perioperative Medicine

The APSF introduced its initiative on High Reliability Perioperative Medicine with a special Spring 2003 issue of the *APSF Newsletter* devoted to High Reliability Organization (HRO) theory and a workshop at the annual meeting of the American Society of Anesthesiologists in October 2003. The workshop was moderated by Drs. David M. Gaba and Jeffrey B. Cooper. As evidence of the multidisciplinary role

of all those who participate in perioperative care, the APSF was pleased to include Dr. James E. Cottrell, President of the American Society of Anesthesiologists, Dr. Thomas R. Russell, Executive Director of the American College of Surgeons, and Thomas A. Cooper, Executive Director of the Association of Perioperative Registered Nurses in the workshop program.

A HRO repeatedly accomplishes its mission while avoiding catastrophic events, despite significant hazards, dynamic tasks, time constraints, and complex technologies. Examples include civilian and military aviation. Many of the features that characterize an HRO are applicable to the operating room environment and perioperative care. The

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The Anesthesia Patient Safety Foundation Newsletter is the official publication of the nonprofit Anesthesia Patient Safety Foundation and is published quarterly at Wilmington, Delaware. Annual membership: Individual - \$25.00, Corporate - \$500.00. This and any additional contributions to the Foundation are tax deductible. © Copyright, Anesthesia Patient Safety Foundation, 2004.

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APSF Leaders Receive Recognition

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APSF believes that anesthesia patient safety may be improved by applying HRO concepts and strategies to the practice of anesthesiology.

Newsletter

The *APSF Newsletter* under the leadership of Robert C. Morell, MD, and an outstanding Editorial Board continues to provide timely and worldwide distribution of vitally important anesthesia patient safety information. Beginning with the Spring 2003 issue, the *APSF Newsletter* was designated the *Official Journal of the Anesthesia Patient Safety Foundation*. During the past year the *Newsletter* has included articles on “smart pump technology” and its relationship to error reduction, continued discussion on perioperative beta blockade, obstructive sleep apnea, postoperative visual loss, and SARS. The Fall 2003 issue of the *Newsletter* was a special issue addressing long-term outcome and the role of anesthetic management and mediators of inflammation.

Continued Research Support

Sponsorship of anesthesia patient safety-related research continues to be a high priority for APSF. In October 2003, the APSF Committee on Scientific Evaluation, chaired by Sorin J. Brull, MD, awarded 3 research grants with funding up to \$65,000. One of these grants received an additional \$5,000 as the Ellison C. Pierce, Jr., MD, Research Award recipient (see Grant Awards, page 50).

An APSF 2002 Grant Applicant Survey conducted by Dr. Karen L. Posner described a total of 272 grant applications received by the APSF between 1987 and 2001. A total of 33 projects have been funded during that time period, and nearly 90% of the funded studies resulted in publications. In the early years, the APSF was the only funding source for patient safety research, and this was important in initial support of investigators pursuing development of simulators for anesthesia, human factors research, and device development. Many of those investigators receiving APSF grants have gone on to develop highly successful academic careers with multiple peer review publications often in the area of anesthesia patient safety.

Special Recognition

David M. Gaba, MD, APSF Secretary, received the 2003 Society for Education in Anesthesia-Duke Award for Excellence and Innovation in Anesthesia Education at that society’s annual meeting in San Francisco in October. Dr. Jeffrey B. Cooper, member of the APSF Executive Committee and Board of Directors, received the 2003 AANA Public Interest in Anesthesia Award as well as the 2003 Eisenberg Award for Lifetime Achievement (see Cooper Award, page 51). Robert K. Stoelting, MD, President APSF, received the 2003 American Society of Anesthesiologists Distinguished Service Award (see next page).

Contributions from individuals, corporations, anesthesia groups, and national and state societies are critical for the APSF to continue and advance its patient safety mission. The generous financial support from our founding sponsor, the American Society of Anesthesiologists, is vital for the continued ability of APSF to provide education, research, and information related to anesthesia patient safety to everyone. All donors and their level of support are recognized in the *APSF Newsletter*. In particular, the support of AstraZeneca in the form of a grant for defraying the costs of the *APSF Newsletter* is greatly appreciated. I believe that all can be proud of the results of their continued support of APSF.

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

Best wishes for a prosperous and rewarding year 2004.

Robert K. Stoelting, MD

President, Anesthesia Patient Safety Foundation

Readers Encouraged to Report Fires

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It was further discussed that the cases of canister fire or extreme heat generation were typically the first case of the day and involved the use of barium hydroxide containing absorbent; however, other case reports have involved desiccated soda lime, as well. Abbott Laboratories, in collaboration with the Food and Drug Administration, is actively investigating the mechanisms of these events and associated factors. Any readers experiencing similar problems are strongly encouraged to report such events to the FDA’s MedWatch program (phone: 1-800-FDA-1088, Fax: 1-800-FDA-0178, or via electronic reporting at the FDA MedWatch Website at www.FDA.gov/medwatch) or to Abbott Laboratories (phone: 1-800-633-9110).

We call the reader’s attention to a most dramatic (American) report by Elena J. Holak, Harvey J. Woehlick, and colleagues at the Medical College of Wisconsin, in which simulated anesthetic conditions were created in the laboratory.² The authors dehydrated the barium hydroxide containing CO₂ absorbent and exposed it to an attempted maintenance of 1 MAC sevoflurane (ET 2.1%) in the presence of 350 ml/min of carbon dioxide “production.” The greater the minute ventilation (and presumably greater exposure of the delivered sevoflurane to the absorbent), the greater was the fresh gas flow (FGF) required to achieve the 2.1% target. At a minute ventilation of 10 L, it required 6 lpm of FGF and a dial setting of 8% to achieve the target. In the absence of sevoflurane uptake by a patient, the high breakdown of sevoflurane was presumed secondary to reaction with the absorbent. In less than 10 minutes of exposure, the upper absorbent canister reached >110°C, and was too hot to touch in 15 minutes. CO production increased exponentially above 70°C, and at 45 minutes the temperature was >200°C, the upper limit of the thermometer. Finally, at 53 minutes, the absorber exploded and burst into flames. It was suggested that a delayed rate of rise of the inspired agent concentration could serve as an early warning before the dramatic rise in temperature of the absorbent. Temperature monitoring of the internal aspects of the absorbent (particularly the layer first exposed to agent) may represent a clinically useful tool to help detect the possibility of sevoflurane breakdown in the presence of desiccated absorbent.

Sevoflurane is flammable at a concentration of 11% in oxygen.³ However, the byproducts of sevoflurane breakdown include methanol and formaldehyde in addition to CO, and these may be potentially combustible.

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AstraZeneca

**The APSF wishes
to thank
AstraZeneca
Pharmaceuticals LP
(www.AstraZeneca.com)
for their continued
support of this
newsletter.**

Awareness and Education Are Key to Fire Prevention

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The exposure to FGF and subsequent dehydration of absorbent within a particular anesthesia machine depends upon a complex set of interactions between flow, resistance, and unidirectional valves. One report describes the removal of the reservoir bag as a cause of increased retrograde flow and desiccation.⁴ However, modern anesthesia machines, with radically different circuits, may also have different paths of least resistance, and thus, fresh gas flow. Differences in APL (adjustable pressure limiting) valve design or entry of the FGF into the circuit distal to the inspiratory valve might also affect desiccation. Perhaps the most important precaution is to ensure that all FGF (including minimum flow) is off when the machine is not in use. Furthermore, it may not be desirable to completely turn off certain modern anesthesia machines because start-up delays could occur in emergency situations (by virtue of automated self-check procedures).^{5,6} Monitoring the frequency with which the CO₂ absorbent is changed and developing site-specific policies for changing the absorbent may also be prudent. The safety of rehydration of absorbent⁷ has not been fully characterized.

Awareness and education are the first steps toward prevention. Numerous and important abstracts from the 2002 and 2003 meetings of the American Society of Anesthesiologists address this topic.⁸ The APSF will continue to communicate closely with clinicians, manufacturers, and other safety organizations to monitor developments and emerging information. It is our continuing goal to assist all anesthesia providers in their attempts to ensure patient safety by disseminating such important information via the APSF website (www.apsf.org) and this *Newsletter*.

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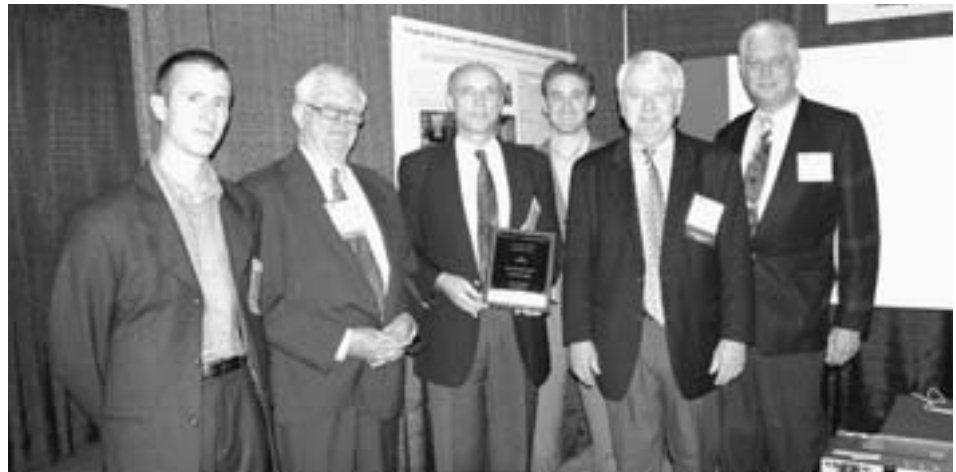
Dr. Robert Stoelting to Receive 2004 ASA Distinguished Service Award

Robert K. Stoelting, MD, has been awarded the 2004 American Society of Anesthesiologists Distinguished Service Award. The announcement came at the ASA's annual meeting in October and the presentation will be made at the 2004 annual meeting. The award is the ASA's highest tribute paid to an anesthesiologist for meritorious service and achievement. Dr. Stoelting, Professor Emeritus of Anesthesia, served as chairman of the Indiana University Department of Anesthesiology for 26 years, retiring this past June. Dr. Stoelting is the President of the Anesthesia Patient Safety Foundation.

Check out the
APSF Website at
[www.apsf.org!](http://www.apsf.org)

3-D Fiberoptic Model Wins Best Scientific Exhibit Award

Dr. Pierre A. Diemunsch and his group from Strasbourg, France, demonstrated an innovative, 3-dimensional, virtual teaching tool for fiberoptic intubation. This program uses actual digital computerized tomography data to provide a virtual reconstruction of the airway. Overlays can be added or deleted to show radiographic views, surface views, or internal views simultaneously displayed with the fiberoptic vantage point. The images can also be rotated in all planes. In addition to serving as an excellent teaching tool, this computerized model can rapidly accommodate digitized data from actual patients and allow the anesthesia team to practice a virtual fiberoptic intubation, prior to performing the procedure on the patient. A team of judges from the APSF Committee on Education and Training awarded Dr. Diemunsch and his team the Ellison C. Pierce, Jr., MD, Award for the Best Scientific Exhibit at the 2003 ASA, held this past October in San Francisco. Congratulations to this group for an exciting addition to patient safety.



Dr. Pierce presents Dr. Diemunsch and colleagues with the E.C. Pierce, Jr., MD, Scientific Exhibit Award at the 2003 ASA.

APSF Papers Highlight Safety

by Glenn S. Murphy, MD, and Jeffery S. Vender, MD

Over 1500 abstracts were presented at the 2003 American Society of Anesthesiologists Annual Meeting in San Francisco. During 6 poster sessions, more than 100 scientific papers were exhibited which related directly to patient safety. The following review will highlight a few of the many interesting patient safety abstracts.

Airway Management

Prion proteins have been identified in human tonsillar tissue. There exists a theoretical risk of transmission of variant Creutzfeldt-Jakob disease from reusable anesthesia equipment. Mathur et al. (A-1232) examined the incidence of protein contamination on cleaned laryngoscope blades. Thirty previously used, cleaned blades were collected, as well as 6 used, unclean blades. Protein staining was identified on all previously used blades, and the degree of protein staining on cleaned blades was statistically indistinguishable from unclean blades. These data suggest that current methods of removing contaminants from airway devices (autoclaving and chemical processes) are insufficient in eliminating protein deposits.

The efficiency of cricoid pressure in reducing the risk of regurgitation during induction of anesthesia has not been previously studied. Oehlker et al. (A-1235) randomized 130 patients at high-risk of regurgitation to receive cricoid pressure or no cricoid pressure. Prior to entering the operating room, each patient swallowed a capsule of methylene blue. During laryngoscopy, regurgitation was evaluated by the presence or absence of blue coloration in the pharynx. No methylene blue was observed in patients in the cricoid pressure group, whereas evidence of regurgitation was noted in 3 patients in the no cricoid pressure group. This study suggests that cricoid pressure might provide protection against gastric content regurgitation.

Two abstracts from the Mayo Clinic-Scottsdale (A-1244, A-1245) examined the effectiveness of methods used to communicate to patients a history of a difficult airway. During a 3 to 4 year period, all patients with a history of a difficult airway were informed of this problem during a postoperative visit and sent a "difficult airway" letter. Of the 113 patients contacted, 50% had no recall of any conversation with their anesthesiologist, and 29% claimed that they had not received a "difficult airway" letter. When 28 of these patients presented for a subsequent surgical procedure, the majority (22 patients) denied any history of previous anesthetic complications. Unfortunately, the combination of verbal communication and written notification might not be an effective method of identifying patients with a history of difficult airways.

Cervical spine surgery may be associated with postoperative airway swelling and the need for emergency re-intubation or tracheostomy. Matsumoto et al. (A-1254) performed a study to deter-

mine if combined anterior-posterior cervical spine surgery resulted in an increased risk of emergent re-intubation, compared with other cervical spine surgeries. Over a 2-year period, 156 patients underwent cervical spine surgery; an antero-posterior approach was used in 10 of these patients. Emergent postoperative re-intubation was required following 30% of the antero-posterior procedures, compared to only 1% of all other surgical approaches. Clinicians should be aware that combined anterior and posterior spine surgery appears to increase the risk of life-threatening postoperative airway swelling in this limited study.

Postoperative Hypoxemia

Hypoxemia after general anesthesia has been associated with adverse postoperative complications. The goal of the study by Billard et al. (A-1302) was to build a model that could identify patients at high risk for hypoxemia in the PACU. Six hundred and five patients were used to establish the model and 196 to validate it. Hypoxemia ($SpO_2 < 90\%$) occurred in 23% of the subjects. Multivariate analysis found that body mass index, age, baseline SpO_2 , peripheral or laparoscopic surgery, anesthesia duration, and methylene blue administration were all significantly related to postoperative hypoxemia. The performance of the model was good when tested on the second group of patients.

Curry et al. (A-1306) compared the incidence of postoperative hypoxic events in patients undergoing major abdominal or major peripheral orthopedic procedures. Continuous central pulse oximetry was performed for 24 hours. No significant differences were found between the groups in the probability of having hypoxic events. These data suggest that factors other than type of surgery play a primary role in postoperative hypoxemia. The authors also observed that the number of hypoxic events recorded with continuous oximetry ($n=3959$) was significantly greater than the number of episodes documented in the chart ($n=23$). In an additional study from the same group (Curry et al., A-1312), the authors tested the hypothesis that intensive postoperative pain control produces postoperative hypoxemia. Orthopedic patients ($n=135$) receiving either intrathecal morphine or intrathecal morphine plus narcotic PCA for postoperative pain management were monitored with central pulse oximetry for 24 hours. More than 75% of patients had 1-2 episodes of hypoxemia per hour, and 31% of these episodes were severe ($SpO_2 < 85\%$). Hypoxic events are common when an aggressive analgesic strategy is used, particularly when a PCA is used in combination with intrathecal morphine.

Miscellaneous

The relationship between bispectral index (BIS) monitoring and clinical outcomes was examined in a study by Monk et al. (A-1361). A retrospective analysis of mortality rates using Medicare data was

performed. Overall 1-year, post-discharge mortality was 9.1%. Risk-adjusted mortality rates were lower in hospitals that routinely used BIS monitoring (8.7%) compared to hospitals with no BIS utilization (9.3%, $p < 0.001$). The authors hypothesized that difference in mortality might be related to a decrease in cumulative deep anesthesia times at hospitals with higher levels of BIS monitoring.

The incidence of drug administration errors in a large academic anesthesia practice was reported by Bowdle et al. (A-1358). During a 21-week period, anonymous survey forms were returned following 6,709 anesthetics. There were 41 reports of errors (0.68%) which were distributed among attendings, residents, and CRNAs. Twenty-nine of these errors resulted in unintended drug effects, and 14 were associated with drug infusions delivered by a pump. These data support the belief that drug administration errors are not rare events in the operating room.

Bhananker et al. (A-1356) analyzed claims from the ASA Closed Claims database to determine patterns of injury and liability associated with monitored anesthesia care (MAC). Of a total of 4,454 cases in the database, MAC accounted for 150 claims. Monitored anesthesia care represented 2% of the claims before 1990, compared to 5% of claims after 1990 ($p < 0.05$). Compared to general and regional claims, MAC cases involved older, sicker patients undergoing more eye and plastic surgery procedures. Inadequate oxygenation and ventilation was also more common in MAC claims. Payments for injuries during MAC were as high as those occurring after general or regional anesthesia.

The wrist is frequently maintained in a hyperextended position following radial artery catheter placement. Chowet et al. (A-1354) studied the effects of wrist hyperextension on motor and sensory conduction in the median nerve. Compound sensory and motor action potentials were measured in 12 awake volunteers. In 10 of 12 subjects, conduction block developed within an average time of 43 minutes. The authors state that prolonged periods of hyperextension may be associated with significant neuropathy.

This brief review only summarizes a small portion of the abstracts on patient safety that were presented at the 2003 ASA Annual Meeting. All of the abstracts from the 2003 meeting may be viewed at the *Anesthesiology* website at www.anesthesiology.org.

Dr. Murphy is the Director of Cardiac Anesthesia at Evanston Northwestern Healthcare and an Assistant Professor at Northwestern University Medical School. Dr. Vender is Chairman of the Department of Anesthesia at Evanston Northwestern Healthcare and a Professor at Northwestern University Medical School. Both are members of the APSF Newsletter Editorial Board.

APSF Awards Three New Grants

by Sorin J. Brill, MD

The Anesthesia Patient Safety Foundation (APSF) is pleased to report that it continues to attract outstanding applications for funding. The scope of investigation areas continues to evolve, and this year the committee expanded the educational focus to include innovative methods of education and training to improve patient safety, development of educational content with application to patient safety, and development or testing of educational content to measure and improve safe delivery of perioperative anesthetic care.

This year 3 grants were selected for funding by the APSF Scientific Evaluation Committee (SEC; for names of committee members, please refer to the list on page 61). As in previous years, the award amount is \$65,000. The SEC members were pleased to note that the committee reviewed 30 applications in the first round, of which 12 were eligible for final review at the ASA Annual Meeting in San Francisco. As in previous years, the grant submissions addressed areas of high priority. The major objective of the APSF is to stimulate the performance of studies that lead to prevention of mortality and morbidity from anesthesia mishaps. A particular priority continues to be given to studies that address anesthetic problems in healthy patients, and to those studies that are broadly applicable and promise improved methods of patient safety with a defined and direct path toward implementation into clinical care.

In addition to the research and educational content that is the major focus of the funding program, APSF also recognizes the patriarch of what has become a patient safety culture in the United States and internationally, and one of the founding members of the Foundation: Ellison C. "Jeep" Pierce, Jr., MD. The APSF Scientific Evaluation Committee thus designates each year one of the funded proposals as the recipient of this prestigious nomination, the **Ellison C. Pierce, Jr. Award**. This award carries with it an additional, unrestricted prize of \$5,000.

The applications this year covered a variety of topics: the value of C-reactive protein in cardiovascular risk stratification; the use of ultrasound for central venous cannulation; the role of prehabilitation in postoperative recovery; the reliability and safety of paresthesia-inducing regional blocks; the hemodynamic consequences of preoxygenation; the detection and elimination of artifacts in electronic record keeping; the use of virtual reality for regional anesthesia; the formation of toxic propofol intermediates and its metabolic polymorphism; the use of a web-based anesthesia machine pre-use check; the safety of analgesic prescription practice upon hospital discharge; the effects of bright lights and caffeine on patients' alertness status; B-cell calcium signaling as a diagnostic indicator of malignant hyperthermia; the role of musical stimuli in the design of auditory



Judith A. Clair, PhD

alarms; the impact of the preoperative process on perioperative morbidity; the development of a pediatric emergence agitation scale; the effect of education on catheter-related bloodstream infections; the use of monoclonal antibodies for neuromuscular block reversal; the effect of carbon dioxide injection on recovery time from inhalational agents; the role of normoglycemia in cardiac surgery patients; the effect of neurosurgical patient positioning on ventilator-associated pneumonia; the effect of depth of hypnosis monitoring on patients undergoing non-cardiac surgery; the effects of body inclination on intraocular pressure in the prone position; the development of a novel sedation/pain scale and treatment algorithm; the assessment and postoperative complications in obstructive sleep apnea patients; the effectiveness of an on-line interactive program for learning by medical students; and the safety of regional anesthesia.

The APSF Scientific Evaluation Committee met during the ASA Annual Meeting on October 11, 2003, in San Francisco for final evaluation of the proposals. Of the 12 finalists, the members of the APSF committee selected 3 awardees:

Judith A. Clair, PhD, is Associate Professor, Department of Organization Studies, Carroll School of Management, Boston College. Her grant proposal is entitled *"Identifying Optimal Debriefing Strategies for Educating Anesthesiologists Using Simulated Critical Incidents."* The objective of this proposal is to systematically describe the process of post-crisis facilitated debriefing by analyzing and coding videotape-recorded debriefings of realistic, simulated anesthesia crises from a number of centers currently practicing this educational modality. The investigators will also conduct a preliminary assessment of the effectiveness of debriefing based on participant assessment of its effectiveness. The results of this research will lead to a more thorough understanding of debriefing methodology, and will derive

data on debriefing's effectiveness as a mechanism to learn about managing anesthesia crises. With a more complete characterization of debriefing and data concerning its efficacy, simulation centers and their faculty will be more effective in educating anesthesiologists as to how best to respond when critical events occur.

This proposal has significant patient safety implications, as it will offer objective criteria and methodologies for teaching anesthesia crisis management. Other personnel listed in Dr. Clair's proposal include co-investigator Ronald L. Dufresne, BS, PhD (Candidate), and consultants Simon Gelman, MD, PhD; Jeffrey B. Cooper, PhD; Daniel B. Reamer, PhD; and Robert Simon, EdD.

In addition to receiving the requested funding of \$65,000 for this project, Dr Clair is also the recipient of the **"Ellison C. Pierce, Jr., MD, Award,"** which consists of an additional, unrestricted grant of \$5,000.



Patricia Fogarty-Mack, MD

Patricia Fogarty-Mack, MD, is Associate Professor of Clinical Anesthesiology, Department of Anesthesiology, Weill Medical College of Cornell University, New York. Her grant proposal is entitled *"The Effect of Timolol on Intraocular Pressure and Postoperative Vision in Patients Undergoing Spine Surgery."* The objective of this proposal is to determine whether preoperative administration of timolol can attenuate the increase in intraocular pressure associated with

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Widely Diverse Grant Topics Continue to Be of High Quality

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prone positioning in a sustained fashion throughout major spine surgery. A second aim of this study is to determine whether preoperative timolol administration affects the incidence of other postoperative visual disturbances, namely changes in visual acuity and visual fields. This proposal has significant patient safety implications, since postoperative vision loss is a rare, but catastrophic complication that has been reported following general anesthesia for major spine surgery in the prone position.

Dr. Fogarty-Mack’s co-investigator is Dr. Charles Cole, Assistant Professor of Ophthalmology, who will perform all ophthalmologic evaluations.

Melanie C. Wright, PhD, is Assistant Professor, Department of Anesthesiology, Human Simulation and Patient Safety Center, Duke University, North Carolina. Her grant proposal is entitled *“Effect of Time of Day and Surgery Duration on Adverse Events in Anesthesia.”* The effects of fatigue on clinical performance are measurable, yet these decrements have not been clearly linked to adverse clinical outcomes following surgery. This research proposes to evaluate existing perioperative data from over 86,000 surgical procedures for two possible sources of adverse events in anesthesia, namely, the time of day of the surgical procedure and the duration of surgery itself. This proposal has major implications on patient safety, as it may ascertain those factors that are most likely to lead to adverse outcomes in surgical patients.



Melanie C. Wright, PhD

Dr. Wright’s co-investigator is Jeff Taekman, MD, and her consultants are Terrence Breen, MD; Katherine Grichnik, MD; Jonathan Mark, MD; Bryan Andregg; Barbara Phillips-Bute, PhD; Iain Sanderson, MD; and Bill Gilbert.

The members of the APSF Scientific Evaluation Committee wish to congratulate all of the investigators who submitted their work to APSF this year, whether or not their proposals were funded. We hope that the high quality of the accepted proposals and the important findings that will undoubtedly result from completion of these proposals will serve as a stimulus for others to submit research grants that will benefit all patients and our specialty.

Dr. Brull is the Chair of the APSF Committee on Scientific Evaluation.

Cooper Receives Eisenberg Award for Lifetime of Achievement

The National Quality Forum and the Joint Commission on Accreditation of Healthcare Organizations established the John M. Eisenberg Patient Safety Award for Lifetime Achievement in May 2002, to honor the memory of Dr. John M. Eisenberg, who passed away in March 2002. Dr. Eisenberg was the highly respected leader of the Agency for Healthcare Research and Quality, and the Eisenberg Patient Safety Lifetime Achievement award recognizes individuals who have demonstrated exceptional leadership and scholarship in patient safety during their career. This year, the 2003 John M. Eisenberg Lifetime Achievement Award was bestowed upon Dr. Jeffrey B. Cooper, the Executive Vice President of the Anesthesia Patient Safety Foundation. Dr. Cooper is one of the original founding members of the APSF and has dedicated his career to improving patient safety. Dr. Cooper is a biomedical engineer who currently holds the titles of Director, Biomedical Engineering, Partners Healthcare System, Inc.; Associate Professor of Anesthesia, Harvard Medical School; Associate Director in the Center for Integration of Medicine and Innovative Technology. He is also the Director of the Center for Medical Simulation in Boston. The Anesthesia Patient Safety Foundation is very proud and fortunate to have Dr. Cooper as Executive Vice President and Member of the Board of Directors and extends its congratulations for this well deserved recognition.

Puza Retires as APSF Administrative Assistant

Wanda Puza has been the “voice of the APSF” to all who have called the APSF office for many years. Wanda has served the APSF as Administrative Assistant to Dr. Ellison C. (Jeep) Pierce and as the administrative backbone, arranging Executive Committee meetings, Board of Director Meetings, retreats and workshops, and keeping our donor lists, committee lists and mailing lists organized. She has been a familiar and friendly face to hundreds of people who have visited the APSF booth at the annual ASA meetings. Finally, as a symbol of her ongoing dedication to the APSF, Wanda has helped to train and orient her successor, Deanna Walker, who assumed the position of Administrative Assistant to APSF President, Dr. Robert Stoelting. We bid a fond farewell to Wanda in her well earned retirement and welcome Deanna.



Wanda Puza receives retirement gift from Dr. Robert Stoelting, APSF President.

ASA Exhibits Promote More Safety Strategies

by John H. Eichhorn, MD

Both the scientific and the commercial technical exhibits at the 2003 Annual Meeting of the American Society of Anesthesiologists included several patient safety related presentations that offered attempted improvements on familiar safety strategies. As was the case the previous year, airway management and anesthesia information systems were the two most common subject areas within the patient safety realm.

Among the Scientific and Educational Exhibits, more than a dozen organized societies or issue-focused groups offered information and programs. Prime among them was the American Sleep Apnea Association with a presentation intended to disseminate information aimed at enhancing safety for sleep apnea patients requiring anesthesia care. Featured was the NIH publication "Sleep Apnea: Is Your Patient at Risk?" which highlights pre-surgery screening and, particularly, postoperative monitoring. The group's own statement, "Sleep Apnea and Same-Day Surgery," was an additional feature of the exhibit.

Also prominent in this section of the exhibits was the Society for Airway Management which displayed its activities to date and sought input regarding future projects. A separate exhibit by a Texas group discussed "SLAM (Street Level Airway Management)" via dissemination of their four component flow chart comprised of difficult intubation, rapid sequence intubation, rescue ventilation airway devices, and cricothyrotomy techniques (with a simulator for practicing). A separate key emphasis was on confirming correct tracheal intubation in the field. Another exhibit presented "Algorithms in Emergency Airway Management" as an expansion upon previously published guidelines. These enhanced protocols emphasized airway management in trauma patients such as those with compromised airways, verification of tracheal tube position and depth in emergency or ICU settings, management of tubes with leaks or exchange, alternate airway devices, laryngospasm, and airway techniques for patients with gut obstructions. Approaching airway teaching from a different aspect was a sophisticated "virtual reality" 3-D computer program developed in France that teaches fiberoptic-assisted intubation on screen with individual prompts and real-time feedback (see 3-D Fiberoptic Model on page 48). Likewise, but for teaching with real patients, there was an exhibit displaying a new video system that both records the performance of anesthesia personnel managing a patient's airway while at the same time a camera lens on the laryngoscope blade shows on the same screen exactly what is being seen in the airway. Correlation of the practitioner's approach and manipulations with the resulting success or failure of airway visualization provides a new and powerful teaching tool for intu-

bation and airway safety. Another exhibit not only featured airway models but showed the latest examples of strikingly realistic simulation devices for practicing IV starts, central line placements, arterial cannulae insertions, and even administration of spinal anesthetics.

Another type of advanced simulator was exhibited as an adjunct to teaching brachial plexus block techniques with obvious positive safety implications for anesthesiology training programs. A remarkably sophisticated anatomically correct plastic upper body mannequin simulator contains electronic sensors wired into a computer, and a monitor screen shows the resulting hand and arm responses as the nerve-stimulator guided needle is advanced. Errant needle placements (intravascular or intrathoracic) are also sensed and signaled. A separate exhibit featured the use of ultrasound images to guide correct placement of peripheral nerve blocks.

A different type of exhibit with clear safety implications was "What to Do When Your Patient Does Not Speak English." Relevant legal and regulatory requirements were featured as well as strategies for coping with this issue. Research into improving communication in such situations was described. Also different was "Herbal Medicines: What Your Patients Don't Know," which highlighted the commonly used herbal preparations that may have an impact on anesthetic pharmacology and management, points often poorly understood by patient and practitioner alike.

In recognition that the FDA prescribed pre-use anesthesia machine checkout protocol is viewed as cumbersome by some practitioners, and that it may also be relatively outdated as far as applicability to the most current models of anesthesia machines, an exhibit by a Milwaukee group offered a new sleeker and more efficient (less than 7 minutes) version of the functional checkout of an anesthesia machine. One of the presenters noted that a manuscript describing the new protocol had been submitted for publication with the hope that this new algorithm might become widely adopted.

Several of the remaining Scientific Exhibits concerned anesthesia information management systems in one way or another. A "do-it-yourself" automated record keeper was displayed that featured computer system drivers to mesh certain of the older monitoring systems with a recording computer. An electronic anesthesia outcome database fueled by PDA input from the bedside during the postoperative visit was presented. Other exhibits showed computer programs for collecting and analyzing quality improvement information.

As has been the case before, the commercial Technical Exhibits trumpeted many new bells and whistles for traditional types of equipment and supplies. Little was displayed in the way of genuinely

new technology or products. Airway management tools and ideas were very prominent, as usual (demonstrating yet again that the airway may well be the one area of anesthesia practice and patient safety concern that has advanced the least over the now nearly 20 years of the modern anesthesia patient safety movement). One company offered an entire catalogue of "Products for the Difficult Airway," which not only focused on devices for a transtracheal approach (including retrograde wires), but also promoted catheters and cannulae for laryngeal access. In addition to a panoply of laryngoscope species, a new version of the video laryngoscope, this one with a sharply curved blade connected to a dedicated small screen on a stand, was displayed. Variations of alternative airway devices (such as "the perilaryngeal airway") were also shown. Anesthesia information management systems, many touting patient safety advantages, were widely exhibited. Enhanced features included such things as voice-recognition software that is intended to chart text entries automatically once the operator's voice is learned by the computer. As with so many of the "advances," the real-world practicality and applicability as well as the potentially significant costs involved will eventually determine whether this and many of the displayed products will survive to be shown in the 2004 and subsequent ASA Annual Meeting Exhibits.

Dr. Eichhorn, Professor of Anesthesiology at the University of Kentucky College of Medicine, was the founding Editor of this publication and now serves on the APSF Executive Committee as well as the APSF Newsletter Editorial Board.

Check out the
**Virtual Anesthesia
 Machine Website**
 and the
**APSF Anesthesia
 Machine Workbook**
 at
www.anest.ufl.edu/vam

ANESTHESIA PATIENT SAFETY FOUNDATION (APSF) GRANT PROGRAM

Application Guidelines for Grants Scheduled to Begin on January 1, 2005

The Anesthesia Patient Safety Foundation (APSF) Grant Program supports research directed toward enhancing anesthesia patient safety. Its major objective is to stimulate studies leading to prevention of mortality and morbidity resulting from anesthesia mishaps.

NOTE: Please read these guidelines carefully. From year to year, there have been changes in areas of priority, in requirements for materials, and specific details of emphasis. For the current funding cycle, the APSF is placing a specific emphasis on PATIENT SAFETY EDUCATION.

To recognize the patriarch of what has become an international model for patient safety, the APSF inaugurated in 2002 the **Ellison C. Pierce, Jr., MD, Education Award**. The APSF Scientific Evaluation Committee will designate one of the funded proposals as the recipient of this honor that carries with it an additional, unrestricted award of \$5,000.

PRIORITIES

Highest priority is given to:

- Studies that address peri-anesthetic problems for relatively healthy patients or
- Studies that are broadly applicable AND that promise improved methods of patient safety with a defined and direct path to implementation into clinical care
- Innovative methods of education and training to improve patient safety.

AREAS OF RESEARCH

Areas of research interest include, but are not limited to:

- New clinical methods for prevention and/or early diagnosis of mishaps
- Evaluation of new and/or re-evaluation of old technologies for prevention and diagnosis of mishaps
- Identification of predictors of patients, anesthesiologists, and anesthetists at increased risk for mishaps
- Development of innovative methods for the study of low-frequency events
- Methods for measurement of cost effectiveness of techniques designed to increase patient safety
- Development or testing of educational content to measure, develop, and improve safe delivery of anesthetic care during the perioperative period
- Development, implementation, and validation of educational content or methods of relevance to patient safety (note that both patient and care provider educational projects qualify).

SCORING

Studies will be scored on:

- Soundness and technical merit of proposed research with a clear hypothesis and research plan
- Adequacy of assurances detailing the proposed means for safeguarding human or animal subjects
- Uniqueness of scientific, educational, or technological approach of proposed research
- Applicability of the proposed research and potential for broad healthcare adoption
- Clinical significance of the area of research and likelihood of the studies to produce quantifiable improvements in patient outcome such as increased life-span, physical functionality, or ability to function independently, potential for reductions in procedural risks such as mortality or morbidity, or significant improvements in recovery time.

Priority will be given to topics that do not have other available sources for funding.

Proposals to create patient safety education content or methods that do not include a rigorous evaluation of content validity and/or benefit will be unlikely to attain sufficient priority for funding.

NOTE: Innovative ideas and creativity are strongly encouraged. New applicants are advised to seek guidance from an advisor/mentor skilled in experimental design and preparation of grant applications. Poorly conceived ideas, failure to have a clear hypothesis or research plan, or failure to demonstrate clearly the relationship of the work to patient safety are the most frequent reasons for applications being disapproved or receiving a low priority score.

BUDGET

The budget request must not exceed \$65,000. Projects may be for up to 2 years in duration, although a shorter anticipated time to completion is encouraged. APSF funds may not be used for indirect costs (overhead).

ELIGIBILITY

Awards are made to a sponsoring institution, not to individuals or to departments. Any qualified member of a sponsoring institution in the United States or Canada may apply. Only one person may be listed as the principal investigator. All co-investigators, collaborators, and consultants should be listed. Applications will not be accepted from a principal investigator currently funded by the APSF. Re-applications from investigators who were funded by the APSF in previous years, however, will be accepted without prejudice.

Applications that fail to meet these basic criteria will be eliminated from detailed review and returned with only minimal comment. A summary of reviewers' comments and recommendations will be provided to investigators requesting it only for those applications that are given full committee review. Please refer to the Spring 1997 issue of the *Anesthesia Patient Safety Foundation Newsletter* for further advice about applications, or contact the Scientific Evaluation Committee Chairman, Sorin J. Brull, MD, by phone: 386-676-1158, fax: 386-676-9872, or email: sjbrull@cfl.rr.com.

AWARDS

Awards for projects to begin January 1, 2005, will be announced at the meeting of the APSF Board of Directors on October 23, 2004 (2004 ASA Annual Meeting, Las Vegas, Nevada).

NOTE: No award will be made unless the statement of institutional human or animal studies' committee approval is received prior to October 1, 2004.

PAPERLESS APPLICATIONS

All applications and accompanying documents, including the departmental chairperson's letter and the applicant's acceptance form, will be accepted in ELECTRONIC form only. Electronic files in Microsoft Word or Adobe Acrobat PDF format are acceptable for all text, charts, and graphics, but must be submitted on CD-ROMs.

NOTE: The original electronic format application must be received no later than Monday, June 14, 2004. Late applications will not be accepted—NO EXCEPTIONS.

Bar Coding May Reduce Drug Errors

by Charles H. McLeskey, MD

Medication errors continue to be one of the many patient safety issues facing the health care industry today. The 1999 landmark study by the Institute of Medicine found that medication errors may contribute to more than 7,000 deaths a year in the United States.¹

Solutions to date have focused on enhancements of drug labeling, separation of storage facilities, and efforts to train staff on proper safety procedures. While these efforts may help, they have not gone far enough to minimize the risk of errors. The United States Pharmacopeia, which establishes quality standards for medicines, announced that most medication errors result from incorrect medication delivery techniques, including dispensing the wrong drug or administering an improper dose. These errors can sometimes produce patient injuries resulting in longer hospital stays and additional treatments, all of which increase costs to the health care system.² Clearly, more can, and should, be done to mitigate this problem.

Bar coding pharmaceutical products has emerged as a promising solution. In fact, the U.S. Food and Drug Administration (FDA) has proposed a rule requiring the pharmaceutical industry to apply bar codes to their products at the unit-of-use or single-dose level.³

Bar coding is not a new idea. The technology, which has been used on consumer retail products since the early 1970s, already is commonly used in retail pharmacy and over-the-counter drugs. However, it is not yet widely used in the inpatient setting, where some of the most critical and most easily confused medications are administered. With this technology, clinicians can scan a patient's wristband ID, and the bar coded drug, and then match them against a computerized list. By cross-checking, the "five rights" can be made more certain. These five rights are the right patient, the right drug, the right dose, the right route of administration, and the right time. Hospitals that have adopted this technology have seen dramatic results. A study conducted by the Veterans Affairs San Diego Health System saw inpatient medication errors drop 50%.⁴ Concord Hospital in New Hampshire reduced medication errors by 80%.⁵

If bar coding offers such promise, why hasn't its adoption by the pharmaceutical industry been more widespread? The answer to this question is technology. Until recently, the technology required to shrink bar codes down to the unit-of-use level has not existed. As a result, manufacturers could not place bar codes on smaller or odd-shaped containers. The Uniform Code Council (UCC) has been working to develop standards and applications for space-constrained products for 4 years. In 2001, the UCC partnered with Abbott Laboratories to test

Reduced Space Symbology® (RSS)—a new technology that allows for a bar code to be applied to single-use containers as small as a pen cap. The test showed that RSS bar codes can be commercially printed, applied, and read, even on small products that previously could not be bar coded.

Subsequently, Abbott has completed an initiative to affix bar codes to *all* of its hospital injectable pharmaceuticals and IV solutions. This effort is particularly important because, in hospitals, the majority of medications are administered via infusion or injection. Of the more than 1,000 products that Abbott has bar coded, more than 25% use this revolutionary RSS technology.

Bar coding also allows for other advances in medication management, such as improvements in patient-controlled analgesia (PCA) devices. PCA devices, introduced by Abbott almost 20 years ago, have become an important pain management tool. Although these devices have simplified the administration of opioids and other potent pain medications, they have not eliminated the risks associated with the administration of these types of medications. In fact, analgesics remain the drug class most frequently associated with adverse drug events, accounting for 30% of such events.⁶

As part of its ongoing effort to reduce medication errors and enhance patient safety in hospitals, Abbott Laboratories recently introduced an advanced PCA device. The LifeCare® PCA3 Infusion System is the first PCA pump to incorporate a built-in bar code reader, allowing the pump to automatically identify and verify the specific drug and drug concentration to be administered. This advance will further enhance the safety profile of these important devices.

Bar coding has the ability to enhance the safety of drug administration, particularly in the hospital setting. Current technological advances made by Abbott Laboratories and others in the pharmaceutical industry, coupled with pending FDA guidance, will help open the door for widespread adoption of this technology. Bar coding is just the beginning, however. Health care providers, manufacturers, and others in the industry must continue to work together to develop additional effective medication management solutions that further ensure the safety of patients and health care workers.

Dr. McLeskey is Global Medical Director/Global Marketing Director, Acute Care, Abbott Laboratories—Global Pharmaceutical Research and Development, Abbott Park, IL.

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APSF Workshop Explores HRO Model

By David Gaba, MD, and Jeffrey Cooper, PhD

How do some organizations succeed in performing intrinsically hazardous work at an intense pace with ultra-low rates of failure? And what lessons might anesthesiologists and their partners in perioperative health care learn about high reliability from such successful organizations? These were the fundamental topics of the APSF Board of Directors Workshop held on Friday October 10, 2003, at the ASA Meeting in San Francisco. Joining members of the Board of Directors were invited representatives of the American College of Surgeons (Dr. Thomas Russell, Executive Director), the Association of Peri-Operative Registered Nurses (Mr. Thomas Cooper, Executive Director), and the American Society of Post-Anesthesia Nurses (Denise O'Brien, BSN, RN). Also present were academic and private practice anesthesiologists from around the nation.

The goals of the workshop were to:

- Present the concept of the High Reliability Organization (HRO)
- Examine the core components of an HRO
- Consider how the HRO concept applies to perioperative health care
- Determine what a high reliability perioperative health care organization would look like
- Outline what steps perioperative health care organizations would need to take to achieve HRO status
- Predict the obstacles to developing HRO components in perioperative health care
- Lay out possible programs that APSF could undertake to assist institutions and health care systems to achieve HRO status.

The Workshop consisted of three parts. In Part 1 APSF Secretary, David Gaba, presented the key elements of High Reliability Organizations (HROs) and gave examples of their applicability to perioperative health care. This presentation expanded upon Dr. Gaba's lead article in the *APSF Newsletter* Special Issue on High Reliability Perioperative Health Care.¹ The Workshop participants then broke into four working groups to facilitate detailed discussion of several key questions including:

- What is a perioperative HRO? What would it look like in practice?
- What steps would perioperative health care organizations need to take to achieve HRO status?
- What are the obstacles that have kept and could keep perioperative institutions from becoming high reliability settings?

- What can the APSF do via projects or programs to help anesthesiologists and their professional colleagues lead institutions toward achieving HRO status?

This presentation was also accompanied by a draft document outlining a "straw man" example describing some details of a hypothetical high reliability cardiac surgery work system. In the third part of the workshop, led by APSF Executive Vice President Jeffrey Cooper, the groups worked as a whole to synthesize the common and key elements of the breakout sessions.

Breakout discussions resulted in the identification of the following characteristics and suggestions:

Vision: What are characteristics of a Perioperative HRO?

- Rewards for honesty, positive sanctions, incentives
- People are rewarded/paid based on outcomes, not just production
- Practices are multi-disciplinary
- Personnel have T.I.A. (Total Information Awareness)
- No wasted work or redundancy
- Time is made available for training
- Work is based on the continuum of care as a system (beyond perioperative)
- Complete information is legibly and readily available
- Belief at a "molecular level" that patient safety is job one
- Care providers at the bedside are empowered to do the right thing
- Ongoing audits of adoption of best practices.

Actions needed to implement HRO concepts in perioperative care:

- Align incentives for all participants
- Create demonstration systems as laboratories to study and formulate what works
- Set up the system to handle specific crises
- Pre-empt new regulations by adopting defined best practices
- Rotate personnel through administration and trenches (for all to see learn how the system works)
- Place one person in charge of perioperative care

- Publicize information on HRO concepts to the general public
- Document efficiencies
- Establish HRO metrics
- Devise methods to ensure competency
- Incorporate training throughout the system
- Statement of quality: "Would you operate on your loved one in these conditions?"
- Bring expert coaches into organizations to facilitate pilot projects
- Match performance to infrastructure, prioritizing patient care and safety
- Develop an entity to promote HRO principles and processes.

Challenges: What have been and are the barriers to change?

- Disparity and autonomy may fragment standardization
- Lack of knowledge about safety/HRO
- Reimbursement system is procedure-based, not based on quality or safety
- Inability to take long-term perspective
- Hierarchical culture
- Clinical personnel shortages
- Competition can result in reduced sharing
- Financial and production pressures
- "Whistle Blowers" become pariahs.

APSF Programs: What can the APSF do to help others achieve HRO status?

- Joint development, e.g., with ASA, ACS, AORN, ASPAN, of codes of conduct
- Anesthesiologists need to take leadership positions
- Provide national peer review of reported data
- Make the business case for safety
- Make high profile awards for perioperative HRO organizations
- Provide a package of resources such as presentations & case studies
- Develop a roadmap to teamwork, including teamwork training programs
- Create a model HRO training program (pilot across the country).

See "Workshop," Next Page

HRO Model Requires Vision, Tools, and Action

“Workshop,” From Preceding Page

Action Plan

Working as a whole, the group identified suggestions for possible APSF action for its constituents and their institutions:

Incentives

- Develop peer review systems to assess HROs
- Discounts on liability premiums for HRO behaviors

Education

- Develop HRO curricula and a resource package
- Provide programs for developing leadership and communication skills
- Support model HRO training program(s)
- Train perioperative professionals to be HRO “coaches”

Cross-Discipline Actions

- Define a clear perioperative goal
- Develop joint codes-of-conduct
- Create office-based perioperative teams
- Develop collaboration between the perioperative disciplines including ACS, AORN, APSF, ASA

Develop HRO Tools

- Near miss reporting systems
- Demonstration structured learning systems

Research to Demonstrate Efficacy

- Conduct demonstration project(s)
- Target one area, e.g., teamwork training
- Devices and human factors
- Define how to measure success
- Learning how to manage information to reduce errors

Recognition

- Baldrige examples
- Co-sponsor with ACS, AORN, and ASA
- Teamwork is key.

A caution was raised that the language of HROs is tenuous. It would be easy to “game” measures of HRO and to have only a superficial appearance of action and progress merely by creating a new language by which current actions are labeled as being HRO compliant. The same pattern occurred during previous quality movements.

The APSF Executive Committee will consider the suggestions and select a set of actions to move the HRO agenda forward.

Dr. Gaba is Director of the Patient Safety Center of Inquiry at the VA Palo Alto Health Care System, Professor of Anesthesia at Stanford University School of Medicine, and Secretary of the APSF.

Dr. Cooper is Associate Professor of Anesthesia at Harvard Medical School and Executive Vice President of the APSF.

Reference

1. Gaba DM. Safety first: ensuring quality care in the intensely productive environment—the HRO model. *APSF Newsletter* 2003;18:1,3,4.



HRO Brainstorming session results in one of several work product organizational charts.



Participants at 2003 HRO Retreat show their enthusiasm during one of the breakout sessions.

Virtual Anesthesia Machine Has Worldwide Impact

by Sem Lamptotang, PhD

The Virtual Anesthesia Machine (VAM)¹ at <http://vam.anest.ufl.edu> is a free, interactive, model-driven web simulation of a generic, traditional anesthesia machine. Instead of complex, dimensional drawings of an anesthesia machine, VAM presents a simplified, transparent mental model designed to help viewers appreciate and retain basic concepts and acquire insight. Gas "molecules" are made visible and are color-coded (4 user-selectable gas color codes: ISO, Georgian, Japanese, US). Users can adjust 30 controls and observe in real time the essential effects of their interventions on gas pressures, flows, compositions and volumes. Machine faults can be simulated. Online help to use the simulation is available as an animated tutorial. The simulation can be used offline and features user-selectable legends in 19 languages (Albanian, Arabic, Chinese, Czech, Dutch, English, Farsi, French, Georgian, German, Greek, Hebrew, Italian, Japanese, Korean, Portuguese, Russian, Spanish, and Turkish).

The VAM simulation has more than 12,000 registered users, is used in more than 350 programs worldwide, and has received favorable peer reviews.^{2,3} The website received 1.4 million hits in the last 12 months ending in September 2003. The VAM simulation deliberately emphasizes graphics with minimal text. Many of the learning objectives are imbedded within the VAM simulation and are not obvious to those who are reticent to explore on their own. Therefore, a subset of users whose learning style requires more "hand-holding" may obtain

only minimal benefit from using the VAM simulation on their own.

To enable a greater number of users and programs to benefit from the VAM simulation to its full potential, the Anesthesia Patient Safety Foundation funded the development of the first chapter in a proposed 8-chapter anesthesia machine workbook. The first chapter was designed to encourage users to more fully explore the VAM simulation and to cover normal function of traditional anesthesia machines by making use of existing simulations within the VAM.

The workbook was divided into 3 main sections designed for instructional use or self-paced learning. Part 1 is a discussion of basic concepts in anesthesia machine function and design. The reader is guided through a process of progressively building an anesthesia machine starting with the most rudimentary design and culminating in the traditional circle system. Part 2 explains how to use the VAM simulation, its outputs (36), and user-adjustable inputs (30). Part 3 contains safety-related, structured exercises, including post-test questions, on the high pressure, low pressure, breathing circuit, manual ventilation, mechanical ventilation, and scavenging systems. Each exercise is presented, whenever possible, as a clinical scenario.

The workbook was drafted in Microsoft Word and converted to a read-only PDF format for free viewing and printing over the web. The original English version was posted to the Web on November 14, 2002, as a 688 KB PDF document. In September 2003, the workbook was switched to a

FlashPaper (Macromedia, San Francisco, CA) format (705 KB) to preserve image quality when viewing the document electronically in different window sizes. Flash player (a free download from Macromedia; www.macromedia.com) is required to view and print the workbook. The FlashPaper document can be printed (color printer recommended) and used as a workbook. Alternatively, it may be viewed simultaneously with the VAM simulation by toggling back and forth between separate web browser windows containing the two applications.

Chapter 1 of the APSF workbook was accessed 1,700 times/month on average and has received favorable peer review: "The manual fills a void that has existed in the field of anesthesia."⁴ This review concludes by recommending the manual to all anesthesia providers.⁴

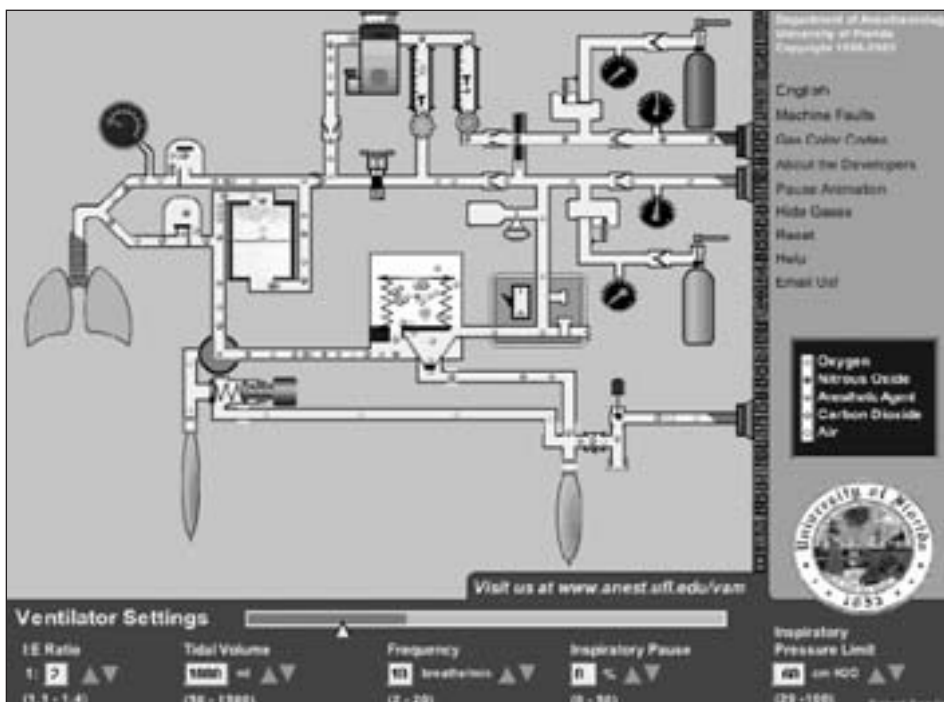
In less than 12 months since it has been publicly available, chapter 1 of the APSF workbook has been translated and posted to the VAM website in German (April 2003), Korean (May 2003), Chinese (September 2003), and Italian (September 2003). The APSF workbook has also been incorporated as part of the curriculum in many institutions worldwide including the University of Pennsylvania, West Virginia University, University of Kentucky, Cleveland Clinic Foundation, University of Louisville, Evanston Northwestern School of Anesthesia, University of Tennessee Health Science Center, Seoul National University, and the University of Florida.

Translations to Spanish, French, Arabic, Farsi, Japanese, and Georgian are currently underway. The translations are peer-reviewed by native-speaking anesthesiologists who are knowledgeable about anesthesia machines. Rapid translation of the APSF workbook in different languages is indicative of the perceived value of the APSF workbook and has helped to disseminate APSF's message on patient safety overseas. For further information on the APSF workbook or to volunteer for translation of the workbook into other languages, please contact Sem Lamptotang, APSF Committee on Education and Training at sem@anest.ufl.edu.

Sem Lamptotang, PhD, is Project Coordinator, *Virtual Anesthesia Machine: An Interactive Model-Driven Simulation*, University of Florida.

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Screenshot of a sample simulation from the Virtual Anesthesia Machine website.

Letters to the Editor:

Reporting Adverse Events is a Double-Edged Sword

To the Editor:

As David Hunt mentioned in the Summer 2003 issue of the *APSF Newsletter*, his group suffered by following APSF and medical insurance companies' recommendations to report any untoward event. We have had a similar experience. Our insurance company gave us about 40 days notice that they were going to terminate our coverage, based on claims history. We reported several untoward events to them as we had been instructed to do in our insurance-sponsored classes to reduce litigation exposure.

Based on several nuisance suits (everyone named even though there was no anesthesia mishap) and those self-reported untoward events, we were considered too risky.

We appealed the decision and won, but had to apply to other carriers in the meantime. We decided to drop our insurance carrier because of a 250% increase in our premium quote with them and because of the way they handled the situation which imposed great stress on our group.

We have a new carrier. They were glad we reported any untoward events because once reported, the carrier is liable for coverage and damages. Now our premium is much less, and our benefits much greater. Our new carrier provides unlimited legal defense for HIPAA and Medicare investigations, and they also pay government/HIPAA fines up to the limits of the policy. Our previous insurer only paid \$25,000 of legal fees in these circumstances, and our current insurer pays up to \$50,000 in legal defense. Neither picks up the fines.

In the end, we are glad it happened. We have a better and cheaper product. Reporting untoward events is a double-edged sword and may not be as benign as the insurance companies would have one believe. We have heard of horror stories of Medicare investigations and feel safer now that we are with a new carrier.

Stacy Tait, MD, FACC
Fort Smith, AR

Power Interruption Still a Major Safety Disruption

To the Editor:

For decades anesthesia has been compared to aviation. The reasons are numerous and widely known, or at least widely repeated. Consistent with this comparison, the cockpit of modern commercial airplane is a delight to every anesthesia practitioner, filled with integrated electronic displays that reveal the raw navigation/aircraft systems data and the refined "big picture" distilled from that information. Current generation anesthesia machines seem, at first glance, to follow this exact philosophy. However, there is a significant difference that only becomes evident with daily use. Modern aircraft have multi-function displays, which allow critical information to be rerouted and displayed as required when the primary display fails—as it sometimes does. The anesthesia machines do not currently have this luxury. A power supply disruption of the sole display of all vital signs and/or critical flow/concentration/ventilation parameters, leaves the practitioner in the dark, with no raw data. Further, programmed for this event, the machine then abruptly becomes the world's largest oxygen flow meter, eliminating the possibility of anesthetic overdose, or in fact any dose. The experience is terrifying. There is a significant design flaw at work here—a final common pathway, the disruption of which creates an immediate patient care crisis. Thirty years in the operating room, never having experienced such events, and a so-called improved technology created the longest 15 seconds in my professional career, as I struggled to reanimate an ECG/pulse oximeter display, frozen on a screen, using the last ditch sophistication of cycling the ON-OFF switch.

Everyone must evaluate new equipment from the view of just one question: what happens if it hiccups? Rest assured, from the greatest lesson of the computer age, it will, and at the moment when it is least acceptable. No single malfunction should deprive the practitioner of information required to verify satisfactory vital signs and provide basic anesthetic requirements—a voltage variation or circuit board failure is not a legitimate medical indication to change anesthetic technique. Nevertheless, it has occurred, and will again, until this flaw is addressed and eliminated.

Alpha-2 Agonists May Also Impact Outcome

To the Editor:

Meiler et al. are to be commended for reviewing the effect of beta-blockers, statins, and "depth" of anesthesia on long-term morbidity following surgery.¹ In addition to these interventions, following the introduction of alpha-2 agonists in human anesthesia,² several large-scale trials or meta-analyses suggested that alpha-2 agonists decrease myocardial ischemia/infarction or mortality following cardiovascular surgery.³⁻⁵ A recent editorial⁶ stated that the "53% reduction in overall mortality [is] actually. . . more impressive than what has been found in the pooled beta-blocker studies." Given the simplicity of oral administration of clonidine 2-6 µg/kg, clinicians should consider this intervention, with appropriate reduction in anesthetic doses and volume loading in coronary/hypertensive patients presenting for major cardiovascular surgery.² The above-mentioned editorial added that investigators should add alpha-2 agonists to the array of drugs under trial to further reduce mortality following surgery.⁶

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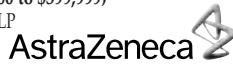
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Letter to the Editor:

Reader Questions Safety of Spinal Anesthesia

To the Editor:

Lambert¹ made a recent call for further examination of the transient radicular irritation syndrome (TRIS) that may occur after spinal anesthesia. This certainly deserves investigation. Although Schneider² pointed out the incidence and possible seriousness of this apparent complication in 1993, one may think that its appearance may have been precipitated by a change in the local anesthetic composition or the technique of injection. However, Vandam and Dripps³ described this precise syndrome in one of their classic series of 3 publications on neurological complications noted in 10,098 patients receiving spinal anesthesia. Moreover, Pizzolato⁴ in 1959 and Gentili et al.⁵ in 1980, using different laboratory techniques, showed that all local anesthetics at high concentrations produce neurotoxicity.

It is not surprising that diagnostic electrophysiological studies do not reveal abnormalities in these cases, as they usually are only contributory after 15 or more days after nerve root injury.⁶ However, experienced radiologists can recognize the early stages of radicular inflammation when MRI images of nerve roots are enhanced with intravenous gadolinium, as shown in Figure 1.⁷⁻¹⁰ These findings can be seen in CAT scans, only when preceded by myelography, which is hardly justifiable under such circumstances, since it can exacerbate radicular injury.¹¹

I echo Lambert's suggestion for further investigation on TRIS and other neurological complications that may follow neuroaxial anesthesia; this is a challenge for all of us, and specifically the APSF.

The evidence against lidocaine in concentrations equal to or greater than 2% continues to mount.^{12,13} A lower incidence has been reported with prilocaine,¹³ mepivacaine and bupivacaine,¹⁴ and tetracaine,¹⁵ thus confirming the axiom proposed by Pizzolato: "All local anesthetics are potentially neurotoxic."⁴ Since even a plain spinal tap results in inflammatory changes in the CSF, the \$60,000 question raised by Gaiser,¹⁶ "Should intrathecal lidocaine be used in the 21st century?" can be expanded to the next logical question, one that we do not want to hear, "Should spinal anesthesia be used at all?"

J. Antonio Aldrete, MD, MS
Birmingham, AL

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Figure 1: Axial view of MR image showing "enhanced" nerve roots which are edematous and have a star-like appearance.

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Letter to the Editor

How May Oral-Tracheal Intubation Be Improved?

To the Editor:

A forum on "Airway Management Continues to Raise Safety Concerns" regularly includes current recommendations on ways to secure a jeopardized airway after attempts at endotracheal tube placement during "difficult intubation" fail.¹ At this stage an effective rescue technique, without question, becomes the only available option to avoid patient injury.

In retrospect many questions must always be asked, including—why did conventional intubation fail, and what technical changes are necessary to improve outcome? To date, the answers have ranged from developing scoring systems in the attempt to pre-emptively identify patients at risk, bettering laryngoscopic view via, for example, altering head position, and assigning cause for difficult intubation to patients' physical characteristics such as obesity.²

The focus on modifying selective aspects of the intubating procedure, however, is based on unproven assumptions about the intubating process itself. Current opinion accepts the principle that oral tracheal intubation, as presently practiced, is the correct way to intubate, since historically it has proven reliable for most intubations and problematic only in a small percentage of cases, the latter constituting "difficult intubations." Longevity, along with absence of a reliable alternative, has, by default, made the current method the standard—to be refined, but never questioned. However, is this reasoning correct, and would using an alternate approach that combines uncomplicated intubation of normal patients with a seamless transition to intubate successfully during "difficult intubations" be desirable? Any such technique would enhance safety by significantly reducing the number of patients requiring emergency airway management, many under adverse circumstances.

The need for a new technique that improves outcome during difficult laryngoscopy, should therefore, at the very least, be recognized and discussed. Only then can the strengths and weaknesses of conventional intubation be debated, and the fundamental factors governing successful tracheal intubation recognized. Failure to do so only propagates the status quo without significantly improving management of unanticipated "difficult intubations."

In practice, does a viable alternative exist, and on what concepts is it based? A complete system for intubation that requires mandatory use of a styleted endotracheal tube and follows obligatory rules has

been used successfully for many years in a variety of clinical conditions.³ I submit that this technique used routinely in the hands of trained operators is a major advance in oral tracheal intubation.

Many experienced anaesthesiologists will not accept the suggestion that their personal method of intubation may be improved, while others search for answers to problems they have encountered. However, the issue of how best to perform oral tracheal intubation should be accepted for what it is, an unresolved clinical problem, with solutions that must meet the criteria of evidence-based medicine. Only then will fact be separated from bias.

Russell B. P. Stasiuk, MD
Vancouver, British Columbia

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APSF Executive Committee Invites Collaboration

From time to time the Anesthesia Patient Safety Foundation reconfirms its commitment of working with all who devote their energies to making anesthesia as safe as humanly possible. Thus, the Foundation invites collaboration from all who administer anesthesia, and all who provide the settings in which anesthesia is practiced, all individuals and all organizations who, through their work, affect the safety of patients receiving anesthesia. All will find us eager to listen to their suggestions and to work with them toward the common goal of safe anesthesia for all patients.

The APSF continues to accept and appreciate contributions for the E.C. Pierce, Jr., MD, Research Award.

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Ellison C. (Jeep) Pierce, Jr., MD, was joined by members of his family at the 2003 APSF-FAER Dinner to honor his contributions to patient safety on the occasion of his retirement from the APSF.

AANA NewsBulletin to Reprint *APSF Newsletter* Articles

The APSF is pleased to announce that future articles of the *APSF Newsletter* may be reprinted by the American Association of Nurse Anesthetists (AANA) to appear in the AANA NewsBulletin. The APSF is pleased that important anesthesia patient safety information will also be available to readers of the AANA NewsBulletin.

Robert C. Morell
Editor, APSF Newsletter

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