



# SENTINEL



**Tom Witkowski,  
M.D., FASA  
PSA PRESIDENT**

***We are moving forward as a Society. Our goal of high-quality care will be best achieved when all our members are involved, and I encourage you to do that.***

## ***President's Message***

As I come to the conclusion of my term of office, I would like to review some of the changes in the Pennsylvania Society of Anesthesiologists for this year. These changes have been made to improve the Society's function, enhance benefits to the members, and answer questions which have been raised by members. We have also maintained our focus on advocating for patient-centered, physician led anesthesia care in the legislative and regulatory arenas.

There has been an ongoing effort to change the governance structure of the PSA and revise the bylaws of the Society, which had not been changed since its founding. As a consequence of the changing health care environment, many of the Society's standing committees have been left with little work to do. A significant amount of the organization's work is being done by the executive committee. A new committee structure with 4 committees: finance, educational affairs, scientific affairs, and professional affairs; each led by a vice president should improve our ability to better involve our members and deal with the issues that we face. This structure mirrors that of our parent organization, the ASA.

At the end of last year, after much discussion, the PSA website was redesigned. This has hopefully made it more user friendly and relevant, but changes continue to be made.

One of the results of a PSA redesign think tank held last November was a desire to reestablish a Pennsylvania Society of Anesthesiologists annual meeting. It is envisioned that this will be a weekend meeting which would provide an opportunity for members to learn as well as discuss relevant anesthesia care issues in the Commonwealth. Tentatively, the initial meeting will be scheduled for Spring 2020. As a lead into this, we are also sponsoring a regional anesthesia ultrasound workshop in Philadelphia this coming Spring. More information will be forthcoming.

There has been a lot of debate about how best to reach our members with information, print or digital. In part, this may be an age-related issue. We will be soliciting your opinion in the coming year on continuing with the print Sentinel, going to digital only, or some hybrid of these two. You will help shape our course moving forward.

There has been a lot of member interest in perioperative surgical home concepts and how to implement them. Our practice management committee is interested in your experiences, both good and bad. We would like to have a repository of this information to help our members as they move forward in this area.

Another area of member interest has been the acquisition of anesthesia practices by venture capital and its effect on clinical care. We have had discussions on current laws which exist to protect medical decision making and how they may need to be strengthened and enforced. It is not certain that there have been or will be

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# EDITORIAL

## *Time to Wipe Out Political Apathy*

Health care is changing rapidly. The political arena has an increasingly important role in health care delivery. Being politically active is now, more than ever, an important part of being a physician.

Advocacy is the process of being engaged in the effort to influence public policy through political, social and economic systems. While it can cover a broad range of activities, the most important for our practices are political contributions to candidates, both individually and through political action committees and reaching out to legislators on specific topics. In general terms, the value of advocacy comes down to who is best able to convince legislators to see things and act on them from our point of view.

In Pennsylvania less than 20% of anesthesiologists contribute to Z-PAC, the political action committee of the Pennsylvania Society of Anesthesiologists, and even fewer contribute to ASA PAC. It's time to realize that it isn't enough to simply provide excellent care, the world of health care delivery is merging with the political world and physicians need to be comfortable in both arenas.

The reasons for apathy are many and as individual as the people. Whatever the individual reasons, the truth is that a collective lack of participation by physicians places decision making in the hands of others. This results in policies that are often counter to good patient care.

Political participation by physicians is needed to preserve autonomy in our profession. As health care evolves, there are increasing external factors - guidelines, regulations, payment policies, licensure and scope of practice changes. If doctors abdicate our role and ignore the political arena, we do so at our own peril. It has become increasingly clear that our responsibility to our patients now extends well beyond our offices and hospitals.

It is time to realize that the world of health care is changing. With the corporatization of medicine, physicians can no longer sit on the sidelines. Doctors need to be involved in the political process. The more doctors are politically involved, the better things will be for our patients and health care. It's time to become leaders outside of the operating rooms and hospitals.

Without better physician participation in advocacy the opportunity to shape future healthcare decisions will be left to corporate interests. ■



**Richard O'Flynn,  
M.D., FASA  
EDITOR**

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is that a  
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## *President's Message* ...continued from page 1

issues with individual practices, but this is an evolving area which may require further legislative activity going forward.

From a regulatory standpoint, PSA was involved in a Pennsylvania Department of Health initiative to prevent wrong site blocks with a webinar held on August 30 and we have also been involved in developing regulations for the use of propofol in surgical centers.

We remain dedicated to the goal of patient centered, physician directed anesthesia care in Pennsylvania and are working to advance legislation which will ensure that. Our members are working to prevent drug shortages, an issue which affects us all. We are also part of a coalition working for a solution to the balance billing problem which will remove the patient from the fight and will allow for fair compensation of providers.

We are moving forward as a Society. Our goal of high-quality care will be best achieved when all our members are involved, and I encourage you to do that. ■

## SAVE THE DATE!

### 9TH ANNUAL ULTRASOUND-GUIDED /CADAVER COURSE IN REGIONAL ANESTHESIA AND POINT OF CARE ULTRASOUND

*Saturday and Sunday*

*May 4- May 5, 2019*

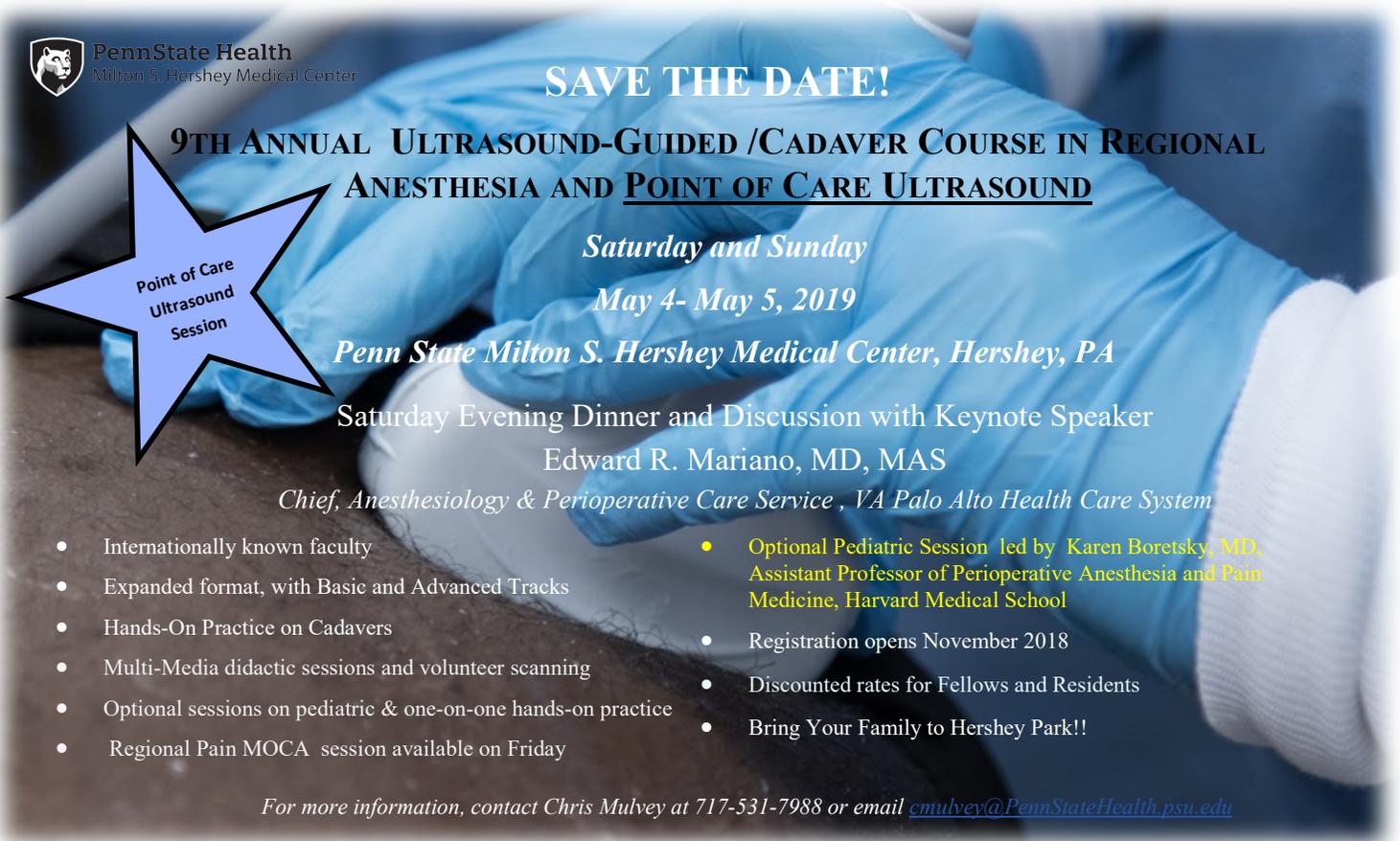
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*For more information, contact Chris Mulvey at 717-531-7988 or email [cmulvey@PennStateHealth.psu.edu](mailto:cmulvey@PennStateHealth.psu.edu)*



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# Post op Pain Blocks for Breast Implant Removal

By David A Goodman, M.D., M.S. and Robert Atkins, M.D.

In a follow up to my previous article<sup>1</sup> on our experience with the provision of ultrasound guided anterior and anterolateral chest wall blocks for various breast surgeries at the Abington Surgical Center, I now report our subsequent experience with the use of different blocks for breast implant removal.

Many patients have reported experiencing pain and other local and systemic symptoms felt to be related to the in-situ presence of breast implants (Breast implant illness syndrome [BIIS]). In early 2018, we began performing breast implant removals in patients experiencing BIIS or those concerned about potential implant-associated health risks. Most of these procedures have been performed by a plastic surgeon.

Typically, these patients receive acetaminophen elixir 1000 mg po preoperatively. The blocks were performed either by my colleague, Dr. Robert Atkins, or me, following induction of general anesthesia (GA) with IV propofol and placement of a laryngeal mask airway (LMA). Anesthesia is maintained with sevoflurane. Dexamethasone 4 mg IV at the beginning and ondansetron 4 mg IV toward the end of the case are given for prophylaxis of postoperative nausea and vomiting.

Initially, our regimen of ultrasound-guided blocks included those we had used successfully in a large cohort of patients undergoing breast implant placement, as we reported previously.<sup>1</sup> These included PECS 1 blocks<sup>2</sup>, PECS2<sup>3</sup> or serratus plane (SP)<sup>4</sup> blocks, and pectointercostal fascia blocks (PIFB)<sup>5</sup>. Many of these patients did well, requiring either a minimal dose (e.g., 50 mcg) of fentanyl IV intraoperatively or a few doses of hydromorphone 0.2 mg IV in the PACU.

However, in contrast to our previously reported cohort of patients receiving breast implants, in whom intermuscular fascial planes are pristine, we noted that many of the patients undergoing breast implant removal had considerable peri-implant scarring which frequently obscured ultrasonic visualization of fascial planes and limited the spread of local anesthetic within those planes.

For that reason, and in our attempt to limit our intra- and postoperative narcotic usage, we chose to switch to the use of the erector spinae plane (ESP) block<sup>6</sup> in conjunction with PIFB. The ESP block was performed after induction of GA and placement of LMA, with the patient subsequently turned into the lateral position. We found, however, that with this

approach our narcotic usage increased.

Rethinking the anatomy, we then changed to use a combination of ESP with PECS1 blocks to cover the sensory distribution to the breast area of nerves from both intercostal and brachial plexus origin. This approach appears to work as well as the combination of SP, PIFB, and PECS1 blocks, but with the advantage of requiring less total volume of local anesthetic, so that a higher concentration can be used, and the fact that fascial planes are more likely to be intact so that ultrasound-guided spread is more predictable.

For the combination SP/PIFP/PECS1 block a total volume of 20/10/10 ml per side is utilized. For the ESP/PECS1 block, 20/10 ml per side is used. The highest concentration of ropivacaine with epinephrine (1:200,000) is utilized based on the patient's body weight and knowledge of the predicted toxic dose threshold.

We have found this approach to be very successful. As of late August 2018, we have used this approach on a total of 45 patients; only 4 patients have had moderate pain at follow up on the first postoperative day. The remainder have had either no, or minimal, discomfort.

We would recommend either the combination of ultrasound-guided SP/PIFP/PECS1 or ES/PECS1 blocks for effective postoperative analgesia for breast implant removal cases. If you are in an institution that has a block room, the ESP block can be performed there with minimal sedation in the sitting position. This block is very easy to learn and perform. ■

#### References:

<sup>1</sup>Goodman DG. Chest wall blocks. Sentinel, PA Society of Anesthesiologists Newsletter. 2018; Summer: 10 11. Accessed via web at [http://issuu.com/ssmsdept/docs/psa\\_sentinel\\_summer\\_2018\\_final\\_issu?e=26258259/63055116](http://issuu.com/ssmsdept/docs/psa_sentinel_summer_2018_final_issu?e=26258259/63055116)

<sup>2</sup>Blanco R. The 'pecs block': a novel technique for providing analgesia after breast surgery. *Anaesthesia*. 2011; 66:847 848

<sup>3</sup>Blanco R, et al. Ultrasound description of Pecs II (modified Pecs I): a novel approach to breast surgery. *Rev Esp Anesthesiol Reanim*. 2012; 59:470 475

<sup>4</sup>Blanco R, et al. Serratus plane block: a novel ultrasound guided thoracic wall nerve block. *Anaesthesia*. 2013; 68:1107 1113

<sup>5</sup>de la Torre PA, et al. A novel ultrasound guided block: a promising alternative for breast analgesia. *Aesthet Surg J*. 2014; 34:198 200

<sup>6</sup>Forero M, et al. The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. *Reg Anesth Pain Med*. 2016; 41:621 627



Charles I. Artz, Esq. | PSA GENERAL COUNSEL

## *Another JUA RAID Found Unconstitutional by a Federal Court*

In Act 41 of 2018, the Pennsylvania General Assembly and the Governor enacted another law to take control of Pennsylvania Professional Liability Joint Underwriting Association (“JUA”).

On May 17, 2018, the federal court issued a permanent injunction finding the prior effort to seize the JUA (Act 44 of 2017) unconstitutional. Under Act 44 of 2017, the JUA was forced to transfer \$200 Million of its surplus and excess funds into the Commonwealth’s general fund. The federal court permanently enjoined the statute because it perpetuated an unconstitutional taking of private property without just compensation.

Act 41 of 2018 would fold the JUA into the Commonwealth’s Insurance Department; shift control of the JUA from its current member-led board to a board comprised of political appointees; oust the JUA’s president in favor of a new executive director hired by the Insurance Commissioner; and mandate transfer of all of the JUA’s documents, files **and assets** to the Insurance Department.

In *JUA v. Wolf*, 2018 WL 3455828 (M.D. PA 2018), Chief Judge Christopher Conner of the federal court in Harrisburg issued a preliminary injunction on July 18, 2018, preventing Act 41 of 2018 from going into effect.

Once again, Judge Conner found that seizing all of the JUA’s funds could be an unconstitutional taking without just compensation; irreparable harm existed; and the other factors necessary to obtain an injunction were established. ■

## *Failure to Report Stolen Controlled Substances: Legal Duty/Potential Malpractice*

A new Pennsylvania Supreme Court decision allowing a negligence claim to proceed against a health care facility is important to consider for liability risk management and compliance purposes.

In *Walters v. UPMC Presbyterian Shadyside*, 187 A.3d 214 (Pa. 2018), a UPMC facility was sued in a negligence case. A UPMC radiology technician engaged in the diversion and substitution of IV fentanyl. The employee injected himself with fentanyl from a pre-loaded syringe, refilled the syringe with saline or another substance, and then replaced the now-contaminated syringe where it could be used by others to inject patients. In doing so years later at a Kansas hospital, the former UPMC employee allegedly transmitted hepatitis C to the Plaintiffs in this case, who were patients at that hospital.

UPMC had a legal obligation to report the diversion of controlled substances to DEA, but failed to do so. Although UPMC reported the employee’s misconduct to the Pennsylvania Attorney General’s office, which opened an investigation, UPMC failed to report the misconduct to the DEA.

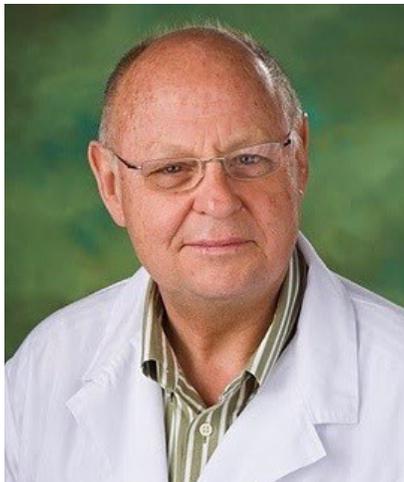
In its lengthy decision, the Supreme Court held that UPMC’s failure to report the drug diversion to the DEA could provide the basis for a professional negligence claim. The Supreme Court, in allowing the negligence claim to proceed, also suggested that reporting to the Pennsylvania Attorney General may be relevant in UPMC’s defense; however, that is just a defense, and does not eliminate the duty and potential liability for failing to report to the DEA.

DEA regulations require all individuals and entities registered with the DEA to notify the local DEA office, in writing, of the theft or significant loss of any controlled substances within one business day of discovery of such loss or theft. 21 C.F.R. §1301.76(b). DEA Form 106 must be filled out to include all required information.

The compliance and liability risk management take-home point is to make sure all providers notify DEA of any theft or significant loss or diversion of any controlled substance as required by the DEA regulations. This mandatory reporting obligation supersedes any HIPAA Privacy protections and does not require an authorization.

The Supreme Court’s new decision opens another avenue of liability that physicians and providers must face. ■

# Weathering Storms



**Craig Muetterties, M.D.**  
PSA TREASURER

***“[...] we see a response when people perceive there is an imminent danger. [...] We cannot afford to sit and wait for the next disaster to hit before acting. We need to speak to our representatives and educate them about the issues.”***

“Advocacy”, what does the mention of this word mean to you? In my early years as an anesthesiologist, I believed that this was something that was done for me by other unnamed people that our society paid to do this work. I was not motivated to get involved in the process as a young physician.

We have a serious problem. Fewer and fewer of today’s physicians seem to be aware of the essential nature of this process. The other day I noticed that our giving for this year amounts to a little less than half what we see in a good year. I was wondering what the problem could be when it hit me, we see a response when people perceive there is an imminent danger. Unfortunately, many of the things that happen in politics are negotiated long before it becomes a public issue. By that time, the damage is done.

A few Sundays ago, my wife and I watched a broadcast of the television show *60 Minutes*. The initial segment of the show discussed excessive damages that were occurring in the United States due to hurricanes. The person they interviewed for this segment was from the Netherlands. This country is below sea level and has had a history of devastating storms that have killed thousands of people. The last significant storm they encountered was in 1953. At that time the government decided that it was going to become proactive instead of reactive with regard to these storms. They fortified all their systems so that when the next storm hit, they would have sufficient protection from the storm. Building the storm wall obviated the need for the country to constantly be in cycles of rebuilding and restoration. The Netherlands has not had a breach of its storm walls since this decision was made. This is in stark contrast to the United States that simply sits and waits for the storm to hit and then rebuilds.

We cannot afford to sit and wait for the next disaster to hit before acting. We need to speak to our representatives and educate them about the issues. They are willing to listen. Remember that these legislators are constantly in a process looking to be reelected and need our help to do that. Your PAC dollars simply open the door for these discussions. The PAC is unaffiliated with any political party, it simply supports good medicine.

We need PAC donations to come from every member. A goal of \$500 for every member of the Society should be attainable. I’m asking you to commit a little less than \$10 a week to this vital function. I am willing to bet that you lose at least that much money in trivial pursuits. There are many storms on the horizon for our society. Take a moment to help us build the storm wall.

An easy way to make contributions outside of our own website, [psanes.org](http://psanes.org), is to set up a recurring payment made out to “Z-PAC” from your own bank:

Z-PAC  
PO Box 325  
Media, PA 19063

Let’s make 2018 a banner year for participation. ■

# LEGISLATIVE UPDATE



**Kevin Harley**  
QUANTUM  
COMMUNICATIONS

As we go to press, much of Harrisburg is focused on the re-election of incumbent members and winning open seats. The Republicans are fighting to preserve their historic majorities (34 Senate seats and 121 House seats) and the Democrats are hoping to pick up enough seats in each chamber to be able to have more influence on legislative agendas.

All of the 203 House of Representatives seats are on the ballot, while 25 of the 50 Senate seats are on the ballot.

While much media attention is centered on the statewide and congressional races, health care policy in Pennsylvania is largely determined by the General Assembly and the governor.

PSA's legislative agenda has been busy with balance billing and supervision legislation.

## **BALANCE BILLING**

Balance billing legislation appears to be done for the legislative session. A coalition of hospital specialists that includes PSA as a key member, known as the Pennsylvania Coalition of Out-of-Network Services, actively stopped a bad bill from passing.

The legislation, circulated in the House, called for using a benchmark rate of 150 percent of Medicare or the in-network rate, whichever is lower. It also included a complicated payment process that doesn't take the patient out of the middle.

PSA and our coalition informed House and Senate leaders that the only state in the nation to adopt a balance billing Medicare default rate is California, which set their rate at 125 percent. Early reports from California, which recently passed their law, are not positive for patients or providers.

PSA and the coalition remain unified in opposition to using a 150-percent Medicare rate. We are prepared to work in the next session to get language inserted that does the following:

- Establishes an equitable payment process that takes the patient out of the middle.
- Uses the 80th percentile of charges from a non-profit, third-party benchmarking claims database – such as Fair Health – to determine the payment for an out-of-network provider.
- Provides for a streamlined and impartial dispute resolution process.
- The House Health Committee, where the bill is currently assigned, has new Republican and Democrat chairmen, Rep. Kathy Rapp and Rep. Tim Briggs, neither of whom were original co-sponsors of the bill.



## **SUPERVISION**

Following a successful hearing in April before the Professional Licensure Committee, PSA and Rep. Jim Christina, prime sponsor of HB 789, felt positive that Chairman Rep. Mark Mustio was poised to move the bill out of his committee and let the full House address physician supervision of anesthesia.

Rep. Mustio, who has indicated his strong support for the legislation and for patient safety, to date has failed to move the bill out.

The PSA-supported legislation places into the Medical Practice Act current Department of Health Regulations that require a physician to supervise the administration of anesthesia in a hospital.

The legislation faces stiff opposition from the CRNAs and the Hospital Association of Pennsylvania. However, it has bi-partisan support in the Professional Licensure Committee and from members throughout the House.

When Rep. Mustio indicated that he was reluctant to move the bill this session, PSA members mobilized to ask House Speaker Mike Turzai to take action on the bill. PSA members called Rep. Turzai and visited his district office, stressing the importance of patient safety and the need to codify the current regulations governing administration of anesthesia.

Meanwhile, Senate companion legislation (SB 960), was introduced for the first time by Sen. Tom Killion. He is poised to reintroduce his bill next session and will seek to gain additional support in committee and throughout the Senate.

## **FENTANYL RESTRICTION**

Rep. Bryan Barbin introduced HB 1987 which would allow the use of fentanyl only in surgery and hospice centers. The bill was amended to allow fentanyl to be used – with a limited seven-day supply – in the management of pain for cancer, medical emergencies and where, in the professional medical judgment of the prescriber, fentanyl is required to stabilize a patient’s acute medical condition. Additionally, the bill was amended on the House floor to allow a physician to prescribe fentanyl in the treatment of chronic pain not associated with cancer.

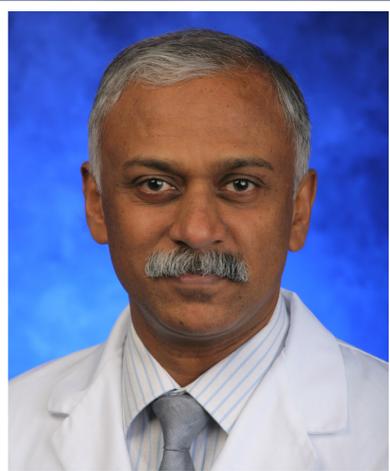
The bill passed the House unanimously, but the Senate did not act on it.

## **ADVOCACY**

While legislative activity is winding down to focus on the November elections, we must remember that advocacy is a year-round priority. Our success depends on members of the General Assembly hearing from you. As a PSA member, you are the strongest lobbying voice we have.

Please make an effort to get to know and talk with your state senator and representative. ■

**If you would like  
Quantum to help  
arrange a visit  
with your senator  
or representative,  
please contact us  
717-213-4955.**



Vergheese Cherian, M.D.

# know your equipment... GAS MONITORS

Monitoring the respiratory gases and the inhalational anesthetic agents is an integral part of anesthetic management. This article is an attempt to explain the functioning and the construction of

concentration of oxygen. Most modern analyzers are constructed such that the channel of the sample gas and the reference gas is interposed with a pressure transducer that can detect minute changes in pressure. When a pulsed magnetic field is applied downstream, it attracts oxygen causing a fluctuation in pressure which is proportional to the amount of oxygen present. (Figure 2)

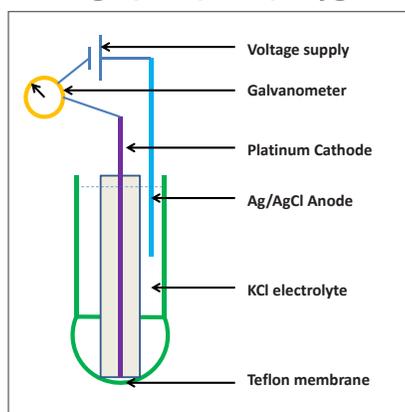
these monitors.

## Measurement of Oxygen

Oxygen ( $O_2$ ), by virtue of the unpaired electron in its outer orbit, has two important properties which are used to measure it.

1. It can accept another electron and therefore is an oxidizing agent and
2. It is attracted towards a magnetic field, or is 'paramagnetic'.

## Polarographic (Clark) Oxygen Electrode: (Figure 1)

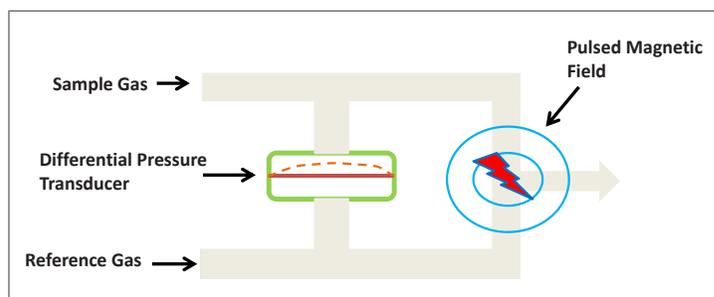


It consists of a platinum cathode and a silver/ silver chloride anode immersed in a KCl solution. When this is exposed to a sample of oxygen, it accepts electrons from the cathode while the anode provides the supply of electrons and thus generates a current. The current is

proportional to the amount of electron taken up, which in turn depends on the amount of oxygen. This principle is used to measure  $PO_2$  in arterial blood samples and also in a 'Fuel cell' used to measure the fraction of inspired  $O_2$  in some older anesthesia machines.

## Paramagnetic Oxygen Analyzer:

Oxygen is attracted towards a magnetic field and the force of attraction is proportional to the amount of oxygen molecules. The construction of the paramagnetic analyzers has changed over the years. The older version consisted of a dumb-bell shaped glass bulb filled with nitrogen suspended in a magnetic field. When oxygen containing gas was passed into the space it caused the dumb-bell to deflect due to its paramagnetic properties and the degree of deflection was proportional to the

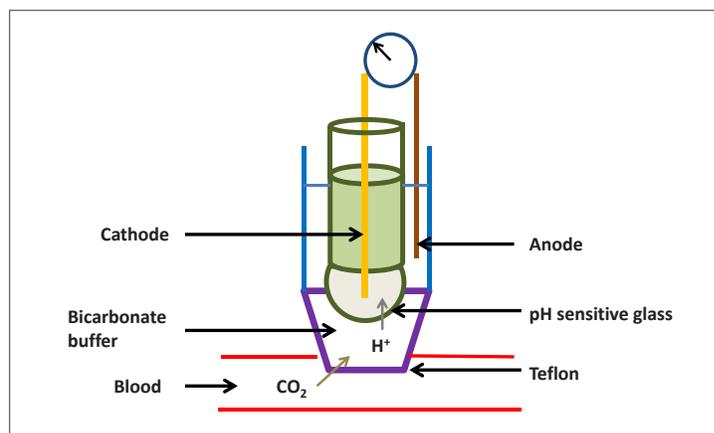


Most modern anesthesia workstations use paramagnetic oxygen analyzers to measure the percentage of oxygen in the breathing circuits.

## Measurement of Carbon dioxide

Carbon dioxide ( $CO_2$ ) reacts with water to produce  $H^+$  ions, which can be measured using a 'glass or pH electrode'. This is the basis of measuring  $PCO_2$  in blood samples by Severinghaus electrode. Measurement of  $CO_2$  in the gaseous phase is based on infrared absorption spectroscopy.

## $CO_2$ (Severinghaus) Electrode: (Figure 3)



The  $CO_2$  electrode is a modified pH electrode that works on the principle that an electrical potential across a glass membrane is proportional to the pH difference across it. The blood is separated from a buffer (bicarbonate) by a Teflon membrane.  $CO_2$  diffuses across this and reacts with the buffer to form  $H^+$ , which in turn crosses the  $H^+$  sensitive glass and reacts with the reference electrode to



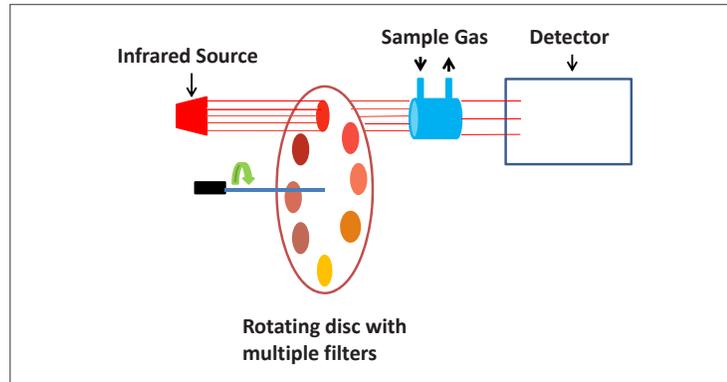
generate a current. The amount of current is proportional to the  $H^+$  produced which depends on  $PCO_2$  in the blood.

### Infrared (IR) Absorption Spectroscopy

Gases with two or more dissimilar atoms, such as  $CO_2$  and the inhalational anesthetics absorb infrared radiation (IR) and each gas absorbs a specific spectrum of IR. The specific absorption spectrum is  $4.3\mu m$  for  $CO_2$ ,  $4.5\mu m$  for nitrous oxide ( $N_2O$ ), and for halogenated anesthetic agents there are two peaks at  $3.3\mu m$  and  $7-13\mu m$ .

According to *Beer-Lambert Law*, the amount of light absorbed by a substance is directly proportional to the concentration of the molecules that absorb it and the distance the radiation travels within the medium. Since the amount of infrared radiation absorbed would be proportional to the concentration of the gas, this can be calculated by measuring the amount of radiation transmitted through the sample of gas. This method *cannot* be used to measure the concentration of gases with similar atoms such as oxygen, helium, xenon, argon and nitrogen, as these gases do not absorb infrared light.

#### Construction (Figure 4)



A source emits a broad-spectrum IR radiation which passes through a rotating disc with multiple filters that allows a particular wavelength to be transmitted. This filtered light of specific wavelength is then passed through the sample of gas in the measuring chamber before reaching an IR detector. Depending on the wavelength of the IR that is transmitted and the amount that is absorbed, the identity and the concentration of the gas is calculated.

The sample of gas from the breathing circuit is aspirated through a narrow sampling tube attached to the junction of the definitive airway or the mask and the breathing circuit. This system is called the 'Side-stream' as opposed to the 'Main-stream' type, wherein a sampling chamber is incorporated into the breathing circuit and the IR analyzer is wrapped around it and measures the gas concentration directly in the breathing circuit. Currently, most gas

analyzers in clinical use are the 'side-stream' type, and the volume of gas aspirated is 150-250 ml/minute. This volume of gas then passes through the paramagnetic analyzer to measure the oxygen concentration and is finally discarded into the scavenging circuit.

Two important points:

- The rapidly rotating disc with filters will allow IR of different wavelengths to be transmitted to identify the different gases in the mixture.
- Gas is continuously aspirated from the anesthetic circuit and delivered to the measuring chamber and since the response time of the analyzer is about 50-300 milliseconds, it is adequate to display a real time waveform of the concentration of different gases, during inspiration and expiration.

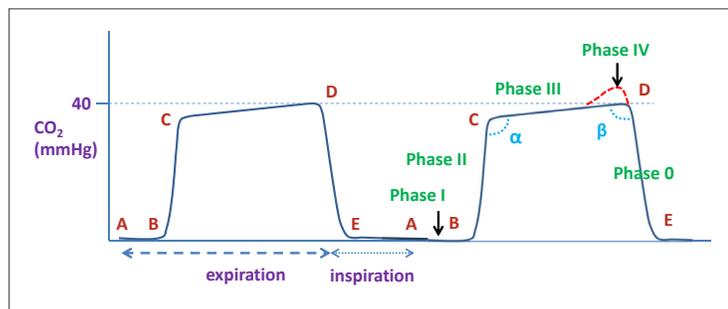
#### Errors in measurement

- The IR absorption spectrums of  $CO_2$  and  $N_2O$  overlap ( $4-5\mu m$ ) and this can interfere in the measurement of  $CO_2$  (*Cross Interference*). This can be reduced by using a narrow band width of IR specific for  $CO_2$  ( $4.26\mu m$ ).
- The gas mixture within the breathing circuit contains higher concentration of oxygen and nitrogen compared to  $CO_2$ , but these do not absorb IR. However, these gases collide with molecules of  $CO_2$  and increase or 'broaden' their absorption spectrum (*Collision Broadening*). This error is compensated by software computation of the amount of other gases present in the mixture.
- The gas aspirated from the breathing circuit is saturated with water vapor at  $37^\circ C$ , and it condenses by the time it reaches the analyzer. Water in the measuring chamber can interfere with the measurement. Therefore, the side-stream monitors have a 'water trap' to eliminate the water before the gas enters the measuring chamber.
- The presence of hydro-fluoro-alkane which is used as aerosol propellant can interfere with measurement of inhaled anesthetics. Therefore, when albuterol aerosol is being administered into the breathing circuit, it is prudent to detach the gas aspiration tubing from the circuit.

#### Capnography

The capnogram is a real time graphic representation of the amount of  $CO_2$  during inspiration and expiration. It provides useful information about the  $CO_2$  production, the pulmonary circulation, the alveolar ventilation, the pattern of ventilation and the integrity of the breathing circuit.

The capnogram has four phases and two angles. **(Figure 5)**

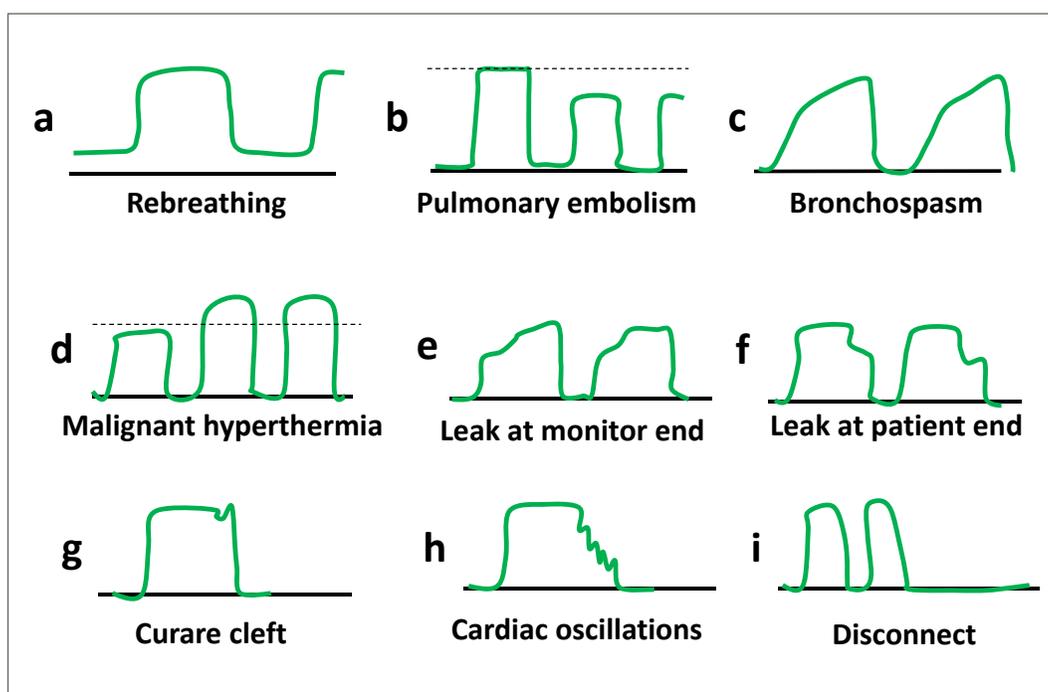


The phase I represents the inspiratory pause (E-A) and initiation of expiration (A). CO<sub>2</sub> is not detected during this phase as it represents the gas from the physiological and equipment dead space. The phase II (B-C) represents the transition between the dead space and the alveolar gas. The phase III (C-D) represents the gas from the alveoli and it has a gentle upward slope due to the variable rates of emptying of the different alveoli. The end of Phase III (D) represents the highest exhaled CO<sub>2</sub> and is displayed as the 'End-Tidal CO<sub>2</sub>'. Phase 0 (D-E) represents the initiation of the inspiratory phase and the CO<sub>2</sub> level drops to zero and is maintained such during the inspiratory pause (E-A). The α-angle between phase II and III is about 100-110°, but may increase with airway obstruction. The β-angle between phase III and 0 is about 90°.

During prolonged expiration or in patients with reduced thoracic compliance, the lung volume may fall below the closing volume and a slight upswing of the exhaled CO<sub>2</sub> at the terminal end of phase III, may be seen. This is labelled as phase IV.

Clinically important information can be interpreted from the capnography. **(Figure 6)**

1. If Phase I is higher than zero it indicates 'rebreathing' (exhausted soda lime, malfunctioning unidirectional valve or using a Mapleson's circuits with inadequate fresh gas flow). **(Figure 6a)**
2. A sudden reduction in ETCO<sub>2</sub> could suggest decrease in cardiac output, hypotension or pulmonary embolism. **(Figure 6b)**
3. A sloping Phase II indicates a slow exhalation (bronchospasm, COPD, kinked or obstructed endotracheal tube). **(Figure 6c)**
4. An increasing ETCO<sub>2</sub> could suggest increased CO<sub>2</sub> production (malignant hyperthermia, shivering), increasing CO<sub>2</sub> load (pneumoperitoneum during laparoscopy, rapid bicarbonate infusion, release of limb tourniquet), or improved cardiac output or return of spontaneous circulation during cardio-pulmonary resuscitation. **(Figure 6d)**
5. A 'step' in the capnography tracing
6. A step from phase II to III could indicate a leak in the sampling tube at the monitor end because the sample is diluted by the aspiration of ambient air. This picture may also be seen in patients with single lung transplant where the improved transplanted lung would expel more CO<sub>2</sub> for a longer time. **(Figure 6e)**
7. A step from phase III to phase 0 could suggest a leak in the sampling tube at the patient end. Initial exhalation has rapid flow and it feeds the sample line but later as the flow decreases ambient air would be aspirated and dilute the CO<sub>2</sub>. **(Figure 6f)**
8. A slight dip near the end of the phase III could indicate an inspiratory effort by the patient and it is commonly known as 'Curare cleft', indicating wearing off of the muscle relaxant. It could also suggest physical pressure on to the diaphragm or chest wall



by the surgeon or assistant! (**Figure 6g**)

9. Cardiac activity may manifest as oscillations during phase 0. (**Figure 6h**)
10. A sudden absence of the capnography trace usually indicates a disconnection of the anesthetic circuit or a blocked sampling tube, which is commonly due to condensed water vapor. It could also indicate a cardiac arrest. (**Figure 6i**)

### **Measurement of Inhalational Anesthetic agents**

Although, the IR absorption technique is commonly used in most modern anesthesia workstations, other methods such as mass spectrometry, Raman scattering, gas chromatography and quartz crystal adsorption can be used to measure inhalational anesthetic gases.

#### **Infrared absorption spectroscopy**

Since the absorption spectrum of the commonly used inhalational anesthetic agents is similar at 3.3 $\mu$ m wavelength of IR radiation, the agent being used needs to be acknowledged. However, if a polychromatic IR radiation of 7-13 $\mu$ m is used, then the monitor can automatically detect the anesthetic agent used because, at these wavelengths, the absorption spectrum is relatively different for the various agents.

#### **Mass Spectrometry**

Mass spectrometry measures the concentration of gases based on their mass or molecular weight. A gas sample is aspirated into a high vacuum chamber and ionized using a beam of electrons. The ions are then accelerated by an electric field into a chamber that has a strong magnetic field perpendicular to the path of the ionized gas. The ions are deflected by this magnetic field proportional to their charge and inversely proportional to their mass and measured by a photodetector. The angle of deflection and the ion flux can be used to identify the gas.

Mass spectrometers are accurate, quick and require a small sample. However, these are expensive and bulky and usually used for research or to analyze gas samples from several patients at different locations.

#### **Raman Spectroscopy**

When a light beam strikes a gas molecule the photons are scattered with intensity less than the incident light but retain their wavelength. This is known as Rayleigh scattering. However, some molecules can absorb part of the energy of the incident light and emit photons of a different wavelength which is unique to the gas. This phenomenon was described by Raman in 1928. The quantity of Raman scattering gives a measure of the concentration of the gas present. The incident light used for this technique of gas measurement is argon laser, making this equipment expensive and bulky.

#### **Gas Chromatography**

If the different gases in a mixture can be separated, then it can be identified and measured. A gas mixture can be separated by a technique of chromatography, which literally means 'writing in color'. The apparatus consists of passing a stream of inert gas such as

nitrogen or argon (the mobile phase) through a long tube packed with silica-alumina beads coated with polyethylene glycol (the stationary phase). The gas mixture to be measured is injected into the mobile phase. Depending on the differential solubility of the different gases in the two phases, the time taken for each gas to reach the other end of the tube varies. The concentration of each gas component is measured at the outlet using one of three techniques – thermal conductivity, flame ionization or electron capture. Although the gas chromatography is very versatile and can measure all the gases in the anesthetic circuit accurately, it does not allow continuous measurement.

#### **Quartz crystal adsorption**

A quartz crystal resonates when a potential is applied to it and this is known as 'piezoelectric' effect. When a quartz crystal coated with a thin layer of oil is exposed to the gas from the breathing circuit, the anesthetic vapor dissolves in the oil film and changes the resonant frequency of the vibrating crystal. The shift in frequency is related to the amount of vapor dissolved in the oil and can thus be measured. The drawback of this monitor is that it cannot differentiate the different vapors and has to be calibrated for the agent being used.

The information obtained by monitoring the respiratory gases and the anesthetic agents is indispensable to ensure patient safety during the perioperative period. As anesthesiologists, it is imperative that we have a good understanding of the physical principles, usefulness and limitations of this equipment. ■

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**Editor's note:** This is a copy of a Letter to the Editor, sent to James Haggerty, Assistant Editorial Page Editor of the Scranton Times-Tribune. The letter was sent on behalf of the Pennsylvania Physicians' Coalition on Out-of-Network Services in response to the article "Surprise Medical Bills Draw Patients' Ire" published August 12, 2018 and the follow-up editorial "State Must Intervene for Patients" published August 14, 2018.

## LETTER TO THE EDITOR

August 17, 2018

Attention Mr. Haggerty,

The Editorial, "State must intervene for patients" (August 14), gets the root cause of the issue right – Insurers have been engaged in a troubling practice of narrowing their networks of covered physicians and specialists. These Narrow networks are increasingly offered by insurance companies to enhance their own bottom lines, but they create "surprise insurance gaps" for patients. Physicians oppose this insurance industry practice and think patients deserve better coverage, better access to care, and better consumer protections. For example, in 2018, 73% of exchange health plans have restrictive networks, up 25% from 2014. These types of plans make Pennsylvanians more likely to receive surprise bills – because their plans cover fewer providers and services than they thought. Insurance companies are covering fewer providers even while they are shifting more costs to patients through higher premiums and deductibles – so, Pennsylvania patients are paying more for less. These gaps become clear in emergencies because patients can't control the time, place or providers needed; doctors don't (and shouldn't) consider insurance status; and EMS protocols require taking patients to the nearest appropriate facility regardless of network status. To address this issue, Pennsylvania should enact comprehensive legislation that takes patients out of the middle of billing disputes, increases transparency, expands physician networks, and requires insurers to cover unexpected out-of-network care dealing directly with providers at fair, market-based rates. Unlike the bills pending in the legislature or the proposal offered by the Editorial Board, under this approach we suggest, patients can be sure they are covered when they can't control which provider renders service, particularly in emergencies when they need care the most. Laws in New York and Connecticut have used this system to end surprise bills while enhancing access to care for patients. Fortunately, thoughtful legislators like Representative Pickett understand this and are working towards this solution.

Respectfully submitted by Dr. Donald Martin, MD, Past President, Pennsylvania Society of Anesthesiologists

With support from the Pennsylvania Physicians' Coalition on Out-of-Network Services:

The Pennsylvania Association of Pathologists

The Pennsylvania College of Emergency Physicians

The Pennsylvania Medical Society

The Pennsylvania Orthopaedic Society

The Pennsylvania Psychiatric Society

The Pennsylvania Radiological Society

The Pennsylvania Society of Anesthesiologists

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## *Won't You Be My Neighbor - A Reflection of Kindness in Medicine*

**Robert Morris, M.D.**

DEPARTMENT OF ANESTHESIOLOGY, PGY-2 | TEMPLE UNIVERSITY HOSPITAL

As physicians, we are experts in benevolence. It is one of the defining characteristics that draw people to medicine. The desire to help others cannot be separated from kindness. The Oxford Dictionary defines kindness as “The quality of being friendly, generous, and considerate.” These are all traits that I think that we can agree upon as being important in a physician, or more comprehensively in any medical provider. We are often taught how to display sympathy and kindness through lectures, discussions and simulated patient interactions. The importance of kindness and understanding with our patients is paramount for the patient experience. One thing that is rarely taught, however, is the importance of positivity and kindness in our interpersonal work relationships, and the benefits it can provide.

As anesthesiologists, we are in a unique position; we never perform our work alone. Not only are we intimately tied to the surgical specialties, but the operating room is inhabited by, and our patients care is dependent on, our interactions with the nursing staff, surgical technicians, operating room technicians, anesthesia technicians, and countless other individuals behind the scenes that make the operating room run. In a sense, the operating room is our ‘neighborhood’ and all of these individuals are our ‘neighbors’. Growing up (and still to this day), one of the most inspirational individuals in my life has been the Pennsylvania born Fred Rogers, or, more famously, Mr. Rogers.

Mr. Rogers is the epitome of a good neighbor. He taught me to value positivity, kindness, understanding, and to always bring out the best in others. As anesthesiologists we have the ability to profoundly affect the atmosphere of the operating room. How we act and conduct ourselves has a greater influence on outcomes than many of us realize. Our approach to the difficult and stressful challenges encountered every day in medicine has a profound impact on everyone else involved in a patient’s care. Despite the stress and challenges inherent to working in the operating room, through our positivity we have the ability to spread positivity. Mr. Rogers addressed this topic when he answered the question “how do we make goodness attractive? By doing whatever we can do to bring courage to those whose lives move near our own—by treating our ‘neighbor’ at least as well as we treat ourselves and allowing that to inform everything that we produce.” Similarly, as the adage goes: good begets good. Be good and influence your neighbors to be good and we can make our neighborhood a more pleasant place.

**Beyond just making our work environment more enjoyable, can our positivity and kindness influence outcomes?** A study by Cameron et al. from the University of Michigan demonstrated a link between positive organizational practices and outcomes in both the financial services industry and nursing units in a health care system. Six different positive practice dimensions were identified and encouraged: caring, compassionate support, forgiveness, inspiration, meaning, and lastly respect, integrity and gratitude. Through various methods, these dimensions were encouraged, and outcomes were measured after a year of implementation. The financial services population saw improvements in employee turnover, work climate, executive judgment of effectiveness, connection to mission, ethics, personal influence and work-life balance. The nursing population saw improvements in patient satisfaction with pain management, patient willingness to recommend the unit, employee turnover and organizational climate. In fact, the units that improved the most in their positivity practices (as identified by self-survey) saw a 26% improvement in patient satisfaction! It becomes more convincing that not only do we have a responsibility to ourselves and our coworkers, but also to our patients to positively influence the culture in which we’re working. How we incorporate kindness into our daily lives and work lives will vary. Some days it will come naturally, while other days it will require a conscious effort. It can be as simple as a smile when you pass someone in the hallway. Whether we recognize it or not, our role as anesthesiologists within the hospital, and as physicians in the world outside the confines of the hospital walls delineates us as leaders. My time with the Army taught me the importance of “leading from the front.” This is a lesson that I try and embody myself, and that I look for in my mentors. We should make every effort to inspire those around us to be better, and the best way to do this is to continually strive to be better ourselves. As medical professionals we are adept with continuing medical education and constantly honing our technical skill and knowledge base. I challenge us to also strive to continually improve our positive organizational presence. It is through this effort that we can foster a culture of positive virtuousness where not only ourselves, but our ‘neighbors’ can truly thrive in our ‘neighborhood’. Perhaps Mr. Rogers said it best: “There are three ways to ultimate success: The first way is to be kind. The second way is to be kind. The third way is to be kind.” ■



**Joseph A. Answine,  
M.D., FASA**

*Dr. Answine is a member of the advisory board for Suggamadex.*

## *Yet They Chose to Ignore*

Many anesthesiologists (sadly, not all) have been painfully aware of our inadequacy to not only effectively reverse neuromuscular blockade, but to appropriately quantify the level of blockade within our patients. Neostigmine has been helpful over the many years but quite frequently not effective in its ability to provide reversal to a Train-of-four (TOF) of 0.9. Furthermore, we rarely wait the 10 minutes or more that it takes if reversal is to occur and even more rarely do we utilize quantitative neuromuscular monitoring to spite the fact that study after study demonstrate an inability of non-quantitative devices to appropriately determine TOF.<sup>1</sup>

I hear commonly from my anesthesiology colleagues; “You must reverse.” And “You must monitor TOF.” Yet, the same individuals will say that quantitative monitoring is not necessary or worth the expense.

Well, we are to be data driven. So, what do the data show? First, we need to accept that a quantitative TOF of less than 0.9 is inadequate and considered residual neuromuscular blockade. Also, we need to accept the fact that we don’t know what we don’t know. A survey published in the Brazilian Journal of Anesthesiology in 2016 found that 70% of anesthesiologists believe that residual neuromuscular blockade occurs less than 10% of the time.<sup>1</sup> A larger survey from 2010 found that the majority of anesthesiologists in the United States and Europe believe that the occurrence of clinically significant residual neuromuscular blockade is less than 1%.<sup>2</sup> The above statistics would be fine if the incidence of residual neuromuscular blockade was truly rare, but it is not. **A meta-analysis from 2007 looking at 2700 patients found that residual neuromuscular blockade in the PACU after the use of intermediate acting neuromuscular blocking agents such as rocuronium, vecuronium and cisatracurium occurred 41% of the time.**<sup>3</sup> Two studies from 2015 found that if acetylcholinesterase inhibitors were used, the incidence was still 30% to 58%.<sup>4,5</sup> These numbers are far greater than what we presume to be true.

However, does the occurrence of residual neuromuscular blockade have clinical significance? Studies on awake volunteers have demonstrated significant effects on pharyngeal and respiratory muscle function with only mild degrees of residual blockade. Using fluoroscopy and manometry to evaluate pharyngeal muscle function with low-dose vecuronium neuromuscular block, investigators found that at a TOF of 0.8, impaired coordination of pharyngeal muscle activity was noted in 20% of subjects and upper esophageal sphincter tone was significantly reduced as well.<sup>6</sup> In another study using vecuronium titrated to achieve TOF ratios of 0.6-0.8 in a small group of awake subjects, using video-manometry of the pharynx and esophagus, there was misdirected swallowing with aspiration in four of the subjects at a TOF ratio of 0.6 and three of the subjects at a TOF ratio of 0.7. These are individuals without the concomitant effects of anesthetics and opioids.<sup>7</sup>

Looking at anesthetized patients, a study out of Spain from 2016 found that residual blockade in the PACU occurred 26.7% of the time and those patients demonstrated a higher incidence of respiratory events including re-intubation. Of interest, the use of neostigmine was associated with a higher incidence of residual neuromuscular blockade.<sup>8</sup> Another study from 2013 found that critical respiratory events such as airway obstruction, hypoxemia and respiratory failure were 3 times more likely if the TOF was less than 0.9.<sup>9</sup>

We are all comfortable now with the data that show that visual and tactile assessment of TOF is at best “bad”. Furthermore, clinical tests such as head lift and hand grip are also quite inadequate.<sup>10</sup> Those with the highest anesthesia acumen cannot tell that a fade exists until the TOF is less than 0.4.<sup>11</sup> Therefore, we can assume the danger zone is 0.4 to 0.9, and that is probably where most of our patients exist at the end of surgery. Why do I say that? Because if we monitor, we are using qualitative devices, and because a study in Anesthesiology from 2003

demonstrated that two hours after a single 2 times the ED95 dose of an intermediate acting neuromuscular blocking agent, 37% of individuals did not have a TOF ratio of 0.9 and in 10%, it was still less than 0.7.<sup>12</sup>

As stated previously, we rarely, whether in academic institutions or private practice settings, utilize quantitative TOF monitoring even though society after society and consensus statement after consensus statement stress the need for such monitoring.

What about sugammadex? Sugammadex is a much better reversal agent than what we call the standard therapy; neostigmine. Sugammadex clinical trial 19.4.301 demonstrated a 13 times faster recovery from 2 twitches to a TOF greater than 0.9 when compared to acetylcholinesterase inhibitors. It was 7.6 times faster when vecuronium was used. The median time to reversal to a TOF of 0.9 for rocuronium was 1.4 minutes versus 17.6 minutes in favor of sugammadex, and 2.1 minutes versus 18.9 minutes when vecuronium was used.<sup>13</sup> Furthermore, all levels of blockade including deep and rescue can be reversed with sugammadex.<sup>14, 15</sup> The study from 2015 mentioned in the second paragraph by Brueckmann et. al. which demonstrated a high incidence of residual blockade with neostigmine reversal found 0 out of 74 patients given sugammadex had residual neuromuscular blockade.<sup>4</sup>

So, what should we do? First, realize that we are missing many patients with residual neuromuscular blockade. Next, we need to realize that it does lead to morbidity especially in our sicker, most vulnerable patients. Then, we need to accept the fact that our current monitoring protocol is inadequate. Lastly, consider the utilization of sugammadex which has proven to be a much more predictable and effective reversal agent for neuromuscular blockade by the most commonly used neuromuscular blocking agents; rocuronium and vecuronium.

We are so smart, that we allow ourselves to sometimes be not so smart, I guess. ■

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# DÉJÀ VU



**Richard O'Flynn,  
M.D., FASA**

As we go to press, the 2017-18 Pennsylvania Legislative Cycle is winding down with less than 7 scheduled session days remaining. The PSA Board remains optimistic that the supervision language will finally be put into statute but, in reality that hope is rapidly fading. We've been here before...in both the 2013-14 and 2015-16 sessions; we had similar legislation that failed to make it through both the House and Senate.

You would think it would be easy! The supervision language already exists in the Department of Health regulations and has for years with no adverse effect on the delivery of patient care so common sense would seem to indicate that this should easily be supported by our legislators. Unfortunately, common sense doesn't seem to be the motivating factor in Harrisburg. Opponents to the bills include the Pennsylvania Hospital Association and the Pennsylvania Association of Nurse Anesthetists. One can easily guess at their motives and patient safety doesn't appear to be the primary driving force.

In fairness to the legislators, they are inundated with bills touching on all aspects of daily life – they obviously can't be experts on, or even have more than a passing knowledge of, the various issues that come before them, so they rely heavily on their staff and constituent input.

While the PSA Board, our lobbyists, Quantum Communications and Z-PAC do a great job educating the legislators, it really comes down to individual constituents having that personal relationship with their legislators in order to be successful. Unfortunately, anesthesiologists, and physicians in general, do a poor job in this regard. Our opponents are out there and very vocal in pushing their agendas. You need to be the voice of medicine and advocate for patient safety. Get to know your legislator, they value your input. Let 2019 be the year that political apathy is wiped out in the Pennsylvania Society of Anesthesiologists. ■

***You need to be the voice of medicine  
and advocate for patient safety.***

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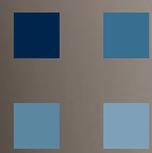
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