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PIA, an official annual publication of the Department of Anesthesiology, University of Pittsburgh School of Medicine, is a vehicle for communication of scholarly, educational, clinical, and administrative activities for those affiliated with the Pittsburgh anesthesiology community.

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PIA welcomes submissions from current residents, fellows, CRNAs, SRNAs, faculty, and medical students, as well as alumni and visiting students, fellows, staff members, and affiliated colleagues. Abstracts for consideration for the 2018 volume must be submitted to the PIA editorial office (sakait@upmc.edu) by August 15, 2018. Reports/articles for consideration for the 2018 volume must be submitted to the PIA editorial office (sakait@upmc.edu) by September 15, 2018. Specific formatting instructions for the text and figures are detailed below.

This activity has been approved by the Department of Anesthesiology Executive Steering Committee.

Instructions for Authors

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Abstract submissions:

Limited to a maximum length of 700 words. These 700 words include ALL TEXT in the piece, including titles, affiliations, and captions. If you use images, subtract 100 words from your total word count for each image. Images must also be included as separate graphics files (see below graphics instructions). Do not embed your figures into your Word file.

If the abstract was presented at a meeting, please include the information (e.g., “This abstract was presented as a poster/as a podium presentation at the 19th annual meeting of the International Liver Transplantation Society, Chicago, IL, July 8-11, 2015.”). Please also indicate whether your abstract won any awards at the meeting. This text must fit into the 700-word limit.

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MESSAGE FROM THE INTERIM CHAIR

Over the decades, the University of Pittsburgh/UPMC Department of Anesthesiology has grown and matured into one of the largest and best anesthesiology departments in the nation. When Dr. Safar arrived in Pittsburgh to start the department in 1961, only three physicians and over 70 nurse anesthetists managed all anesthesia services. During FY17, we served 18 clinical sites, managed over 300,000 cases, and were staffed with more than 185 faculty physicians and over 377 CRNA full-time equivalents. Our ACGME-accredited residency program is now widely considered one of the best in the nation, and we recently launched a Combined Anesthesiology-Pediatrics Residency program in collaboration with the Children’s Hospital of Pittsburgh of UPMC Department of Pediatrics. We host eight fellowship training programs. Our ACGME-accredited fellowships are in adult cardiothoracic, pediatric, obstetric, and now acute pain/regional anesthesiology, which was accredited in FY18, as well as anesthesiology critical care medicine and pain medicine. We also offer fellowships in hepatic transplantation anesthesiology and neuroanesthesiology. We train about 120 residents and clinical fellows every year. We also host two National Institutes of Health (NIH) T32 research fellowships to train pain researchers and physician scientists to become the next generation of leading researchers and physicians in academic anesthesiology.

At our 18 clinical sites, now including UPMC Altoona, the latest to come under the umbrella of the department in FY17, we managed 306,416 cases, an approximate 3.6% increase from the FY16 overall UPMC case load.

In FY17, the National Institute of General Medical Sciences of the NIH awarded a third five-year term of funding to our T32 program “Research Training in Anesthesiology and Pain Medicine,” directed by Professor Yan Xu, PhD, Vice Chair of Basic Sciences. The training faculty consists of 35 leading scientists in anesthesiology and related disciplines, including critical care medicine, surgery, computational & systems biology, neurobiology, and cognitive neuroscience. The program supports three trainee positions per year through 2022.

We continue to set the standard for academic and clinical accomplishments by anesthesiology residents, fellows, faculty, CRNAs, researchers, and medical students. I would like to commend every member of the department for their outstanding accomplishments over the course of FY17, as well as our colleagues and supporters. Collectively, we have upheld our department’s strong legacy of excellence over the past year and going forward into the future.
MESSAGE FROM THE EDITOR-IN-CHIEF

It is a distinctive pleasure to present the second edition of the *Pittsburgh Journal of Anesthesiology* (*PJA*). *PJA* is the official publication of the Department of Anesthesiology in the University of Pittsburgh Medical Center (UPMC) and the University of Pittsburgh School of Medicine. This annual comprehensive review journal showcases the contributions and various accomplishments of our department members in the field of anesthesiology. You will surely appreciate the passion, dedication, and joy of our faculty, fellows, residents, CRNAs, and staff in serving patients; advancing scientific knowledge in the field; educating the next generation of physician anesthesiologists and nurse anesthetists; supporting the community’s well-being locally, nationally, and internationally; and cherishing our own social lives.

The journal highlights achievements under the department’s three pillars: education, clinical care, and research. The education section introduces our residency, fellowship, and medical student programs. Clinical division reports provide an impressive overview of patient care in our department, which is one of the largest anesthesiology departments in the US. The research section presents our wide variety of accomplishments in basic, translational, and clinical trials research.

I wish to express my utmost gratitude to the individual authors whose hard work, dedication, and timely submissions have expedited the production of this second edition. Production of the *PJA* depends on scholarly grants provided to the department by several visiting physicians from Japan, especially from Toyama Prefectural Central Hospital, Toyama, Japan (Kenich Ogura, MD, PhD). As always, Ms. Christine Heiner (Scientific Writer, Department of Anesthesiology/Department of Surgery, University of Pittsburgh School of Medicine) should be fully acknowledged as a major force facilitating publication of the journal with her editorial and graphic design work (with valuable guidance and help from Pitt Communications Services).

Again, I sincerely hope you enjoy the second edition of the *Pittsburgh Journal of Anesthesiology*!
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Tiziana Carollo, MD – Staff Anesthesiologist and CCM Senior Attending
Luigi Centineo, MD – Staff Anesthesiologist and CCM Senior Attending
Giuseppe Chiaramonte, MD – Staff Anesthesiologist, CCM Senior Attending, Fiandaca - Simulation Center Director
Marco Farbo, MD – Anesthesia CCM Junior attending
Veronica Ferrazza, MD – Anesthesia CCM Junior attending
Giovanni Lino, MD – Staff Anesthesiologist and CCM Junior Attending
Fabio Lullio, MD - Staff Anesthesiologist and CCM Junior Attending
Gennaro Martucci, MD – Staff Anesthesiologist and CCM Senior Attending
Giovanna Occhipinti, MD – Anesthesia CCM Junior attending
Giovanna Panarello, MD – Clinical Director, ICU Staff Anesthesiologist, and CCM Senior Attending – Infectious Disease Attending
Federico Pastore, MD - Staff Anesthesiologist and CCM Junior Attending
Marcello Piazza, MD – Pediatric Senior Attending Anesthesiologist
Filippo Sanfilippo, MD - Staff Anesthesiologist and CCM Senior Attending
Maria Scarlata, MD – Anesthesia and CCM Junior Attending
Roberto Serretta, MD – Staff Anesthesiologist and CCM Senior Attending

UPMC MERCY
Bryce C. Bernard, MD – Clinical Assistant Professor
Scott D. Brinkmeyer, DO – Clinical Assistant Professor
Brandon Chinn, MD – Clinical Assistant Professor
Eric L. Davidson, MD – Clinical Assistant Professor
Calin Gorun-Gorunescu, MD - Clinical Assistant Professor; Interim Chief Anesthesiologist
Andrew Herlich, DMD, MD, FASA – Professor
Mark E. Hudson, MD, MBA – Professor
Andres J. Jakymec, MD – Clinical Assistant Professor
Vida R. Kasuba, MD - Clinical Assistant Professor
Amy L. Kemp, MD - Clinical Assistant Professor
Robin A. Lawson, MD - Clinical Assistant Professor
Michael D. Minton, MD – Visiting Clinical Associate Professor
Kristin M. Ondecko Ligda, MD, FASA – Assistant Professor
Joel M. Pomerantz, MD – Clinical Assistant Professor; Director, OB Anesthesiology
Susan T. Rooksby, MD – Clinical Assistant Professor
Anjali Rosario, MD – Clinical Assistant Professor
Alison C. Schmeck, MD – Clinical Assistant Professor
Vladislav I. Shick, MD – Clinical Assistant Professor
Paul Shih, MD – Clinical Assistant Professor
Keith Vogt, MD, PhD – Assistant Professor
William Wallisch, MD – Clinical Assistant Professor
Annie C. Ward, DO - Clinical Assistant Professor
Ryan D. Ball, MD – Clinical Assistant Professor
Carl J. Daltner, MD – Clinical Assistant Professor
David Glover, DO – Clinical Assistant Professor
Wende Goncz, DO - Clinical Assistant Professor
Christopher J. Hodge, MD – Clinical Assistant Professor
Touichi Kawabe, MD - Clinical Assistant Professor
Kevin King, DO - Clinical Assistant Professor
Frank A. Kunkel, MD - Clinical Associate Professor
James V. Kunkel, MD - Clinical Assistant Professor
Stuart Charles Law, MD - Clinical Assistant Professor
Charles Lin, MD – Clinical Assistant Professor
Charles B. Luke, MD – Clinical Assistant Professor
Vimala Ramesh, MD – Clinical Assistant Professor
Anthony Silipo, DO – Clinical Assistant Professor
Daniel Sullivan, MD, JD, MBA – Associate Professor; Chief Anesthesiologist
Katherine B. Szabo, MD - Clinical Assistant Professor

UPMC PASSAVANT

Vasyl Bondarenko, PhD – Research Instructor
Qiang "Charles" Chen, PhD – Research Instructor
Suzanne Doolen PhD - Visiting Research Associate Professor
Howard B. Gutstein, MD – Professor
Gregg E. Homanics, PhD – Professor
Stephanie Puig, PhD - Research Assistant Professor
Ghanshyam Sinha PhD - Research Assistant Professor
Pei Tang, PhD – Professor
Bradley K. Taylor, PhD - Professor
Tommy Tillman, PhD - Research Assistant Professor
Yan Xu, PhD – Professor; Vice Chair for Basic Sciences

UPMC ALTOONA

Joshua F. Chacon, DO - Clinical Assistant Professor
Domenico Falcone, MD – Clinical Assistant Professor; Chief Anesthesiologist
Joseph A. Martinelli, MD – Clinical Assistant Professor
Elizabeth Mburu, MD – Clinical Assistant Professor
Sal N. Nasser, MD – Clinical Assistant Professor
David M. Rasmussen, MD – Clinical Assistant Professor
Paul S. Schultz, MD – Clinical Assistant Professor
Przemyslaw P. Smolarchyk, MD – Clinical Assistant Professor
Vijay H. Vakharia, MD – Clinical Assistant Professor
Daniel F. VanRiper, MD – Clinical Assistant Professor

UPMC BEDFORD MEMORIAL HOSPITAL

Christopher J. Samuel, MD – Clinical Assistant Professor, Chief Anesthesiologist
Nasr Yazigi, MD - Clinical Instructor

UPMC HORIZON

Matthew W. Caldwell, MD – Clinical Assistant Professor
Lakshmi Digumarthi, MD – Clinical Assistant Professor
Mohan Ettyreddy, MD – Clinical Assistant Professor
Suvir Kooor, MD – Clinical Assistant Professor
Mariivic G. Manrique, MD – Clinical Assistant Professor
Chandresh Shah, MD – Clinical Assistant Professor
Sarah Smolik, MD – Clinical Assistant Professor
Jun Wang, MD – Clinical Assistant Professor
Cynthia Wells, MD - Clinical Assistant Professor; Chief Anesthesiologist

PETER M. WINTER INSTITUTE FOR SIMULATION, EDUCATION, AND RESEARCH (WISER)

Paul E. Phrampus, MD – Associate Professor; Director, WISER
In addition to the educational endeavors in which department faculty members participate for the benefit of residents, fellows, medical students, and colleagues, many are involved in educational projects and presentations that contribute to the field of anesthesiology education and give the department national and international prominence. In FY17, Dr. Metro, while continuing in his role as Anesthesiology Residency Program Director, was promoted to Vice Chair for Education and Faculty Affairs. Dr. Rita M. Patel transitioned to Vice Chair for Faculty Development.

GRAND ROUNDS
Under the direction of Dr. Charles Boucek, Director of the Grand Rounds Program, and Dr. David G. Metro, Vice Chair for Education and Faculty Affairs, the Department of Anesthesiology Grand Rounds series continued with the many innovative program features convenient for faculty, fellows, residents, and medical students in the department. New in FY17, live stream sessions were added to the existing digitally recorded modules. Live streaming allowed for more faculty, regardless of distance, to participate in Grand Rounds. Review of recorded modules allows for continuing medical education credit and the modules are maintained online indefinitely as an educational resource.

The UPMC Center for Continuing Education in the Health Sciences provides accreditation for the series, and the University of Pittsburgh Internet-Based Studies in Education and Research website hosts the recorded modules as enduring material.

In 2016-2017, faculty members viewed 30 presentations. Journal Clubs organized by Dr. Stephen McHugh were held monthly from September through May with great involvement from the Residency Program. The department hosts lectures from visiting professors on various topics. Both the Journal Clubs and visiting professor lectures are integral to the success of the Grand Rounds series.

AMERICAN SOCIETY OF ANESTHESIOLOGY (ASA)
The American Society of Anesthesiologists (ASA) Annual Meeting is a heavily attended event, with extensive departmental representation. An impressive number of medical students, residents, fellows, and faculty members present every year. The 2016 meeting was held from October 22-26 in Chicago, IL. Department members delivered 65 presentations and 20 faculty members and three residents served on ASA and ASA-related committees. The department’s yearly alumni reception was held Sunday, October 23rd at the Hyatt Regency Conference Center and was attended by almost 200 faculty, fellows, residents, and alumni.

Many department members participated in pre-ASA meetings such as the Society of Pediatric Anesthesia Annual Meeting and the Society for Education in Anesthesia Fall Meeting. Faculty and residents presented problem-based learning discussions, panels, clinical forums, workshops, scientific papers, and scientific & educational exhibits.
<table>
<thead>
<tr>
<th>Presentation Date</th>
<th>Presenter(s)</th>
<th>Presentation Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1, 2016</td>
<td>Shawn Palmeri, MD* Chelsey Woodrum, MD*</td>
<td>Journal Club 1: ERAS for Liver Surgery</td>
</tr>
<tr>
<td>September 15, 2016</td>
<td>Simon Gelman, MD, PhD, FANZCA Leroy D. Vandam/Benjamin G. Covino Distinguished Professor of Anaesthesia, Department of Anesthesiology, Harvard Medical School/Perioperative and Pain Medicine Brigham and Women's Hospital, Boston, MA</td>
<td>The Function of the Venous System: The Physiologic Story</td>
</tr>
<tr>
<td>September 22, 2016</td>
<td>Richard P. Kidwell, JD Sr. Assoc. Counsel and VP, UPMC Risk Management Steven L. Orebaugh, MD* Daniel R. Sullivan, MD, JD, MBA*</td>
<td>Mock Trial</td>
</tr>
<tr>
<td>September 29, 2016</td>
<td>Tetsuro Sakai, MD, PhD, MHA, FASA* (Faculty Mentor)</td>
<td>ASA Rehearsals</td>
</tr>
<tr>
<td>October 6, 2016</td>
<td>Marshall Bahr, MD * Nathan Hoaglund, MD*</td>
<td>Journal Club 2: Neuromuscular Blocking Drugs &amp; Postoperative Pneumonia</td>
</tr>
<tr>
<td>November 3, 2016</td>
<td>Eric Magda, MD* Patrick Kennedy, MD*</td>
<td>Journal Club 3: Anesthesia Technique and Mortality after Total Hip or Knee Arthroplasty</td>
</tr>
<tr>
<td>November 17, 2016</td>
<td>Karen Boretsky, MD Associate in Perioperative Anesthesia and Pain Medicine, Harvard Medical School/ Boston Children’s Hospital, Boston, MA</td>
<td>Point of Care Ultrasound: From Uncertain Technology to Essential Perioperative Assessment Tool</td>
</tr>
<tr>
<td>December 1, 2016</td>
<td>Jonah Abraham, MD* Philip Carullo, MD*</td>
<td>Journal Club 4: Effect of Post-extubation High-Flow Nasal Cannula vs. Noninvasive Ventilation on Re-intubation and Post-extubation Respiratory Failure in High-Risk Patients</td>
</tr>
<tr>
<td>January 5, 2017</td>
<td>Liora Yehushua, MD Lucas Davanzo, MD</td>
<td>Journal Club 5: Obstetric Anesthesiology</td>
</tr>
<tr>
<td>January 19, 2017</td>
<td>Michael G. Fitzsimons, MD, FCCP Director, Division of Cardiac Anesthesia, Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital</td>
<td>Impaired Providers, Now it is a Patient Safety Issue: Drug Testing May be the Answer</td>
</tr>
<tr>
<td>January 26, 2017</td>
<td>Ian Gilron, MD, MSc, FRCPC Director of Clinical Pain Research; Professor of Anesthesiology and Perioperative Medicine, Biomedical &amp; Molecular Sciences, and Center for Neuroscience Studies, Queen’s University, Kingston General Hospital, Ontario, Canada</td>
<td>Chronic Pain After Surgery – Can We Find the Ounce of Prevention?</td>
</tr>
<tr>
<td>February 2, 2017</td>
<td></td>
<td>Journal Club 6: ITE Jeopardy</td>
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<tr>
<td>Presentation Date</td>
<td>Presenter(s)</td>
<td>Presentation Title</td>
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| February 16, 2017 | Daniel Barnett, MD, MPH  
Associate Professor, Department of  
Environmental Health & Engineering/  
Department of Health Policy &  
Management, Johns Hopkins Bloomberg  
School of Public Health, Baltimore, MD | Examining Health Workers’ Perceptions of Organizational Expectations Following Disasters |
| February 23, 2017 | Samuel DeMaria, Jr., MD  
Associate Professor of Anesthesiology;  
Director, Division of Liver Transplantation,  
Mount Sinai Health System, New York, NY | The Checklist Fiasco                                                                |
| March 2, 2017     | Andrea Ibarra, MD*  
Courtney Mechling, MD* | Journal Club 7: Dexmedetomidine for the Prevention of Postoperative Delirium          |
| March 16, 2017    | Andrew Herlich, DMD, MD, FAAP, FASA* | Murder Most Foul                                                                   |
| March 23, 2017    | Franklin Dexter, MD  
Director, Division of Management Consulting, University of Iowa, Carver  
College of Medicine, Department of Anesthesia | Evaluating Quality of Anesthesiologists’ Supervision                                |
| March 30, 2017    | Daniel Sessler, MD  
Michael Cudahy Professor; Chair,  
Department of Outcomes Research  
Department of Anesthesiology & Pain Management, Cleveland Clinic | Lost in Translation                                                                |
| April 6, 2017     | Steven Bartels, MD*  
Hayden Hundley, MD, MPH* | Journal Club 8: Incidence of Connected Consciousness after Tracheal Intubation      |
| April 20, 2017    | Philip Carullo, MD* | History and Innovation in Anesthesia                                                |
| April 27, 2017    | PARRC Rehearsals                                                        |                                                                                   |
| May 4, 2017       | Brandon Staub, MD, MS*  
Evan Lebovitz, MD* | Journal Club 9: Effect of Conservative vs. Conventional Oxygen Therapy on Mortality Among Patients in an Intensive Care Unit: The Oxygen-ICU Randomized Clinical Trial |
| May 18, 2017      | Raymond Roberge, MD, MPH  
Research Medical Officer, National Personal  
Protective Technology Laboratory, National  
Institute for Occupational Safety and Health  
Centers for Disease Control and Prevention | Personal Protective Equipment Update for Anesthesia Practitioners                    |
| May 25, 2017      | Joshua Zimmerman, MD, FASE  
Associate Professor, Department of Anesthesiology; Director, Perioperative  
Echocardiography, University of Utah | Echocardiography Service Update                                                    |
### Saturday, October 22, 2016

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Room</th>
</tr>
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<tbody>
<tr>
<td>AW: Workshop on Flexible Endoscopy for Lung Isolation*</td>
<td>8:00-9:15 AM</td>
<td>W180</td>
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<tr>
<td>William Simmons, MD (co-moderator); Andrew Herlich, DMD, MD, FAAP</td>
<td></td>
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<tr>
<td>(faculty)</td>
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<tr>
<td>AW: Difficult Airway Workshop With Simulation*</td>
<td>9:00 AM -12:00 PM</td>
<td>W470ab</td>
</tr>
<tr>
<td>Joseph J. Quinlan, MD (co-moderator); Faculty: David G. Metro, MD;</td>
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<tr>
<td>Shawn T. Beaman, MD; Theresa A. Gelzinis, MD; Robert G. Krohner, DO;</td>
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<tr>
<td>Ryan Romeo, MD</td>
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<tr>
<td>AW: Workshop on Flexible Endoscopy for Lung Isolation*</td>
<td>9:30-10:45 AM</td>
<td>W180</td>
</tr>
<tr>
<td>William Simmons, MD (co-moderator); Andrew Herlich, DMD, MD, FAAP</td>
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<tr>
<td>(faculty)</td>
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<tr>
<td>MCC: Awake Fiberoptic Intubation in Patient With Congenital Airway</td>
<td>10:00 AM-12:00 PM</td>
<td>Hall F1 Foyer Monitor 06</td>
</tr>
<tr>
<td>Anomalies, Subglottic Stenosis and Recent Tracheal Resection</td>
<td></td>
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<tr>
<td>Complicated by Wound Dehiscence</td>
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<tr>
<td>Zachary C. Cohen, MD; Anna L. Hardy, MD; Ibtessam A. Hilmi, MB, CHB</td>
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<tr>
<td>Robert Parness, MD, DMD</td>
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<tr>
<td>MCC: Anterior Spinal Artery Syndrome Following Spinal Anesthesia</td>
<td>10:30 AM - 12:00 PM</td>
<td>W476</td>
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<tr>
<td>for Elective Inguinal Hernia Repair</td>
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<tr>
<td>Youngeon Cho, MD; Manisha L. Trivedi, MD</td>
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</tr>
<tr>
<td>AW: Workshop on Flexible Endoscopy for Lung Isolation*</td>
<td>1:10-2:25 PM</td>
<td>W180</td>
</tr>
<tr>
<td>William Simmons, MD (co-moderator); Andrew Herlich, DMD, MD, FAAP</td>
<td></td>
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<tr>
<td>(faculty)</td>
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<td></td>
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<tr>
<td>AW: Difficult Airway Workshop With Simulation*</td>
<td>1:10-4:10 PM</td>
<td>W470ab</td>
</tr>
<tr>
<td>Joseph J. Quinlan, MD (co-moderator); Faculty: David G. Metro, MD;</td>
<td></td>
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<tr>
<td>Shawn T. Beaman, MD; Robert G. Krohner, DO; Ryan Romeo, MD</td>
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<tr>
<td>OP: Metabolomics Profiling in Patients With Malignant Hyperthermia</td>
<td>1:00-3:00 PM</td>
<td>Hall F1 Foyer Monitor 16</td>
</tr>
<tr>
<td>(MH)</td>
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<tr>
<td>Sheila Riazi, MD; Natalia Kraeva, PhD; Marcin Wasowicz, MD; Jerome</td>
<td></td>
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<tr>
<td>Parness, MD, PhD</td>
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<tr>
<td>Resident and Fellow Session: The Business Side of Anesthesia</td>
<td>2:00-2:50 PM</td>
<td>Grand Ballroom CD</td>
</tr>
<tr>
<td>Mark E. Hudson, MD, MBA (speaker)</td>
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<tr>
<td>Clinical Forum: Management of Pulmonary Hypertension in the</td>
<td>2:20-3:20 PM</td>
<td>W196c</td>
</tr>
<tr>
<td>Operating Room</td>
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<tr>
<td>Kathirvel Subramaniam, MD, MPH</td>
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<tr>
<td>AW: Workshop on Flexible Endoscopy for Lung Isolation*</td>
<td>2:30-3:45 PM</td>
<td>W180</td>
</tr>
<tr>
<td>William Simmons, MD (co-moderator); Andrew Herlich, DMD, MD, FAAP</td>
<td></td>
<td></td>
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<tr>
<td>(faculty)</td>
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<tr>
<td>PP: Index Profile System: A Novel Approach to Identify Patients at</td>
<td>3:15-3:45 PM</td>
<td>Hall F Foyer-Area B Monitor 05</td>
</tr>
<tr>
<td>Risk for the Triple Low State and Postoperative Mortality</td>
<td></td>
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<tr>
<td>Michael P. Schnetz, MD, PhD; Melissa Giraldo Duque, MD; Steven L.</td>
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<tr>
<td>Whitehurst, MD; A. Murat Kaynar, MD, MPH</td>
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</tr>
<tr>
<td>MCC: Ketamine Infusion and Paravertebral Nerve Block Catheters as</td>
<td>3:15-5:15 PM</td>
<td>Hall F1 Foyer Monitor 16</td>
</tr>
<tr>
<td>Key Components of Multimodal Analgesia in a Patient for</td>
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<tr>
<td>Exploratory Laparotomy</td>
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<tr>
<td>Kathleen O. Coy, MD; Joshua D. Eaton, DO; Kristin Oondecko Ligda, MD</td>
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<tr>
<td>MCC: Intraoperative Takotsubo Cardiomyopathy During Complex Spine</td>
<td>3:15-5:15 PM</td>
<td>Hall F1 Foyer Monitor 02</td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
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<tr>
<td>Diana S. Deandrade, MD; Li Meng, MD, MPH</td>
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</tr>
<tr>
<td>MCC: Ur-ine Trouble: Cloudy With a Chance of Uric Acid</td>
<td>3:15-5:15 PM</td>
<td>Hall F1 Foyer Monitor 07</td>
</tr>
<tr>
<td>Evan E. Lebovitz, MD; Elizabeth A. Ungerman, MD, MS; Shawn R.</td>
<td></td>
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<tr>
<td>Palmeri, MD; Mario I. Montoya, MD</td>
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</tr>
</tbody>
</table>

*Bold=Presenter names
*Denotes duplicate presentation

All events take place at the Hyatt Regency McCormick Place unless otherwise noted.
### Saturday, October 22, 2016 (continued)

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCC: Lung Isolation for Video-Assisted Thoracoscopic Surgery (VATS) in a Patient With a Total Laryngectomy by Use of an Endobronchial Blocker Via a Tracheostomy Tube</td>
<td>3:15-5:15 PM</td>
<td>Hall F1 Foyer</td>
</tr>
<tr>
<td><strong>Eugene P. Raggi, MD; Christopher C. Johnson, MD; Catalin S. Erazu, MD</strong></td>
<td></td>
<td>Monitor 08</td>
</tr>
<tr>
<td><strong>Pulsar Li, DO; Jamie L. Estock, MA; Jack B. Schumann, PhD; Steven L. Grebaugh, MD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBLD: 78-Year-Old With Severe Mitral Regurgitation for MitraClip Placement</td>
<td>4:00-5:00 PM</td>
<td>Hall F1</td>
</tr>
<tr>
<td><strong>Theresa A. Gelzinis, MD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>AW: Workshop on Flexible Endoscopy for Lung Isolation</em></td>
<td>4:00-5:15 PM</td>
<td>W180</td>
</tr>
<tr>
<td><strong>William Simmons, MD (co-moderator); Andrew Herlich, DMD, MD, FAAP (faculty)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PBLD: Peripheral Nerve Blockade as Perioperative Anesthetic and Pain Management of Patient With Severe Aortic Stenosis for Charcot Foot Reconstruction</strong></td>
<td>4:05-4:15 PM</td>
<td>Hall F1 Foyer</td>
</tr>
<tr>
<td><strong>Alex M. Dressler, MD; Kristin Ondecho Ligda, MD</strong></td>
<td></td>
<td>Monitor 16</td>
</tr>
</tbody>
</table>

### Sunday, October 23, 2016

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBLD: 78-Year-Old With Severe Mitral Regurgitation for MitraClip Placement*</td>
<td>9:50-10:50 AM</td>
<td>Hall F1</td>
</tr>
<tr>
<td><strong>Theresa A. Gelzinis, MD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCC: Intraoperative Rhabdomyolysis and Myoglobinuria in Prolonged Multistage Spinal Procedure</td>
<td>10:00-10:10 AM</td>
<td>Hall F1 Foyer</td>
</tr>
<tr>
<td><strong>Alex M. Dressler, MD; Charles J. Lin, MD</strong></td>
<td></td>
<td>Monitor 09</td>
</tr>
<tr>
<td>PP: Cost Effectiveness of Postoperative Ketamine Infusion after Chiari Decompression</td>
<td>11:00-11:30 AM</td>
<td>Hall F Foyer-Area A Monitor 01</td>
</tr>
<tr>
<td><strong>Charles J. Lin, MD; Michael McDowell, MD; Beverly A. Pearce-Smith, MD; Robert Friedlander, MD</strong></td>
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</tr>
<tr>
<td>PBLD: Is it Battery? Adolescent With Terminal Disease and an Emergent Difficult Airway</td>
<td>11:00 AM-12:00 PM</td>
<td>Hall F1</td>
</tr>
<tr>
<td><strong>Phillip S. Adams, DO; Doreen E. Soliman, MD</strong></td>
<td></td>
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</tr>
<tr>
<td>PP: Variability in the Effect of Experimental Pain on Long-Term Memory During Sedation With Dexmedetomidine and Midazolam</td>
<td>11:30 AM-12:00 PM</td>
<td>Hall F Foyer-Area D Monitor 15</td>
</tr>
<tr>
<td><strong>Keith M. Vogt, MD, PhD; James W. Inbison, MD, PhD; Josh J. Tremel, BS; Vencislav Popov, BA; Lynne M. Reder, PhD; Julie A. Fiez, PhD</strong></td>
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</tr>
<tr>
<td>PP: Institutional Tissue Plasminogen Activator Policy for Intraoperative Pulmonary Thromboembolism During Liver Transplantation</td>
<td>11:30 AM-12:00 PM</td>
<td>Hall F Foyer-Area E Monitor 19</td>
</tr>
<tr>
<td><strong>Daniel R. Mandell, MD; Raymond M. Plainisic, MD; Fernando E. Melean, MD; Christopher Hughes, MD; Abhinav Humar, MD; Benjamin Cassidy, PharmD; Richard Simmons, MD; Andre M. De Wolf, MD; Tetsuro Sakai, MD, PhD</strong></td>
<td></td>
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</tr>
<tr>
<td>MCC: Implementation of Extracorporeal Membrane Oxygenation to Manage Refractory Ventricular Fibrillation after Peri-Operative Myocardial Infarction</td>
<td>1:00-3:00 PM</td>
<td>Hall F1 Foyer</td>
</tr>
<tr>
<td><strong>Christopher C. Johnson, MD; Sean M. DeChancie, DO</strong></td>
<td></td>
<td>Monitor 04</td>
</tr>
<tr>
<td>FAER Medical Student Anesthesia Research Fellowship Symposium</td>
<td>2:00-5:00 PM</td>
<td>W375a</td>
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<tr>
<td>PP: Immune Changes in the ICU Following Sepsis: an Experimental Model of Sepsis in Drosophila melanogaster</td>
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<td><strong>Anh Nguyen</strong> (mentor: A. Murat Kaynar, MD, MPH)</td>
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<tr>
<td>PP: Hemoadsorption Removes Plasma Cytokines after Experimental Cardiac Arrest in Rats</td>
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<tr>
<td><strong>Elizabeth Snajdar</strong> (mentor: Tomas Drabek, MD, PhD)</td>
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<tr>
<td>PBLD: Right Ventricular Failure Following LVAD Insertion: What’s New in RV Support?</td>
<td>2:20-3:20 PM</td>
<td>Hall F1</td>
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<tr>
<td><strong>Theresa A. Gelzinis, MD</strong></td>
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<tr>
<td>MCC: Atypical Takotsubo Cardiomyopathy Post Simultaneous Liver and Kidney Transplantation</td>
<td>2:40-2:50 PM</td>
<td>Hall F1</td>
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<tr>
<td><strong>Derek S. Lauter, MD; Ibtessam A. Hilmi, MB, CHB, FRCA</strong></td>
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<td>Monitor 04</td>
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<tr>
<td><strong>David G. Metro, MD (abstract moderator)</strong></td>
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<tr>
<td><strong>Nicole Verdecchia, MD; Vladislav Melnyk, MD; Joseph Pichamuthu, MS; David Vorp, PhD; Steven L. Grebaugh, MD</strong></td>
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<tr>
<td>MCC: Successful Management of a Neonate With Pyriform Aperture Stenosis by Long-Term Placement of a Laryngeal Mask Airway</td>
<td>3:15-5:15 PM</td>
<td>Hall F1 Foyer</td>
</tr>
<tr>
<td><strong>Ian R. Miller, MD; Mihaela Visoiu, MD</strong></td>
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<td>Monitor 13</td>
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</tbody>
</table>
Monday, October 24, 2016

MCC: It’s Not Just Pain: Continuous Peripheral Nerve Block Infusion to Reduce Risk of Adrenal Crisis after Orthopedic Surgery
Charles J. Lin, MD
3:15-5:15 PM
Room F1 Foyer

MCC: Placement of Endovascular Stent for Aortic Thrombus Exclusion Guided by Transesophageal Echocardiography
Joshua B. Knight, MD; Theresa A. Gelzinis, MD
3:15-5:15 PM
Hall F1 Foyer Monitor 16

MCC: Not Your Average Lap Chole
Kelsey M. Bauer, MD; Ibtesam A. Hilmi, MB, CHB, FRCA; Brian T. Gierl, MD
3:15-5:15 PM
Hall F1 Foyer Monitor 02

MCC: Complex Considerations in Anesthetic Management of Patients With Osteogenesis Imperfecta
Vladyslav Melnyk, MD; Mario I. Montoya, MD
3:35-3:45 PM
Hall F1 Foyer Monitor 05

MCC: Extensive Bleeding During Oral Surgery in a Patient With Type 2B Von Willebrand’s Disease
Karin L. Michaelsen, MD, PhD; Petra Martin, BS; Ibtesam A. Hilmi, MB, CHB, FRCA
3:15-5:15 PM
Hall F1 Foyer Monitor 07

MCC: Pregnancy, Obesity, and Prone Positioning in the Third Trimester
Patricia L. Dalby, MD; Eleni Kotsis, DO; Jamie M. Zorn, MD
3:15-5:15 PM
Hall F1 Foyer Monitor 10

Women in Anesthesiology
Kristin Ondecko Ligda, MD (founding member)
2nd Annual Meeting
5:30-9:00 PM
Conference Center Chicago

Alumni Reception
Hyatt Regency Conference Center
Room Prairie B, 2nd floor, 2233 S. Martin L. King Drive, Chicago, IL

6:00 PM – 9:00 PM

60-minute panel: Academic Perspective-East Coast
Mark E. Hudson, MD, MBA

Governmental Affairs Committee Chair presentation
Erin A. Sullivan, MD (committee chair)

MCC: Insanity on the Labor Unit: Schizophrenia and Ethical Dilemmas
Andrius V. Giedraitis, MD, MBA; Jamie M. Zorn, MD; Allison Serra, MD; Joshua B. Knight, MD; Eleni Kotsis, DO; Patricia L. Dalby, MD
1:00-3:00 PM
Hall F1 Foyer Monitor 10

MCC: Intravenous Remifentanil Infusion for Labor and Delivery in a Patient With Failed Neuraxial Technique
Lieu T. Tran, MD; Kyle Heselpoth, SRNA; Anthony T. Silipo, DO
1:00-3:00 PM
Hall F1 Foyer Monitor 12

MCC: Intravenous Ketamine Infusion for Treatment of Refractory Lower Extremity Chronic Regional Pain Syndrome
Daniel S. Sandusky, MD; Andrew M. Clary, DO; Michael P. Mangione, MD
1:00-3:00 PM
Hall F1 Foyer Monitor 08

MCC: Post-extubation Airway Emergency in a Patient after Posterior Cervical Spine Surgery
Lieu T. Tran, MD; Li Meng, MD, MPH
1:00-3:00 PM
Hall F1 Foyer Monitor 07

AW: Peripheral Nerve Blocks: Ultrasound, Simulation and Stimulation*
Jacques E. Chelly, MD, PhD, MBA (faculty)

Ad Hoc Committee on Women in Anesthesia Panel: Developing the Leaders of the Future
Kristin Ondecko Ligda, MD (member)

MCC: Don’t Get Stabbed in the Back by a Difficult Airway
Elizabeth A. Ungerman, MD, MS; Mary Margaret Lim, MD; Diane Johnston, CRNA; Anthony T. Silipo, DO
2:00-4:00 PM
Regency E

MCC: Dystonic Reaction Likely Induced by Ondansetron
Elizabeth A. Ungerman, MD, MS; John J. Hache, MD; Patrick J. Forte, MD
2:20-2:30 PM
Hall F1 Foyer Monitor 08

MCC: Inability to Ventrilate an Intubated Patient With Hunter Syndrome
Rachel E. Pool, MD; Jerome Parness, MD, PhD
2:30-2:40 PM
Hall F1 Foyer Monitor 08

MCC: Dexmedetomidine in the Perioperative Pain Management of a Patient With Huntington’s Disease
Eugene P. Raggi, MD; Joshua D. Eaton, DO; Andrew Herlich, DMD, MD, FAAP
3:15-5:15 PM
Hall F1 Foyer Monitor 13

MCC: Sudden Cardiac Arrest after Patient Proning Prior to Craniectomy for Clot Evacuation and Arteriovenous Malformation (AVM) Resection
Brandon P. Staub, MD; Li Meng, MD, MPH
3:15-5:15 PM
Hall F1 Foyer Monitor 17

MCC: Sudden Cardiac Arrest after Patient Proning Prior to Craniectomy for Clot Evacuation and Arteriovenous Malformation (AVM) Resection
Brandon P. Staub, MD; Li Meng, MD, MPH
4:05-4:15 PM
Hall F1 Foyer Monitor 09

AW: Advanced Workshop
MCC: Medically Challenging Case
PD: Poster Discussion
PP: Poster Presentation
Bold=Presenter names
*Denotes duplicate presentation
All events take place at the Hyatt Regency McCormick Place unless otherwise noted
### Tuesday, October 25, 2016

**Point-Counterpoint: Checklists, Barcodes, Automated Medication Systems, and Prefilled Syringes—Are Our Patients Safer in the Ambulatory Setting?**
Andrew Herlich, DMD, MD, FAAP (moderator)

**PP: Teaching Medical Students Anatomy for Regional Anesthesia Using Multi-Modal Instruction**
Kaarina L. Michaelsen, MD, PhD; Steven L. Orebaugh, MD

**AW: Peripheral Nerve Blocks: Ultrasound, Simulation and Stimulation**
Jacques E. Chelly, MD, PhD, MBA (faculty)

**PBLD: Right Ventricular Failure Following LVAD Insertion: What’s New in RV Support?**
Theresa A. Gelzinis, MD

**AW: Peripheral Nerve Blocks: Ultrasound, Simulation and Stimulation**
Jacques E. Chelly, MD, PhD, MBA (faculty)

**PBLD: Is It Battery? Adolescent With Terminal Disease and an Emergent Difficult Airway**
Phillip S. Adams, DO; Doreen E. Soliman, MD

**PP: Adverse Outcomes Associated With Peripheral Nerve Blocks**
Vladyslav Melnyk, MD; Nicole Verdecchia, MD; Steven L. Orebaugh, MD

### Wednesday, October 26, 2016

**Point-Counterpoint: Intensivists Improve Outcomes and Reduce the Cost of Healthcare**
Stephen Esper, MD, MBA (moderator)

**60 Minute Refresher Course Lecture, The Myths of Plasma and Synthetic Colloid Use During Cardiac Surgery; Presentation: “Albumin”**
Jonathan H. Waters, MD

**PD: Intrapartum Pain Improvement Is a Predictor for Postpartum Depression: Labor Pain Matters**
Grace Lim, MD; Francesca Facco, MD, Lia Farrell, BS; Michael Gold, PhD; Ajay D. Wasan, MD

**PD: Racial and Ethnic Disparities in Pain During Childbirth**
Andrea J. Ibarra, MD; Grace Lim, MD

### National Representation

- **James G. Cain, MD, MBA, FAAP** - ASA House of Delegates; ASA Ad Hoc Committee on Access to Safe Pediatric Surgery; Pennsylvania Society of Anesthesiologists (PSA) Board of Directors
- **Thomas M. Challifoux, MD** - Society for Obstetric Anesthesia and Perinatology (SOAP) Education Committee
- **Franklyn P. Cladis, MD** - Society for Education in Anesthesia (SEA) Finance Committee; SEA Research Committee; Society for Pediatric Anesthesia (SPA) Board of Directors; SPA Education Committee
- **Zachary C. Cohen MD** - President, PSA Fellow & Resident Component; ASA House of Delegates
- **Patricia Dalby, MD** - SEA Membership Committee; SOAP Education Committee; SOAP International Outreach Committee; SOAP Membership Committee; SOAP OB Fellowship Committee
- **Peter J. Davis MD, FAAP** - Anesthesia Patient Safety Foundation Committee on Scientific Evaluation
- **Patrick J. Forte, MD** - SEA Resident Education Committee
- **Andrew Herlich, DMD, FAAP** - FAAP Committee on Ambulatory Surgical Care (adj.); ASA House of Delegates; ASA Liaison to the American Dental Association, the American Association of Oral and Maxillofacial Surgeons, and the American Dental Society of Anesthesiologists/American Society of Dentist Anesthesiologists; PSA President
- **Mark E. Hudson, MD, MBA** - ASA Committee on Practice Management; PSA Board of Directors; ASA House of Delegates (alternate delegate)
- **Grace Lim, MD** - SEA Simulation Committee; SOAP Education Committee
- **David G. Metro, MD** - ASA Abstract Review Subcommittee on Patient Safety and Practice Management; SEA Journal of Education in Perioperative Medicine Committee
- **William R. McVor, MD** - SEA Simulation Committee
- **Kristin Ondeckio Ligda, MD** - ASA Ad Hoc Committee on Women in Anesthesia; SEA Medical Student Education Committee; SEA Resident Education Committee; PSA Board of Directors, ASA House of Delegates (alternate delegate); PSA Alternate Delegate to PA Medical Society; Chairperson, PSA Physician Resources Committee
- **Jerome Parness, MD, PhD** - SPA Quality and Safety Committee; SPA Research Committee
- **Rita M. Patel, MD** - Foundation for Anesthesiology Education and Research Academy of Education Mentors in Anesthesiology
- **Raymond M. Planinsic, MD** - Society for the Advancement of Transplantation Anesthesiology (SATA) Board of Directors; SATA Fellowship Committee
- **Tetsuro Sakai, MD, PhD** - SATA Board of Directors; SATA Fellowship Committee; SEA Research Committee (Designee Chair and member)

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**MCC: Anesthetic Management of Labor and Intrapartum Cesarean Delivery in a Patient With Conversion Disorder**
Peter Yeh, MD; Kathleen O. Coy, MD; Elizabeth A. Ungerman, MD, MS; Grace Lim, MD

4:15-4:25 PM  Hall F1 Foyer
Monitor 12
EDUCATIONAL GRANT
A new Department of Anesthesiology Educational Grant program was established in FY17 under the direction of Drs. Metro and Sakai. Departmental funds were made available biannually to support new educational projects. This Educational Grant provides up to $8,000 (maximum amount per project), and is available for anesthesiology residents, fellows, and faculty, as well as medical students from the University of Pittsburgh School of Medicine. The purpose of the grant is to inspire and assist aspiring anesthesiology investigators who do not have current funding to start an educational project. Both curriculum development projects and research projects are eligible.

AMERICAN BOARD OF ANESTHESIOLOGY
Drs. Shawn Beaman, Franklyn Cladis, and Erin Sullivan are American Board of Anesthesiology (ABA) board examiners. ABA Examiners help establish and demonstrate the highest standards for board certification through their service. Individuals may be nominated by another ABA diplomate or may nominate themselves. They must possess valid, unexpired board certification in anesthesiology and actively participate in the Maintenance of Certification in Anesthesiology (MOCA) program. Examiners must spend, on average, at least one day per week in clinical practice.

These faculty are active participants in the semi-annual mock oral sessions, directed by Dr. Erin Sullivan, which are provided to anesthesiology residents, fellows, and faculty.

NATIONAL BOARD OF ECHOCARDIOGRAPHY
Many department clinical fellows, residents, faculty members, and alumni passed the National Board of Echocardiography basic perioperative transesophageal echocardiography (TEE) examination in FY17. Drs. Kathirvel Subramaniam, Michael Boisen, Theresa A. Gelzinis, and Stephen McHugh organized a department “TEE boot camp” to help residents and faculty prepare for the exam.

UNIVERSITY OF PITTSBURGH ACTIVITIES
The 62-member University of Pittsburgh School of Medicine Academy of Master Educators recognizes and rewards excellence in education, advances education through innovation and professional faculty development, and supports and promotes educational scholarship. Seven department faculty members are academy members: Drs. Steven Orebaugh, Michael Mangione, William McIvor, Rita Patel, Shawn T. Beaman, Tetsuro Sakai, and David Metro. Members of the academy must be involved in the education of medical students, graduate students, and/or residents for the duration of their appointment to the academy. These physicians were selected based upon their exceptional contributions to medical education.

EDUCATIONAL ACTIVITIES
Faculty members who hold committee positions in the Society for Education in Anesthesia include the following:

- K. Grace Lim, MD and William McIvor, MD – Simulation Committee
- Kristen Ondecho-Ligda, MD – Medical Student Education & Resident Education Committees
- Patrick Forte, MD – Resident Education Committee
- Patricia Dalby, MD – Membership Committee
- Tetsuro Sakai, MD, PhD – Designee, Research Committee Chair
- Franklyn Cladis, MD – Finance Committee
- David G. Metro, MD – Journal for Education in Perioperative Medicine Committee
- Scott Brancolini, MD, MPH President, American Academy of Pain Medicine
- David G. Metro, MD – President, University of Pittsburgh Medical Alumni Association (2015-2019)
- Rita M. Patel, MD - Continued as a member of the Institutional Review Committee of the ACGME, the review committee that accredits sponsoring institutions.
ANESTHESIOLOGY RESIDENCY PROGRAM

DAVID G. METRO, MD, Director

Under the leadership of Dr. David G. Metro, the UPMC Anesthesiology Residency Program remains fully-accredited by the Accreditation Council for Graduate Medical Education (ACGME) to provide training and education in anesthesiology leading to American Board of Anesthesiology (ABA) certification. Dr. David Nelson served as Chief Resident and Drs. Jessica Cassavaugh and Derek Lauter served as Associate Chief Residents for the 2016-2017 academic year.

In April 2012, the ACGME granted the maximum allowable 10-year accreditation to the Anesthesiology Residency Program, as well as continued 10-year accreditation to the fellowship programs in Pediatric Anesthesiology, Anesthesiology Critical Care Medicine, Adult Cardiothoracic Anesthesiology, and Pain Medicine. In February 2016, the Obstetric Anesthesiology Fellowship Program received a continued accreditation until July of 2022, which was the maximum allowable renewal.

The ACGME annually surveys all residents and core faculty as part of the accreditation process. Data obtained from this survey is used towards accreditation status and identifying areas in need of improvement for all programs. We are pleased to announce that in this year’s survey, 96% of residents and 100% of faculty rated the program as “positive” or “very positive” overall. In addition, the residents rated the program above the national average in all areas, including duty hours, faculty, evaluation, educational content, resources, and patient safety/teamwork.

Twenty residents completed the continuum of education in anesthesiology and graduated from the program in 2017 (a complete list with graduation plans is provided at the end of this section). As in previous years, academic year 2016-2017 was a period of excellence and innovation in education, as well as adaptation to the emergent and evolving changes that characterize contemporary graduate medical education.

CURRICULUM

The Curriculum Subcommittee, consisting of rotation directors at each site and co-chaired by Drs. Orebaugh and Gelzinis, further reviewed and developed the didactic and clinical curricula. This subcommittee annually updates the residents’ curricula, which outlines and describes important resident and faculty responsibilities, states a complete set of goals and objectives for each clinical rotation, and provides clearly-defined criteria for evaluation. Special lectures, presentations, and educational sessions were included in the curriculum on anesthesiology billing, practice management, ethics, patient care, and systems-based practice.

DIDACTIC PROGRAMS

The academic year was also notable for continued excellence in didactics. The committee coordinated core topics for post-graduate year (PGY)-1, PGY-2, PGY-3, and PGY-4 residents in seminar and lecture series formats. The lectures are cataloged online, allowing residents unlimited access and review. Fourth-year residents participated in a curriculum consisting of evidence-based medicine, case management, and oral board preparatory sessions. Under the continued direction of Dr. Theresa Gelzinis, case-management sessions are presented in American Society of Anesthesiology problem-based learning discussion format to facilitate active learning in small groups.

The educational program is augmented by weekly Grand Rounds under the direction of Dr. Charles Boucek, in which local speakers and visiting professors provide up-to-date reviews of relevant topics. A monthly Journal Club session was included in the Grand Rounds curriculum under the direction of Dr. Stephen McHugh. During these sessions, residents research and present important articles with the goals of increasing their understanding of scientific literature and sharpening their presentation skills.

An introductory program organized by Dr. Todd Oravitz consists of simulation sessions, one-on-one instruction in the operating room, and didactic teaching. Simulation exercises during the first week of PGY-2 training, under the direction of Dr. William McIvor, provide new residents with a safe and instructive setting in which to gain experience prior to their actual clinical work in the operating room. The introductory course culminates with a performance test held in the simulator prior to residents beginning work in the actual operating room.
REGIONAL ANESTHESIOLOGY ULTRASOUND
The Regional Anesthesia Ultrasound Lab is held the first week of the regional rotation each month. During this half-day activity, residents meet with rotation director Dr. Steven Orebaugh and spend an hour evaluating a previously dissected cadaver to gain an appreciation of the actual three-dimensional gross anatomy that is relevant for the most common sites of extremity and trunk peripheral nerve blockade. This session is followed by two to three hours of ultrasound scanning of a live model at the Peter M. Winter Institute for Simulation Education and Research (WISER), juxtaposed with projected gross anatomy and cross-sectional anatomy photos, to help residents develop an appreciation for the two-dimensional ultrasound images that will be generated at the bedside.

POINT OF CARE ULTRASOUND
Physician-performed ultrasonography at the point-of-care (POC) has become central to the practice of perioperative and critical care medicine. In 2016-17, the core residency program launched a new curriculum in POC ultrasonography complementing the extensive existing training residents receive in ultrasound for regional anesthesiology and central venous cannulation. The curriculum was developed by a task force of expert faculty led by Dr. Michael Boisen and consists of online learning modules with knowledge assessments followed by workshops in the fall and spring that utilize an ultrasound simulator and human model patients. Current modules include cardiac/transthoracic ultrasound and hemodynamic assessment, pulmonary ultrasound, abdominal ultrasound (FAST and gastric contents), and vascular ultrasound, including lower extremity deep vein thrombosis; plans for expansion include airway applications and optic sheath diameter for intracranial pressure.

INTERNATIONAL MISSION ROTATION
The ever-popular Advanced Pediatric Rotation with an international component provides a unique opportunity for PGY-4 residents to advance their knowledge of pediatric anesthesiology and prepare to become members of global medical outreach programs. International mission trip rotations allowed anesthesiology residents and faculty to supply medical care for populations in developing countries and prepared residents for functioning as valuable team members on international missions, stressing advanced planning, cultural sensitivity, and strict adherence to ASA standards of care.


During these mission trips, care ranging from cleft palate repair to general surgical needs was provided for patients ranging from infants to the elderly in collaboration with Surgicorps. The ability to participate in mission trips is only one of the attractive aspects of this residency program, as quoted by one of the residents.
ANESTHESIOLOGY RESIDENCY PROGRAM

DAVID G. METRO, MD, Director

UPMC ISMETT INTERNATIONAL ROTATION

The International Anesthesia Experience at the Mediterranea Institute for Transplantation & Advanced Specialized Therapies/Instituto Mediterraneo per i Trapianti e Terapie ad alta Specializzazione (ISMETT) (UPMC Palermo, Italy) for PGY-4 residents, under the direction of Filippo Giuseppe Sanfilippo, MD, PhD, EDIC, is designed to allow senior anesthesiology residents apply and refine their knowledge, enhance their judgment, and expand their skills in the practice of anesthesiology and critical care medicine at an international facility.

This two-month rotation takes place at the UPMC Palermo facility and is elective. During this rotation, residents can participate in the care of general surgery, cardiothoracic surgery, and solid organ transplant patients. Preoperative, intraoperative, and postoperative care are all be addressed during this rotation, which takes place both in the operating rooms and the critical care units. Clinical and didactic teaching are included throughout the rotation. English is the official language used at this facility.

SIMULATION TRAINING

Many educational sessions are conducted at WISER. These courses provide both didactic and hands-on experience in the management of problems that are uncommon, or common but clinically challenging. In simulation courses offered this past year, residents could sharpen their skills and build confidence in crisis leadership, fiberoptic endotracheal intubation, central venous cannulation, Advanced Cardiac Life Support, and difficult airway management. In addition, residents were given the opportunity to orient or receive additional training for subspecialty rotations in regional, obstetric, and liver transplantation anesthesiology.

MEDICAL STUDENT TEACHING

A standard requirement in the residents’ curricula is participation in at least one session of the Clinical Procedures Course sponsored by the University of Pittsburgh School of Medicine. This allows residents the opportunity to teach medical students in a traditional classroom setting, in addition to clinical teaching during the medical student clerkships and electives.

QUALITY INITIATIVES

Resident participation in patient safety and quality improvement initiatives increased this year. Dr. Daniel Mandell, Junior Chief of Patient Safety and Quality Improvement, spearheaded this initiative both departmentally and system-wide. Residents hold important roles in departmental, hospital, and system groups such as the Patient Safety and Quality Improvement Committee, which provides summary reports related to organizational performance and improvement, adverse events, regulatory encounters, and vulnerabilities and environmental safety; promotes housestaff education, engagement, and participation in quality and patient safety initiatives; and recommends priorities for quality and safety improvement, commissioning all improvement teams to address quality and safety vulnerabilities.

ABA BOARD EXAMINATION PREPARATION

Under the direction of Dr. Erin Sullivan, the PGY-2 and PGY-4 curriculum continues to include mock oral examination sessions proctored by department faculty members in the fall and spring of each year. Subspecialty rotations during the PGY-3 year also continue to include mock oral board examinations as part of the rotation.

In the 2016-17 year, for the fourth consecutive year, all graduating residents passed the ABA written boards on the first attempt. This passing rate is a clear indicator of the success of the educational programs and faculty members.
EVALUATION AND COMPETENCE
The Evaluation and Competence Subcommittee, chaired by Dr. James Ibinson, closely monitors resident educational progress and works to develop policies regarding resident responsibilities, resident incentives, and academic progress. This year, the subcommittee reviewed existing program policies and updated those necessary to keep current with ACGME requirements. The committee continued to work on strategies to improve resident performance on standardized exams, clinical performance, and professionalism. The committee continued their work on incorporating milestones into the residency program. In this process, objective data evaluating each resident in 25 different areas was collected and assessed.

PROGRAM REVIEW
The Program Review Subcommittee ensures that educational policies and procedures are in place, reviews program design and function, and collects and compiles an extensive amount of data regarding the program and the activities of faculty members and residents. This committee oversees the planning of the Annual Program Review. The entire residency program was reviewed in detail. The information gained and discussions that ensued are used to make improvements to the residency program annually.

PARRC
The Anesthesiology Residency Program attended the 11th annual Pennsylvania Anesthesiology Resident Research Conference (PARRC) on May 20, 2017, which was sponsored by Temple University, Lewis Katz School of Medicine. PARRC is an opportunity for residents and faculty to learn about current cutting edge research conducted by anesthesiology residents from all eight programs across the state of Pennsylvania. Both original research and case reports were submitted in both the oral presentation and poster categories, representing scholarly activities performed at each institution. UPMC was well-represented, with the following residents winning awards (winner names bolded).

First Place Award, Original Poster Presentation - David F. Nelson, MD, MBA; Robert Boretsky, MD; Trent Emerick, MD, MBA; Andrius Giedraitis, MD, MBA, MSE; Mark Hudson, MD, MBA: “Creating A System-Wide Operating Room Running Cap in a Large Multi-Hospital System”

Second Place Award, Original Poster Presentations - Joshua B. Knight, MD; Evan E. Lebovitz, MD; Ibtesam A. Hilmi, MB CHB; Theresa A. Gelzinis, MD: “Predictors of Unexpected Post-operative Intensive Care Unit Admission: A Retrospective Study”

Second Place Award, Original Oral Presentations - Richard Hubbard, MD; Grace Lim, MD, MS; David Seng, DO; Kamal Choudhury, MBBS: “Treatment Patterns for Respiratory Distress Syndrome in Low-Resource Settings: A Report from Bangladesh”

RESIDENT SCHOLARLY ACTIVITY
Resident scholarly activity is overseen by Dr. Tetsuro Sakai, Director of Resident Research. An ACGME program requirement mandates that residents complete an academic assignment prior to the completion of their training. This assignment may include “grand rounds presentations, preparation and publication of review articles, book chapters, manuals for teaching or clinical practice, or similar academic activities.” Additionally, a resident may
elect to participate in either clinical or laboratory research, the outcomes of which are expected to be suitable for presentation at the local, regional, or national level. In addition to departmental recognition, several residents received accolades for their scholarly activity in a variety of forums. Residents made the following presentations at regional, national, and international meetings:

<table>
<thead>
<tr>
<th>PGY-4 Authors</th>
<th>Title</th>
<th>Meeting</th>
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<tbody>
<tr>
<td>Jessica Cassavaugh</td>
<td>Cerebral Vascular Thrombospondin-1 Associates with the Epsilon 4 Allele of Apolipoprotein E in Clinical Alzheimer's Disease</td>
<td>Association of University Anesthesiologists 2017</td>
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<tr>
<td>Youngeun Cho</td>
<td>Preliminary Evaluation of Keyword Database as a Tool to Improve Performance of Pain Medicine Fellows on In-Training-Examination</td>
<td>Pain Medicine Meeting 2017</td>
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<tr>
<td>Melanie Hodge</td>
<td>Management of a Patient with Pallister-Hall Syndrome and a History of Difficult Intubation</td>
<td>PARRC 2017</td>
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<tr>
<td>Richard Hubbard</td>
<td>Treatment Patterns for Respiratory Distress Syndrome in Low-Resource Settings: A Report from Bangladesh</td>
<td>International Anesthesia Research Society (IARS) 2017</td>
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<td>Richard Hubbard</td>
<td>Teaching Anatomy to Pre-Clinical Medical Students Using Multi-modal Instruction: A Pilot Study</td>
<td>PARRC 2017</td>
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<td>Joshua Knight</td>
<td>Placement of Endovascular Stent for Thoracic Aortic Thrombus Exclusion Guided by Transesophageal Echocardiography</td>
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<td>ASA Practice Management Conference 2017</td>
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<tr>
<td>David Nelson</td>
<td>Anesthesia Labor Costs at Different Hospitals Within a Large, Multi-Hospital Health System</td>
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<td>Dan Sandusky</td>
<td>Will Increased Fibromyalgia Criteria Scores Correlated with Increased Opioid Consumption? A Prospective Cohort Study</td>
<td>PARRC 2017</td>
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<tr>
<td>Dan Sandusky</td>
<td>IV Ketamine for Treatment of Refractory Complex Regional Pain Syndrome</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Lindsay Stollings</td>
<td>Isoflurane Effects on Pro-Inflammatory Interleukin-23 Activity in Mice</td>
<td>PARRC 2017</td>
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<thead>
<tr>
<th>PGY-3 Authors</th>
<th>Title</th>
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<tbody>
<tr>
<td>Kelsey Bauer</td>
<td>Not your average Lap Chole</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Ian Brotman</td>
<td>Parasternal Nerve Block Catheters in a Critically III Patient with Anterior and Sternal Rib Fractures</td>
<td>Regional Anesthesiology and Acute Pain Medicine Meeting (ASRA) 2017</td>
</tr>
<tr>
<td>Ian Brotman</td>
<td>The Effects of Isoflurane and Fentanyl on Biomarkers of Neurological Injury in Neonatal Rats</td>
<td>IARS 2017</td>
</tr>
<tr>
<td>Anna Carpenter</td>
<td>Awake Fiberoptic Intubation in Patient with Congenital Airway Abnormalities, Subglottic Stenosis, and Recent Tracheal Resection Complicated by Wound Dehiscence</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Author</td>
<td>Title</td>
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<tr>
<td>Kathleen Coy</td>
<td>Ketamine Infusion and Paravertebral Nerve Block Catheters as Key Components of Multimodal Analgesia in a Patient for Exploratory Laparotomy</td>
<td>ASA 2016</td>
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<tr>
<td>Kathleen Coy</td>
<td>Anesthetic Management of Labor and Intrapartum Cesarean Delivery in a Patient with Conversion Disorder</td>
<td>ASA 2016</td>
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<tr>
<td>Diana DeAndrade</td>
<td>Intraoperative Takotsubo (Stress) Cardiomyopathy During Elective Complex Spine Surgery</td>
<td>ASA 2016</td>
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<tr>
<td>Diana DeAndrade</td>
<td>Surgical Repair of an Isolated Parachute-like Asymmetric Mitral Valve (PLAMV) Defect in an Adult</td>
<td>Society of Cardiovascular Anesthesiologists (SCA) 2017</td>
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<tr>
<td>Diana DeAndrade</td>
<td>Factors Associated with Increased Composite Morbidity Following Adult Orthotropic Heart Transplantation</td>
<td>SCA 2017</td>
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<tr>
<td>Diana DeAndrade</td>
<td>Factors Associated with Improved Quality of Hemostasis Following Adult Heart Transplantation</td>
<td>SCA 2017</td>
</tr>
<tr>
<td>Alex Dressler</td>
<td>Peripheral Nerve Blockade as Perioperative Anesthetic and Pain Management of Patient with Severe Aortic Stenosis for Charcot Foot Reconstruction</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Alex Dressler</td>
<td>Intraoperative Rhabdomyolysis and Myoglobinuria in Prolonged Multistage Spinal Procedure</td>
<td>ASA 2016</td>
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<tr>
<td>Andrius Giedraitis</td>
<td>Insanity on the Labor Unit: Schizophrenia and Ethical Dilemmas</td>
<td>ASA 2016</td>
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<tr>
<td>Andrius Giedraitis</td>
<td>Anesthesia Labor Costs at Different Hospitals Within a Large, Multi-Hospital Health System</td>
<td>ASA Practice Management Conference 2017</td>
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<tr>
<td>Dan Mandell</td>
<td>Institutional Tissue Plasminogen Activator Policy for Intraoperative Pulmonary Thromboembolism during Liver Transplant</td>
<td>ASA 2016</td>
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<tr>
<td>Vladyslav Melnyk</td>
<td>Adverse Outcomes Associated with Peripheral Nerve Blocks</td>
<td>ASA 2016</td>
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<tr>
<td>Vladyslav Melnyk</td>
<td>Complex Considerations in Anesthetic Management of Patients with Osteogenesis Imperfecta</td>
<td>ASA 2016</td>
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<td>Vladyslav Melnyk</td>
<td>The Physical Relationship of the Sciatic Nerve and its Paraneural Sheath</td>
<td>New York School of Regional Anesthesia (NYSORA) Symposium on Regional Anesthesia, Pain, and Perioperative Medicine, 2016</td>
</tr>
<tr>
<td>Kaarin Michaelsen</td>
<td>Teaching Medical Students Anatomy for Regional Anesthesia Using Multi-Modal Instruction</td>
<td>ASA 2016, PARRC 2017</td>
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<tr>
<td>Kaarin Michaelsen</td>
<td>Extensive Bleeding During Routine Oral Surgery in a Patient with Type 2B Von Willebrand's Disease</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Eugene Raggi</td>
<td>Lung Isolation for Video-Assisted Thoracoscopic Surgery (VATS) in a Patient with a Total Laryngectomy by Use of an Endobronchial Blocker Via a Tracheostomy Tube</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Eugene Raggi</td>
<td>Dexmedetomidine in the Perioperative Pain Management of a Patient with Huntington's Disease</td>
<td>ASA 2016</td>
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<tr>
<td>Lieu Tran</td>
<td>Post-Extubation Airway Emergency in a Patient after Posterior Cervical Spine Surgery</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Lieu Tran</td>
<td>Intravenous Remifentanil Infusion for Labor and Delivery in a Patient with Failed Neuraxial Technique</td>
<td>ASA 2016</td>
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<tr>
<td>Elizabeth Ungerman</td>
<td>Get Stabbed in the Back by a Difficult Airway</td>
<td>ASA 2016</td>
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<tr>
<td>Elizabeth Ungerman</td>
<td>Acute Dystonic Reaction Possibly Induced by Ondansetron</td>
<td>ASA 2016</td>
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<tr>
<td>Elizabeth Ungerman</td>
<td>Ur-ine Trouble: Cloudy with a Chance of Uric Acid</td>
<td>ASA 2016</td>
</tr>
<tr>
<td>Elizabeth Ungerman</td>
<td>Acute Aortitis and Associated Mycotic Aneurysm After Recent Endovascular Repair</td>
<td>SCA 2017</td>
</tr>
<tr>
<td>Elizabeth Ungerman</td>
<td>Mindfulness and Burnout in Junior Anesthesiology Trainees</td>
<td>Society of Education in Anesthesia (SEA) 2017</td>
</tr>
</tbody>
</table>
A system-based practice project is required of every PGY-4 resident. This project consists of identifying a system-wide problem/issue, addressing it by conducting appropriate research, and presenting an executive summary to the department’s site chiefs and key faculty upon completion. These projects represent complete investigations and potential solutions to departmental and system-wide clinical issues.

Senior resident system-based practice projects were under the direction of Dr. Rita M. Patel since 1996. Dr. Patel provided the senior residents with two didactics sessions, introducing them to the process and formulation of a system-based practice project.

This year’s graduating residents presented the following projects under the direction and guidance of Dr. Andrew Herlich, who provided direction and guidance during the project formulation process, provided oversight, and moderated the residents’ presentations to the faculty.

<table>
<thead>
<tr>
<th>Name</th>
<th>Project</th>
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<tbody>
<tr>
<td>Bryce Bernard</td>
<td>Prevention of Blood Product Waste</td>
</tr>
<tr>
<td>Jessica Cassavaugh</td>
<td>Intraoperative Glucose Monitoring to Reduce Post-operative Complications</td>
</tr>
<tr>
<td>Youngeon Cho</td>
<td>Improving Continuity of Care: Management of Anesthetic Complications</td>
</tr>
<tr>
<td>Zach Cohen</td>
<td>OR Time Management</td>
</tr>
<tr>
<td>Courtney Garbee</td>
<td>Montefiore Hospital Operating Room Oxygen E-Cylinder Supply Quality Improvement Recommendation</td>
</tr>
<tr>
<td>Melanie Hodge</td>
<td>Systematic Implementation of Practices to Decrease a Never Event: Central Line Guidewire Retention</td>
</tr>
<tr>
<td>Richard Hubbard</td>
<td>Optimizing Waste Disposal in the Operating Room Setting: A Quality Improvement Project</td>
</tr>
<tr>
<td>Andrew Hulme</td>
<td>Sugammadex: Moving Forward in Reversal</td>
</tr>
<tr>
<td>Josh Knight</td>
<td>Expanding Informed Consent to Anesthesia</td>
</tr>
</tbody>
</table>
### SIMULATION EDUCATION for Residents

Simulation education is an indispensable method used in resident clinical education. All anesthesiology simulation training takes place at the Peter M. Winter Institute for Simulation, Education, and Research (WISER), 230 McKee Place Suite 300, 3rd Floor Pittsburgh, PA 15213. WISER is a University of Pittsburgh institute with a mission to conduct research and training programs utilizing simulation-based education to provide a safer environment for patients of UPMC and its affiliates.

#### COURSES

**ADVANCED CARDIAC LIFE SUPPORT (ACLS) (all residents)**

*Director: Theresa A. Gelzinis, MD*

Traditional ACLS course taught by instructor. Specific content for anesthesiology residents.

**CENTRAL VENOUS CANNULATION TRAINING (PGY-1 and PGY-2)**

*Director: Ryan C. Romeo, MD*

Course content focuses on proper central line placement, including the use of ultrasound guidance and manometry for locating and verifying venous access sites. The course includes a web-based multimedia didactic emphasizing patterns of injury, site anatomy, central venous catheter indications and alternatives, as well as complication recognition and corrective maneuvers. A hands-on practical component is then undertaken at WISER using partial task trainers to develop psychomotor skills for the placement of internal jugular, subclavian, and femoral lines. A strong focus is placed on ultrasound use and sterile techniques. Patient safety is emphasized at every opportunity.

**INTRODUCTION TO ANESTHESIOLOGY SIMULATION (PGY-2)**

*Directors: William R. McIvor, MD, FASA; David G. Metro, MD, FASA*

This course uses high-fidelity human patient simulation to help students develop the skills necessary for their first day of clinical care. Students practice airway management skills (facemask ventilation and endotracheal intubation via direct laryngoscopy), rehearse intravenous inductions of GET, establish maintenance anesthesia, and manage emergences. They also practice operating room set up, anesthesia machine check, and post-anesthesia care unit transport and admission. Prior to completing the course, participants perform a simulation that encompasses all the aforementioned aspects of anesthetic care.

**DIFFICULT AIRWAY MANAGEMENT (PGY-2)**

*Directors: Joseph J. Quinlan, MD; Shawn T. Beaman, MD*

All anesthesiology residents and fellows participate yearly in this simulation and Intranet-based training to develop a working knowledge of the American Society of Anesthesiologists (ASA) guidelines for approach to the difficult airway.
BASIC CRISIS RESOURCE MANAGEMENT (PGY-2)
Directors: Miriam Cremer, MD, MPH; William R. McIvor, MD, FASA
The goal of this course for participants to develop skills associated with the initial approach to common changes in the physiological status of patients receiving general anesthesia. Topics include an introduction to crisis resource management principles and basic first approaches to hypotension, hypertension, hypoxia, tachycardia, bradycardia, hypocarbia, and hypercarbia.

POCUS (Point of Care Ultrasound) (PGY-2)
Directors: Marek A. Radomski, DO, FACEP, RDMS; Christopher Schott, MD, MS
This rotation introduces trainees to the use of POCUS over four weeks. Students are exposed to the use of focused POCUS to make bedside clinical decisions for the care of acutely ill patients. POCUS is one of the most rapidly growing skills in contemporary medicine. It has spread from specific use in cardiology, obstetrics, and radiology to broader applications for virtually any organ system or procedural guidance.

PERIOPERATIVE ULTRASOUND WORKSHOP (PGY-2)
Director: Michael Boisen, MD
This course is designed to provide POCUS mini-lectures and skill stations covering the lungs/pleurae, cardiac ultrasound, abdominal/focused assessment with sonography for trauma, vascular ultrasound, and deep vein thrombosis to anesthesiology residents.

NEURAXIAL INTRODUCTORY WORKSHOP
Directors: Robert Krohner, DO; Kristin M. Ondecko Ligda, MD, FASA
This introductory workshop covers neuraxial anesthesia topics.

ANESTHESIA CRISIS LEADERSHIP TRAINING (PGY-2 through PGY-4)
Directors: Thomas M. Chalifoux, MD; Joseph S. Goode Jr., MSN, CRNA; William R. McIvor, MD, FASA
All anesthesiology residents, fellows, and nurse anesthesia students participate yearly in this simulation and Intranet-based training to develop an understanding of potential medical errors and practice crisis-management skills.

FIBEROPTIC BRONCHOSCOPY (PGY-2 through PGY-4)
Director: Stephen M. McHugh, MD
All anesthesiology residents and fellows participate yearly in this simulation and web-based training to develop basic and advanced skills in fiberoptic bronchoscopy.

ADVANCED DIFFICULT AIRWAY MANAGEMENT (PGY-3 through PGY-4)
Directors: Shawn T. Beaman, MD; Joseph J. Quinlan, MD
This course teaches advanced concepts in the application of the ASA Difficult Airway Management algorithm.

ANESTHESIA FOR LIVER TRANSPLANTATION (PGY-4)
Directors: Charles D. Boucek, MD; Ibtesam A. Hilmi, MB, CHB, FRCA
The Department of Anesthesiology offers this six- to eight-hour course at WISER for anesthesiologist, residents, CRNAs, SRNAs, and fellow-visitors. This hands-on experience gives trainees the chance to provide anesthesia for orthotopic liver transplantation (LTX) in a simulation setting. The course is conducted by individuals with a special interest and experience in LTX anesthesia and emphasizes a multidisciplinary team approach that includes:

- Pre-operative assessment
- Operating room set up
- Placement of central venous access and insertion of wide bore venous lines for infusion of large volume
- Invasive monitoring
- Management of massive blood transfusion, coagulopathy, metabolic abnormalities, physiological hemostatic variables
- Special emphasis on veno-venous bypass issues

The course is conducted in the format of the most commonly seen clinical scenarios. After the end of each scenario, the instructor conducts debriefing and the whole episode is discussed in detail with the aid of video recording that is monitored during the performance. Attendees are given and expected to review reading materials prior to the course. A written test (multiple choice) is given before and after the course. Upon completing the course, attendees should understand perioperative management of LTX patients and be comfortable with invasive monitoring, assembling and using the rapid infusion system, thrombelastography interpretation, and management of massive blood loss and physiological hemostasis.
RESIDENCY PROGRAM - Clinical Base Year (PGY-1)

HISTORY
The UPMC Anesthesiology Residency Program first offered a clinical base year (CBY) program during the 2005-2006 academic year. Previously, the program had only offered advanced positions to residents after completing an internship in another department or program. Although many residency programs offer post-graduate year (PGY)-1 training spots, our department was one of the first of our peer programs to integrate a PGY-1 year curriculum within anesthesiology. The CBY program was designed for the 2005-2006 academic year by Drs. John P. Williams (former Chair, Department of Anesthesiology), Rita M. Patel (then Anesthesiology Residency Program Director and Vice Chair for Education), David G. Metro (then Associate Anesthesiology Residency Program Director), Joseph DeRenzo (department faculty member and inaugural director of the CBY program), and Shawn T. Beaman (Anesthesiology Chief Resident in 2005-2006).

The first CBY class of six highly competitive interns completed rotations in acute pain, anesthesiology, critical care medicine (two months), emergency medicine (one month adult and one month pediatric), internal medicine (two months, inpatient floors), preoperative evaluation clinic, and general surgery (two months). This initial curriculum also allowed an elective month. Dr. Beaman served as director of the CBY program from 2006 until 2016 and strongly shaped it into its current dynamic training experience.

PRESENT PROGRAM
Currently, 17 PGY-1 residents match into our CBY program each year. Mostly based at UPMC Presbyterian and UPMC Montefiore, all our interns now complete rotations in the following areas:

- Acute pain
- Anesthesiology
- Anesthesiology professional practice
- Cardiology consultation
- Cardiovascular ICU at UPMC Mercy
- Emergency medicine
- Head and neck surgery
- Internal medicine
- Medical ICU
- Pediatric emergency medicine at Children’s Hospital of Pittsburgh of UPMC
- Transfusion medicine at Magee-Womens Hospital of UPMC

Some representative clinical experiences that make our CBY program unique include the opportunity to surgically create and manage tracheostomies, discuss blood therapy with hematology experts, and care for both adult and pediatric medical and surgical patients across a wide variety of care settings and acuities. Residents finish the CBY year well-prepared to care for patients as they begin their advanced clinical anesthesiology training.

This breadth of clinical training would not be possible without the contributions of many excellent physician educators. We are thankful to the many faculty within and outside our department who helped develop these rotations and continually provide excellent educational experiences for the CBY program. The CBY residents also have their own monthly didactic series that include faculty lectures as well as peer-education, as they each give a clinical presentation to their classmates.

The non-clinical opportunities provided as part of the CBY year are unparalleled in other anesthesiology training programs. First, the Anesthesiology Professional Practice rotation covers a broad spectrum of topics relevant to anesthesiology and the practice of medicine in general. As part of this rotation, all CBY residents are afforded the opportunity to attend the American Society of Anesthesiologists Annual Meeting in October. Finally, many CBY residents become active members of our department, often engaging in educational, quality improvement, or research projects. Opportunities for independent conference presentations and publications are not uncommon during the CBY year, and these endeavors are fully supported.
The Anesthesiology Professional Practice (APP) rotation for our clinical base year (PGY-1) residents was created in 2014, thanks to the vision and hard work of many in the residency program leadership. Since its inception, this dedicated one-month non-clinical rotation has grown stronger each year. During the APP rotation, our new physician trainees come together as a class and learn about many broad issues surrounding the modern practice of anesthesiology and medicine. A complete listing of sessions is too long to include, but the didactic sessions center around content areas including the following:

- Research techniques and statistical methods
- Evidence-based medicine
- Authorship and publication
- Professional and licensure issues
- Leadership and mentorship
- Operation room management
- Quality improvement
- Patient safety
- Litigation involving medical practice
- Medical education
- Business of medicine
- Coping with patient complications
- Technology transfer
- Environmental impact of medical practice
- Resident wellness

The APP rotation also allows the interns to experience interactive sessions that intersect with these topic areas in which they hone their presentation skills, expand their computer knowledge, and shadow the charge anesthesiologist at UPMC Presbyterian. Along the way, each of them learns insightful things about themselves and how they interact with others while bonding as a residency class.

Last but not least, the APP rotation culminates with opportunity for the entire class to attend the American Society of Anesthesiologists annual meeting. This mentored conference experience gives them broad exposure to the issues facing anesthesiologists nationally and allows them to explore in-depth their interests from the topics above covered in the rotation curriculum.

This unique rotation is a highlight of our residency training program. The APP experience lays a strong foundation for our residents’ subsequent clinical anesthesiology training and is extremely well-liked by the residents that have completed it. Our goal in providing this early exposure to these important topics is that we position each of our residents to become leaders in their future practices, regardless of what that setting ultimately becomes. We also hope to inspire them to be consummate physician professionals whose contributions to our specialty extend beyond providing clinical care.
The Resident Recruitment and Selection Committee is responsible for all aspects of resident selection. The 2017 interview season started in September with the opening of the Electronic Residency Application Service (ERAS). This is a service of the Association of American Medical Colleges that allows applicants to prepare their applications and then apply to multiple programs. In FY17, 1,096 ERAS candidates applied for 21 positions; 17 categorical, three advanced, and one combined anesthesiology-pediatrics. After the initial screening, applicants were offered interview spots with a target of approximately 16 applicants per interview day. Twelve interview days were conducted from mid-October through late January. One of the days was reserved for applicants with a strong interest or background in research. Applicants were invited to an informal gathering of current residents the night before the interview. A casual atmosphere allowed applicants to meet all resident attendees and ask pointed questions about the program. The interview days started with a detailed overview of the residency program, including information about didactics, clinical experience, research opportunities, and clinical sites. The applicants were then welcomed by the Chair and the day was split into two interview sessions. Half of the candidates were interviewed in the morning by the Program Director, Associate Program Director, Chair of the Selection Committee, and two other attendings, while the other half were given a tour of UPMC Presbyterian and Montefiore. After a lunch attended by current residents, the groups were switched in the afternoon. In FY17, 197 applicants were interviewed for the 21 positions. After the final interview day, the entire Resident Education Committee met to review and assign a numerical score to each applicant. All committee members and current residents in attendance were voting members in the process. A final rank list was then prepared and submitted to the National Residency Matching Program. The process culminated with Match Day on March 17, 2017.

Our submitted rank list contained 194 applicants. As in past years, after the match, surveys were sent to the top 100 applicants who did not match with UPMC, asking them to compare multiple aspects of our program to the program they ultimately matched into. The information gained from these surveys helps the committee make changes to the interview process and perhaps changes to the program itself.

**2017 MATCH RESULTS**

**Categorical Four-year Positions**
- Leath Abdullah, MD, Drexel University College of Medicine
- Dustin Elswick, MD, Marshall University Joan C. Edwards School of Medicine
- Melissa Giraldo Duque, MD, Pontificia Universidad Javeriana Bogotá Facultad de Medicina
- Samuel Goldstein, MD, Sidney Kimmel Medical College at Thomas Jefferson University
- Maria Hernandez, MD, Universidad de la República Facultad de Medicina
- Daniel Huettner, MD, Drexel University College of Medicine
- George Karam, MD, West Virginia University School of Medicine
- Andrew McNicol, MD, Northeast Ohio Medical University
- Christopher McNulty, MD, Sidney Kimmel Medical College at Thomas Jefferson University
- Christian Molzahn, MD, University of Cincinnati College of Medicine
- Kylie Muraski, MD, The University of Toledo College of Medicine

**Advanced Three-year Positions**
- Jose Cabrera, MD, Florida International University
- Sergio Hickey, MD, University of Pittsburgh School of Medicine
- Juan Rango, MD, Michigan State University College of Human Medicine

**Combined Anesthesiology/Pediatrics**
- Constantin Robles, MD, University of Texas School of Medicine at San Antonio
- Neal Shah, MD, Saint Louis University School of Medicine
- Aisha Ullah, MD, West Virginia University School of Medicine
- David Wen Rui Wang, MD, Harvard Medical School
- Michelle Yanik, MD, The Brody School of Medicine at East Carolina University
- Edgar Zamora, MD, The Brody School of Medicine at East Carolina University

**Combined Anesthesiology/Pediatrics**
- Lilinete Polsunas, MD, University of Pittsburgh School of Medicine
2016-2017Residents

**PGY-1**

Douglas Adams, MD  
Daniel Bintrim, MD  
Anusari Dewasurendra, MD  
Luke Doney, DO  
Michael Gemma, MD  
Lindsay Hahn, MD, Med

Maciej Klosowski, MD  
Sofiane Lazar, MD  
Donald Miller, MD  
Kelsey Mitchell, MD, MPH  
Claudia Mulock, MD  
Kevin Pardo, MD

Kate Petty, MD  
Tyler Smith, MD  
Michael Sypert, DO

**PGY-2**

Jonah Abraham, MD  
Marshall Bahr, MD  
Steven Bartels, MD  
Philip Carullo, MD  
Luke Davanzo, MD  
Nathan Hoaglund, MD

Hayden Hundley, MD MPH  
Andrea Ibarra, MD  
Brandy Johnson, MD  
Patrick Kennedy, MD  
Evan Lebovitz, MD  
Eric Magda, MD
### GRADUATING RESIDENTS - JUNE 2017

<table>
<thead>
<tr>
<th>Name</th>
<th>Post-grad Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryce Bernard, MD</td>
<td>Faculty, UPMC</td>
</tr>
<tr>
<td>Jessica Cassavaugh, MD, PhD Associate Chief Resident</td>
<td>Anesthesiology Critical Care Medicine (CCM) Fellowship, UPMC</td>
</tr>
<tr>
<td>Youngeun Cho, MD</td>
<td>Pain Medicine Fellowship, UPMC</td>
</tr>
<tr>
<td>Zachary Cohen, MD</td>
<td>Chronic/Interventional Pain Medicine, University of California San Diego</td>
</tr>
<tr>
<td>Courtney Garbee, DO</td>
<td>Pediatric Anesthesiology Fellowship, University of North Carolina (UNC)</td>
</tr>
<tr>
<td>Melanie Hodge, MD</td>
<td>Pediatric Anesthesiology Fellowship, Children’s Hospital of Pittsburgh of UPMC</td>
</tr>
<tr>
<td>Richard Hubbard, MD</td>
<td>Pediatric Fellowship, Nationwide Children’s, Columbus, OH</td>
</tr>
<tr>
<td>Andrew Hulme, MD</td>
<td>Regional/Acute Pain Fellowship, UNC</td>
</tr>
<tr>
<td>Joshua Knight, MD</td>
<td>Adult Cardiothoracic Anesthesiology Cardiac Fellowship, Cleveland Clinic</td>
</tr>
<tr>
<td>Derek Lauter, MD</td>
<td>Adult Cardiothoracic Anesthesiology Fellowship, Hospital of the University of Pennsylvania</td>
</tr>
<tr>
<td>David Nelson, MD, MBA</td>
<td>½ OR Management Fellowship, ½ Faculty at Jefferson University Hospital, Philadelphia, PA</td>
</tr>
<tr>
<td>Lauren Parker, MD</td>
<td>Anesthesia Associates of Lancaster (private practice)</td>
</tr>
</tbody>
</table>
### Name | Post-grad Employment
---|---
Rachel Pool, MD | Anesthesiology CCM Fellowship, UPMC
Daniel Ripepi, MD | Excela Health, Westmoreland Hospital
Daniel Sandusky, MD | Pain Medicine Fellowship, UPMC
Brenda Satterthwaite, MD | Pediatric Fellowship, Children’s National Hospital Network, Washington DC

### Name | Post-grad Employment
---|---
Meghan Saxen, MD | Chronic Pain Fellowship, Cleveland Clinic
Lindsay Stollings, MD | Pediatric Fellowship, Children’s National Hospital Network, Washington DC
Michael Thompson, DO | ACV Anesthesia, Roanoke Virginia, Carilion Clinic Hospital
Peter Yeh, MD | Obstetric Fellowship, UCSF

### 2017-2018 INCOMING RESIDENTS

**PGY-1**
- Leath Abdullah, MD
- Dustin S. Elswick, MD
- Melissa Giraldo Duque, MD
- Samuel J. Goldstein, MD
- Maria A. Hernandez Malaquina, MD
- Daniel P. Huetter, MD
- George J. Karam, MD
- Andrew J. McNicol, MD
- Christopher A. McNulty, MD

**PGY-1**
- Christian M. Molzahn, MD
- Kyle V. Muraski, MD
- Lilinete Polsunas, MD
- Constantin N. Robles, MD
- Neal Shah, MD
- Aisha P. Ullah, MD
- David Wang, MD
- Michell A. Yanik, MD
- Edgar Zamora, MD

**PGY-2**
- Sean McDermott, MD
- Annie Xu, MD
RESIDENT LEADERSHIP, 2016-2017

Chief Positions
David F. Nelson, MD, MBA - Chief Resident
David entered our program from the University of Kentucky College of Medicine. In his PGY-3 year he served as one of the junior chief residents for recruitment. He authored or coauthored 10 ASA Practice Management Conference presentations, winning four awards for his work. David is also the drummer for the resident band “Bropofol.” After graduation, he will pursue a fellowship in perioperative management and practice anesthesia as a junior faculty member at Thomas Jefferson University Hospital in Philadelphia, PA.

Jessica Cassavaugh, MD, PhD - Associate Chief Resident
Jessica entered our program from the University of Vermont College of Medicine. In her PGY-3 year, she worked tirelessly as a junior chief for scholarly activity. She presented basic science research abstracts at several national conferences, including IARS and AUA, and served as the resident member on the Clinical Competency Committee. Upon graduation, Jessica will pursue a critical care fellowship at UPMC.

Derek Lauter, MD - Associate Chief Resident
Derek entered our program from Jefferson Medical College. In his PGY-3 year he served as a Junior Chief for Patient Safety and Quality Improvement (QI). He has a national presentation to his credit and has been heavily involved with patient safety as one of the members of the department’s Resident Patient Safety Committee and UPMC Presbyterian’s QI committee. Upon graduation, Derek will pursue an adult cardiothoracic anesthesiology fellowship at the University of Pennsylvania in Philadelphia, PA.

Junior Chief Positions
Advocacy: Elizabeth Ungerman, MD
Elizabeth coordinated resident involvement in professional society and physician advocacy conferences, events, and activities. She was instrumental in organizing a very successful charity event that raised money for the pediatric burn unit at UPMC Mercy. She regularly updated residents on active political issues and coordinated resident efforts in communicating with government officials.

Education: Kaarin Michaelsen, MD, PhD; Geno Raggi, MD; and Daniel Springer, MD
Kaarin, Geno, and Daniel worked to improve clinical teaching, didactics, and other aspects of resident education. They constructed and distributed case scenarios to demonstrate clinical teaching points for young residents, worked to improve lecture/PBLD content, re-vamped rotation goals/objectives, and were involved in keyword-driven curriculum design. They participated regularly in the Resident Education Committee and Curriculum Subcommittee and collected input from residents for improvements to education.

Journal Club & Grand Rounds: Kathleen Coy, MD and Vladyslav Melnyk, MD
Kathleen and Vlad coordinated monthly journal club sessions, including assigning residents to groups, assisting residents in choosing and analyzing articles, and developing their presentations. In addition, they expanded the position to include presentations by them to educate the group on statistical methods relevant to the topic. They also coordinated resident Grand Rounds practice presentation sessions prior to major conferences and assisted the grand rounds faculty coordinator with invited speakers as needed.

Patient Safety/Quality Improvement: Sara Straesser, MD and Daniel Mandell, MD
Sara and Dan worked throughout the year as integral members of the UPMC Presbyterian Anesthesiology QI Committee and reviewed difficult airway calls at UPMC Presbyterian and Montefiore. They additionally served on the hospital-wide QI committee at Magee-Womens Hospital of UPMC. A new role for the junior QI chiefs this year was planning the quarterly Residency Patient Safety Committee meetings with Dr. Metro.

Recruitment: Diana DeAndrade, MD; Alex Dressler, MD; and Nicole Verdecchia, MD
Diana, Alex, and Nicole planned and coordinated all aspects of 12 unique pre-interview recruitment dinners during the 2016-17 resident recruitment season. They managed correspondence with applicants and coordinated logistics among current resident volunteers and potential residents, as well as helped plan interview days.

Scholarly Activity (Research): Ezeldeen Abuelkasem, MB, MSc and Andrius Giedraitis, MD, MBA
Ez and Dre coordinated resident research and other scholarly activity. They facilitated matching faculty and residents to work on projects of mutual interest including research projects, case reports, and book chapters. They coordinated participation in the resident research rotation and presentation of resident work at conferences. Ez and Dre also coordinated the Resident Poster Review Committee.

Committee Representatives
- System-Wide QI: Derek Lauter, MD
- Compensation and Benefits Subcommittee: David Nelson, MD, MBA
- PSA Resident House of Delegates President: Zachary Cohen, MD
RESIDENT SCHOLARLY ACTIVITY

TETSURO SAKAI, MD, PHD, MHA, FASA
Director, Resident Research Rotation; Director, Scholarly Development

The UPMC Anesthesiology Residency Program Class of 2017 (19 residents) engaged in many scholarly activities during their training. Of note, 11 residents elected to do a one to three month research rotation in their senior year to augment and complete scholarly activities: Jessica Cassavaugh, MD, PhD; Youngeun Cho, MD; Meghan Cohen, MD; Courtney Garbee, DO; Melanie Hodge, MD; Richard Hubbard, MD; Joshua Knight, MD; David Nelson, MD, MBA; Rachel Pool, MD; Daniel Sandusky, MD; and Lindsay Stollings, MD. Dr. Hubbard spent two research rotation weeks in Bangladesh to collect clinical data for a study. This marked the first time our residency program provided the opportunity for a resident to oversee such a research project.

All scholarly activity products reported to the ACGME were reviewed. Scholarly activities by residents based on work prior to entering our residency program were excluded. Also, intramural presentations (e.g. lectures, morbidity and mortality rounds presentations, journal club presentations) were excluded. Abstract presentations from the same study but at different conferences were counted independently. Works authored by multiple residents were counted independently.

89 total scholarly products (4.7 products per resident, range 0 – 12)

- 17 peer-reviewed publications
  - 8 original articles
  - 4 reviews
  - 5 case reports
  - 13 articles first-authored by residents
- Abstracts:
  - 56 total presentations (25 original studies and 31 case reports)
  - 42 national/international meetings and 14 state-level meetings
- Two book chapters
- 16 IRB-approved study protocols
- One other publication (society bulletin)

Peer reviewed Publications Authored by the Class of 2017 (resident author names bolded)


The academic year kicked off with a Welcome Picnic at the home of Drs. Howard Gutstein and Jill Schumacher on July 9, 2016.

Our annual “Dunk the Residency Program Director” tradition continued, with many department members throwing their best pitches to hit the target and drop Dr. Metro into the dunk tank.
EDUCATION

RESIDENT SOCIAL ACTIVITIES
UPMC residents Melanie Hodge and Anne Kamarchik and faculty on a service trip in Guatemala with Surgicorps International in August 2016.

PGY-3s loving the beginning of the new academic year.

Kickoff of the 2016-2017 interview season.

A great showing for our residents at Anesthesiology 2016 in Chicago, Illinois.

Our residents with Drs. Sakai and Vogt running the ASA Run for the Warriors at the Chicago Yacht Club.
EDUCATION

RESIDENT SOCIAL ACTIVITIES

PGY-1s visiting “the bean” in Chicago after the Run for the Warriors.

Dr. Gelzinis’ annual Halloween party.

Residents giving back and doing a little painting with Habitat for Humanity in December 2016.
The Anesthesiology resident band Bropofol helped raise nearly $1000 for UPMC Mercy Hospital’s Pediatric Burn Unit in January 2017.


These three planned a wonderful season of interview dinners at Ten Penny.
Residents and attendings enjoy some R&R at the department sponsored Anesthesiology Legal Education Symposium in St Thomas, US Virgin Islands in March 2017.

PGY-4s Brenda Satterthwaite, Derek Lauter and David Nelson had a great showing at the Pittsburgh Half Marathon in May 2017.

Bhutan mission trip with Surgicorps in April 2017.
PEDiatricS-ANESTHESIOLOGY COMBINED RESIDENCY PROGRAM

PETER J. DAVIS, MD, Professor; Program Director
ERICA L. SIVAK, MD, Assistant Professor; Associate Program Director
RHETT LIEBERMAN, MD, Assistant Professor of Pediatrics; Associate Program Director

The Departments of Pediatrics and Anesthesiology jointly offer this dual board acceptable opportunity to train in both specialties. The combined residency program is approved by both the American Board of Anesthesiology and the American Board of Pediatrics. At the end of the five-year program, residents will be eligible to become board-certified in both specialties. This rigorous academic program has complete and enthusiastic support from both departments.

The program is ideally suited for the applicant who is dedicated to the care of pediatric patients, but also desires adult anesthesiology experience, which is required for application for anesthesiology board certification. Candidates for this program will most likely have a desire to pursue further training in pediatric critical care, pediatric emergency medicine, pediatric anesthesiology, or pediatric pain medicine. Residents will be excellent and highly sought candidates for fellowship programs throughout the country.

Peter J. Davis, MD, who is certified in both pediatrics and anesthesiology, is the program director for the combined residency. He is closely supported by Associate Program Directors Rhett Lieberman, MD, Department of Pediatrics Division of Pediatric Emergency Medicine, and Erica L. Sivak, MD, Department of Anesthesiology at Children’s Hospital of Pittsburgh of UPMC. The program also has the full support and resources of Stephanie Dewar, MD and Andrew Nowalk, MD, PhD, Program Directors of the Pediatrics Residency, and David G. Metro, MD, Program Director of the Anesthesiology Residency.

Combined residents in the departments are afforded the same benefits that anesthesiology and pediatrics residents enjoy. The combined program fully complies with ACGME graduate medical trainee duty hour regulations and must comply with the ACGME core program requirements of each specialty.

During the 2016-2017 academic year, the program successfully recruited its first intern from a pool of 27 applications that were received. The program is approved for one resident per year of training.

The first year of the combined program is similar to that for categorical pediatric residents, including continuity clinic. Additionally, residents attend one half day of anesthesia didactic sessions per month. Rotations include: General Inpatient Pediatrics, Subspecialty Experiences, Emergency Medicine, Neonatal Intensive Care Unit, and Term Newborn. The combined program residents will join clinical base year anesthesiology residents during the one month Anesthesiology Professional Practice rotation.

The second year will be the same as that of a first-year anesthesiology resident, including the following rotations: Basic Anesthesiology, Post-Anesthesia Care Unit, and Pediatric Anesthesiology and the Preoperative Clinic. Beginning in the second year, the combined resident will maintain close ties with the Department of Pediatrics by maintaining a monthly continuity clinic – conducting both well child visits and acute illness follow-up appointments. The resident will also attend monthly pediatric didactic sessions. The Department of Anesthesiology values these responsibilities as imperative to the resident’s training and attendance at the pediatric clinic and didactics are guaranteed.

The program’s remaining three years will consist of advanced subspecialty rotations and elective time. The resident will alternate every six months between pediatrics and anesthesiology. Throughout the entire program, residents will maintain pediatric continuity clinic and didactics while on anesthesiology rotations and will attend anesthesiology didactics while on pediatrics rotations.
ADULT CARDIOThorACIC AnESTHESIOLOGY

The Department of Anesthesiology offers an ACGME-accredited Adult Cardiothoracic Anesthesiology (ACTA) Fellowship Program with a clinical training length of one year and four fellow positions. Graduates of ACGME-accredited anesthesiology residency programs who seek advanced training in the management of patients presenting for adult cardiac, thoracic, and vascular surgery are invited to apply. The fellowship program received initial accreditation with commendation in July 2010 for three years, the maximum cycle length for a newly accredited program. In April 2014, the program received full continued ACGME accreditation with two commendations for the program’s substantial compliance with the ACGME’s Program and Institutional Requirements for Graduate Medical Education, as well as the quality of leadership, organization, record of scholarship, and the dedication of one morning each week for teaching. The ACTA fellowship program received its most recent ACGME Continued Accreditation in January 2017. The fellowship program has transitioned into the Next Accreditation System (NAS) with a self-study visit scheduled for April 22, 2022.

Education/training occurs at three hospital locations: UPMC Presbyterian, UPMC Shadyside, and UPMC Passavant. An elective rotation is also intermittently available at ISMETT, located in Palermo, Sicily. ACTA fellows receive advanced training in the subspecialty inclusive of: emergency and elective complex cardiothoracic surgery, perfusion/ventricular assist device theory and operation, management of patients with electrophysiologic cardiac disturbances requiring ablation therapy or implantation of AICD/pacemakers, management of patients for minimally invasive implantable cardiac devices in the cardiac catheterization and electrophysiology lab, cardiothoracic critical care medicine, and heart/lung transplantation.

In addition to advanced clinical training in the perioperative management of cardiothoracic and vascular surgery patients, ACTA fellows also obtain extensive experience with diagnostic intraoperative transesophageal echocardiography (TEE) to develop their skills and meet the requirements necessary for certification in Advanced Perioperative Transesophageal Echocardiography by the National Board of Echocardiography. A formal one month introductory intraoperative TEE rotation is offered at UPMC Presbyterian to introduce fellows to the principles of echocardiography and methods to perform a diagnostic exam. This rotation is under the direction of the cardiothoracic anesthesiology faculty. A two-week elective in transthoracic echocardiography is also offered.

Fellows receive rotation goals and objectives at the beginning of each clinical rotation along with a list of required reading material. One day per week is dedicated to academics. Didactic programs consist of intraoperative clinical teaching, weekly lectures, and case reviews based on topics related to cardiothoracic anesthesiology. Fellows participate in a weekly TEE review moderated by the cardiothoracic anesthesiology faculty and a monthly interdepartmental echocardiography conference (IDEC) that is held jointly with cardiothoracic anesthesiology, cardiology, cardiac surgery, critical care medicine fellows and faculty. A combined adult cardiothoracic anesthesiology faculty and fellow conference is held quarterly and includes case presentations, morbidity and mortality discussions, journal club, and quality improvement topics. Fellows also attend cardiothoracic surgery education sessions and departmental grand rounds that are held weekly.

Fellows are encouraged to submit scholarly work for presentation at the annual Society of Cardiovascular Anesthesiologists (SCA) meeting. Fellows have been active participants in the SCA meeting over the past five years and have received recognition for outstanding presentations.
FY17 Scholarly Activity

Beau Bergeron, MD
Regional & National Presentations

Department Presentations

Bryant Bunting, DO
Regional & National Presentations

John Hamilton, MD
Regional & National Presentations

Department Presentations
Contrast Echocardiography. Presented at: Adult Cardiothoracic Anesthesiology Fellow Didactics. 4/05/2017

M. Margaret Lim, MD
Regional & National Presentations

Department Presentations
CMV safe, leukoreduction, and irradiated blood products in solid organ transplants. 03/29/2017.

ACA Fellow Post-graduation Plans

<table>
<thead>
<tr>
<th>Name</th>
<th>Future Plans</th>
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<tbody>
<tr>
<td>Beau Bergeron, MD</td>
<td>Our Lady of the Lake, Baton Rouge, LA; Employed by Anesthesiology Associates</td>
</tr>
<tr>
<td>Bryant Bunting, DO</td>
<td>Faculty, Department of Anesthesiology, UPMC Shadyside</td>
</tr>
<tr>
<td>John Hamilton, MD</td>
<td>Peninsula Regional Medical Center, Salisbury, MD; Employed by Sheridan Healthcare</td>
</tr>
<tr>
<td>Mary Margaret Lim, MD</td>
<td>Cleveland Clinic, Hillcrest Hospital, Cleveland, OH</td>
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The Critical Care Medicine (CCM) Fellowship Program in anesthesiology is one of the oldest and most established programs in the world. Fellows are trained to be excellent bedside physicians, educators, and researchers, following in the footsteps of giants like Drs. Peter Safar, Ake Grenvik, Jan Smith, Miroslav Klain, and James Snyder. The spirit of those leaders is still alive and most of the faculty work in perioperative settings in the operating room as well as the intensive care units (ICUs).

The program is unique in that it crosses two prominent departments in the School of Medicine, the Department of Anesthesiology and the Department of Critical Care Medicine. In addition, it is an integral part of the Multi-Disciplinary CCM Training Program, established by Drs. Peter Safar and Grenvik in the early 1960s. Fellowship training encompasses 12 months following the completion of an ACGME-accredited anesthesiology residency. Fellows are exposed to a variety of critically-ill patients in diverse ICUs within UPMC. In addition to clinical care, fellows are exposed to research opportunities, scholarly projects, and instruction in teaching to prepare them for future careers. In addition to enhancing the clinical and educational aspects of the program, the fellowship program emphasizes research. Because of the 12-month duration of the fellowship, bench-based projects are not feasible. Therefore, fellows are provided the opportunity to continue research through second- or third-year NIH T-32 training grants. With abundant and excellent resources, faculty, facilities, patient volume and variety, the Anesthesiology CCM Fellowship Program provides exceptional experience and education in the field.

Murat Kaynar, MD, MPH was recognized for his leadership of the Anesthesiology Critical Care Medicine Fellowship, as well as his outstanding teaching, at the Department of Critical Care Medicine’s graduation ceremony on Saturday, June 3, 2017. Dr. Kaynar successfully achieved international collaborations and will be visiting the University of Evry, Paris to further increase his collaborative research for an R01 grant on the role of zinc and other trace elements in the resolution of inflammation. Dr. Kaynar received a UPP grant to further his project on the same theme.

Nationally, the number of applicants to critical care anesthesiology programs has been decreasing nationally over the last 10 years. However, after discussions with Drs. Rita M. Patel, David G. Metro, Mark Hudson, and Derek Angus, the visibility of Anesthesiology Critical Care Medicine as a career choice has been enhanced through the following efforts and the number of applicants to our program increased by over 30% despite the national decrease:

- A CCM interest group was established within the School of Medicine in addition to the fourth-year medical school elective. The Critical Care Medicine elective course (CCM 5430 MSIV), taught by Drs. Christopher Schott and Christopher Brackney, continues to have one of the highest enrollments amongst senior medical students (55 Pitt students and four visiting students).
- Anesthesiology residents now participate together with fellows in the CRISMA research seminars in the Department of Critical Care Medicine to expose them to research opportunities. Dr. Kaynar is the primary mentor for Dr. Michael Schnitzer, NIH Research Scholar.
- Cooperation has increased between the Departments of Anesthesiology and Critical Care Medicine to identify prospective faculty from the training program. Dr. John Wallisch was recruited as a faculty member with an appointment to both departments. Fellowship 2017 graduate, Alexander Preus, MD was appointed
as Clinical Assistant Professor with Critical Care Medicine performing services at UPMC Mercy. He also has an Anesthesiology appointment at the VA Pittsburgh Healthcare System.

• The program experienced a 3% increase in the number (186) of residents who rotated through intensive care units compared to FY16 and continues to host visiting residents both internally and nationally. Highly qualified and top rotation performers are prospective applicants to the Anesthesiology Critical Care Medicine Fellowship Program.

These efforts led to the seventh consecutive year of filling all four anesthesiology/CCM fellowship positions for academic year 2018-19, with a fellow mix of internal and external candidates. The program received 66 applications and interviewed 31 applicants for four positions. In addition to fellow recruitment efforts, the program continually sought new methods to improve recruiting current fellows for UPMC faculty positions.

**Summary of Post-doctoral Fellows and Activities**

The ACGME Anesthesiology Residency Review Committee reviewed the program and accredited it again for 10 years with commendations.

During FY17, the Anesthesiology Critical Care Medicine Fellowship Program experienced innovations and improvements such as the following:

• New Critical Care Medicine Faculty in the Cardiac Intensive Care Unit
• Involvement in the Recruitment Process of Future Fellows
• Assigning of a CCM Liaison in the Anesthesiology Residency Program
• Quality Improvement (QI) Projects
• Quality measures of teaching efforts
• New teaching programs, courses, and educational innovations

### Anesthesiology CCM Fellow Post-graduation Plans

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<thead>
<tr>
<th>Name</th>
<th>Future Plans</th>
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<tbody>
<tr>
<td>Christopher Johnson, MD</td>
<td>St. Luke’s Hospital University Health Network, Bethlehem, PA</td>
</tr>
<tr>
<td>Rohan Panchamia, MD</td>
<td>New York Presbyterian Hospital-Weill Cornell Medical Center, New York, NY</td>
</tr>
<tr>
<td>Alexander Preus, MD</td>
<td>VA Pittsburgh Healthcare System &amp; UPMC, Pittsburgh, PA</td>
</tr>
<tr>
<td>Yiyu Zhao, MD</td>
<td>University of Virginia, UVA Health System, Charlottesville, VA</td>
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**HEPATIC TRANSPLANTATION ANESTHESIOLOGY**

Hepatic Transplantation Anesthesiology (HTA) Fellowship training takes place at UPMC Presbyterian, a leading center of organ transplantation of the liver, small bowel, pancreas, and multiviscera. The HTA team is comprised of uniquely-qualified anesthesiologists who pioneered and developed the field of transplantation anesthesiology, including founding the International Liver Transplantation Society. The HTA fellowship program provides a comprehensive curriculum emphasizing perioperative care, with ample collaborative research opportunities with colleagues in surgery, hematology, and critical care medicine. By the end of the training year, fellows achieve sufficient qualification to become a Director of HTA in other major medical centers, thus joining the vast alumni of this highly-successful fellowship program.

**RAYMOND M. PLANINSIC, MD, FASA**

Director
FELLOWSHIP PROGRAMS

Fellows’ primary responsibilities include preoperative assessment of transplant candidates, participation in candidate selection, intraoperative management, and postoperative visits. Preoperative consultation of transplant candidates is the main strength of the service. As true consultants, anesthesiologists provide hepatologists and surgeons with valuable information on extrahepatic organ function. All candidates are evaluated at the Thomas E. Starzl Transplantation Outpatient Clinic or as inpatients at UPMC. Preoperative information is discussed at weekly multi-departmental transplant morbidity and mortality conferences. Clinical information is exchanged on individual patients to improve patient care and recommendations are made to optimize patients for transplantation.

NEUROANESTHESIOLOGY

UPMC Presbyterian has an extraordinarily busy neurosurgical service, performing over 4,000 cases annually. This translates into six to seven neurosurgical operating rooms daily. In addition, anesthesia support is occasionally requested in interventional neuroradiology or for other diagnostic studies. Over 3,000 cases involve neurophysiologic monitoring. A wide variety of cases are performed: spine and spinal cord work, surgical for carotid artery disease and intracranial vascular disease, microvascular decompression on cranial nerves, and a broad variety of tumor surgery and skull base work, much involving stereotactic or image guidance and trauma neurosurgery. Pediatric neurosurgery is performed at Children’s Hospital of Pittsburgh of UPMC (CHP). In addition to adult neurosurgical cases at UPMC Presbyterian, fellowship rotations include neurophysiologic monitoring, neuroradiology, neurosurgical intensive care, and pediatric neuroanesthesiology at CHP. Research activities in neuroanesthesiology, brain resuscitation, and neurosurgical critical care continue to expand.

Opportunities exist for collaborative work with members of the departments of Neurological Surgery, Neurocritical Care or Neurophysiology, or with members of UPMC Presbyterian neuroanesthesiology division, as well as work within the Safar Center of Resuscitation Research.

Monthly neuroanesthesiology division meetings are held at UPMC Presbyterian as part of the weekly UPMC Presbyterian anesthesiology conferences. Additionally, there are weekly stroke conferences and the neurosurgical department meetings to attend, including morbidity and mortality conferences.

Didactics focus heavily on intraoperative teaching, although non-clinical time is scheduled for academic pursuits, and a broad range of reference materials are available within the department. As fellows progress, they contribute to the teaching of the PGY-2-4 residents who rotate on the neuroanesthesiology service.

Clinical excellence in providing neuroanesthesiology care is the first goal of the fellowship. Individuals interested in developing teaching and research skills will have ample opportunity to do so. On completion of the neuroanesthesiology fellowship, the anesthesiologist will be ready to enter academic practice or assume a leadership position in neuroanesthesiology within a non-academic group.

The neuroanesthesiology fellowship program did not train any neuroanesthesiology fellows in academic year 2016-17, but continued to train fellows from various UPMC Critical Care Medicine programs and hosted a Neurocritical Care Fellow from Brigham and Women’s Hospital.

BRIAN GIERL, MD
Director
The Department of Anesthesiology at Magee-Womens Hospital of UPMC (MWH) offers an Obstetric (OB) Anesthesiology Fellowship with two positions available per year. MWH is one of the leading woman-care centers in the country, performing over 10,000 OB deliveries annually. Utilizing all methods and techniques of contemporary OB anesthesiology, the one-year fellowship offers fellows the opportunity to manage high-risk OB patients. Fellows’ responsibilities include clinical teaching and supervision of residents, medical students, and nurse anesthesia students. Scholarly activity includes the organization and preparation of didactic lectures, educational sessions, national presentation of research, facilitation of University of Pittsburgh School of Medicine courses, and seminars. In addition to teaching and instruction, special emphasis is placed on consulting, multidisciplinary coordination of patient care, improving oral presentation and writing skills, and academic research. Fellows receive interdisciplinary training in maternal fetal medicine, antepartum fetal testing, ICU, and neonatology. Additional instruction and education is provided in difficult OB airway management, ultrasound use, and OB crisis simulation and team training.

Opportunities to perform clinical research studies or basic science investigations in the discipline are numerous and scholarly activity is encouraged. Fellows participate in all facets of research, including study design, Institutional Review Board (IRB) protocol submission and approval, project implementation, data analysis, and manuscript preparation and submission for publication. Fellows initiate their own quality assurance and quality investigational studies through MWH’s own committee. The nationally-recognized Maternal-Fetal Medicine and Neonatology Departments, and the Magee-Women’s Research Institute further enhance the environment for education in clinical research. Opportunities are available for active involvement and participation in a monthly multidisciplinary OB Crisis Team Training course. Fellows involved in the American Board of Anesthesiology oral or written board process participate in annual departmental review courses, if desired. A fellowship-specific fiber optic bronchoscopy and difficult airway management course specific to the OB patient is a requirement of the fellowship. A one month elective opportunity is offered in a unique combined neurology and transfusion medicine elective.

Fellows are prepared for careers in academic medicine or leadership roles in an OB anesthesiology division of a major medical center. Faculty present and publish numerous research abstracts, case reports, and problem-based learning discussions at major anesthesiology meetings. Meetings where OB faculty and fellows have presented include the Society for Obstetric Anesthesia (SOAP), American Society of Anesthesiologists (ASA), the International Anesthesia Research Society (IARS), Society for Education in Anesthesia (SEA), and various international and local meetings.

In June 2015, the OB Anesthesiology Fellowship program underwent a three-year site review by the ACGME and was granted continued accreditation through April 2022.

Erica Coffin, MD completed her fellowship in June 2017 and joined Allegheny West Penn Hospital. Thomas Vernon, MD also graduated from the fellowship program in June 2017 and joined anesthesiology group in his home town of Phoenix Arizona with a professional emphasis on OB anesthesia.
Presentations

Books

Abstracts

Teaching Awards
- 2016, Lim G. 2nd Place, Best Poster Presentation Award, 14th Annual Safar Symposium Multi-Departmental Research Day. “Intrapartum Pain Improvement is a Predictor for Post-partum Depression: Labor Pain Matters.”
- 2016, Lim G. University Health Sciences Leadership Academy, University of Pittsburgh.
- 2016, Romeo R. The Dr. Peter M. Winter Award for Excellence in Medical Student Teaching, University of Pittsburgh.
PAIN MEDICINE

The Department of Anesthesiology is proud to offer trainees a top-ranked highly competitive ACGME-accredited Pain Medicine Fellowship Program. The nationally recognized program and winner of the American Academy of Pain Medicine’s 2016 Pain Medicine Fellowship Excellence Award is the only one in the country that has received a maximum five-year ACGME accreditation three consecutive times. In April 2012, the ACGME accredited the program for five years with no citations and special commendation for the specific course of research programs. The program meets and exceeds the ACGME requirements set forth for pain medicine. Under the expert guidance of Dr. Ajay Wasan, Vice Chair for Pain Medicine and world-renowned pain medicine clinician and researcher, the program has reinvigorated itself to a nationally recognized level of excellence.

One of the unique aspects of the program is the truly multidisciplinary environment in which the fellows practice daily. Fellows are exposed to faculty within the division who bring expertise from a variety of medical specialties including anesthesiology, physical medicine and rehabilitation (PM&R), psychiatry, and neurology. Elective rotations afford fellows the opportunity to work with the palliative care service at Hillman Cancer Center, the acute pain service at UPMC Mercy, the pediatric pain service at Children’s Hospital of Pittsburgh of UPMC (CHP), neuroradiology at UPMC St. Margaret, and a National Cancer Institute-designated Comprehensive Cancer Center at UPMC Shadyside. Fellows are exposed to additional services ranging from pain rehabilitation to interventional therapies to acute pain medicine, which affords opportunities to learn from psychologists, physical therapists, and occupational therapists. Rotations with the neurosurgery and interventional radiology departments may be incorporated in the curriculum for additional surgical procedures performed at UPMC Presbyterian. The division also provides fellows the opportunity to participate in a unique group-based therapy program designed for fibromyalgia patients, which is exclusively managed by the department.

Scott Brancolini, MD, MPH is the Pain Medicine Fellowship Program Director. He was elected to the Board of the Association of Pain Program Directors as Secretary/Treasurer in FY16. Part of his service for this organization includes the development of a national curriculum that is based on his own work that can be disseminated to educate and be available to all pain medicine fellowships. He is an active member of the Society of American Anesthesiology Associations (SAAA) and has served nationally on the Pain Medicine Milestones Implementation and Reference Committee in the American Association of Specialty Program Directors (AASPD). Additionally, he is a member of the American Society for Anesthesiology (ASA), the Society for the Education in Anesthesia (SEA), and the American Academy of Pain Medicine (AAPM). Dr. Brancolini is also the Chronic Pain Medicine Rotation Director for both residents (including anesthesiology, internal medicine, neurology, psychiatry, physical medicine and rehabilitation, family medicine, geriatric medicine, and radiology) and the University of Pittsburgh School of Medicine rotation for medical students. He is an active member of the UPMC Graduate Medical Education Committee, the Anesthesiology Resident Education Committee, and the Medical Student Education Committee.

Dr. John Hache is the Associate Program Director. He is a former graduate of the UPMC Anesthesiology Residency and Pain Medicine Fellowship programs. He is also a primary member on the liver transplant anesthesia team and serves multiple interdisciplinary roles in the department.
Recruitment
The UPMC Pain Medicine Fellowship hosts eight fellows entering at the PGY-5 level. The recruitment and interviewing process begins in July for the following academic year and the entire interdisciplinary division of faculty comprises the selection committee. Prospective fellows spend a day interviewing with key faculty and touring clinics within the division in the Pittsburgh area. In recent years, fellows have entered the program after completing accredited residencies in anesthesiology, PM&R, neurology, emergency medicine, internal medicine, family medicine, and psychiatry. Physicians who have completed an ACGME-accredited residency may apply for a fellowship beginning each July. In 2016, the Pain Medicine Fellowship interviewed 56 applicants over the course of three days; the program is now in its third year of participating in the National Residency Matching Program. The Electronic Residency Application Service was utilized for the second time this past year; 240 applicants from subspecialties such as neurology, PM&R, anesthesiology, and psychiatry submitted applications. This figure has tripled in number from the previous two years, further indicating that the Pain Medicine Fellowship program is nationally renowned.

Tracks
The program offers three innovative tracks for fellows to achieve a first-rate education and training in Pain Medicine. The first track is a traditional one-year, clinically-based fellowship. The second track is for anesthesiology residents interested in continuing research and receiving clinical research training. The third option is for physicians who are interested in pursuing clinical or basic science research for a longer period and receive more extensive training by completing a one-year fellowship followed by two years of research funded in part by NIH T32 programs. The Department of Anesthesiology is one of a select group of academic medical centers in the country that is accredited to offer two NIH-funded T32 positions per academic year. Productive research and scholarly activities are encouraged and supported.

Education
The UPMC Pain Medicine education and clinical training occurs at multiple locations: UPMC Montefiore, UPMC St. Margaret, Centre Commons in Shadyside, UPMC McKeesport, UPMC Passavant, UPMC Mercy, UPMC Southside PM&R, CHP, and UPMC Monroeville. Multiple locations allow trainees the opportunity for exposure to a variety and multitude of physicians and practice settings. Fellows spend approximately two months at each site to enhance the longitudinal clinical experience as well as required education in the disciplines of neurology (eight weeks), psychiatry (eight weeks), PM&R (four weeks), radiology, palliative care, cancer pain, and neurosurgery (four weeks, combined). Additionally, electives at CHP allow fellows to gain further exposure to pediatric pain medicine. The department is currently expanding the study of pediatric pain medicine and has plans to become a top center for pediatric pain.

Fellows receive goals and objectives at the beginning of each clinical rotation and a list of required reading materials. Educational programs consist of written didactics, internet websites, clinical and cadaver courses, tutorials, morbidity and mortality conferences, journal clubs, a pharmacology course, a pain board key word course (to aid in preparation for board certification), and access to a basic science course entitled Mechanisms and Clinical Presentation of Pain. This course provides attendees with vocabulary and knowledge about the anatomy, physiology, mechanisms, and modulation of pain. This fundamental knowledge is complemented by assigned readings from the literature and clinical presentations about pain syndromes and pain management. Additionally, journal clubs and morbidity & mortality conferences are held quarterly regarding up-to-date subject matter, and the entire division congregates biannually for a pain medicine retreat that focuses on best practice, patient safety, and other medical knowledge and systems-based practice competencies. These educational efforts have been universally welcomed and praised.
UPMC Pain Medicine and its fellowship program director Dr. Scott Brancolini have made multiple changes to the overall curriculum for the 2016-17 academic year. An important and major update to educational content was the continuation of a key word database bank to help the fellows study and prepare for their In-Training and Pain Medicine Board exams. This Quality Improvement (QI) project aims to study and assess changes in fellow confidence while developing this key word database. All fellows participated in this project, along with four residents interested in pain medicine from multiple disciplines. This project has also attracted the national interest of other pain medicine program directors; the ultimate plan is to develop a Pain Medicine Review Book. To date, a 200-page document has been carefully edited and constructed and was internally published to assist the fellows with their studies.

The six-week introductory Pain Medicine Board Review Key Words course given each year also helps fellows prepare for the written Pain Medicine Boards. Fellows participate in the ABA In-Training Exam process to prepare for the exam and scores to date have been superior. The pass rate has greatly improved over the past three years since the exam was first conducted. The most recent Pain Medicine board certification pass rate for eligible candidates was 100% on the written exam.

Exciting changes have been recently made to the Pain Medicine Fellowship education programs. The fellowship partnered with Dr. Kentaro Onishi from UPMC Sports Medicine PM&R to develop an eight-week course detailing how to conduct a comprehensive musculoskeletal examination under ultrasound guidance. Fellows were given additional weekend access to ultrasound technology to further practice and refine their interventional skills. Additionally, the Pain Medicine Fellowship Grand Rounds were revised based on fellow feedback. Multiple new lectures were added; examples include new overviews of rheumatology and advanced interventional techniques. The past academic year also added one day training sessions in vertebroplasty and kyphoplasty, as well as training in cooled radiofrequency techniques for hip, knee, cervical, lumbar, and disc pain with didactics, and a cadaver-based lab.

The Pain Medicine fellows were once again given a revised all day orientation conducted by Dr. Brancolini. Also given in the past academic year was Dr. Brancolini’s Pain Medicine curriculum of 19 lectures that is given on a monthly repeating cycle to all fellows, rotating residents, and medical students. Changes were also made to the Pain Medicine quarterly journal club. Under the new direction of Associate Program Director Dr. John Hache, meticulous attention was paid to both incorporate topics proposed by the fellows, along with a supplementation of up-to-date and landmark journal articles. All fellows are required to participate in research projects during elective time and develop systems-based practice projects. Dr. Brancolini oversees this project and the Pain Medicine faculty participates in and supervises all projects. Leading our fellows’ QI projects is Dr. Trent Emerick, who was recently appointed Chief of Pain Medicine Quality Improvement.

Under the direction of Drs. Brancolini and Tetsuro Sakai, the UPMC Pain Medicine Research Committee will be entering its third year of fruitful collaboration between trainees interested in pain medicine and faculty sponsoring research projects. This ongoing multidisciplinary committee meets annually to attract trainees and students interested in pain medicine research. To date, Drs. Brancolini and Sakai have sponsored two residents (and an upcoming third) in a formal month-long research rotation, resulting in multiple submitted publications, posters, and abstract presentations at conferences. Also, ongoing in the past year was the continuation of the Pain Medicine Patient Safety Committee. Meeting weekly under the direction of Dr. Brancolini, fellows are required to present a patient safety case study. In these group discussions, elements of patient safety, “near miss” situations, and root cause analyses are reviewed.

During the 2016-17 academic year, fellows gave presentations, presented posters, authored peer-reviewed articles, completed QI projects, and presented a total of eight systems-based practice projects. The following data details scholarly activity for the 2016-17 academic year.
FELLOWSHIP PROGRAMS

Scholarly Activity

Hasan Abed, MD
- Intradiscal PRP Injections. UPMC Pain Medicine Journal Club. 12/14/2017
- HNP Treatment Review. UPMC Pain Medicine Journal Club. 09/21/2016
- Systems-based Project: Fluoroscopic View for The Requisite Interventional Pain Procedure
- QI Project, Keyword Database

Kwadwo Achampong, MD
- Pharmacology Lecture Series: Anticonvulsants. UPMC Pain Medicine Grand Rounds. 10/19/2016
- Complications During Routine Intrathecal Pump Refill. UPMC Pain Medicine M&M Conference, 6/28/2017
- Systems-based Practice Project: Use of Needle Free Injection System for Local Skin Infiltration Prior to Interventional Pain Procedures. 01/05/2017
- QI Project, Keyword Database

Gianna Casini, MD
- Discitis. UPMC Pain Medicine M&M Conference. 3/08/2017
- Systems-based Practice Project: Site Cheat Sheets for First Day of Rotation
- QI Project, Keyword Database

Andrew Clary, DO
- Pharmacology Lecture Series: Anticoagulants. UPMC Pain Medicine Grand Rounds. 11/05/2016
- Fluoroscopy Study. UPMC Graduate Medical Education Conference poster presentation, Pennsylvania Anesthesia Regional Research Conference. 11/17/2016
- UPMC Pain Medicine M&M Conference. Rare Diagnoses in Common Procedures. 3/08/2017
- Chief Fellow Scholarly Officer. 07/06/2016 -06/06/2017
- Systems-based Practice Project: Procedure Efficiency Improvement
- QI Project, Keyword Database
- Scholarly Research Fellow

Alcinto Guirand, MD
- Infection after RF. UPMC Pain Medicine M&M Conference. 3/08/2017
- System Based Practice Project: Radiology & Imaging
- QI Project, Keyword Database

David Itskevich, DO
- Pharmacology Lecture Series: NSAIDs. UPMC Pain Medicine Grand Rounds. 11/16/2016
- Systems-based Practice Project: Literature for New Rotations and Improved Performance
- QI Project: Keyword Database
Alexander Matz, MD
- Buprenorphine as an Adjuvant to Prolong Celiac Plexus Block. Research: Trent Emerick, MD. 10/24/2016
- Pharmacology Lecture Series: Muscle Relaxants. UPMC Pain Medicine Grand Rounds. 11/30/2016
- Systems-based Project: Stentor Linking
- QI Project, Keyword Database

Eric Yuan, DO
- System Based Project: Ultrasound for Guidance of Injections
- QI Project, Keyword Database

Evaluation and Competence
Fellows are evaluated by faculty at the end of every clinical rotation based on the ACGME milestone guidelines. These evaluations are then made available to the fellows for their review. Evaluations, clinical progress, and any other issues are also discussed with Dr. Brancolini during two semi-annual program director meetings. Fellows evaluate both the faculty and the educational value of each clinical rotation. Lastly, 360-degree evaluations, where feedback is solicited from nurses and other ancillary staff regarding the performance and attitude of the fellows, are a required component of the fellowship program. The ACGME Pain Medicine milestones are fully incorporated into the fellow evaluation system. In this process, objective data evaluating each fellow in different areas must be collected and assessed in compliance with ACGME guidelines. The UPMC Pain Medicine fellowship was one of the first in the country to complete the milestone implementation process.

Pain Medicine Fellow Post-graduation Plans
<table>
<thead>
<tr>
<th>Name</th>
<th>Future Plans</th>
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<tbody>
<tr>
<td>Hasan Abed, MD</td>
<td>Pain Medicine, First Colonies Anesthesia Associates in Towson, Maryland</td>
</tr>
<tr>
<td>Kwadwo Achampong, MD</td>
<td>Pain Medicine, Madison, Wisconsin</td>
</tr>
<tr>
<td>Gianna Casini, MD</td>
<td>Pain Medicine, Parkview Hospital, Fort Wayne, Indiana - Parkview Comprehensive Pain Center</td>
</tr>
<tr>
<td>Andrew Clary, DO</td>
<td>Pain Medicine, Woodbury Clinic (Woodlake Center)/Summit Orthopedics, Minneapolis, Minnesota</td>
</tr>
<tr>
<td>Alcinto Guirand, MD</td>
<td>Conemaugh Physician Group, Pain Management, Johnstown, Pennsylvania</td>
</tr>
<tr>
<td>David Itskevich, DO</td>
<td>Regenerative Orthopedics and Sports Medicine, MD/DC/VA area</td>
</tr>
<tr>
<td>Alexander Matz, MD</td>
<td>Baltimore Medical System at St. Agnes Community Health Center in Baltimore, Maryland</td>
</tr>
<tr>
<td>Eric Yuan, DO</td>
<td>Kaiser Permanente, Palm Springs, California</td>
</tr>
</tbody>
</table>
The ACGME-accredited Pediatric Anesthesiology Fellowship Program is designed to develop trainees’ clinical skills in pediatric anesthesiology and prepare graduates to be leaders in their field.

Over 90 candidates apply through the National Residency Matching Program (NRMP) for nine ACGME-approved positions each year in the UPMC Pediatric Anesthesiology Fellowship Program. The program is now getting ready for its sixth year in the match. In Spring 2017, pediatric anesthesiology fellowships began using the Electronic Residency Application Service (ERAS).

Dr. Erica Sivak continues to serve as the Associate Program Director. Dr. Sivak completed her anesthesiology residency at the University of Virginia and the Pediatric Anesthesiology Fellowship at Children’s Hospital of Pittsburgh of UPMC (CHP). She has been a faculty member since 2009. She is also the Associate Program Director of the UPMC Combined Pediatric-Anesthesiology Residency Program.

Program director Dr. Franklyn Cladis continues to serve as a Junior Part Two Examiner for the American Board of Anesthesiology (ABA) and was a co-editor of the ninth edition of the textbook Smith’s Anesthesia for Infants and Children, which was published in January 2017. In addition, he serves on the board of directors for the Society for Education in Anesthesia (SEA). He is also a member of the board of directors for the Society for Pediatric Anesthesia (SPA) and Chair-elect of the Pediatric Anesthesia Program Directors Association (PAPD).

Over the past five years, three workshops have been developed for the pediatric anesthesiology fellows. These include a pediatric hands-on regional workshop, a hands-on point-of-care ultrasound workshop, and a conflict resolution workshop.

Pediatric anesthesiology fellows continue to participate with in-situ simulation. Every other Thursday, pediatric faculty, post-anesthesia care unit (PACU) nurses, and fellows run an on-site multidisciplinary mock code in the PACU. Feedback is provided immediately after the code. This process has helped improve system-based issues and improve patient care at CHP.

The ABA continues to offer sub-specialty certification in pediatric anesthesiology. Dr. Franklyn Cladis participated in the question-writing process for the inaugural exam and was promoted to the Senior Exam Writing Committee. All the faculty members at CHP are subspecialty-certified in pediatric anesthesiology. All 2016-17 fellows that took the Part 2 ABA Applied Exam passed and are now board-certified anesthesiologists.

The Pediatric Pain Medicine Service continues to significantly augment fellows’ experience with peripheral nerve blocks. The ACGME requires a minimum of 11 peripheral nerve blocks. Each pediatric fellow performs on average 60-70 peripheral nerve blocks; the service provides approximately 2,000 pediatric peripheral nerve blocks per year and is one of the most well-developed pediatric regional services in the country.

Pediatric anesthesiology fellows have a one month critical care experience in the cardiac ICU (CICU). They must complete a two-month pediatric cardiac anesthesiology rotation prior to the CICU rotation. The cardiac anesthesiology
rotation prepares them with patient care, medical knowledge, system-based practice, and interpersonal skills
to manage CICU patients. During the CICU month, the fellow is expected to become part of the care team and
participate in daily rounds. They also provide sedation care for patients that must travel to off-site locations
(interventional radiology, MRI) for imaging or interventions.

CHP continues to be one of the highest volume centers for pediatric liver transplantation. Fellows provide anesthesia
for two to three pediatric liver transplants on average throughout the year. Each fellow is ensured the opportunity
to perform anesthesia for liver transplants through a home-call system. In addition to in-house call, fellows can
be called in from home only for transplants. Since implementing this home-call system, all fellows perform two to
three liver transplants.

Scholarly Activity

Sabrina Carrié, MD
• Carrié S, Leeper C, Yazer M, Gaines B, Triulzi D, Cladis F. Uncrossmatched Whole Blood for Pediatric Civilian
  Trauma Transfusion. IARS Spring 2017

Daniel Goldstein, MD
• Goldstein D, Straesser S, Brozanski B, Mingrone T, Scott M, Angelilli S, Himmelrick T, Soliman D. Baby It’s

Angela Ingram, MD
• Ingram AR, Cladis F, Visoiu M, Grunwaldt L. PECS 1 and 2 Blocks for Adolescent Reduction Mammoplasty.
  Society for Pediatric Anesthesia March 2017, Austin Texas

Anne E. Kamarchik, MD
• Sevoflurane Exposure and Pediatric Renal Allograft Survival: A Retrospective Analysis. SAFAR Symposium
  May 2017, University of Pittsburgh, Pittsburgh PA

Michael Kolan, MD
• Praslick A, Kolan M, Humar A, Ganoza A, Visoiu M. Quadratus lumborum blocks for postoperative pain relief
  after pediatric kidney transplantation. Society for Pediatric Anesthesia March 2017, Austin Texas

Jessica Latzman, MD
• Latzman JA, Soliman DE. LMA: Friend or Foe in a Case of Mehta Cast Placement. Society for Pediatric
  Anesthesia March 2017, Austin Texas

Keila Maher, MD
• Maher K, Cladis F, Wound catheter vs paravertebral catheter for iliac crest bone graft. American Society of
  Anesthesiology, October 2017, Boston MA

Alexander Praslick, MD
• Praslick A, Kolan M, Humar A, Ganoza A, Visoiu M. Quadratus lumborum blocks for postoperative pain relief
  after pediatric kidney transplantation. Society for Pediatric Anesthesia March 2017, Austin Texas

Dritan Prifti, MD
• Prifti D, Vockley G, Sharma M, Nguyen K, Palmer D, Blasiole B. Perioperative Management of a Patient with
  Maple Syrup Urine Disease Undergoing Open Heart Surgery. Society for Pediatric Anesthesia March 2017, Austin Texas.
• Prifti D, Moses B, Bykowski M, Losee J, Cladis F. Serum Ropivacaine Concentrations in Pediatric Patients
  Receiving Continuous Wound Catheter Analgesia. Society for Pediatric Anesthesia March 2017, Austin Texas.
FELLOWSHIP PROGRAMS

Pediatric Anesthesiology Fellow Post-graduation Plans

<table>
<thead>
<tr>
<th>Name</th>
<th>Future Plans</th>
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</thead>
<tbody>
<tr>
<td>Sabrina Carrié, MD</td>
<td>Pediatric pain fellowship, Boston Children’s Hospital</td>
</tr>
<tr>
<td>Daniel Goldstein, MD</td>
<td>Adult and pediatric anesthesiologist, Cleveland Clinic Foundation</td>
</tr>
<tr>
<td>Angela Ingram, MD</td>
<td>Long Island Jewish Hospital System</td>
</tr>
<tr>
<td>Anne E. Kamarchik, MD</td>
<td>Faculty, CHP</td>
</tr>
<tr>
<td>Michael Kolan, MD</td>
<td>Private practice, Columbus Ohio</td>
</tr>
<tr>
<td>Jessica Latzman, MD</td>
<td>Upstate Medical Center, Syracuse, NY</td>
</tr>
<tr>
<td>Keila Maher, MD</td>
<td>Private practice, Spectrum Medical Group, Portland, Maine</td>
</tr>
<tr>
<td>Alexander Praslick, MD</td>
<td>Faculty, CHP</td>
</tr>
<tr>
<td>Dritan Prifti, MD</td>
<td>Cleveland Clinic; Children’s Department of General Anesthesiology</td>
</tr>
</tbody>
</table>

REGIONAL ANESTHESIOLOGY

The Regional Anesthesiology and Acute Pain Medicine Fellowship Program consists of 12 months of subspecialty training for qualified physicians who have completed an accredited anesthesiology residency. Preference is given to mature individuals with an interest in acute pain management and regional anesthesiology, a sub-specialty focused on the perioperative management of patients receiving neuraxial or peripheral neural blockade for anesthesia or analgesia. Fellowship training is concerned with the development of expertise in the practice and theory of acute pain management and regional anesthesiology and the understanding of the related physiology and pharmacology in the provision of patient care.

The core clinical curriculum includes five months of Regional Anesthesiology, three months of Acute Pain Medicine, and two weeks of Chronic Pain Medicine. Experiences in pediatric regional anesthesia and trauma complete the curriculum. Electives are offered in acupuncture, scientific auriculotherapy, neurology, and blood banking and may be chosen based on the fellow’s interest. To achieve these goals, fellows completed inpatient regional and acute pain rotations at UPMC Presbyterian, UPMC Shadyside, UPMC Mercy, UPMC Passavant, Children’s Hospital of Pittsburgh of UPMC, and Magee-Womens Hospital of UPMC. Fellows completed the ambulatory rotation at UPMC South Surgery Center, UPMC Passavant (Cranberry Township Campus), and the UPMC Harmarville Ambulatory Centers. Fellows completed the chronic pain rotation at UPMC St. Margaret.

Faculty members of the Acute Pain and Regional Anesthesiology Division select fellows based on written applications, academic records, documented performance, and interviews. Fourteen Regional Anesthesiology and Acute Pain Medicine were trained in FY17.

Jacques E. Chelly, MD, PhD, MBA returned to the position of Program Director of the fellowship program in April of 2017. Dr. Chelly is the founding director of the program, initially implementing the fellowship at UPMC in 2003. He transformed and developed the program into one of the largest, most prestigious in the country. He has been instrumental in the design and implementation of all educational components of the fellowship as well as instituting many quality improvements.
On April 20, 2017, under the direction of Dr. Chelly, the fellowship program submitted an accreditation application to the Accreditation Council for Graduate Medical Education (ACGME). The application is scheduled for review on September 21, 2017.

During the five-month regional anesthesiology rotation, the fellows are expected to achieve the necessary level of expertise to be familiarized with the indications, contraindications, techniques, and complications of regional anesthesia techniques, including neuraxial and peripheral nerve blocks. Under appropriate supervision, the fellows perform lower and upper extremity, paravertebral, thoracic truncular (PECS I, PECS II, serratus anterior), quadratus lumborum, and TAP blocks. Blocks involve both single shot and continuous techniques. Emphasis is placed on both ultrasound-guided and neurostimulation techniques. A unique experience in pediatric regional anesthesiology is provided through a rotation at Children’s Hospital of Pittsburgh of UPMC. The regional anesthesiology rotations also focus on a variety of treatment modalities such as multimodal approaches including single and continuous peripheral nerve block (inpatient and ambulatory) techniques.

Under faculty supervision, the regional fellows performed 51% of the 23,799 total nerve blocks placed by the department in FY17, including 12,715 extremity blocks (5,575 upper extremity and 7,190 lower extremity) and 8,457 truncular blocks. A total of 11,441 nerve blocks were performed using an ultrasound-guided technique. The total average of blocks performed by each fellow was 866, including 307 continuous nerve blocks.

During the 12-week acute pain rotation, the fellows were involved in the care of patients on the Acute Interventional Perioperative Pain & Regional Anesthesiology Service (AIPPS), including being responsible for the management of regional techniques performed to enhance patient recovery as a part of a multimodal approach. Management of patients into the postoperative period in association with Enhanced Recovery After Surgery (ERAS) protocols was emphasized when appropriate. These rotations were also an opportunity for the fellow to improve their cognitive, psychomotor, and affective skills to safely and effectively provide acute pain management for surgical and non-surgical patients.

In FY17, the fellows contributed to the 33,830 visits, including 16,808 pre-procedure consults and 17,030 postoperative visits performed by AIPPS.

Fellows attended mandatory weekly lectures, monthly journal clubs, a pediatric regional ultrasound workshops, and an anatomy workshop. The fellowship incorporated all ACGME program requirements into the training program.

Weekly formal lectures, Regional Anesthesiology and Acute Pain Medicine Grand Rounds, were attended by both the fellows and faculty every Wednesday from 5:00-6:00pm. This series was organized by Drs. Anna Uskova and Sharad Khetarpal. The grand rounds series is composed of lectures, cases, and audience participation sessions to address medical knowledge, clinical care, communications, professionalism, systems-based practice, and practice-based improvement, as well as a monthly journal club. More specifically, the Grand Rounds series’ goals and objectives are to keep faculty and fellows updated on the knowledge of regional anesthesia and acute pain medicine, provide a platform to discuss the latest guidelines and techniques to provide optimum patient care, and maintain up to date knowledge on the current literature and guidelines to better inform patients about the risks and benefits of regional anesthesia and acute pain.

**FY17 Didactic Lectures**
- Summation of Grand Rounds Topics and Didactics
- Introduction to AIPPS
- Informed consent and medico-legal considerations
- Paravertebral block
- TAP and other supplemental blocks
- Ultrasound: basic principles, knobology, safety, applications, and limitations
- Pediatric Regional Ultrasound Symposium
- Multimodal analgesia
- Upper and lower extremity: anatomy review
- Lower extremity blocks: lumbar plexus, femoral nerve, adductor canal, obturator, etc.
- Lower extremity blocks: different approaches to the sciatic nerve block
- ERAS protocols (orthopedic surgery, colorectal surgery)
FELLOWSHIP PROGRAMS

- Chronic pain/treating acute pain in chronic pain patients
- Upper extremity blocks: approaches, practical applications
- Toward your next job: applying the acute pain medicine fellowship
- Opioid pharmacology (including patient-controlled analgesia, alternative opioids, alternative method of administration)
- Spinal and epidural for postoperative analgesia
- Neuraxial (spinal and epidural) anesthesia/ adjuvants for surgical anesthesia
- Local anesthetic adjuvants
- Pediatric regional anesthesia
- Acute pain medicine and patient outcome (short term, long term)
- Local anesthetic pharmacology and toxicity
- Opioids, opiate abuse and dependence
- Neurologic outcomes of peripheral nerve block
- Closed claims and liability
- Maintenance of Certification in Anesthesiology Program® (MOCA®)
- Anticoagulation and regional anesthesia
- Regional anesthesia in trauma/burn patients
- Death by power point
- Auriculotherapy
- Oncologic aspects of anesthesia and pain management
- Regional anesthesia for ambulatory surgery
- Controversies in regional and acute pain medicine
- Billing and compliance in acute interventional pain service
- Acupuncture
- Anticonvulsants in pain management
- Complications in regional anesthesia
- Case studies: complications of regional anesthesia
- Organizing a pain service: where do I start?
- Blocks of the head and neck (airway blocks, facial blocks; blocks for thyroid and carotid surgery)
- How to develop an acute pain and regional anesthesia service

For those interested in research, a two-year NIH T32 clinical research track program is available for qualified candidates. The NIH T32 Postdoctoral Research Fellowship aims to develop clinician-scientists who will be leaders in the field of anesthesiology and pain research, by providing rigorous postdoctoral research training with an emphasis on hypothesis-driven laboratory or clinical research.

Fellows are encouraged to present at local, regional, and national meetings, and are required to participate in quality improvement projects. The large volume and diversity of cases also allows great opportunity for clinical, translational and basic research.

In FY17, the fellows contributed to the publication of two case reports, two letters to the editor, and one abstract. In addition, the fellows presented scholarly work at the annual American Society of Regional Anesthesia meeting (ASRA) and at the first Regional Anesthesiology and Acute Pain Medicine fellowship research symposium held in June 2017.

On June 3, 2017, the First Annual Regional Anesthesiology and Acute Pain Medicine Fellowship Research Symposium took place with Drs. Bruce Ben-David and Jacques E Chelly as co-directors. Forty-two participants attended the symposium. The audience included anesthesiologists, anesthesiology residents and fellows, CRNAs, and SRNAs. The program provided the attendees with a clear understanding of approaches to manage perioperative pain in different types of patients, a clear understanding of how regional anesthesia and multimodal approaches apply to surgical patients, including those undergoing total joint replacement, updates in the pharmacology of local anesthetics and nerve blocks in patients undergoing surgery, as well as how to optimize outcomes in surgical patients. All fellows presented scholarly activity at the symposium as a culmination of their scholarly activity efforts during the fellowship.
The University of Pittsburgh School of Medicine designated the live activity for a maximum of 7.0 AMA PRA Category 1 Credits. The symposium was sponsored by the University of Pittsburgh Physicians Department of Anesthesiology and the University of Pittsburgh School of Medicine Center for Continuing Education in the Health Sciences.

**Regional Anesthesiology Fellow Post-graduation Plans**

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Alexandra Belfar, MD</td>
<td>Allegheny General Hospital</td>
</tr>
<tr>
<td>Douglas S. Bentley, MD</td>
<td>Staff anesthesiologist at UPMC South Side/East</td>
</tr>
<tr>
<td>Vikram Bhasin, MD</td>
<td>Staten Island University Hospital</td>
</tr>
<tr>
<td>Brandon Chinn, MD</td>
<td>Faculty, UPMC</td>
</tr>
<tr>
<td>Samantha Dao, MD</td>
<td>Staff anesthesiologist, Florida</td>
</tr>
<tr>
<td>Shimon Frankel, MD</td>
<td>Undecided at press time</td>
</tr>
<tr>
<td>Brian Greenberg, MD</td>
<td>Staff anesthesiologist at White Plains Hospital, New York, NY</td>
</tr>
<tr>
<td>Stephanie Jean-Noel, MD</td>
<td>University Physicians of Brooklyn</td>
</tr>
<tr>
<td>Nicholas J. Schott, MD</td>
<td>Assistant Professor, University of Pittsburgh</td>
</tr>
<tr>
<td>Plinio Silva, MD</td>
<td>Assistant Professor, University of Pittsburgh</td>
</tr>
<tr>
<td>Rachel Stahl, MD</td>
<td>Assistant Professor of Anesthesiology, University of Rochester Medical Center</td>
</tr>
<tr>
<td>Rae Stewart, MD</td>
<td>NYU Lutheran Medical Center</td>
</tr>
<tr>
<td>David Sum, MD</td>
<td>Undetermined</td>
</tr>
<tr>
<td>Dinah White, MD</td>
<td>General anesthesiologist, Cleveland Clinic Foundation</td>
</tr>
</tbody>
</table>
On Friday, June 9th, the UPMC Anesthesiology resident and fellow classes of 2017 celebrated their graduation at the University Club in Oakland, PA.

Derek Lauter, MD was honored with the Mark H. Gilland, MD Award for the Best Clinical Resident. Richard Hubbard, MD was recognized as the Best Resident Scholar. Anesthesiology attendings were also recognized for their dedication to resident and medical student education. Stephen McHugh, MD, an anesthesiologist at UPMC Shadyside and a 2012 graduate of our residency program, was presented with the Leroy Harris Award for Excellence in Teaching. William McIvor, MD from UPMC Presbyterian received the Peter M. Winter Award for Excellence in Medical Student Teaching. Others were honored with the distinction of Excellence in Clinical Teaching of Residents: Lauri Adler, MD; Scott Brancolini, MD, MPH; Brian Gierl, MD; James Ibinson, MD; James Luther, MD; Steven Orebaugh, MD; Dennis Phillips, MD; Filippo Sanfilippo, MD, PhD, EDIC; Anthony Silipo, DO; Doreen Soliman, MD; Edward Teeple, MD; Keith Vogt, MD, PhD; and William Wallisch, MD.

The graduation ceremony marked the end of four years of hard work for our 20 resident graduates. They collectively delivered anesthetics to 25,920 patients, 2,554 of which were children; assisted 3,745 mothers in childbirth, including 2,489 vaginal deliveries and 1,256 C-sections; performed 5,042 peripheral nerve blocks; and conducted medical missions in Bangladesh, Bhutan, Guatemala, Zambia, and Vietnam. All have great career paths ahead of them. Sixteen graduates will pursue fellowship training in the following subspecialties: five in pediatric anesthesiology, two in adult cardiothoracic anesthesiology, one in regional pain, one in obstetric anesthesiology, two in critical care medicine, four in pain medicine, and one in OR management. One resident will become an attending within the UPMC system, and three others will join private practice groups in Lancaster, PA, Westmoreland, PA, and Roanoke, VA. Congratulations to the UPMC Anesthesiology resident and fellow classes of 2017 and good luck in all your future endeavors!
MEDICAL STUDENT PROGRAMS

The Department of Anesthesiology medical student programs are recognized nationally as among the best in the nation. Under the leadership of Dr. Michael Mangione, faculty members continued their enthusiastic participation in clinical teaching during the anesthesiology clerkship and in the electives offered by the Department in academic year 2016-2017. The department maintained a strong presence throughout the four-year University of Pittsburgh School of Medicine (UPSOM) curriculum.

CLINICAL PROCEDURES COURSE

The Clinical Procedures Course is designed for second-year medical students just prior to the start of clinical rotations and Drs. Rita Patel and Ryan Romeo are the course directors. This four-week course consists of brief introductory lectures followed by “hands-on” sessions. Medical students studied the details of airway assessment and endotracheal intubation under the leadership of Patricia Dalby, MD. They received a brief introduction to hemodynamic monitoring and interpretation of blood-gas reports in the session led by Dr. Kristin Ondekko Ligda. Students learned how to perform lumbar punctures with Thomas Chalifoux, MD, nasogastric tube insertion with Dr. Peter Bulova (Associate Professor of Internal Medicine), and Foley catheter insertion during sessions with Drs. Raymund Ramirez and Katherine Theisen (residents in Urology). Under the guidance of session leaders Drs. Catalin Ezaru and Robert Krohner, they utilized universal precautions and performed intravenous cannulation and venipuncture.


We are unique among anesthesiology departments because of our faculty’s extensive involvement in pre-clinical medical student education. In very few U.S. medical schools are pre-clinical courses directed by clinical department faculty members. Based on written evaluations from the medical students, the Clinical Procedures Course received an overall approval rating of 88%. Students said they valued the opportunity to learn these basic procedures prior to performing them on patients.

SURGERY AND PERIOPERATIVE CARE CLERKSHIP

The mandatory Surgery and Perioperative Care Clerkship for third year medical students consists of an eight-week course directed by Drs. Michael Mangione (anesthesiology segment) and Peter Ferson (surgery segment). The surgery and anesthesiology portions of the course are fully integrated in terms of coordination, although the grades are generated separately. The curriculum for the anesthesiology portion underwent a revision that was instituted at the beginning of the School of Medicine academic year. This effort was led by Dr. Mangione and residents Rachel Pool and Lauren Parker. The new curriculum reflects updated concepts and issues relevant to medical education for all students.

The anesthesiology portion of the course is an intensive two-week introduction to the practice of perioperative medicine. This rotation is intended to develop knowledge, skills, and patient-management principles that are vital for all physicians. The course is structured around a detailed curriculum with a 10-day didactic and clinical program.
Students rotate through four on-campus sites (UPMC Presbyterian, UPMC Montefiore, Magee-Women’s Hospital of UPMC, and the VAPHS) and four community-based sites (Children’s Hospital of Pittsburgh of UPMC, UPMC Mercy, UPMC Shadyside, and UPMC St. Margaret), where they receive extensive clinical experience. While completing the two-week anesthesiology portion of the clerkship, students also attend four required sessions at the Peter M. Winter Institute for Simulation Education and Research (WISER) under the direction of Dr. William McIvor and his faculty. This portion of the course continues to be very successful; in written evaluations, students described the simulation sessions as “outstanding.” Students also spend one morning of the anesthesiology rotation at Western Psychiatric Institute and Clinic of UPMC (WPIC). This experience allows students to receive concentrated exposure to bag-mask ventilation, a critical skill for future physicians. During this clerkship, department faculty members regularly present four didactic lectures: “Preoperative Evaluation,” “Cardiac Evaluation for Non-Cardiac Surgery,” “Cardiac Physiology,” and “Acute Pain Management.” A review session occurs at the end of the course and is conducted by members of the PGY-4 residency class. The anesthesiology residents are a key component to the department’s teaching efforts. Their effectiveness as educators has been rated at 88% over the last two years.

A Medical Student Clinical Coordinator at each site is responsible for the education of students assigned to that site. Coordinators follow a formal curriculum (“Ten-Day Program”) and assign students to various attending physicians to provide one-on-one teaching in the operating room and to offer clinical performance feedback to the student, course director, and School of Medicine. Coordinators are also readily available to answer pertinent questions regarding subspecialties and to review clinical scenarios.

Thanks to the teaching efforts of the faculty, this course enjoyed another very successful year, as evidenced by excellent evaluations and feedback. Students continue to give excellent evaluations of the quality of the clerkship. Ninety percent of the medical students for the 2016-17 academic year rated the clerkship as outstanding or good. Ninety-nine percent of the students rated the overall teaching as good quality. The trend of excellent teaching by residents and fellows continued its upward ascent, with a 96% approval for the last academic year.

ELECTIVES

One month-long electives provide in-depth exposure to anesthesiology. Four electives are offered:

- **General Anesthesiology**, which provides advanced training in the clinical practice of anesthesiology in both the operative setting and through a specialized simulation curriculum. The elective is guided by a detailed curriculum emphasizing advanced problem solving concepts and case studies. In addition, students are required to give a presentation during their rotation. This requirement, guided by the faculty, furthers students’ skills in performing critical literature analyses, making evidence-based recommendations, and presenting the material to their colleagues. At the VAPHS, for example, the senior medical student presentation is a staple of the Wednesday morning lecture series. Coordinators include the following faculty: Drs. Romeo, Hall-Burton, Montoya, Ezaru, Ondecko, and Hayanga. In addition to hosting UPSOM medical students, the anesthesiology elective is very popular with visiting medical students from other institutions, many of whom end up matching with our residency program. Twenty-six students participated in this elective.

- **Anesthesiology Research**, which provides opportunities for students to pursue scholarly activities in basic research in either a laboratory or clinical setting.

- **Subspecialties in Anesthesiology**, which provides an opportunity for students to develop expertise in one or more of the anesthesiology subspecialties.

- **Pain Medicine**, coordinated by Dr. Scott Brancolini, provides exposure to acute and chronic pain patients.
Medical students who learn basic principles of pain management will develop increased confidence in reducing their patients’ pain and will understand proper timing for consulting pain medicine specialists. Dr. Brancolini supervises students who rotate through this specific elective. Eight students participated in this elective.

Due primarily to the enthusiastic involvement of the faculty, as evidenced by evaluations, these electives continue to be well-received.

**FAER SUMMER RESEARCH FELLOWSHIP**

The Department of Anesthesiology was one of 37 sites nationwide selected to host trainees as part of the 2017 Foundation for Anesthesia Education and Research (FAER) Medical Student Anesthesia Summer Research Fellowship (MSARF) program in the summer of 2017. This program was created to encourage talented medical students to consider careers in anesthesiology research and perioperative medicine and offers medical students an eight-week anesthesiology-related research experience. MSARF fellows can present research abstracts at the American Society of Anesthesiologists annual meeting. The department has hosted at least one student every summer since 2008 and a total of 16 students have participated in the fellowship. This year’s student was Matthew Orlowski (West Virginia University School of Medicine), whose project, “Effects of Tolerance of Morphine Induced Interactions Between PDGFR-beta and EGFR in Rat Models” was sponsored by Dr. Howard Gutstein.

**SCHOLARLY PROJECTS**

UPSOM students are required to undertake a mentored longitudinal scholarly activity beginning in their second year and concluding in their final year. There is broad latitude in the choice of topic with the restriction that it must be medicine- or healthcare-related. Students are to read and critically evaluate scientific and medical literature, present a research proposal and receive direct feedback from faculty and other students on that proposal, perform a research project under direct mentorship from an expert in that field, present the research project in both informal and formal collegial venues, discuss, troubleshoot, and critique the research, and present the research to their colleagues in their medical school class.

Several of our faculty members continued to serve as mentors for scholarly projects in academic year 2016-17.

<table>
<thead>
<tr>
<th>Mentor</th>
<th>Student</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibtesam Hilmi, MB CHB, FRCA</td>
<td>Brian Guedes</td>
<td>Quality of Clinical Outcomes in Patients with and without Dialysis Treatment Prior to Renal Transplantation</td>
</tr>
<tr>
<td>Ajay Wasan, MD</td>
<td>Claire Paduano</td>
<td>Pain Matrix Activity following Negative Mood Induction in Patients with Chronic Lower Back Pain</td>
</tr>
<tr>
<td>Jonathan Waters, MD</td>
<td>Megan Milne</td>
<td>Modification of Red Blood Cell Rheology and Shear Induced Hemolysis during Pregnancy</td>
</tr>
</tbody>
</table>
ANESTHESIOLOGY INTEREST GROUP
The Anesthesiology Interest Group (AIG) that was formed by two third-year University of Pittsburgh medical students in 2005 continues to thrive, with Dr. Mangione serving as Faculty Mentor. This group welcomes students from all four years of medical school who are interested in our specialty. Meeting topics have included the application process, residency programs, and the residency match. Students at all levels, including AIG leaders Ragini Gupta and Milap Rakholia, generated a great deal of enthusiasm among their peers. An increasing number of students have been accepted into the ASA Student Membership component. Departmental support was also provided about the AIG’s lunch and social meetings, which were well attended by both faculty and residents. Our faculty and residents continue to enthusiastically support the students’ efforts.

SPECIALTY NIGHT
Each spring, our department chair, vice chair for education, residency and medical student program directors, along with several faculty and residents, host a “Specialty Night” for University of Pittsburgh students who are in their final year of medical school. This proves to be an excellent forum for students who are interested in our specialty to learn about anesthesiology, as well as our residency program application process. The 2017 Specialty Night took place on June 15th.

Four UPSOM students (Class of 2016) matched into anesthesiology residencies:
- Alessandra Cardi – Hospital of University of Pennsylvania
- Ragini Gupta – Hospital of University of Pennsylvania
- Rajan Mannmohan – University of Arizona
- John Seely – University of Virginia

UPSOM MEDICAL STUDENTS IN THE MATCH, 2006-2017
Comprising 12 classes between 2006 and 2017, 96 medical students entered the anesthesiology match. A total of 99% (95/96) matched successfully. Half of these medical students matched into programs ranked in the top 10 residency programs by US News and World Report, including 24 into the University of Pittsburgh residency. Over 80% of these medical students matched into programs ranked in the top 25.

ROBERT L. WILLENKIN AWARD
Each year at the medical student award banquet, one senior medical student is recognized as the best student in anesthesiology. The 2017 awardee was Ragini Gupta. For the 2016-17 academic year, the award was renamed after former Vice Chair of Education Dr. Robert L. Willenkin.

Dr. Willenkin came to the University of Pittsburgh in 1982 by way of Yale University and then the University of California at San Francisco. He served on the faculty from 1982 until retiring as Professor Emeritus in 1996. Dr. Willenkin was a local and national leader in anesthesiology education during his career. He served as Vice Chair for Education in the Pitt Department of Anesthesiology and presented more than 60 invited national lectures during his career and beyond. In 1984 he became one of the founding members of the Society for Education in Anesthesia (SEA), an organization in which he continues to be active. In 1998, he received the Prestigious SEA-Duke University Award for Excellence and Innovation in Anesthesia Education.
HONORS AND SERVICE
This year, the Department of Anesthesiology awarded the Peter M. Winter Award for Excellence in Medical Student Teaching to Dr. William McIvor, who was recognized for his outstanding contributions to the medical student program and high teaching evaluations from students. This award is named in honor of our former department chairman, Dr. Peter M. Winter, who successfully helped build our department into one of the nation’s largest academic departments of anesthesiology.

Dr. Rita M. Patel is a member of the UPSOM Executive Committee. Drs. William McIvor and Rita M. Patel served on the School of Medicine’s Curriculum Committee. Dr. Michael Mangione also served on several School of Medicine committees such as the Medical Student Promotions Committee and the Retention Committee. Drs. Patricia Dalby and William Simmons served on the UPSOM Admissions Committee.

Faculty members Drs. Charles Boucek, Patricia Dalby, William McIvor, David Metro, Joseph Quinlan, and Ryan Romeo served as UPSOM applicant interviewers.

EDUCATIONAL CREDIT UNITS (ECUS)
Our faculty participated in various medical student activities such as small group sessions and problem-based learning sessions in the first-year course “Introduction to Being a Physician.” Second year courses taught by our faculty include “Integrated Case Studies,” “Basic Science of Care,” and “Clinical Procedures.” Our faculty served as facilitators for mandatory simulator sessions taught to third and fourth year students during the Surgery & Perioperative Care Clerkship and the Anesthesiology Elective. Several faculty members participated in the lecture series conducted during the Surgery & Perioperative Care Clerkship.

The administrative activities category of the ECU report encompasses administrative responsibilities of those faculty members who serve as Medical Student Course Directors for Clinical Procedures, the Surgery & Perioperative Care Clerkship, and the various Anesthesiology Electives. Additional ECU categories include scholarly project mentoring, research elective mentoring, and advising activities. The University of Pittsburgh committee activities category of the ECU report includes participation in various committees such as the Curriculum, Promotions, and Retention Committees, as well as the Dean’s Applicant Interviewer and Ethics & Professionalism Task Force. Several of our faculty members served as members on each of these formal committees.

Our faculty’s teaching activities were also well represented in the graduate student ECU categories. Instructional activities included teaching small group sessions and lecturing in such courses as Neuropharmacology, Biology of Signal Transduction, and Cellular & Molecular Neuroscience. Faculty also participated in graduate student mentoring and advising activities. We received credit in additional ECU categories for graduate student teaching such as lab supervision and graduate program administrative committees.
This abstract was an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

CRITICAL EVALUATION OF CLOTTING TIMES OF ROTATIONAL THROMBOELASTOMETRY

E. Abuelkasem, MBCh, MSc\textsuperscript{1}, S. Hasan, MHS\textsuperscript{2}, S. Singh, BS\textsuperscript{3}, K. Tanaka, MD, MSc\textsuperscript{2}

\textsuperscript{1}Department of Anesthesiology, UPMC, \textsuperscript{2}University of Maryland School of Medicine, \textsuperscript{3}University of Central Florida College of Medicine

BACKGROUND
Coagulopathy and bleeding are major challenges after complex cardiac surgery using cardiopulmonary bypass (CPB). Thromboelastometry (ROTEM®) has been shown to be effective in guiding hemostatic therapies after CPB. Decreased plasma coagulation factor levels are usually diagnosed by prolonged CT on EXTEM, which is often used interchangeably with FIBTEM CT. However, evaluation of EXTEM and FIBTEM CT for interchangeability has not been done before. (1,2)

HYPOTHESIS
FIBTEM-CT is shorter than EXTEM-CT because FIBTEM reagent contains cytochalasin-D (CD), which speeds up thrombin generation.

AIMS
Specific aims of this study were:
• To investigate whether there a difference between EXTEM and FIBTEM CT values at the clinical level (retrospective).
• If there is a difference, investigate whether CD is responsible for EXTEM and FIBTEM CT difference (ex vivo experiment).

METHODS, RETROSPECTIVE PORTION
Retrospective chart review included ROTEM® data from cardiac surgical patients treated at the University of Maryland Medical Center from October 2015 to May 2016. The measurements were done either at baseline, during rewarming on CPB, or after protamine reversal of heparin anticoagulation. The difference between the mean EXTEM-CT and FIBTEM-CT (seconds [sec]) values were calculated and were compared using Mann Whitney test; a p-value of < 0.5 was considered significant.

RESULTS, RETROSPECTIVE PORTION

<table>
<thead>
<tr>
<th>CT (sec)</th>
<th>Mean</th>
<th>SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (N=118)</td>
<td>EXTEM</td>
<td>76.1</td>
<td>31.1</td>
</tr>
<tr>
<td>CPB (N=73)</td>
<td>FIBTEM</td>
<td>71.4</td>
<td>30.5</td>
</tr>
<tr>
<td>Post protamine (N=111)</td>
<td>EXTEM</td>
<td>82.5</td>
<td>17.3</td>
</tr>
<tr>
<td>Post protamine</td>
<td>FIBTEM</td>
<td>74.9</td>
<td>18.4</td>
</tr>
</tbody>
</table>

Table 1: Paired statistics of retrospective EXTEM and FIBTEM CT values.

METHODS, EX VIVO PORTION
Thrombin generation (TG) assays were run using platelet-rich plasma which, was diluted in 1:3 volume ratios with normal plasma (NP). Plasma samples were tested for TG using Calibrated Automated Thrombinscope (CAT®) before and after addition of CD at a volume of 5.33 μM (which matches the amount of CD in FIBTEM reagent). The median and IQR (sec) of lag times of TG were compared using Mann Whitney test. A p-value of <0.05 was considered statistically significant.
RESULTS, EX VIVO PORTION

<table>
<thead>
<tr>
<th></th>
<th>Median</th>
<th>IQR (25-75) %</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag time-NP(sec)</td>
<td>220.2</td>
<td>(210.7-236.8)</td>
<td></td>
</tr>
<tr>
<td>Lag time-NP+CD(sec)</td>
<td>139.8</td>
<td>(71.8-178.6)</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Table 2: Ex vivo TG data (NP vs. NP+CD). Data expressed in Median and IQR. * Mann Whitney test.

DISCUSSION

The prelim analysis indicates that FIBTEM-CT is shorter than EXTEM-CT for cardiac surgical patients at baseline and post-protamine, but not during CPB, which may be secondary to extreme inhibition of TG by systemic heparinization. This finding was reproduced in the ex vivo experiment, which showed a shorter lag time of TG in samples mixed with CD compared to NP only. This CD “enhancing” effect on TG and hence shorter FIBTEM CT may be due to the release of procoagulant microparticles from the surface of activated platelets. (3)

CONCLUSION

In conclusion, EXTEM-CT and FIBTEM-CT do not appear to be interchangeable because of the effect of CD on FIBTEM-CT.

POSSIBLE IMPLICATIONS

Patients with significantly discrepant EXTEM/FIBTEM CTs may have highly functioning platelets and may not need any hemostatic interventions despite prolonged EXTEM CT, so combined EXTEM/FIBTEM assays may be recommended. Further studies are needed.

REFERENCES


This abstract was presented as a poster at the Association of University Anesthesiologists 64th Annual Meeting, Washington, DC, May 4-5, 2017 and the Annual Meeting and International Science Symposium of the International Anesthesia Research Society, Washington, DC, May 6-9, 2017. It was also an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

CEREBRAL VASCULAR THROMBOSPONDIN-1 ASSOCIATES WITH THE EPSILON 4 ALLELE OF APOLIPOPROTEIN E IN ALZHEIMER’S DISEASE

Jessica Cassavaugh, MD, PhD; Caitlin A. Czajka, PhD; Grace Lee; Caterina Rosano, MD; Julie Kofler, MD; Eric McDade, OD; Jeffrey S. Isenberg, MD, MPH

1Department of Anesthesiology, 2Heart, Lung, Blood and Vascular Medicine Institute, 3Graduate School of Public Health, 4Department of Pathology, University of Pittsburgh School of Medicine, Pittsburgh PA, 5Department of Neurology, Washington University School of Medicine, St. Louis, MO

BACKGROUND

Alzheimer Disease (AD) is a global epidemic expected to affect over eight million people in the United States by 2030. Inhaled anesthetics have been shown to increase beta (β)- amyloid in pre-clinical models. β-amyloid deposition within cerebral blood vessels, termed cerebral amyloid angiopathy (CAA), is found in up to 80% of patients with AD, and alters vascular integrity promoting micro- and intralobar-hemorrhage and stroke. The matricellular protein thrombospondin-1 (TSP1) is a dominant inhibitor of the pleiotropic effects of vascular nitric oxide (NO) and has been linked to aging vasculopathy in animals and people.
HYPOTHESIS
TSP1 is induced in AD-associated cerebral amyloid angiopathy.

METHODS
Quantification within cerebral vessels of immunofluorescent TSP1, as well as CCA and markers of reactive nitrogen and oxygen species (RNS and ROS), was performed in post-mortem brain tissue sections from a cohort of 24 individuals with clinically document advanced AD and further assessed in relation to expression of epsilon alleles 3 and 4 of apolipoprotein E (ApoE3 and 4). Samples were histologically graded for severity of CAA.

RESULTS
Immuno-reactive β-amyloid and TSP1 were significantly elevated in sections from individuals with the ApoE4 allele (ApoE3/4) when compared to individuals with only ApoE3 alleles (ApoE3/3). Additionally, vascular TSP1 expression was significantly decreased in women younger than 80 years old compared to women over 80. Conversely, vascular TSP1 expression was stable in cerebral vessels from elderly men, suggesting an age-dependent sex association.

Markers of ROS and RNS were significantly elevated in cerebral vessels with severe CAA compared to mild CAA burden, but were not altered as a function of ApoE allele expression.

DISCUSSION/CONCLUSIONS
These results for the first time demonstrate (1) a strong association in cerebral vessels of AD patients between anti-angiogenic TSP1 and the clinically more severe ApoE4 allele and (2) an association between vascular ROS and RNS with severe CAA burden. Future directions include examining the possible relationship between CAA and inhaled anesthetics with post-operative microhemorrhage and cognitive decline.

REFERENCES

This abstract was presented as a poster at the annual meeting of the Annual Pain Society, Pittsburgh, PA, May 18, 2017. It was also presented at the Society for Education in Anesthesia (SEA) 32nd Spring Annual Meeting, April 27-30, 2017, Jacksonville, FL.
Among 150 keywords per ITE since 2013, a total of 99 keywords with less than a 50th percentile of correct answers from UPMC fellows were selected and assigned to eight fellows from the class of 2017. After literature review, the fellows organized relevant information into one-page templates, which were reviewed by attending physicians for quality control. One month prior to the 2016 ITE, fellows discussed their keywords in a review session and had access to the entire database. Average ITE scores were analyzed using unpaired t-test.

Average ITE score was 60.6 in 2013 (SD 6.63, n=8), 58.6 in 2014 (SD 4.53, n=11), 66.1 in 2015 (SD 5.64, n=9), and 70.4 in 2016 (SD 6.09, n=8). The increase in the 2016 average ITE score was statistically significant compared to the average 2013-2015 score of 63.5 (SD 6.6, p=0.004). There was no statistical difference between scores in 2015 and 2016, likely due to the small sample size.

Despite the preliminary nature of the study, we believe a keyword database can serve as an effective educational tool by addressing topics with the most knowledge gaps. Also, fellowship programs can identify areas in need of more exposure and improve the curriculum accordingly. We plan to continue keyword analysis with future ITEs and expand the database to create a useful resource for residents and fellows interested in chronic pain medicine.

This abstract was an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

**UTILITY OF PECTORAL BLOCK FOR ANTERIOR RIB FRACTURES**

Douglas Curphey, MD
Department of Anesthesiology, University of Pittsburgh

Significant mortality is associated with multiple rib fractures, particularly with advancing age. Regional analgesic techniques such as thoracic epidural block or paravertebral block are recommended for analgesia and to minimize risk of post traumatic pneumonia. Pectoral nerve block (Pecs block) is an ultrasound-guided, interfascial plane block intended to provide anesthesia or analgesia of the upper anterior chest wall. Here, we successfully utilized Pecs blocks to achieve clinically significant analgesia in two patients with anterior rib and sternal fractures. The Pecs block is advantageous because it avoids that neuraxial region, provides good coverage of the anterior chest wall, and requires minimal patient positioning. Our findings suggest a viable alternative regional-anesthetic option in polytrauma patients with pain originating from the anterior chest.

This abstract was presented as a poster at the Society for Education in Anesthesia (SEA) 32nd Spring Annual Meeting, April 27-30, 2017, Jacksonville, FL.

**FEASIBILITY OF STRUCTURED BASIC TRANSESOPHAGEAL ECHOCARDIOGRAPHIC EDUCATION AMONG ANESTHESIOLOGY RESIDENTS**

Kathirvel Subramaniam, MD, MPH; Luke Doney, MD; Sofiane F. Lazar, MD

**BACKGROUND**

Transesophageal echocardiography (TEE) is an important tool for clinical anesthesiologists in almost every practice setting. Bringing structured TEE education to an anesthesia residency program can improve competency in basic echocardiography skills, increase numbers of TEE exams performed, and allow residents an opportunity to become certified in basic TEE skills.
NEEDS ASSESSMENT
The amount of time dedicated to resident education in TEE remains inconsistent across many residency programs. This structured curriculum provided residents with a knowledge of basic TEE skills that can be translated to any future practice setting, a training they might not have otherwise received through a traditional training program. Additionally, the curriculum afforded residents the opportunity to become certified in basic TEE examination upon completion of the course, an objective attestation of the course’s efficacy.

CURRICULUM DESIGN
Two months of perioperative TEE training was provided for interested residents during their PGY-4 year. In preparation for the rotation, residents were given reading materials, as well as TEE simulation to provide spatial orientation to 2D TEE views. Rotations were completed in four different hospitals where cardiac surgeries were performed. During the rotation, residents were given a dedicated number of TEE days in a week, without any conflicting patient care commitment. Specific goals and expectations were provided on a weekly basis for the first month of the rotation. The second month gave residents the ability to utilize the skills they learned in the first month to complete the required number of TEE exams in order to take the TEE examination and certification. At the end of the rotation, the rotation director reviewed and evaluated documentation and logs of the TEE exams with the resident. Residents were then required to complete a post-test to pass the rotation. Completion of the post-test allowed residents the opportunity to take the TEE certification exam if they so chose.

CURRICULUM EVALUATION
The main levels of evaluation for the course were feedback by the rotation director on logs performed, number of logged TEE examinations by the residents, and completion of the post-rotation examination. Successful completion of the examination along with completion of required clinical training (150 TEE examinations, 50 personally performed) deemed the residents eligible for TEE certification. After completion of the residency program, surveys will be given to all residents in order to evaluate the usefulness of the rotation in regards to their current practice in anesthesiology.

This abstract was a case report poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

MANAGEMENT OF A PATIENT WITH PALLISTER-HALL SYNDROME AND A HISTORY OF DIFFICULT INTUBATION: A CASE REPORT

Melanie Catherine Hodge, MD and Li Meng, MD, MPH
Department of Anesthesiology, UPMC

INTRODUCTION
Pallister-Hall syndrome (PHS) is a rare, genetic condition caused by a defect in the transcription factor gene GLI3 (1). Clinical features commonly associated with PHS include polydactyly, hypothalamic hamartoma, and bifid epiglottis. We report a case of a patient with PHS and a known difficult airway and discuss the anesthetic plan and implementation.

CASE PRESENTATION
A 67-year-old male with a history of PHS, hypothalamic hamartoma, gelastic seizures, polydactyly, hypertension, OSA, testosterone deficiency, and diabetes presented to our institution for an MRI-guided laser thermal ablation of his seizure focus. He denied any renal or cardiac disease. His surgical history included amputation of his polydactyly digits as an infant and sinus surgery. He had a known history of a “difficult airway” requiring a flexible fiberoptic bronchoscope for successful intubation (after multiple attempts with direct laryngoscopy). His blood chemistries, CXR, and EKG were unremarkable. Airway exam revealed a normal cervical range of motion, Mallampati score of IV, reduced mouth opening, and a thyromental distance of 2 cm. Given his history of difficult intubation, the anesthetic plan included an awake fiberoptic intubation. The procedure was fully explained and written consent was obtained.

Standard monitors were applied. Glycopyrrolate was provided for reduction in secretions, midazolam provided anxiolysis, and dexmedetomidine was given for sedation. Lidocaine nebulizer and oxygen was applied via a face mask. For further oropharyngeal anesthesia, pledgets soaked in 4% lidocaine were applied to the base of the palatoglossal arch bilaterally.
An awake fiberoptic intubation was successfully performed. General anesthesia was then induced. For further analysis, an evaluation of the airway was performed using a video laryngoscope (size 3 blade), which revealed his bifid epiglottis (Figure 1). The patient tolerated both the anesthesia and procedure without complications.

DISCUSSION
First described in 1980, PHS is a rare, genetic disorder that can be diagnosed when a specific combination of clinical features exists (2). Most cases of PHS are inherited in an autosomal dominant manner. However, some cases do result from new genetic mutations of GLI3. Confirmation of PHS is obtained via molecular genetic testing (1). Features of PHS may include polydactyly, bifid epiglottis, hypothalamic hamartoma, renal and neuroendocrine abnormalities, imperforate anus, and pulmonary lobulation anomalies (2). In patients with PHS, a possible neurologic complication of hypothalamic hamartoma is gelastic seizures, which are partial complex seizures that simulates laughter via movements of the chest and diaphragm (1).

CONCLUSION
Administering anesthesia to a patient with PHS presents unique challenges for the anesthesiologist. Due to the possibility of airway anomalies, a comprehensive review of systems and mindful preparation of airway management is imperative.

REFERENCES
TEACHING ANATOMY TO PRECLINICAL MEDICAL STUDENTS UTILIZING REGIONAL ANESTHESIA INSTRUCTION: A PILOT STUDY

Richard Hubbard, MD; Kaarin Michaelsen, MD, PhD;
Kristin Ondecko Ligda, MD; Steven Orebaugh, MD
Department of Anesthesiology, UPMC

INTRODUCTION
For centuries, anatomical education of medical students emphasized dissection of cadavers, supplemented with didactic lectures; however, new interactive and three-dimensional (3-D) learning tools have begun to change this paradigm. Concurrently, clinically-relevant learning has become a major emphasis in undergraduate medical education. Extant research on medical student instruction in regional anesthesia remains extremely sparse, and, to date, no work has yet been published correlating anatomic knowledge in pre-clinical medical students with regional anesthesia education.

HYPOTHESIS/GOALS
This study sought to determine whether multimodal instruction in regional anesthesia results in improved knowledge of neck and axillary anatomy in pre-clinical medical students. It was hypothesized that using clinically-relevant, multimodal anatomy training as part of a designated regional anesthesia course would demonstrate improved understanding of relevant anatomic structures, as assessed on written exams.

METHODS
Pre-clinical medical students who voluntarily enrolled in a regional anesthesia course were included in the study. The class met for 90 minute sessions weekly for one month. Each session included a brief lecture, followed by interactive modules including: gross anatomic review with ultrasound image correlations, 3-D anatomical review of the neck and axilla, training with ultrasound probe and needle manipulation, and ultrasound scanning on live models. Participants were given an identical 12-question multiple choice exam on gross and ultrasound anatomy before and after the course (Table 1). A paired, two-tail T-Test was used to compare scores. A survey on student perceptions of the course was also completed, utilizing a five-level Likert scale.

RESULTS
Fourteen students completed the course. Average scores improved from 6.21 to 9.14 correct answers when comparing the pre- and post-course samples (p<0.001, 95% CI 1.52-4.33). A total of 85.7% of respondents reported that the course met their expectations to a “considerable” or “very high” degree, and 100% assessed the course as “good” or “outstanding.” A significant difference was found in Likert scores for hands-on learning sessions (mean 4.85/5) versus instructional teaching sessions (mean 4.15/5, p<0.001, unpaired two sample T-Test, Figure 1).

DISCUSSION/CONCLUSION
As medical education evolves, methods of making anatomy both clinically-relevant and interactive have been sought. This study suggests that combining instruction in regional anesthesia with the teaching of anatomy will improve anatomic knowledge, as demonstrated on written exams. Further, participants’ subjective experiences of the course were strongly positive, in particular those portions which involved hands-on learning.

REFERENCES


TREATMENT PATTERNS FOR RESPIRATORY DISTRESS SYNDROME IN LOW-RESOURCE SETTINGS: A REPORT FROM BANGLADESH

Richard Hubbard, MD1; Grace Lim, MD, MS1; David Seng, DO1; Kamal Choudhury, MBBS2

1. Department of Anesthesiology, UPMC; 2. Department of Pediatric Surgery, BIRDEM-II Hospital

INTRODUCTION

Respiratory Distress Syndrome (RDS) is a disease of inadequate endogenous surfactant production and immature lung anatomy, typically affecting premature neonates.1,3 Advances in neonatal critical care have led to an 85% mortality reduction in wealthy nations.4 However, RDS remains the leading cause of neonatal death in low-income countries, where resources for respiratory support (continuous positive airway pressure and/or mechanical ventilation) and surfactant replacement may be limited, or non-existent.2,4 Even if available, the cost of care may limit access for the sickest children.5

OBJECTIVES

The objective was to identify practice patterns in the care of RDS-afflicted neonates in the developing world and to isolate risk factors for mortality prior to discharge in this population.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Survived</th>
<th>Died</th>
<th>Unadjusted OR (95% CI)*</th>
<th>Adjusted OR (95% CI)</th>
<th>Unadjusted p value</th>
<th>Adjusted p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Invasive</td>
<td>21</td>
<td>37</td>
<td>79.3 (12.1-423.8)</td>
<td>101.5 (7.1-1099.9)</td>
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<td>17</td>
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<td>≥ 1500g</td>
<td>51</td>
<td>5</td>
<td>22.4 (7.1-88.1)</td>
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</table>

*OR = Odds Ratio, CI = Confidence Interval

Table 1: Univariate and multivariate analysis of suggested risk factors for mortality
METHODS
This retrospective, observational study included all neonates diagnosed with RDS at a tertiary care facility in Bangladesh between July 2015 and June 2016. The primary endpoint was death prior to discharge. The presence/absence of the following hypothesized risk factors for mortality were recorded: gestational age less than 32 weeks, birth weight less than 1500g, vaginal delivery, birth outside the study location (a tertiary care facility), diagnosis of sepsis, and requirement for intubation/mechanical ventilation. Univariate analysis of each factor on the primary endpoint was completed utilizing the Fischer’s Exact Test. Adjusted odds ratios for mortality were completed utilizing a multivariate regression analysis.

RESULTS
A total of 104 neonates were included in the study, of whom 38 died (mortality 36.5%). Of all babies who died, 97% were mechanically ventilated prior to death. Of those who were mechanically ventilated, 22% received surfactant. Univariate analysis found a significant link between the following risk factors and mortality: mechanical ventilation, birth outside the study facility, vaginal delivery, gestational age less than 32 weeks, and birth weight less than 1500g (Table 1). However, adjusted odds ratios based on the multivariate analysis suggested only mechanical ventilation and birth weight less than 1500g as independent risk factors for mortality. Univariate and multivariate subgroup analysis on invasively ventilated patients demonstrated a trend towards mortality benefit with surfactant administration, but was not statistically significant (Table 2).

<table>
<thead>
<tr>
<th>Mechanically Ventilated Patients</th>
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<tr>
<td><strong>Surfactant use</strong></td>
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<tr>
<td>Yes</td>
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</table>

Table 2: Subgroup analysis of ventilated patients

DISCUSSION
As low-income countries develop economically, attempts have been made to modernize neonatal care. The results of this study demonstrate an adequate availability of mechanical ventilator support at the study site, while simultaneously showing a very low utilization of surfactant replacement therapy.

CONCLUSION
In relation to neonatal mortality, multivariate analysis demonstrated a significant relationship only to low birth weight, and mechanical ventilation. Though not statistically significant, a clear trend towards survival benefit in surfactant replacement in mechanically ventilated patients was demonstrated.

REFERENCES
This abstract was an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

ANALYSIS OF PACU TIMES FOLLOWING ACL SURGERY FOR VARIOUS NERVE BLOCK TECHNIQUES

Andrew R. Hulme, MD; Michael L. Kentor, MD; Steven L. Orebaugh, MD
Department of Anesthesiology, University of Pittsburgh School of Medicine

INTRODUCTION
Patients undergoing anterior cruciate ligament (ACL) surgery have varying levels of pain and nausea in the post-anesthesia care unit (PACU). Patients with less pain/nausea leave the PACU and are discharged home more quickly, which is a desirable outcome for both the patient and hospital. One factor influencing the amount of pain/nausea following ACL surgery is choice of preoperative nerve block.

OBJECTIVE
Our goal was to investigate the effect of choice for regional anesthesia on PACU time following ACL surgery. Four nerve block groups were studied as follows: none, adductor canal (AC), femoral (Fem), and femoral plus sciatic (FS). Secondary outcomes included opioid doses, nausea, PACU pain scores, and time to discharge home.

METHODS
After obtaining IRB approval, we performed a retrospective chart review of all ACL surgeries performed at the UPMC Mercy Southside Outpatient Center from 2012 – 2017. Relevant exclusion criteria included secondary procedure (ex: meniscus repair) and age < 18. We gathered data from each of the most recent surgeries until the goal number of cases per each nerve block group was met. For the AC group, only 17 cases total were available considering all exclusion criteria. Opioid doses were converted to IV morphine equivalents. Transfer time to Phase 2 recovery was used as PACU stop time, and the last timestamp in nursing documentation was used for discharge home time. Administration of post-op anti-emetics was used as a surrogate for post-operative nausea and vomiting.

RESULTS
Patient demographic data did not significantly differ among groups. However, surgery duration and surgeon did vary significantly (P < 0.001) between the nerve block groups. Using an ANOVA test, choice of nerve block did have an effect on PACU duration (P = 0.012).

However, when analyzing comparisons of PACU time among groups, the only significant comparison was FS vs. AC, with AC being longer. Pertinent secondary outcomes showed a significantly higher dose of intraoperative opioids for the “none” group compared to all other groups. Nausea and non-opioid mediations were not a significant factor. Initial PACU pain was significant, but when compared, only significant between FS and AC, with AC having more pain. Final PACU pain was comparable among all groups.
DISCUSSIONS
Patients without a nerve block received more intraoperative opioids than those with a nerve block. However, pain scores were eventually made equivalent with opioid use, as the final PACU pain scores were comparable among all groups. Interestingly, the AC group appeared to have higher initial PACU pain scores and longer PACU stays. This may indicate that the AC block did not help pain as much as FS or FEM and may have been hindered by reducing OR opioids, since the patient was perceived to have a block.

A main limitation of this study is the correlation between type of nerve block and surgeon. Surgeon preferences occasionally dictate the type of nerve block used, to the point where it may be unclear whether we are studying PACU times based on differences in nerve block or differences between surgeons. Other limitations included the availability of information extracted from the electronic medical record, the sample size for the AC group, and theoretic delay in PACU discharge based on transport personnel instead of patient symptoms.

CONCLUSIONS
Use of extra opioids appeared to mitigate any effect on PACU duration; however, the best mix of pain control and minimizing opioids seemed to occur with the FS block. Given the limitations of surgical preference for block type, further study is likely warranted.

REFERENCES

This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017.

EFFECT OF ULTRASOUND-GUIDED ANALGESIC FEMORAL BLOCK ON SENSATION BY THE LATERAL FEMORAL CUTANEOUS NERVE AND THE SAPHENOUS NERVE

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Department of Anesthesiology, University of Pittsburgh School of Medicine

INTRODUCTION
A femoral nerve block (FNB) with a high volume of medication is traditionally thought to affect the lateral femoral cutaneous nerve (LFCN). Recent trends have been to reduce nerve block volume to reduce the chance of local anesthetic toxicity. It is unclear whether lower volumes of medication in a FNB will affect the LFCN.

HYPOTHESIS
A FNB volume of 20mL or less will not affect the LFCN.

METHODS
IRB approval was obtained and 30 patients undergoing anterior cruciate ligament (ACL) reconstruction at the UPMC Mercy South Side Outpatient Center consented to an observational study. A standard FNB was performed under both ultrasound
guidance and peripheral nerve block stimulator guidance. Twenty milliliters of bupivacaine 0.125% was injected either beneath or over top of the femoral nerve. Nerve block effectiveness was then tested by assessing motor function and sensation in the femoral nerve distribution. Concomitant evaluation of sensation was tested in the LFCN distribution and saphenous nerve distribution by both cold touch and pin prick sensation. Sensory scores of 1, 2, or 3 (respectively, no feeling, partial sensation, normal sensation) were recorded at five, 10, 20 and 30 minutes following the nerve block.

RESULTS
Demographic information was comparable among all patients. All 30 patients had an effective FNB within 30 minutes for both sensation and motor function. For the saphenous nerve distribution, all patients described no feeling or partial sensation within 30 minutes (90% no feeling for cold, 93.3% no feeling for sharp). No patients reported complete loss of sensation in 30 minutes for the LFCN distribution (83.3% normal sensation for cold, 83.3% normal sensation for sharp). No patients complained of knee pain after the surgery.

CONCLUSIONS
The volume of 20ml for an ultrasound-guided FNB provides motor and sensory blockade of the femoral nerve and adequate post-operative pain control. This volume of medication often numbs sensation of the saphenous nerve, but does not significantly affect sensation in the LFCN distribution.

SIGNIFICANCE
Regional anesthesia is the constant search for the perfect combination of medication volume, concentration, and location of injection to safely block isolated target nerves without systemic toxicity. This study could help guide providers performing FNBs when considering whether a LFCN block is desirable (ex: to treat tourniquet pain) at the cost of higher volumes of medication and thus the likely higher risk of toxicity.

RESEARCH / GRANT SUPPORT
None.

This abstract was presented at the Society for Education in Anesthesia (SEA) 32nd Spring Annual Meeting, April 27-30, 2017, Jacksonville, Florida.

EFFECTIVENESS OF MENTAL IMAGERY TEACHING FOR INTRAVENOUS CANNULATION AMONG NOVICES

Andrew Hulme, MD; K. Grace Lim, MD; Robert G. Krohner, DO; Catalin Ezaru, MD

INTRODUCTION
Intravenous (IV) cannulation is a commonplace clinical procedure; however, it often causes significant patient anxiety and pain. Teaching options to improve providers’ IV skills have been studied in the past in hopes of improving patient safety and satisfaction. However, many teaching methods are costly (i.e. mannequin arms, IV supplies) and painful for the trainee. We hypothesized that “mental imagery”, a no-cost and pain-free teaching method, is as effective as traditional teaching methods for IV placement.

METHODS
Thirty-one new post-graduate year (PGY)-2 anesthesia residents were tested. After participating in a lecture on IV cannulation, including a five-minute instructional video, they were randomized into either a “mental imagery” (MI) or “standard teaching” (ST) group. The MI group spent 20 minutes visualizing placing an IV as a moderator read from a script detailing the entire procedure. They also mentally practiced the entire procedure at least twice. The ST group spent 20 minutes placing IVs on each other, guided by experienced attending anesthesiologists. All participants then attempted an IV placement on a standard mannequin arm, which was observed by an unbiased PGY-4 anesthesiology resident and scored by an IV cannulation checklist generated by expert anesthesiologists through a Delphi technique.

Scores of 0 – 13 were recorded, as well as a survey of confidence in IV skills taken by participants before and after the training. Scores between groups were compared by the two-sample Student t-test. Demographic variables were compared using the Student t-test or Fisher’s exact test where appropriate. Changes in confidence level between the two groups
RESULTS
Demographics are shown in Table 1. There was no statistical difference in scores for performance between learners trained by MI and learners trained by ST (mean group MI, 12.1±0.99 vs. mean group ST, 11.9±0.96, 95% CI 11.6 to 12.4, P=0.47). MI training and ST training were both associated with a significant increase in confidence levels for IV placement (For MI: pre-training confidence score mean, 51.5±20.1 vs. post-training confidence score mean, 64.7±15.3, 95% CI for the change 6.7 to 19.5, P<0.001. For ST: pre-training confidence score mean, 55.3±23.5 vs. post-training confidence score mean, 67.9±19.5, 95% CI for the change 5.66 to 19.7, P=0.002).

DISCUSSION
Our results suggest that standard teaching is no different from mental imagery for IV cannulation skills training. Also, MI training results in a significant increase in confidence levels for IV placement. Therefore, mental imagery could be a low-resource and pain-free alternative to traditional teaching methods for IV placement.

This abstract was presented as a poster at the 2017 American Society of Anesthesiology Practice Management Conference, Grapevine, TX, January 27th, 2017.

DEVELOPMENT OF A PERSONALIZED SMART SCHEDULE IN AN OUTPATIENT CHRONIC PAIN CLINIC THROUGH USE OF A GANNT DIAGRAM

H. Hundley1, M. E. Hudson1, T. D. Emerick1,2
1 Department of Anesthesiology, UPMC, Pittsburgh, PA
2 Division of Chronic Pain Medicine, UPMC, Pittsburgh, PA

INTRODUCTION
A Gantt diagram is a horizontal bar chart that can be used to analyze process efficiencies. This chart is commonly applied to project schedules to achieve better visibility of workflow constraints (e.g. bottlenecks in processing rate or wait time). A five-day sample of patient waiting and service times in a single provider chronic pain clinic schedule was analyzed using this method with the aim of identifying scheduling inefficiencies and reducing wait time. To the best of our knowledge, a personalized schedule based on diagnosis, mean service time, and mean wait time using a Gantt diagram has not been applied to this setting in an effort to create a more efficient schedule.

METHODS
After hospital quality improvement committee approval, data for the development of the Gantt diagrams were collected from 81 patients from five separate clinic days during March 2016 at UPMC Montefiore Chronic Pain Clinic. All patients were under the medical care of the same attending. Data collected included patient appointment time, patient diagnosis, new patient versus follow up visit category, arrival time, time when the provider entered the room, and the time when the provider left the room. Total service time included the total time a mid-level provider, resident, fellow, or attending physician spent with the patient, as well as injection time.
RESULTS
A Gannt diagram (Figure 1) was created using Microsoft Excel® software. A separate Gannt diagram was created using for each clinic day with the appointment time displayed on the x-axis and the de-identified patient number of the y-axis. Daily patient mean wait time and mean service time data were calculated, and mean service times were stratified by diagnosis for the five clinic days. Summary data is presented in Table 1. The mean wait duration for new patients was 25 ± 21.8 minutes and 22.4 ± 17.1 minutes for return patients. The mean service times for new and return patients were 25.8 ± 9.0 minutes and 20.1 ± 13.1 minutes, respectively. In this sample, mean service times were highest for chronic abdominal/pelvic pain (24.4 ± 10.5) and lowest for myalgia (8.0 ± 0).

DISCUSSION
The Gannt diagram was used within a single UPMC pain medicine clinic to identify both scheduling inefficiencies and areas for process improvement. For example, the diagrams have identified the most common daily bottlenecks, which include overscheduling at approximately 09:30 and underbooking after 13:00. Time slots have been adjusted accordingly based on these observations. The schedule also revealed significantly different service times depending on diagnosis; this had not previously been widely reported in the literature and would be a novel booking scheme for patients. The standard practice of booking 30 minutes for new patients and 15 minutes for follow up patients has also been shown to differ from real life practice. These smart schedules are very specific to a particular location or practice and need to be individually developed based on each clinic appointment.

This abstract was presented as a poster at the 2017 American Society of Anesthesiology Practice Management Conference, Grapevine, TX, January 27th, 2017.

OUTPATIENT CHRONIC PAIN CLINIC SCHEDULING EFFICIENCY ANALYSIS
H. Hundley¹, M. E. Hudson¹, T. D. Emerick¹,²
¹ Department of Anesthesiology, UPMC, Pittsburgh, PA
² Division of Chronic Pain Medicine, UPMC, Pittsburgh, PA

INTRODUCTION
A Gannt diagram is an easy to visualize bar chart often used in manufacturing or project management sectors to help analyze process efficiencies. The diagram typically is used in manufacturing process analysis to determine mean waiting time, mean processing time, and mean processing rate for a certain product in a work queue. To the best of our knowledge, this type of scheduling diagram has not been used in an outpatient clinic medical setting or a chronic pain clinic to more thoroughly understand scheduling efficiency. Queue line theory descriptive statistics can also be applied to a chronic pain clinic to analyze clinic efficiency.
METHODS
After hospital quality improvement committee approval, data for the development of the Gannt diagrams were collected from 24 patients on March 15, 2016 at the UPMC Montefiore Chronic Pain Clinic. All patients were under the medical care of the same attending. Data collected included patient appointment time, patient diagnosis, new patient versus follow up visit, arrival time, time for provider in-room, time for provider leaving the room. Total processing (service) time was calculated as time leaving room minus time in-room. Mean waiting room wait times, mean exam room waiting times (time in exam room before provider arrived), and total exam room times (exam room waiting time plus service time) were also calculated. Provider time included the total time a mid-level provider, resident, fellow, or attending physician spent with the patient.

RESULTS
A Gannt diagram (see Figure 1 in previous abstract) was created using Microsoft Excel ® software. All patients seen on the study day in March 2016 were return patients scheduled for 15 minute appointments. Descriptive statistics included a mean processing (service) time of 22 ± 8 minutes, mean waiting time in the waiting room of 7 ± 10 minutes, mean waiting time in the exam room of 12 ± 10 minutes, and mean total waiting time of 19 ± 13 minutes. Individual service times according to patient diagnosis are provided in Figure 2. The mean time a patient spent in the exam room (exam room waiting time plus service time) was 35 ± 13 minutes, which was approximately 20 minutes greater than the typical 15-minute appointment slot. On average, patients spent 31% (S.D. ± 23%) of their total exam room time waiting for the provider.

DISCUSSION
A Gannt diagram is a convenient way to identify bottlenecks in a schedule, such as time of day when patients wait the most and least. This information can be used to adjust appointment slots accordingly to improve schedule efficiency. Gannt diagrams can be used to make a personalized “smart” schedule for each physician based on a provider’s average service rates (provider time with patient) and waiting time rates. Schedule efficiency analysis also shows that the typical 15-minute return patient time allotment is unrealistic for specific patient diagnoses. Exam room utilization was also inefficient with approximately 31% of exam room time being used as idle time. Rooms can be utilized more efficiently by increasing provider (service time) coverage or consideration of scheduling by diagnosis instead of the designated 15-minute allotment for return patient (30-minute allotment for new patient).

This abstract was an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

PREDICTORS OF UNEXPECTED POST-OPERATIVE INTENSIVE CARE UNIT ADMISSION: A RETROSPECTIVE STUDY

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Department of Anesthesiology, UPMC, Pittsburgh PA

INTRODUCTION
Postoperative admission to an intensive care unit (ICU) is standard for patients undergoing certain highly invasive surgeries such as coronary artery bypass grafting, or patients with significant medical comorbidities such as severe congestive heart failure. For most patients, however, immediate post-op ICU admission is unnecessary, as it is expensive, utilizes major resources, and is associated with worse overall outcomes (1,2). Nevertheless, certain factors or events can change a patient’s post-operative disposition from the post-anesthesia care unit (PACU) to the ICU. Indicators in neurosurgical (3), thoracic (4), and vascular (5) surgery populations have been well-studied. Few studies, however, have examined determinants of ICU admission across many surgical subtypes.

OBJECTIVE
We sought to determine which pre-operative patient characteristics contribute significantly to unexpected post-operative ICU admissions in a large university hospital system.
METHODS
UPMC electronic medical record data for the years 2011-2015 were analyzed. Using anesthesiology quality improvement (QI) databases, a list of surgeries resulting in unexpected ICU admissions was compiled. This list was used to filter system-wide ICD-9 data for patients experiencing one of these surgeries plus an ICU admission. Patients with cardiac/trauma/transplant surgeries and an ICU room acquisition time outside the intraoperative period were excluded. A corresponding patient group undergoing the same surgeries without an ICU admission was obtained. Demographics, presence of key comorbidities, length of stay, and in-hospital mortality data were collected for both groups.

Propensity score matching was performed to minimize differences between the ICU and non-ICU groups; outcomes of ICU admission and in-hospital mortality were determined using multivariate regression analyses.

RESULTS
We identified 125 unexpected ICU admissions in the QI databases. In the system-wide record, 18,464 patients underwent one of these surgeries plus a concurrent ICU admission. After excluding cardiac/trauma/transplant surgeries, 1,192 (6.4%) patients had an intraoperative disposition change to an ICU. There were 28,498 patients that underwent the same surgeries that did not have an ICU admission. Propensity score matching resulted in an ICU and non-ICU group each with 1,191 patients (Table 1). Patients with congestive heart failure (CHF), acute or chronic kidney injury, peripheral vascular disease (PVD), and heart valve disease were all associated with increased unexpected ICU admission (Table 2). Acute/chronic kidney injury and history of stroke (CVA) were associated with increased mortality in all patients (Table 3), with CVA also associated with increased mortality, specifically in the ICU population (Table 4).

DISCUSSION
This is the first study to our knowledge to utilize a large data set to identify patient-related factors pertaining to unplanned ICU admissions across many surgery specialties in an academic center. Age and gender had no effects on admission or mortality. Certain factors had unexplained protective effects, such as insulin-dependent diabetes, on admission or PVD on ICU mortality. Knowledge of the interplay with intraoperative factors such as blood loss, not in the scope of the database, would assist in the application of these results.

CONCLUSION
CHF, acute/chronic kidney injury, PVD, and valve disease were significantly associated with increased unexpected ICU admission, with stroke increasing mortality in those admitted.

REFERENCES
CRITICAL IMPORTANCE OF TISSUE PLASMINOGEN ACTIVATOR POLICY FOR INTRAOPERATIVE PULMONARY THROMBOEMBOLISM DURING LIVER TRANSPLANTATION

Daniel Mandell, MD; Raymond M. Planinsic, MD; Fernando Melean, MD; Christopher Hughes, MD; Amit D. Tevar, MD; Abhinav Humar, MD; Benjamin J. Cassidy, PharmD; Richard Simmons, MD; Andre De Wolf, MD; Tetsuro Sakai, MD, PhD
Departments of Anesthesiology, Surgery, and Pharmacy, UPMC, Pittsburgh, PA; Department of Anesthesiology, Northwestern University Feinberg School of Medicine, Chicago, IL

INTRODUCTION
Intraoperative pulmonary thromboembolism (PTE) is a devastating complication of adult liver transplantation (LT), having a 4% incidence with a 30% intraoperative mortality. Low-dose tissue plasminogen activator (tPA) has been reported to successfully treat this emergency. Success depends on timely administration. Often tPA administration is delayed due to fear of uncontrolled bleeding and storage in a refrigerator often outside of operating rooms.

METHODS
In April 2014, a multi-departmental committee at an academic adult liver transplantation center implemented a policy for intraoperative tPA storage and use during LT. The policy includes 1) administering tPA (0.5-4mg) for intraoperative PTE; 2) keeping two vials of tPA (2mg/vial) in the operating room at room temperature; and 3) transferring unused tPA vials to the cardiology catheterization laboratory for next-day use. A prospective observational study was conducted to record the incidence of PTE during LTs, the usage of tPA, and its effectiveness. Transesophageal echocardiography and a pulmonary artery catheter were placed in all cases at the beginning of LT as standard monitors.

RESULTS
Over the following 19 months, 99 adult LTs were performed with one (1.0%) intraoperative PTE. The patient was a 45-year-old woman with hepatitis C (Model for End-stage Liver Disease score of 40) undergoing deceased donor LT. Within five minutes after graft reperfusion, she developed hemodynamic compromise (heart rate, 41 bpm; systemic mean arterial pressure, 41 mmHg; mean pulmonary artery pressure, 48 mmHg) despite vasopressors. PTE was expediently diagnosed with intraoperative transesophageal echocardiography (TEE). Then, 2 mg tPA was intravenously administered with hemodynamic improvement and TEE evidence of clot lysis. Thromboelastography (TEG) showed a flat line, which required blood transfusions. TEG normalized in 90 minutes and surgical hemostasis was achieved. The patient’s postoperative course was uncomplicated and she was discharged to home on postoperative day 13.

CONCLUSION
A multidisciplinary tPA policy for intraoperative PTE was critical to a patient’s survival. Coagulopathy incurred after tPA administration was manageable.

REFERENCES
TEACHING RESIDENTS TO PERFORM ULTRASOUND-GUIDED CRICOThYROIDOTOMY ON PORCINE TRACHEA:
A NOVEL TRAINING MODALITY

Daniel Mandell MD, Steven Orebaugh MD
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BACKGROUND
Cricothyrotomy is a risky but potentially life-saving procedure. Adjunctive use of ultrasonography may increase safety and procedural success. Because cricothyrotomy is rarely encountered in a clinical setting, anesthesia residents have limited exposure to learning this procedure. Therefore, animal models of the human airway are increasingly being utilized to teach invasive airway techniques. We propose a novel training model utilizing porcine cadaveric trachea and ultrasonography.

METHODS
Ten post-graduate year 3 anesthesiology residents underwent a brief training session on cricothyrotomy technique and ultrasound-guided airway exam. Following this session, residents performed cricothyroidotomy on cadaveric porcine trachea. A model of an airway with “easy” landmarks was first constructed. Residents performed both percutaneous and open cricothyroidotomy techniques on this model. Following successful completion, a model with “difficult” airway landmarks was constructed. Residents used ultrasonography to identify pertinent airway landmarks and then performed an open cricothyroidotomy on this model. A post-session survey was given to residents.

RESULTS
All residents were able to perform cricothyroidotomy on the “easy” airway. All residents were able to identify the cricothyroid membrane and perform a cricothyroidotomy on the “difficult” airway model. The post-session survey revealed residents found the curriculum to be helpful.

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>The exercise introduced new information to me about emergency cricothyroidotomy</td>
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</tr>
<tr>
<td>The exercise provided important hands-on experience that cannot be replicated with plastic mannequins</td>
<td>4.88</td>
</tr>
<tr>
<td>The exercise taught me to utilize ultrasound to locate the laryngeal cartilages and the cricothyroid membrane</td>
<td>4.63</td>
</tr>
<tr>
<td>The exercise improved my overall confidence in locating the cricothyroid membrane</td>
<td>4.88</td>
</tr>
<tr>
<td>The exercise augmented my skills in exposing and incising/entering the cricothyroid membrane</td>
<td>4.88</td>
</tr>
<tr>
<td>The exercise augmented my skills at placing a tracheal tube into the airway during cricothyroidotomy</td>
<td>4.63</td>
</tr>
</tbody>
</table>

Table 1: Post-session survey given to 10 residents. Residents gave each question a numeric score from 1-5, with “1 – strongly disagree” and “5 – strongly agree.” Left column shows mean score of responses among 10 residents.

CONCLUSION
We report a novel training curriculum utilizing ultrasonography to identify airway landmarks and practice cricothyrotomy. Residents found this training to be realistic and helpful.

REFERENCES
2. Siddiqui et al., Anesthesiology 2015
3. Curtis et al., Acad Emerg Med 2012
INTRODUCTION
Current economic conditions in health care increasingly demand cost-reductive strategies requiring improved operating room (OR) management. Anesthesiology departments are ideally positioned to participate in these efforts because of their intimate familiarity with OR operations and because of the desirability of gain sharing with hospital leadership. The University of Pittsburgh Medical Center (UPMC) Department of Anesthesiology provides anesthesia services for the system’s 14 core hospitals and can shift anesthesia providers between hospitals depending on need. Historically, the daily number of providers varied dramatically, both between hospitals and on different days of the week at the same hospital. To address this variability, UPMC sought to emphasize system-wide OR efficiency by tracking overall OR utilization and instituting a “sites-running” cap that would represent the maximum number of anesthetizing locations allowed across the system for a given day. This “cap” attempts to minimize the day-to-day variability in the total number of anesthesia providers.

METHODS
From September to December 2015, daily anesthesia sites running data was collected for each of 14 core facilities in Allegheny County in the UPMC system. Using site-specific OR utilization as a benchmark for efficiency, individual hospital performance was calculated for each day using surgical minutes (wheels-in to wheels-out) divided by total available surgical minutes (number of rooms staffed to run at given site multiplied by eight hours per room). Then, using “system-wide rules” already established for block management, optimum target caps for number of rooms running were created for each site based on historical data showing a number in which OR utilization was maximized. These individual site caps were then used to create a system-wide cap of 200 ORs in May 2016.

RESULTS
In the six months prior to the implementation of a system-wide cap, average daily ORs running ranged from 165-224, with a monthly average mean of 203 and average standard deviation of 9. Average system-wide utilization during this time was 62%. After establishment of the cap, daily running ORs decreased to an average of 191 (max 207, min...
162, standard dev. 7). This was accompanied by an average system-wide utilization of 63%. The decrease in average daily anesthesiology sites running from 203 prior to the cap to 191 after the cap represents a yearly cost savings of approximately $14.4 million (12 operating room reduction multiplied by avg. operating cost of $1.2 million per room).

DISCUSSION
In today’s healthcare landscape, there are many incentives to develop novel cost-reducing measures, as well as to optimize resource management. Nowhere in healthcare is this more relevant than in the operating room. While generally considered the highest revenue area of a health system, inefficiently used ORs can be a tremendous cost. In a large health system, capitalizing on data availability and resource sharing to develop and implement system wide “best-practices” is vital to financial success. By developing system-wide management goals based simply on utilization data, millions of dollars can be saved over the course of the year, all while preserving revenue and safety standards. It is evident that management strategies such as these are of critical importance not just for individual health systems, but also for the field of anesthesiology as we strive to demonstrate value.

This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017.

ANTENATAL ANEMIA INCREASES THE RISK OF RECEIVING POSTPARTUM BLOOD TRANSFUSIONS
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2Department of Pathology, University of Pittsburgh School of Medicine

OBJECTIVE
To determine whether antenatal anemia predisposes women to requiring a postpartum red blood cell (RBC) transfusion.

HYPOTHESIS
Women who are anemic during the antenatal period are more likely to require a blood transfusion postpartum than women who are not anemic.

METHODS
Women who gave birth at a regional specialist maternity hospital between 1 December 2015 and 31 September 2016 who had a hemoglobin concentration measured in their third trimester and who received a small volume transfusion (≤2 RBC units) between the time of delivery and discharge were included in this study. It was assumed that women who received >2 RBC units postpartum were experiencing a significant postpartum hemorrhage and that transfusion would not have been avoidable, even without antenatal anemia. The included women were divided into those who were anemic (third trimester hemoglobin <11.0 g/dl) and those who were not anemic (third trimester hemoglobin ≥11.0 g/dl). The frequency of receiving an RBC transfusion between the anemic and not anemic women was determined and the mode of delivery was also correlated with the frequency of receiving a small volume transfusion.

RESULTS
There were 8,007 women who met the inclusion criteria: 1,548 (19%) were anemic and 6,459 (81%) were not anemic. Of the anemic women, 43/1548 (2.8%) received a small volume transfusion compared to 31/6459 (0.48%) of the not anemic women [p=0.0001, odds ratio 5.92, 95%, confidence interval (3.72-9.43)]. Third trimester anemia was a significant predictor of receiving a small volume transfusion for those who delivered vaginally (p=0.0001) or by Caesarean delivery (p=0.0001) compared to those who were not anemic.

CONCLUSION
Third trimester antenatal anemia is a significant predictor of receiving a small volume postpartum transfusion.

SIGNIFICANCE
These findings help to support and provide evidence to highlight the importance of clinical identification of antenatal anemia and increase the awareness of clinicians to those women who are more likely to receive a blood transfusion postpartum. The goal for clinicians should be to optimize a mother’s hemoglobin prior to delivery to try and reduce likelihood of requiring a blood transfusion.
This abstract was an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017, and was presented at the 37th International Symposium on Intensive Care and Emergency Medicine in Brussels, Belgium March 21-24, 2017.

CAN SUBLINGUAL MICROCIRCULATION PREDICT MICROVASCULAR AND TISSUE RESPONSIVENESS TO USUAL RESUSCITATION IN A PORCINE MODEL OF SEPSIS?

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INTRODUCTION
Common clinical markers of sepsis severity and treatment efficacy have been called into question, including central venous pressure, systemic lactate, mean arterial pressure (MAP), mixed venous oxygen saturation, and veno-arterial carbon dioxide difference. Additionally, the general practice of high volume intravenous fluid bolus with early resuscitation has been questioned regarding increased mortality risk. Focus has shifted from systemic circulatory parameters to the microcirculation, with the goal of directly addressing the foci of sepsis pathophysiology.

HYPOTHESIS/OBJECTIVE
We hypothesized that sublingual (SL) microcirculatory parameters 1. Can predict microvascular response to resuscitation during sepsis; and 2. Are associated with tissue level lactate, lactate/pyruvate ratio (L/P), and tissue to blood lactate gradient (T-BLac).

METHODS
Lipopolysaccharide (LPS) was administered to 23 anesthetized Yorkshire-Durock pigs for 45 minutes. Thirteen animals received late (90 min after LPS) and 10 early (immediately after LPS) resuscitation. Five animals per group had available data for this opportunistic study. Sublingual microcirculatory parameters (microvascular flow index (MFI) and perfused vessel density (PVD)) were collected. Tissue level lactate and pyruvate were measured using microdialysis catheters inserted in the liver, kidney, and tongue at baseline and pre-/post-resuscitation (Pre-R, Post-R). Resuscitation was driven by MAP and SvO2 targets, with SVV for fluid responsiveness. Data are shown in median (interquartile range).

RESULTS
Pre-R MFI correlated with Post-R MFI (r²=0.562, p=0.008). Microvascular “responsive” animals (i.e. increase in MFI>50% or any increase in PVD) had lower Pre-R MFI and PVD (Fig. 1). The presence of Pre-R systemic hyperlactatemia did not predict microvascular fluid responsiveness (p=0.05) as defined by an increase MFI>50%. A higher Pre-R MFI (>2.5) was associated with lower SLT-BLac (-0.42 (0.74) vs. 3.49 (0.34), p=0.008). An increased Post-R T- BLac was associated with a lower Pre-R MFI in the kidney (p=0.06. Post-R PVD was associated with Post-R L/P in the liver (p=0.04) (Fig. 2).

DISCUSSION
Pre-resuscitation MFI and PVD were associated with post-resuscitation microvascular changes, but not pre-resuscitation systemic lactate levels.
Pre- and post-resuscitation sublingual MFI and PVD were associated with local metabolic changes in the tongue as well as in the kidney and the liver.

CONCLUSION
Pre-resuscitation MFI and PVD may predict post-resuscitation microvascular responsiveness.

REFERENCES

This abstract was presented as a poster at the Association of University Anesthesiologists 64th Annual Meeting, Washington, DC, May 4-5, 2017 and the Annual Meeting and International Science Symposium of the International Anesthesia Research Society, Washington, DC, May 6-9, 2017. It was also an original research poster presentation at the Pennsylvania Resident Research Conference (PARRC), Temple University Lewis Katz School of Medicine, May 20, 2017.

ISOFLURANE EFFECTS ON PRO-INFLAMMATORY INTERLEUKIN-23 ACTIVITY IN MICE

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INTRODUCTION
Although perioperative stress pre-exposes patients to immune vulnerability, general anesthetics also modulate the immune system. Whether exposure to anesthetics causes an elevated sensitivity to inflammation is an important clinical question, especially considering the recent implications linking volatile anesthetic exposure to the early onset of certain neurodegenerative diseases, which are possibly associated with neuroinflammation. In this study, we focus on isoflurane’s modulation of IL-23, a key pro-inflammatory cytokine essential for both acute and chronic inflammation.
HYPOTHESIS
Isoflurane modulates IL-23, a pro-inflammatory cytokine involved in acute and chronic inflammatory pathways.

METHODS
Bone-marrow-derived dendritic cells (BMDCs) were exposed to 1.5% isoflurane for 4 h with or without lipopolysaccharide (LPS) challenge. The gene expression of inflammatory cytokines was quantified using quantitative reverse transcription PCR. The effects of isoflurane on the LPS-induced signaling pathways were also analyzed using western blot. In parallel in vivo experiments, the levels of inflammatory cytokines and downstream signaling in the spleen and lung were quantified in CD1 mice treated with 1.5% isoflurane for 4 h with and without LPS. Analysis of variance followed by Fisher’s least-significant difference post hoc test was performed to determine the effects of isoflurane. A p value of < 0.05 was considered statistically significant.

RESULTS
As expected, 0.1 and 1 ng/ml LPS enhanced IL-23 mRNA level in BMDCs. Isoflurane further increased IL-23 mRNA expression (p < 0.001). Even in the absence of LPS, isoflurane exposure increased the IL-23 mRNA level twofold. Isoflurane increased levels of phosphorylated p38 (p-p38) regardless of LPS treatment. In contrast, levels of p-ERK, p-JNK, IRF3, p-IRF3, IκB, or p-IκB were not affected by isoflurane. Pretreating BMDCs with 5 μM SB203580, a specific p-p38 inhibitor, abolished LPS- and isoflurane-induced IL-23 mRNA, suggesting that the isoflurane-induced enhancement of IL-23 expression is dependent on p-38 MAP kinase. Consistent with ex vivo results, in vivo measurements showed that isoflurane administration increased levels of IL-23 mRNA and p-p38 in splenic tissue.

DISCUSSION
This study shows that isoflurane has the ability to modulate the function of a critical immune cell, the dendritic cell, in vitro. Furthermore, in vivo study confirmed that isoflurane exposure increases the expression of the pro-inflammatory cytokine IL-23. Finally, this increased expression is likely to be a result of p38 MAPK cell signaling, which was demonstrated both in vitro and in vivo. Further work with other volatile agents and further mechanistic investigation to better understand the pathways through which these agents operate is necessary.

CONCLUSION
A clinically relevant dose of isoflurane modulates the function of dendritic cells by increasing the expression of the pro-inflammatory cytokine IL-23, likely through p38 MAPK activation. Similar elevation of splenic IL-23 mRNA and p-p38 protein expression in isoflurane-anesthetized animals suggested the possibility of adverse immune modulation by isoflurane. Further clinical investigations are warranted to determine whether an isoflurane-induced increase in IL-23 expression occurs in humans and, if so, what impact this might have on the short- and long-term outcomes of surgical patients.

REFERENCE
CASE DESCRIPTION
A 66-year-old male with an abdominal aortic aneurysm status post endovascular repair (EVAR) and coronary artery disease with two drug-eluting stents placed two months previously presented with septicemia. Further workup revealed an enlarging mycotic thoracoabdominal aortic aneurysm extending from the superior mesenteric artery to the renal arteries with periaortic inflammatory changes consistent with artitis. CT angiography showed interval changes suggestive of impending rupture. The patient underwent open resection and replacement of the infected aortic graft and splenectomy under total intravenous anesthesia. Intraoperative transesophageal echocardiography (TEE) demonstrated an ejection fraction of 45%, grade I diastolic dysfunction, and significant plaques throughout the aorta. The patient required vasopressor support throughout the procedure and received more than 10 liters of blood products and cell salvage.

DISCUSSION
Thanks to modern diagnostic and surgical techniques, infectious aortitis is a rare condition. Most cases of infectious aortitis are associated with mycotic aneurysms. Mycotic aneurysms are commonly caused by bacterial septicemia seeded from a distant source. These can develop from preexisting aneurysms or from the breakdown of the vessel intima from inflammation. Various microorganisms have been associated with infectious aortitis: Streptococcus, Staphylococcus, Enterococcus, and Salmonella. Although aortitis classically precedes aneurysm formation, in most cases the two are diagnosed together. Most cases are seen in middle-aged males with multiple comorbidities. Without intervention, the mortality is 100%.

The intima of the aorta is generally resistant to bacterial growth due to its exposure to high velocities and shear stress. This patient previously underwent endovascular graft placement, creating a nidus for infection following hematogenous seeding from the septic source. Infectious seeding causes transmural inflammation and focal microabscesses, leading to medial thinning and subsequent dissection. Furthermore, TEE demonstrated the presence of atherosclerotic plaques throughout the aorta that may also have played a role. Atherosclerosis causes both acute and chronic inflammation that may contribute to medial thinning and potential dissection. The combination of positive blood cultures and significant atherosclerotic disease suggests that both of these risk factors contributed to aneurysm formation.

Surgical management of mycotic aneurysms consists of resection of the infected graft and debridement of the surrounding infected or necrotic region. This can be performed via reconstruction utilizing preserved aortic stumps, extra-anatomic arterial bypass, or total aortic reconstruction. These techniques can be accomplished in a staged procedure. Complications include but are not limited to fistulas, perforation, and further propagation of the initial infection.

REFERENCES
This abstract was an oral presentation at the UPMC Graduate Medical Education Leadership Conference on February 17, 2017. It was also presented at the Society for Education in Anesthesia (SEA) 32nd Spring Annual Meeting, April 27-30, 2017, Jacksonville, FL.

**MINDFULNESS AND BURNOUT IN JUNIOR ANESTHESIOLOGY TRAINEES**

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Department of Anesthesiology, University of Pittsburgh School of Medicine

**INTRODUCTION**

Physician burnout has been linked to poorer quality of care, patient dissatisfaction, and increased medical errors. Physicians who implement more "mindful" behaviors receive better patient satisfaction scores and have higher job satisfaction. Our objective was to determine whether "mindful" behavior would correlate with burnout.

**HYPOTHESIS**

Physician trainees able to implement more mindful behavior will have less self-perceived burnout.

**METHODS**

First-year UPMC anesthesia interns (INTs) underwent a mindfulness course (lecture, workshop, daily online activities) based on the FISH! Philosophy (ChartHouse Learning; Burnsville, MN), which emphasizes four principles: play, be there, make their day, and choose your attitude. Then, INTs completed a survey regarding ability to implement the FISH! Philosophy; they were also asked to complete the Maslach burnout inventory, which is subcategorized into exhaustion, depersonalization, and personal achievement. PGY-2 anesthesia residents (RESs) who were not exposed to the mindfulness training completed the same survey/questionnaire as the INTs. Non-normally distributed intergroup results were compared using Wilcoxon rank-sum testing and statistically significant ($p<0.05$) correlations were identified using Pearson's product moment correlation.

**RESULTS**

Sixteen (100%) INTs and 13 (81%) RESs completed the survey/questionnaires. Aside from age, no baseline characteristics differed. Perception of personal achievement was less in INTs ($p=0.006$). In the INT group, mindfulness had a significant negative correlation with depersonalization ($r=-0.65$, $p=0.006$), while it did not have a significant correlation with exhaustion or personal achievement. In the RES group, mindfulness had significant negative correlations with exhaustion ($r=-0.70$, $p=0.008$) and depersonalization ($r=-0.72$, $p=0.006$), and a positive correlation with personal achievement ($r=0.79$, $p=0.001$).

**CONCLUSIONS**

Perceived burnout did not differ significantly between INTs and RESs aside from a sense of personal achievement being lower in INTs. Trainees who felt they could implement more mindful practices had lower burnout scores. Interestingly, even RESs, who did not participate in the mindfulness course, showed strong correlations between mindfulness and burnout scores. Longitudinal evaluation is needed to see whether mindfulness training has an intragroup impact over time.

**SIGNIFICANCE**

More mindful practices correlate with less burnout, suggesting that formal mindfulness training could significantly improve perceived physician burnout, which may lead to improved job satisfaction, patient outcomes, and patient satisfaction scores.

**RESEARCH SUPPORT**

Supported by the Department of Anesthesiology Education Fund. PSA is supported in part by a training grant from the NIH (T32GM075770).
CAN ANESTHESIOLOGISTS DISTINGUISH CLOSELY ASSOCIATED NERVE ELEMENTS FROM ONE ANOTHER WITH ULTRASOUND IMAGING?

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UPMC Department of Anesthesiology

INTRODUCTION
In the interscalene groove, nerve roots and trunks are in close proximity and may not be visible as separate structures\(^1\). This may increase the risk of insertion of the needle-tip within the epineurium. We hypothesized that if nerve roots or trunks are lying in contact, it is not possible for an experienced anesthesiologist to identify them as discrete structures on ultrasound images, and created an ex vivo model to assess this.

METHODS
Approval from the University of Pittsburgh Committee for Oversight of Research and Clinical Training Involving Decedents (CORID) was obtained for this study. Elements of four proximal brachial plexuses were harvested from two cadavers and placed in a water bath. Ultrasound images were taken of nerve structures lying one atop the other at the C5-C6 nerve root level and the superior and middle trunk level. Three scenarios were created at each level, including: separation of the two nerve structures by a 2mm metallic spacer, the same two nerve structures in direct contact, and the same two nerve structures with fascial tissue interposed between them. For each of these scenarios, three ultrasound images were taken, with slight translation of the transducer for each one. The total number of ultrasound images was 24 for each scenario (72 images).

Ultrasound image files were then arrayed randomly in a PowerPoint slideshow, with seven duplicates to assess consistency in responses. The slideshow was distributed to four experienced regional anesthesiologists who were instructed to answer “yes” if they could distinguish the nerves as two separate structures, or “no” if they couldn’t.

RESULTS
A total of 312 responses were generated, 78 from each evaluator. For structures separated by the spacer, there were 62% “yes” and 38% “no” responses. For nerves with interposed fascia, there were 10% “yes” and 90% “no” responses. For the scenarios in which nerves were in direct contact, there were 14% “yes” and 86% “no” responses (Table 1). For duplicate images, responses were consistent among each participant.

DISCUSSION
The responders indicated that both the root level structures and trunk level structures could be distinguished more easily when there was a 2mm spacer between them under ultrasound. However, when nerve structures were separated by connective tissue only, or directly touching, only a small minority of responses indicated that the difference could be determined. This model suggests that it is difficult to distinguish between nerve elements when they are in close proximity, as they are in the interscalene groove. These findings support those of other authors who have suggested that needle placement between nodules in the interscalene groove may result in subepineurial injection.\(^3\)\(^-\)\(^4\)

REFERENCES
2. Orebaugh, S. In Ultrasound-Guided Interscalene Block, Do We Know Where the Epineurium Is?

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Table 1. Number of responses for nerve elements when separated by a metallic spacer, a piece of fascia, and touching. * “Yes” responses indicate the ability to distinguish two separate nerve elements, while “No” responses indicate that the anesthesiologist was not able to discriminate between the two on the ultrasound image.
EXECUTIVE SUMMARY

The UPMC/University of Pittsburgh Department of Anesthesiology serves 19 clinical sites:

UPMC PRESBYTERIAN/MONTEFIORE
UPMC Presbyterian is a Level I Regional Resource Trauma Center, as well as a renowned center for organ transplantation and a recognized leader in cardiology and cardiothoracic surgery, critical care medicine and trauma services, and neurosurgery. UPMC Montefiore is part of the UPMC Presbyterian system and specializes in ambulatory services and liver transplantation.

CHILDMEN’S HOSPITAL OF PITTSBURGH OF UPMC (CHP) is devoted solely to the care of infants, children, and young adults and is one of the few hospitals in the nation to go completely paperless. CHP was again named in the 2017-2018 U.S. News & World Report’s Honor Roll of America’s Best Children’s Hospitals.

MAGEE-WOMEN’S HOSPITAL OF UPMC is a world-class center for both women’s health and comprehensive medical-surgical care and a National Center of Excellence in Women’s Health, one of the first recognized by the U.S. Department of Health and Human Services. Their Neonatal Intensive Care Unit is the largest in Pennsylvania and the country.

UPMC ST. MARGARET, a 249-bed acute care and teaching hospital in Aspinwall, is a Magnet™ designated hospital. Magnet status is the highest international recognition for nursing excellence and leadership.

UPMC SHADYSIDE also holds Magnet™ status and is home to the Hillman Cancer Center, one of the nation’s largest and most advanced cancer research and patient care facilities.

VETERANS AFFAIRS PITTSBURGH HEALTHCARE SYSTEM serves as an acute care facility and major surgical tertiary care facility for veterans of the United States military.

UPMC MCKEESPORT is an acute care community hospital and an approved site for the Program of All-Inclusive Care for the Elderly (PACE).

UPMC MERCY is Pittsburgh’s only Catholic hospital with specialized services, including Level I trauma and burn services, the neurosciences, physical medicine and rehabilitation, and women’s health.

UPMC MERCY SOUTH SIDE OUTPATIENT CENTER is an ambulatory surgical center that serves as a one-stop location for diagnostic and routine outpatient services such as x-rays, lab work, and same-day surgery.
UPMC PASSAVANT is a tertiary care center north of Pittsburgh with two campuses in McCandless and Cranberry Township (Butler County), focusing on specialties such as cancer, cardiac care, orthopedics, and spine surgery.

UPMC SOUTH SURGERY CENTER, located in Pittsburgh’s South Hills, accommodates outpatient procedures such as dental surgery, gastroenterology, general surgery, gynecology, neurosurgery, ophthalmology, orthopedics, otolaryngology, pediatrics, plastic surgery, podiatry, and urology.

UPMC EAST is a 300+ bed hospital with seven state-of-the-art operating rooms and 140 medical-surgical patient rooms equipped with specially designed SmartRoom software to help monitor, track, and document patient care.

UPMC BEDFORD MEMORIAL is an acute care general hospital in Everett, PA with units for telemetry services and medical, surgical, obstetrical, intensive, and coronary care. The hospital also operates a cardiac-pulmonary rehabilitation program and outpatient and ambulatory surgical units.

UPMC DIGESTIVE HEALTH & ENDOSCOPY CENTER is an outpatient endoscopy facility recognized for a high level of specialized care in gastroenterology, including screening and therapeutic colonoscopy, gastroscopy, and management of Gastroesophageal Reflux Disease and swallowing disturbances.

UPMC MONROEVILLE SURGERY CENTER offers the quality and experience of the region’s most skilled surgeons. The center offers outpatient procedures such as breast oncology, general and orthopedic surgery, and pain management.

UPMC HORIZON is a full-service academic community hospital with campuses in Greenville and the Shenango Valley. With a wide range of available surgical specialties, UPMC Horizon is the destination for world-class surgical care in the Mercer County region.

UPMC ALTOONA provides exceptional health care to Blair County, PA and surrounding areas. The 380-bed tertiary hospital offers an array of specialized programs and services, more than 200 years of health care experience, and nearly 3,000 employees as the largest employer in the county.

UPMC JAMESON is a full-service community hospital providing inpatient hospital care, surgical services, diagnostic imaging, emergency medicine, senior care, rehabilitation, and a variety of specialized health care services to the residents of Lawrence County, PA and its surrounding communities.

UPMC PALERMO (ISMETT) serves as a major transplantation center for Southern Italy and other countries in the Mediterranean region.
Overview
UPMC Presbyterian/Montefiore continues to function as the largest quaternary care hospital of the UPMC Health System and the largest in Western Pennsylvania. It remains the department’s core hospital in terms of clinical activity and resident education and is a nexus for clinical research.

The Department of Anesthesiology’s UPMC Presbyterian clinical site is larger than many entire academic departments found elsewhere in the country. It is comprised of 48 faculty members who cover 42 operating rooms and up to 14 additional, non-OR anesthetizing locations. The site is staffed by almost 100 full-time-equivalent Certified Registered Nurse Anesthetists (CRNAs). Up to 15 residents and 10 student nurse anesthetists (SRNAs) rotate at UPMC Presbyterian at any one time. Three Certified Registered Nurse Practitioners (CRNPs) provide care throughout the site as well as at the Pre-Anesthesia Evaluation and Testing Center, which conducts pre-anesthesia consultations and evaluations.

Patient Care and Clinical Activities
Compared with the prior fiscal year, overall clinical case volume in FY17 at UPMC Presbyterian decreased. Presbyterian faculty supervised a grand total of 37,869 anesthetics, a decrease of 2,545 cases (6.3%) from the previous fiscal year. Locations where services were provided included the gastroenterology lab (where up to seven provider teams work each day), bronchoscopy suite, electroconvulsive therapy (ECT) suite (at Western Psychiatric Institute and Clinic [WPIC]), electrophysiology suite, cardiac catheterization lab, interventional radiology, and the cardiac MRI suite (where craniotomies are performed).

Education and Training
Anesthesiology services at UPMC Presbyterian are highly subspecialty-oriented. Many of the advanced subspecialty resident rotations in anesthesiology (liver transplantation, cardiac, ENT, thoracic, trauma, and neuroanesthesiology) are based here. Many novice residents and SRNAs perform their first cases at UPMC Presbyterian. The UPMC Presbyterian faculty is very active in medical student and resident education; they not only teach in the OR, but also deliver lectures, coordinate problem-based learning discussions (PBLDs), design and implement rotation curricula, serve on medical student and resident education committees, interview resident applicants, and teach at the Peter M. Winter Institute for Simulation Education and Research (WISER). Several teaching conferences are held specifically for trainees rotating at UPMC Presbyterian on Wednesday mornings. Monthly Quality Improvement Morbidity and Mortality conferences are provided by a select group of faculty members, and PBLDs are also conducted monthly at UPMC Presbyterian. Subspecialty services also hold weekly or monthly conferences on topics in their subspecialty areas (e.g., neuroanesthesiology, cardiac, hepatic transplantation, and ambulatory anesthesiology). Continuing medical education credits are awarded for these activities.
Anesthesiologists, CRNAs, and anesthesiology residents at UPMC Presbyterian play an integral role in caring for trauma patients 24 hours a day. The hospital is a Level 1 trauma center accredited by the Pennsylvania Trauma Systems Foundation (PTSF). The program renewed its accreditation in 2015 after a PTSF site visit and received the maximum accreditation possible - three years. Designation as a Level 1 center requires a fully-staffed operating room to be available 24 hours a day. As part of this requirement, anesthesiology care teams are always present in the hospital, ready to care for trauma patients at a moment's notice, regardless of their resuscitative or operative needs.

The UPMC Presbyterian Trauma program is one of the top five busiest trauma programs in the United States. The program is somewhat unique in that the average age of trauma patients exceeds the national average of 45 years old. The significantly older trauma patient often presents with pertinent co-morbid conditions that require careful consideration by everyone caring for the patient, including the anesthesiology care team.

The UPMC Presbyterian Trauma program meticulously tracks patient outcomes and strives to constantly improve. The coordinated efforts of every member of the trauma care team contributes to these favorable outcomes when compared to national averages for similar size centers. This certainly includes the immediate resuscitative and stabilization efforts of the anesthesia care team.

Clinical Collaboration
As a member of the UPMC Presbyterian Trauma Medical Advisory Committee, the Chief Anesthesiologist regularly collaborates with other members of the trauma care team, including Medical Director of the trauma program, Dr. Louis Alarcon. Recent collaborative efforts have focused on implementation and refinement of the massive transfusion protocol, improved documentation of intraoperative products transfused, expansion of intraoperative coagulation testing, and mass casualty coordination.

Education and Training
Educational efforts surrounding the care of the traumatized patient continue every year within the Department of Anesthesiology. Trauma topics were presented during anesthesiology faculty development sessions, combined faculty/resident/CRNA meetings, the anesthesiology resident lecture series, anesthesiology resident problem-based learning educational series, and the anesthesiology resident simulation-based Difficult Airway Course and Anesthesia Crisis Leadership Training.
Overview
The UPMC Presbyterian Neurosurgical Anesthesiology service provided anesthetic care for almost 5,000 neurosurgical procedures during FY17. Procedures included expanded endonasal approaches to skull base pathologies, craniotomies for tumor, retromastoid craniectomy for microvascular decompression of various cranial nerves, stimulator device insertion, and spinal surgery. Two separate Neurosurgical Intensive Care Units at UPMC Presbyterian have continued to facilitate innovative approaches to the acute care of patients with cerebrovascular pathology, neurotrauma, and other acute injuries.

UPMC Presbyterian Neuroanesthesiology welcomed Drs. Lumei Miller and James Baumgardner to the team in FY17.

Patient Care & Clinical Activities
Presby Neuroanesthesiology is highly involved with the anesthetic management of patients at the Center for Neurointerventional and Neuroendovascular Therapy (CNNET), led now by Dr. Brian Jankowitz. A second full bi-plane angiography suite will open late this year to help CNNET meet their growing clinical demand and allow patients more opportunities for treatment with novel therapies related to cerebral vascular aneurysms, arterio-venous malformations, tumors, and dural and cavernous sinus fistulae; treatment of refractory epistaxis, sclerotherapy, stroke thrombolysis and thrombectomy, dural sinus thrombosis, and thrombectomy; temporary balloon occlusion testing with blood flow evaluation; petrosal sinus sampling; carotid, vertebral artery, subclavian artery, and intracranial arterial stenting; vessel sacrifice; WADA testing; and routine angiography.

The Center for Minimally Invasive and Cranial Base Surgery, led by Drs. Paul Gardner and Carl Snyderman (Otolaryngology), continues to attract unique patients from across the globe. Pioneering cutting-edge endoscopic minimally invasive craniotomy techniques, the team has performed hundreds of procedures in the past fiscal year, earning national and international recognition.

The complex spine service regularly engages in exceedingly challenging interventions, and we are instituting new protocols for pain control and resuscitation to optimize patient care. The Epilepsy and Movement Disorders program is one of the busiest in the country and is participating in many innovative clinical trials, including stem cell placement. We frequently provide care to patients of Dr. Mark Richardson (Neurosurgery) during real-time magnetic resonance imaging (MRI)-guided procedures.

The remaining clinical caseload includes care for traumatic intracranial injuries, evacuations of intracranial hemorrhages, placement of spinal cord stimulators and ventriculoperitoneal shunts, and various stereotactic procedures such as computed tomography or MRI-guided stereotactic surgery with three-dimensional localization.

Education & Training
The division’s didactic program currently consists of a monthly subspecialty conference, intraoperative teaching, and a new electronic curriculum. In addition, the residents have lectured at all levels on neuroanesthesiology topics and in small group learning sessions.
SAME DAY SERVICES

Same Day Services at UPMC Presbyterian/Montefiore includes both Same Day Surgery (SDS) and the Preoperative Evaluation Center (PEC). In FY17, a total of 12,864 patients were processed in SDS, either as same day-admitted patients (6,595) or outpatient surgery patients (6,269); 4,086 patients were seen in the PEC.

Patient Care and Clinical Activities
Most patients scheduled for both outpatient surgical procedures and same day-admit procedures at UPMC Presbyterian and Montefiore receive care at the SDS unit at UPMC Montefiore. The PEC continues to function as a multidisciplinary unit with anesthesiology and internal medicine support. The clinic receives referrals from surgeons for prior anesthetic problems, complex medical conditions, patient concerns, or pre-surgical history and physical. All preoperative testing and consults are then combined with a detailed pre-anesthetic evaluation and physical examination conducted by a nurse practitioner, anesthesiology resident, or internal medicine attending physician. An attending anesthesiologist is available at all times to review complicated patients or test results with the PEC providers. The entire evaluation is then available to the patient’s attending anesthesiologist on the day of surgery. Patients who are not seen in the PEC are called and evaluated the day before surgery by SDS nurses. The goal of the unit is 100% patient review prior to surgery, resulting in minimal unforeseen delays and cancellations on the day of surgery. Current data shows that patients who are seen in the PEC are significantly less likely to have their scheduled surgeries delayed or cancelled.

Additional screening procedures continue, including a sleep apnea questionnaire, deep venous thrombosis risk assessment, and the calculation of cardiac risk indices. Beginning in July 2016, patients were also screened for frailty at the surgeons’ offices and if they were deemed to be at risk for postoperative complications, they were scheduled for an extended appointment in the PEC, which included recommendations for cardiopulmonary or nutritional optimization prior to surgery.

Education and Training
Anesthesiology faculty members at UPMC Montefiore continued to be active in resident education in FY16, teaching principles of ambulatory, ENT, orthopedic, and regional anesthesiology. Residents participate in outpatient evaluations and learn a variety of regional anesthesiology techniques and principles of outpatient anesthesiology. The PEC continues to serve as the site of the postgraduate year (PGY)-2 Preoperative Evaluation Rotation, which is mandated by the Accreditation Council for Graduate Medical Education (ACGME) for anesthesiology residency programs. Residents see a variety of patients prior to the day of surgery, order appropriate testing, and obtain consultations if necessary. The residents then create a detailed note available to the attending or resident assigned to the case on the day of surgery.
Patient Care and Clinical Activities
Anesthesiologists in the UPMC Presbyterian/Montefiore Division of Transplantation Anesthesiology (TA) care for patients undergoing liver, intestinal, multivisceral, kidney, pancreas, and composite tissue allograft (CTA) transplantation. In addition, TA provides anesthesiology care and work-up for patients undergoing major hepatic resections.

The primary responsibilities of TA include preoperative assessment of transplant candidates, participation in candidate selection, intraoperative management, and postoperative visits. Preoperative consultation of transplant candidates is the main strength of the service. As true consultants, anesthesiologists provide hepatologists and surgeons with valuable information on extrahepatic organ function. All candidates are evaluated at the Thomas E. Starzl Transplantation Outpatient Clinic or as inpatients at UPMC. As division chief, Dr. Planinsic reviews all the preoperative testing of candidates, concentrating on cardiovascular risk, and makes recommendations to the transplant surgery division if further testing or intervention is required.

Anesthetic management of hepatic, intestinal, multivisceral, kidney, pancreatic, and CTA transplantation requires both highly sophisticated monitoring and tight control of physiologic variables. An anesthesiologist carries out this management with the assistance of trainees, CRNAs, and clinical technicians. For hemodynamic monitoring, TA staff members routinely determine right ventricular ejection fraction, right ventricular end-diastolic volume, and mixed-venous oxygen saturation using a pulmonary artery catheter. Two-dimensional transesophageal echocardiography also plays an important role in determining and optimizing cardiac contractility and preload.

During FY17, 329 adult total solid organ abdominal transplants were performed at UPMC Presbyterian/Montefiore, a nearly 17% increase from FY16. These included 210 kidney (152 deceased-donor and 58 living-donor), 110 liver (63 deceased-donor and 47 living-donor), one small bowel, and eight pancreas-kidney transplants.

Education and Training
Education in the UPMC Presbyterian/Montefiore TA service is comprised of a mandatory rotation (four weeks) for postgraduate year (PGY)-3 trainees and an elective rotation (three to nine months) for PGY-4 and PGY-5 trainees. Teaching objectives vary with the level of training. PGY-3 residents are expected to carry out anesthesia for liver transplantation with supervision and apply clinical skills learned during this rotation to other high-risk patients undergoing major surgery. PGY-4 trainees should comprehend the complex pathophysiology of patients with hepatic dysfunction and perform anesthetic care with minimal supervision. PGY-5 trainees should be able to perform anesthetic care independently and prepare themselves to become a consultant and/or a director of a liver TA program.

Residents beginning their rotation have the additional benefit of training at the Peter M. Winter Institute for Simulation, Education, and Research (WISER) in a course titled “Anesthesia for Liver Transplantation,” initially developed by Drs. Aggarwal, Boucek, and Planinsic. This course has been well reviewed by the residents and is offered at the beginning of the rotation and again upon completion of their OR experience with the UPMC Presbyterian/Montefiore TA division.

Research
TA members participate in diverse academic activities. During FY17, the TA faculty was very productive and participated in numerous meetings and symposiums, presenting their work related to organ transplantation.
Overview
The Children’s Hospital of Pittsburgh of UPMC (CHP) anesthesiology clinical division comprises 30 faculty members, 13 FTE CRNAs, and eight CRNPs (4.5 FTE) who provide both anesthesiology and surgical perioperative care. The main CHP Hospital is one of the first fully-digital hospitals in the nation and sits on a 10-acre, environmentally sustainable campus at a new site in the Lawrenceville neighborhood of Pittsburgh. In addition to the Lawrenceville Campus, CHP also has an outpatient surgical center in Wexford (CHP North). The Wexford surgical center was specifically designed for family-centered care for surgical patients. Anesthesiology services are provided every day of the week, as well as one Saturday a month. CHP pediatric anesthesiologists and CRNAs are responsible for all perianesthetic care at Wexford. Dr. Laima Bendel serves as medical director of the satellite.

Patient Care and Clinical Activities
In FY17, the division provided anesthesiology services for a total of 27,922 procedures, a slight decrease (406 cases) from the prior year (28,328). Of the total number of procedures, 8,064 were carried out at CHP North and 19,858 were carried out at the main hospital.

The CHP perioperative pain control service continued to serve a large number of patients under the guidance of Dr. Mihaela Visoiu. The acute pain anesthesiologists provide service at both the Lawrenceville and Wexford locations. The use of patient-controlled analgesia, epidural narcotics, epidural local anesthetics, pediatric caudal anesthetics, and regional blocks is now routine. It has become increasingly common to provide paravertebral, extremity, transabdominal, and rectus sheath blocks either with or without catheters. In addition, thoracic epidurals for postoperative analgesia in older patients and threaded caudal catheters in infants are used for thoracic and upper abdominal surgeries. Almost all regional blocks are performed under ultrasound guidance with or without nerve stimulation. The CHP acute pain service has improved patient care and provides resident and fellow training opportunities. Presently, two fellows are assigned to the acute pain service on a daily basis. Over 2,000 pediatric regional blocks are performed annually in 1,200 patients.

Inpatient chronic pain patients are covered by our consult service that incorporates a multidisciplinary approach to patient care and involves the services of behavioral health, physical therapy, and physical medicine and rehabilitation. The CHP chronic pain outpatient clinic treats patients at the Lawrenceville campus, CHP North, and the new CHP campus in Bridgeville.

Other specialty anesthesiology service divisions at CHP include abdominal organ transplantation, radiology, and cardiology, headed by Drs. Daniela Damian, Brian Blasiole, and Patrick Callahan, respectively. The abdominal organ transplantation anesthesiologists also provide transplant anesthesia for pediatric patients undergoing liver transplantation at the University of Virginia.

The pediatric cardiac anesthesia service provides care for patients undergoing open heart procedures and patients undergoing diagnostic and/or interventional procedures in the cardiac catheterization lab. In FY17, 296 bypass cases and 151 closed procedures were performed. In the catheterization lab, anesthesia services were provided for 761 procedures.

The pediatric anesthesiology radiology service covers off-site locations that involve MRI, invasive radiology, PET scan, CT, nuclear medicine, and radiation therapy. In FY17, anesthesia services were provided for 4,097 procedures.

Education and Training
Under faculty supervision, CHP pediatric anesthesiology fellows prepared and presented teaching activities including...
mini-lectures, core lectures, and case conferences. Anesthesiology residents spend three months at CHP during their third post-graduate year (PGY-3) for clinical training. Additional time in pediatric anesthesiology can be elected during the PGY-4 year. Dr. Doreen Soliman oversees the resident training program and Dr. Denise Hall-Burton directs the medical student clerkships at CHP. Faculty members actively participated in medical student courses, including introduction to medicine (a first-year course), clinical problem-based learning (second-year), clinical skills (third-year), and various anesthesiology clerkships for third- and fourth-year students. The pediatric anesthesiology education programs continued to provide special training for Critical Care Medicine fellows, pediatric dentists, emergency medical residents, and nurse anesthesia students rotating through the service. In addition, faculty members participated in an oral board preparation course for senior residents (PGY-3 and PGY-4).

In addition to the anesthesiology residency program, an ACGME-approved combined anesthesiology/pediatric residency has begun. This five-year program accepts one resident per year. The Program Director and Associate Program Director are Dr. Peter Davis and Dr. Erica Sivak, respectively. Program applicants go through a separate match as fourth-year medical students. Further information on the pediatric medical student and residency programs and the pediatric anesthesiology fellowship is available in the education section of this report.

Research
Research efforts at CHP focus on pediatric anesthetic pharmacology, respiratory physiology, and outcomes-based protocols. Clinical trials are also conducted and are an active research component at CHP. More details can be found in the research section of this report.

ACUTE INTERVENTIONAL PEDIATRIC PAIN SERVICE

The Acute Pediatric Interventional Pain Service at Children’s Hospital of Pittsburgh of UPMC (CHP) is responsible for the care of pediatric patients (0 days-26 years-old) undergoing various surgical procedures and requiring postoperative pain control management. The group includes six pediatric regional anesthesiologists: Drs. Mihaela Visoiu, Denise Hall Burton, Antonio Cassara, R. Scott Lang, Joshua Eaton, Franklin Cladis, as well as two acute pediatric pain nurses, Anne Stevens and Annette Sellhorst. The CHP acute pain group’s goal is to find optimal, individualized therapeutic regimens that not only decrease pain scores and opioid consumption, but outlast postoperative pain, improve quality of care, increase patient and family satisfaction with pain control, and reduce healthcare costs.

Pediatric perioperative pain control is challenging and requires both advanced regional anesthesia techniques such as neuraxial and peripheral nerve blocks, single injections and catheters, and an understanding of neonatal and pediatric anatomy, physiology, and pharmacology. Ultrasound-guided truncal blocks (paravertebral, rectus sheath, transversus abdominis, quadratus lumborum, pectoralis, and serratus nerve blocks) represent the largest part of the peripheral nerve blocks performed at CHP. In addition, the service performs upper extremity and lower extremity nerve blocks (cervical, brachial, and lumbar plexus; sciatic, femoral, adductor canal, and saphenous); during FY17 they sent home more than 200 patients (77% on the same day of surgery) with continuous peripheral nerve blocks and on-Q pumps. Pediatric pain attendings provide anesthesia and sole postoperative pain care at the North Surgical Center in Wexford for orthopedic and general surgical procedures (110 patients, 148 blocks). Anesthesiologists at CHP work with a new regional anesthesiology and pediatric fellow every month and train fellows to be expert consultants in all aspects of pediatric regional anesthesia and acute pain management. In FY17, the acute pain service completed 2,934 blocks (93% peripheral nerve blocks, 7% neuraxial, 26% catheters), on 1,338 patients as follows: 2% neonates, 7% in the one-12 month-old group, 29% in the one-10 year-old group, and 52% in children older than 10 years old. In addition, the CHP acute pain group provides daily coverage for inpatient and outpatient chronic pain patients after 4 pm and nights.
TRANSPANTATION ANESTHESIOLOGY

Anesthesiologists in the Division of Transplantation Anesthesiology (TA) at Children’s Hospital of Pittsburgh of UPMC (CHP) are responsible for the care of pediatric patients undergoing liver, intestinal, multivisceral, kidney, pancreas, and composite tissue allograft (CTA) transplantation. Additionally, these anesthesiologists, as part of the multidisciplinary CHP transplantation team, provide consultation and care in conjunction with University of Virginia (UVA) Pediatric Anesthesiologists for a newly created joint CHP-UVA pediatric liver transplantation program.

Anesthetic management for pediatric transplant patients requires both highly sophisticated monitoring and tight control of physiologic variables. An anesthesiologist may provide sole care of these patients or work in an anesthesia care team model with fellows, CRNAs, and/or residents while assisted by anesthesia technicians.

During FY17, both living donor and cadaveric donor transplants were performed. The CHP TA faculty included Drs. Phillip Adams, Brian Blasiole, Franklyn Cladis, Daniela Damian, Peter Davis, W. Scott Jones, Anne Kamarchik, Gregory McHugh, David Rymer, and Mihaela Visoiu. Forty-nine pediatric transplants were completed by CHP TA faculty in FY17. Of these cases, eight were kidney, six were living-donor kidney, 19 were liver, 12 were living-donor liver, and four were small bowel transplants.

SEDATION SERVICES AND OFF-SITE ANESTHESIA

Anesthesiology and sedation services for off-site locations at Children’s Hospital of Pittsburgh of UPMC (CHP) continues to grow and serve the children of Pittsburgh and beyond. The department provides anesthesia and sedation for children in interventional radiology, magnetic resonance imaging (MRI), computed tomography (CT), nuclear medicine, positron emission tomography (PET), radiation oncology, and hematology-oncology. Due to the unique restrictions and challenges that accompany safe administration of anesthesia for children undergoing MRI, a dedicated group of anesthesiologists that includes Drs. Brian Blasiole, Patrick Callahan, Daniela Damian, Khoa Nguyen, Greg McHugh, Erica Sivak, Cristina Roosen, Susan Rooksby, Scott Jones, and Mihaela Visoiu specifically provide care in this area. This group of physicians coordinates other care for these medically complex children after MRI, commonly under one anesthetic, including lumbar punctures, dental and ophthalmologic exams, transthoracic echocardiograms, and transport to the OR for other invasive procedures. The number of MRI cases performed under general anesthesia in FY17 remained steady at 1,723, a decrease in 18 cases compared to the prior year. The number of interventional radiology cases requiring general anesthesia was 2,143 in FY2017, an increase in 147 cases compared to FY2016.

FY17 marks the first year that the Sedation Service at CHP was operated under the Department of Anesthesiology. Previously run by the Division of Pediatric Emergency Medicine and the Department of Pediatrics, the Sedation Service expanded their services to not only provide sedation in the out-of-OR locations, but also serve as consultants in guiding the appropriate care for imaging and other procedures using approaches that range from distraction techniques, anxiolysis, sedation, and general anesthesia. Most sedations are for MR exams and diagnostic and therapeutic procedures for hematology-oncology patients. Compared to FY16, sedations in FY17 decreased from 1,449 to 1,386. It is important to note that the Sedation Service expanded its approach in FY17 and demonstrated tremendous success in sedating children with intranasal Precedex for transthoracic echocardiograms and auditory brainstem response exams, a notable sea change in practice considering these exams were previously performed under general anesthesia in selected patients. Urmila Tirodker, MD, who previously worked at Akron Children’s Hospital in the Pediatric ICU, and Isabela Caijao-Angelelli, MD, previously from the Pediatric Emergency Department at CHP, joined the Sedation Service this past year.
Overview
The Magee-Womens Hospital (MWH) anesthesiology clinical site comprises 20 faculty members, 33 CRNAs, and one full-time Certified Registered Nurse Practitioner (CRNP) who provide care within the operating and delivery suites, in the pre-anesthesia evaluation and testing center, and in off-site locations such as Radiation Oncology, MRI, and Invasive Radiology. The division also provides emergency management in conjunction with members of the Department of Critical Care Medicine for all cardio-respiratory arrests (Condition A), as well as in conjunction with our obstetricians for all maternal emergencies (Condition O). MWH anesthesiologists’ primary focus is providing in-house, 24-hour anesthesia coverage in two primary anesthetizing locations: the WomanCare Birth Center (WCBC) and the main Surgical Services Center.

Patient Care and Clinical Activities
MWH anesthesiologists provide state-of-the-art anesthesia and obstetric care to their patients. Most services are provided in the WCBC. In FY17, the Obstetric Anesthesia section oversaw 8,795 deliveries, an approximate 6% decrease from FY16. Of these deliveries, 6,044 were vaginal births (69% of all deliveries) and 2,751 (31% of all deliveries, a 25% decrease from FY16) were cesarean deliveries. Additional procedures performed on the unit include combined cesarean/abdominal hysterectomy, external cephalic version, percutaneous umbilical blood sampling, manual placental extraction, urogenital laceration repair, and postpartum tubal ligation. Fetal surgery continues to increase as the hospital focuses more resources on this activity. Fifty-four fetal procedures were managed during FY17.

Beyond the birthing suite, MWH provided anesthetic management for 14,702 cases in the Surgical Services Center in FY17, a 713 case decrease from FY16. The FY17 site total (including deliveries and off-site cases) was 23,497 cases. The Surgical Services Center consists of 14 general operating rooms, a cystoscopy suite, and two minor procedure rooms. Of these, four state-of-the-art minimally invasive suites were used to accommodate a growing variety of minimally-invasive surgical procedures.

One CRNP is available Monday through Thursday in the pre-anesthesia evaluation and testing center for pre-anesthesia consultations and evaluations. In FY17, approximately 40% of surgical patients were evaluated preoperatively in the center.

Education and Training
MWH is a primary educational site for medical students, nurse anesthesia students (SRNAs), residents, and fellows from programs within the University of Pittsburgh and UPMC. The division provides both obstetrical anesthesiology and general anesthesiology rotations. In addition, anesthesia residents from other programs in the city rotate through the division for subspecialty obstetrical anesthesiology training. All residents, under the direction of Dr. Rob Krohner, attend daily didactic lectures covering topics in obstetric and gynecologic anesthesiology. Mock ABA oral examinations given by the faculty to each resident are an important aspect of the educational experience. Continuous quality improvement and formal case-discussion conferences are also held each week. With close faculty assistance, residents attend monthly journal clubs that review recent literature in obstetrical anesthesiology. Informal case-management discussions related to obstetrical anesthesia complement the didactic program. A list of these topics is kept in a database and is repeated during each resident rotation. All residents rotating through obstetrical anesthesiology become certified in neonatal resuscitation by Dr. Ryan Romeo.
Dr. Krohner, Ms. Dani Meholic, RN, CRNA, and Valerie Pomerantz, RN, CRNA, coordinate the SRNA program at MWH. These students rotate through both the labor and delivery and general operating suites.

Dr. Ryan Romeo supervises the anesthesiology clerkship for third-year medical students during their surgery and perioperative care rotation. In addition, many fourth-year medical students opt to take a one-month elective to further expand their knowledge of anesthesia.

MWH serves as the principal site for the department’s clinical fellowship in obstetric anesthesiology, directed by Dr. Patricia Dalby. The Accreditation Council for Graduate Medical Education (ACGME) re-accredited the program in January of 2016 until 2022. Lectures and research opportunities for the fellows encompass areas which are not normally part of the residency program. For instance, fellows rotate through maternal fetal medicine as well as the neonatal ICU. Last year, a new elective rotation that exposes fellows to women’s neurology as well as blood banking was developed. We believe that this is highly unique to MWH.

Research
Research efforts by MWH faculty in both obstetric and general anesthesiology led to the publication of several manuscripts and case reports and the presentation of numerous abstracts. Additional MWH anesthesiology faculty accomplishments include a published book, several published book chapters, and invited lectures and presentations. For further information, see the publications section of this report.
CLINICAL DIVISIONS

UPMC SHADYSIDE

Overview
The UPMC Shadyside Anesthesiology Division consists of 20 faculty members and 52 CRNAs. The division provides adult anesthesiology services for a 22-room main operating suite and a six-room ambulatory surgery center, as well as coverage for two gastrointestinal labs, two electrophysiology labs, and invasive radiology.

Patient Care & Clinical Activities
During FY17, clinical anesthesiology services were performed for 20,819 cases at UPMC Shadyside. Our caseload spans the full range of adult surgical procedures, including major thoracic, cardiovascular, neurosurgical, orthopedic, urologic, gynecologic, oncologic, and general surgery, as well as outpatient orthopedic, plastic, dental, gynecologic, and general surgery. The division provides subspecialty care in cardiac anesthesiology and neuroanesthesiology with subspecialty-trained and credentialed faculty. UPMC Shadyside was recently designated as an “Aortic Center” and is the regional referral center for complex cases involving the aortic valve and aorta. The cardiac anesthesiology team, consisting of Drs. Robert Boretsky, Bryant Bunting, Brent Cain, Rama Joshi, Michael Ingram, Mark Hudson, Steven McHugh, Mahesh Sardesai, Jill Suffield, and Sudakar Yenem, provides 24/7 coverage for cardiac surgical cases. All are board-certified in transesophageal echocardiography. Drs. McHugh, Sardesai, and Sharad Khetarpal provide neuroanesthesiology expertise.

Dr. Jonathan Waters and the acute pain team of Drs. Bruce Ben-David, Brandon Chinn, Sharad Khetarpal, Rita Merman, Carl Rest, Anna Uskova, and Sudakar Yenem offer 24-hour postoperative pain management for the majority of our orthopedic, thoracic, and urologic patients. UPMC Shadyside Anesthesiology also provides 24-hour in-house coverage for emergency surgical cases and emergency airway management.

Education & Training
The division provides educational opportunities for its staff and faculty, as well as to a diverse set of students from other departments. Teaching activities include weekly case presentations, where faculty members prepare and present lectures. Dr. Mahesh Sardesai, the division’s Director of Quality Assurance, presents a monthly morbidity and mortality conference. UPMC Shadyside Anesthesiology faculty members actively participate in the medical student anesthesiology rotation organized and administered by Dr. Shiv Goel. Dr. Daniel Sabo, director of the UPMC Shadyside internal medicine residency rotation in anesthesiology, and Dr. Rama Joshi, director of the family practice residency rotation, provide instruction in clinical skills, airway management, and invasive monitoring. UPMC Shadyside is a designated primary instruction site for the University of Pittsburgh School of Nursing’s Nurse Anesthesia program. Our CRNAs and faculty anesthesiologists actively participate in the education and training of these students. Airway management training is also provided for paramedic students from the Center for Emergency Medicine. Department faculty members also participate in the didactic educational program. Dr. Robert Boretsky is the Medical Director for the UPMC Shadyside School of Perfusion.

Research
UPMC Shadyside has become a major center for clinical research, generating publications in acute pain management, surgical outcomes, or management, and economics.
NEUROANESTHESIOLOGY

Neuroanesthesiology services at UPMC Shadyside are primarily provided by Stephen M. McHugh, MD, Mahesh Sardesai, MD, and Sharad Khetarpal, MD. In FY 2017, 1,444 neuroanesthesiology cases were performed at the hospital. A wide variety of cases were carried out, including craniotomies under general anesthesia, “awake” craniotomies, spinal fusions, discectomies, laminectomies, and implantation of ventriculoperitoneal shunts, spinal cord stimulators, and pain pumps.

PGY-3 and PGY-4 residents complete a neuroanesthesiology rotation at UPMC Shadyside. The hospital provides a unique environment for resident education. UPMC Shadyside is a tertiary care referral hospital where residents encounter patients needing specialized neuroanesthesiology care. The rotation is limited to one resident per month, allowing us the unique opportunity to pick the best and most appropriate cases for them to learn.

The rotation is designed to provide both excellent knowledge of the theory of neuroanesthesia and strong exposure to the clinical practice of caring for patients undergoing these procedures. Residents are closely supervised as they learn the specifics of these cases. Frequent lectures are given both during and after cases and residents receive a mock oral exam at the end of their rotation. Knowledge content is further expanded by conducting literature reviews as interesting cases occur.
Overview
Veterans Affairs Pittsburgh Healthcare System (VAPHS) Anesthesiology is staffed by 12.5 physician full-time equivalents, a mix of VA and University of Pittsburgh employees. CRNAs provide care to veteran patients in a team care model, providing clinical care for veterans in a 12-room operating suite, three gastrointestinal (GI) labs, a cardiac electrophysiology (EP) suite, a fully integrated vascular angiography suite, a preoperative evaluation clinic, and a multi-disciplinary pain clinic. The staff is involved in a wide range of administrative, educational, research, and quality assurance activities at both VAPHS and the University of Pittsburgh School of Medicine (UPSOM).

Patient Care and Clinical Activities
Clinical service volume for FY17 continued the trend of increasing case volumes. A total of 7,404 OR cases were completed, an 11% increase over the year prior, including nearly 100 solid organ transplants. Off-site anesthesiology coverage continued to expand significantly, primarily in the GI lab with 3,285 cases (a 70% increase). The number for EP Lab cases, interventional radiology, pulmonary, MRI, and other off-site cases totaled 748 cases, a small drop from the prior year.

Pain management services again saw an increase in patient load for FY17. A total of 1,211 new consults (4% increase), 1,140 follow-up encounters (no change), and 899 interventional procedures (19% increase) were completed. The Acute Pain Medicine/Regional Anesthesia team remained very active and further enhancements of the Enhanced Recovery After Surgery (ERAS) program were instituted.

Education and Training
During FY17, both third- and fourth-year medical students rotated through VAPHS under the direction of Dr. Catalin Ezaru. The rotation continues to be highly successful and highly-rated. Dr. Mangione continues to serve as an educational leader in the University of Pittsburgh Department of Anesthesiology, where he serves as Director of Medical Student Programs, and at the UPSOM, where he serves as Clerkship Director for anesthesiology courses. He also serves on a variety of UPSOM committees and is a member of the Academy of Master Educators.

The VAPHS Anesthesiology Division continues to provide clinical experience for residents of all levels, with a total of 33 different residents rotating during the year. In addition, a liver transplant rotation for senior residents was instituted. Evaluations of both the rotations and the individual faculty members remain consistently excellent. The VA continued to be a key location for PGY-4 residents looking for experience in sub-staffing at a junior attending level. Dr. Todd Oravitz continues to coordinate the resident rotations, as well as the 20-day introductory program. VAPHS anesthesiologists also provide clinical training for SRNAs, dental residents, and anesthesia technology students. Teaching activities include weekly teaching conferences and lectures for UPSOM medical students and residents, as well as various programs for hospital employees. Dr. James Ibinson continues to educate and mentor graduate students at the University of Pittsburgh.

Research and Scholarly activity
In FY17, faculty members were active in terms of scholarly activity, authoring 10 peer-reviewed publications and several abstracts/poster presentations. Dr. Brian Williams $1.9 million US Department of Defense grant, “Four-drug Nerve Block versus Plain Local Anesthetic for Knee and Hip Arthroplasty Analgesia in Veterans,” began recruiting patients. Drs. Ibinson and Mangione are co-investigators on this grant. Dr. Ibinson was awarded a VISN 4 Competitive Pilot Program Grant, “Quantifying the Neural Correlates of POCD.”
Overview
UPMC Mercy is a 488-bed tertiary care hospital in the uptown district of Pittsburgh. UPMC Mercy has a rich history, from its beginning as the first permanent hospital in Pittsburgh and the first Mercy hospital in the world to its current role as a provider of faith-based care to its patient population, including the underserved in our region. The hospital remains the only Catholic hospital in the region, providing specialized services such as women’s health, neurological, cardiac, and orthopedic care; in addition, it serves as a Neuroradiology Stroke Intervention Center, Level 1 Adult Trauma Center, and an American Burn Association-verified Adult and Pediatric Burn Center. The hospital has been a focal point for student and resident teaching for the University of Pittsburgh Schools of Medicine, Dental Medicine, and Nursing for many years and continues to provide educational experiences for our residents in multiple specialties, including neuroanesthesiology, cardiothoracic anesthesiology, regional anesthesiology, and acute pain management.

The UPMC Mercy anesthesiology faculty consists of approximately 13.45 clinical full-time equivalent (FTE) anesthesiologists and 40 CRNA FTEs who cover 16 inpatient operating rooms (ORs), six outpatient ORs, an obstetrical suite with two cesarean-section rooms, a busy endoscopy suite, interventional neuroradiology suite, MRI, hydrotherapy unit for burn care, and electrophysiology suite. A pre-anesthesia evaluation (PEC) center is staffed by two CRNPs with a full-time physician director. The case selection includes all but solid organ transplants. Highlights include voice, airway-modification, robotic, thoracic, trauma, and complex maxillofacial surgeries. Burn care is a focal point at UPMC Mercy for both children and adults. UPMC Mercy’s Level I trauma service has a team dedicated to the care of parturients who suffer either blunt or penetrating trauma.

Patient Care and Clinical Activities
In FY17, UPMC Mercy clinicians supervised 17,942 cases. The endoscopy, electrophysiology, and radiology suites played a greater role in total anesthetic activities, which parallels a local and national trend, with nearly 20% of our prime time (7a – 5pm) coverage provided to these areas.

Education and Training
The teaching component of the UPMC Mercy anesthesiology site consists of rotating residents, fellows, and SRNAs, as well as off-service residents and students from the emergency medicine, surgery, and transitional year programs. Trainees from podiatric medicine and EMT programs and medical students from the University of Pittsburgh spend time on the service. Hospital lectures include site Grand Rounds, Journal Club, Quarterly Morbidity and Mortality conferences, and monthly staff meetings. There are also weekly medical student/resident conferences, where fourth-year medical students benefit from weekly one to one tutorials. Most weekly departmental conferences have been certified for CME credits, as well as CEU credits for CRNAs.
Overview
UPMC St. Margaret bridges the gap between community anesthesiology practice and tertiary care center. Efforts are focused on patient care in the operating rooms and GI suites of both the main hospital and Harmar Ambulatory Center. The UPMC St. Margaret anesthesiology clinical site comprises nine full-time physicians and 42 CRNAs. In September 2014, UPMC St. Margaret again achieved ANCC Magnet Recognition® status, the highest international recognition for nursing excellence and leadership granted by the American Nurses Credentialing Center. The anesthesiology division was very active in the magnet designation process and recertification efforts.

Patient Care and Clinical Activities
The UPMC St. Margaret and Harmar Ambulatory Center Anesthesiology Division have maintained a growing perioperative environment for the past six years at a time when the local population continues to decline. In FY17, anesthetics were provided for 19,778 cases; 16,522 cases were completed at the main hospital and 3,256 at the Harmar site. Anesthetics were provided at 21 sites at UPMC St. Margaret and the Harmar Ambulatory Center; these sites included 13 hospital and five ambulatory OR rooms, four GI rooms, and one remote location site, including a cardiology lab and invasive radiology suite. A large variety of surgical procedures were performed at St. Margaret, including orthopedic (spine, total joint, sports, and foot and ankle); general; thoracic; urologic; gynecological; vascular; ophthalmologic; plastic; and ear, nose, and throat surgery. Minimally invasive surgeries for knee and hip replacements were routinely performed here, and regional anesthesia with nerve blocks and post-operative pain control were used for orthopedic and general surgery cases. The combination of the two sites encompasses a large ultrasound-based regional anesthesiology and perioperative pain control program and manages the largest of UPMC’s outpatient peripheral nerve block catheter programs. In addition, the UPMC St. Margaret Anesthesiology Division is an integral member of the hospital’s geriatric fracture program.

Education and Training
In FY17, UPMC St. Margaret was a rotation site for anesthesiology residents, medical students, SRNAs, dental anesthesiology residents, and pain (acute and chronic) and critical care fellows. The hospital was also a popular rotation site for senior residents in the advanced clinical track focusing on perioperative pain management and operating room management. The faculty also provided an educational experience for other UPMC facility faculty members in the practice of ultrasound-based regional anesthesiology. In addition, UPMC St. Margaret anesthesiologists participated in didactic sessions for the hospital medical staff and family practice residents. The group at UPMC St. Margaret has become increasingly involved in clinical research, participating in several industry-supported projects.
UPMC EAST

FY17 was UPMC East’s fifth full year of service after opening on July 2, 2012. Located in the heart of Monroeville, UPMC East is a full-service community hospital providing patient-centered care. It is a 156-bed facility – 120 medical-surgical beds; 16 ICU beds; 19 rehab beds – and houses seven operating rooms with 31 pre-op/PACU bays, two endoscopy rooms, and two integrated interventional procedural and catheterization labs. The Chief Anesthesiologist at UPMC East is Michael Kentor, MD, and the Chief CRNA is Cindy McGettigan. The faculty at East consists of the same faculty who staff UPMC Mercy South Side Outpatient Center, and includes Drs. Monica Bolland, Kimberly Cantees, William Ehrman, Tara Knizner, Michael Kentor, Scot Muir, Steven Orebaugh, Rita Toshok, and Charles Law, who shares his time with UPMC Passavant. Dr. Ehrman will be resigning at the end of August 2017. We hope to hire a replacement. In addition, starting in July 2017, Dr. Doug Bentley will be joining the faculty as a full-time FTE and we will be sharing the services of Dr. Bryce Bernard with UPMC Mercy.

Our surgical volume covers a wide spectrum of surgical specialties, including general surgery, orthopedics, podiatry, plastics, ENT, urology, neurosurgery (consisting mainly of spinal procedures), and thoracic, gynecology, and vascular surgery. The case load at UPMC East steadily increased over the year, resulting in 9,562 cases in FY17, an over 15% increase from the prior fiscal year. In addition, we have a very active inpatient/outpatient GI lab that uses anesthesia services on almost all of their cases. Our volume of anesthesia cases in the GI lab increased by over 33%, going from 3,592 to 4,796 cases. Requests for anesthesia services in the interventional procedure suites also continue to grow. In addition, the number of peripheral nerve blocks for post-operative pain performed at UPMC East increased from 608 the previous fiscal year to 617 blocks in FY17.

UPMC MONROEVILLE SURGERY CENTER

MICHAEL L. KENTOR, MD
Director

The UPMC Monroeville Surgery Center is now in its 25th year of operation and became part of UPP (under the umbrella of Department of Anesthesiology) on July 1, 2015. It was one of the very first free standing outpatient surgery centers in western Pennsylvania. Since opening, over 100,000 anesthetics have been administered. In FY17, the center provided anesthesia services for 4,023 cases. The surgery center is housed on the first and second floors of a four-story building at 125 Daugherty Drive, Monroeville.

FY17 saw significant changes at the center. At the end of September 2016, we closed the GI center on the second floor, moving a significant number of our GI cases to UPMC East. The remaining GI cases were relocated to the operating room on the first floor. This enabled us to run the surgery center with one anesthesiologist. Starting July 2017, Michael Kentor, MD became the Director of Anesthesia Services.

A variety of surgical procedures, as well as a large chronic pain service are provided at the surgery center. Surgical specialties include ophthalmology, orthopedics, urology, and general surgery. Specialized areas within these groups include hand, glaucoma, and breast surgery. The majority of the foot and ankle cases are being moved to East.
CLINICAL DIVISIONS

UPMC DIGESTIVE HEALTH AND ENDOSCOPY CENTER

MICHAEL L. KENTOR, MD
Chief Anesthesiologist

The UPMC Digestive Health and Endoscopy Center is an ambulatory endoscopy facility located in Penn Hills that is recognized for a high level of specialized care in gastroenterology, serving the adult and geriatric population requiring diagnostic procedures related to gastrointestinal and hepatobiliary disorders. The center was founded in 2001 by a group of private physicians and in 2014 become part of the UPMC enterprise.

The endoscopy center is unique in that is has private patient rooms that are utilized for pre-procedural assessment and post-procedural recovery/discharge. The center has two functioning procedure rooms. Anesthesia is provided by CRNAs with Dr. Kentor serving as the Medical Director of Anesthesia. All procedures are done on an outpatient basis. The FY17 anesthesiology staff included CRNAs Claudia Klickovich and Loren Pulliam.

UPMC Digestive Health and Endoscopy Center is also unique in that is has been approved by the Department of Health to operate as a unit of UPMC Shadyside as a hospital outpatient-based department located off the Shadyside campus. As a department of UPMC Shadyside, the center has access to certain ancillary services provided by that campus.

Samir Ayasso, MD (Medical Director/gastroenterologist) is responsible for the quality of medical care provided within the center and participates in performance improvement activities. Lynn Chabalie BSN, RN is responsible for the overall center operations. Other medical staff includes gastroenterologists Drs. Su Min Cho, Wendy Craig, Farhad Ismail-Beigi, Tina Musahl, and Hitendra Patel.

UPMC MERCY SOUTH SIDE OUTPATIENT CENTER

MICHAEL L. KENTOR, MD
Chief Anesthesiologist

STEVEN L. OREBAUGH, MD
Assistant Chief Anesthesiologist

Overview
FY17 was UPMC Mercy Southside Outpatient Center’s eighth full year of service after its conversion from an inpatient facility to an ambulatory surgical center. The orthopedic sports medicine and ophthalmology services remain the primary source of surgical cases, along with a lesser number of podiatry cases and an occasional ENT case. Off-site provision of anesthesia for GI cases continued as well. Eighty percent (80%) of the nurse anesthetists in our division share time between Mercy Southside and other institutions, mainly UPMC Mercy and the UPMC South Surgery Center in Bethel Park, as well as UPMC East. Mercy Southside continues to serve as the primary core site for resident peripheral nerve block training, with two residents rotating here each month, each of whom typically provides 50 to 80 nerve blocks.

Patient Care and Clinical Activities
Although there was a significant decrease in surgical/procedural cases in the years following the metamorphosis of Mercy Southside into an ambulatory facility, the increasing volume of the sports/orthopedic service, as well as the integration of the ophthalmology department into this site, has resulted in restoration of the case numbers. The UPMC Mercy South Side Anesthesiology Division continues to provide high-quality ambulatory services to these patients using multi-modal analgesia, aggressive prophylaxis against postoperative nausea and vomiting, and regional anesthesia (when practical) to mitigate against postoperative pain. The total number of cases performed at the center, including off-site GI cases, was 5,083 during FY17 (an 11.3% decrease from FY16).
Overview
UPMC McKeesport is a 222-bed community hospital serving patients along the Monongahela Valley.

Currently, the division is staffed by two full time anesthesiologists with assistance over the course of the year, as well as four full time, two part time, and two casual CRNAs, with the help of one full time network CRNA. Plans are to continue to staff with two anesthesiologists per day until the division transitions with the move of the GI lab into the OR suite, at which time one MD per day will provide coverage.

In FY17, UPMC McKeensport provided anesthesia for 3,694 cases. OR cases accounted for 2,427 of those procedures and 1,267 were off-site procedures. In addition, anesthesiologists performed 180 acute pain regional blocks for immediate post-operative pain control and provided blocks for chronic pain patients. Seventy-nine consultations were conducted and twenty-eight subsequent epidural steroid injections were performed.

Clinical Activities
Typical of a community hospital, the surgical procedures performed at UPMC McKeensport include major non-cardiac vascular surgery, lumbar laminectomies, spinal fusions, total joint replacements/orthopedic cases, abdominal surgery, gynecologic surgery, urologic. ENT, ophthalmologic, plastic surgery, and minimally invasive chronic pain procedures. Anesthesiology services are also provided at non-OR sites for GI, cardiac catheterization and pacemakers, bronchoscopy, radiologic, and radiation oncology procedures. The division provides back-up support for Emergency Department physicians, intensivists, and hospitalists in managing patients with difficult airways.

UPMC McKeensport Anesthesiology has been instrumental in creating difficult airway carts in strategic locations within the hospital and has established protocols for preoperative recognition and identification of surgical patients with obstructive sleep apnea, as well as the perioperative management of these patients.

Periodic evaluation and assessments are done to ascertain compliance with Surgical Care Improvement Project (SCIP) initiatives, central line-associated bloodstream infection (CLABS) preventive measures, indicators for Physician Quality Reporting Initiatives (PQRI), and patient safety measures.

Teaching Activities
Morbidity and mortality conferences, journal club meetings, and appropriate clinical updates are conducted regularly. The perioperative team undergoes a yearly mock fire drill with participation from the hospital’s safety officer. A malignant hyperthermia update and review is conducted annually. Updates on anesthesia awareness are conducted on a biennial basis.

Teaching activities at UPMC McKeensport include teaching airway management to non-anesthesiology-trained chronic pain fellows, internal medicine and family practice residents, as well as EMT students. Residents in both disciplines also receive training and gain experience with insertion of invasive lines. UPMC McKeensport anesthesiologists and CRNAs are committed to the clinical teaching and training of student nurse anesthetists.
Overview
As UPMC’s tertiary care center north of Pittsburgh, UPMC Passavant is a 434-bed, state-of-the-art hospital offering world-class medical care at campuses in McCandless and Cranberry. Our staff and physicians, dedicated to quality and innovation, provide exceptional service, including all the capabilities of an academic medical center, by utilizing cutting-edge technology in a patient- and family-centered atmosphere.

UPMC Passavant–McCandless attracts patients from around the region and country for advanced cardiovascular, cancer, neurosurgical, gastrointestinal, and colorectal care. The hospital’s new seven-story pavilion, the first Leadership in Energy and Environmental Design (LEED)-certified hospital addition in the North Hills, has enhanced the ability of UPMC–McCandless to provide specialized medical and surgical treatment while improving the patient and family experience. Located in the new pavilion, UPMC Cancer Center at UPMC Passavant provides high-quality, comprehensive cancer care to residents in Pittsburgh’s northern communities.

UPMC Passavant’s 35-bed campus in Cranberry Township includes an expanded Emergency Department; a Comprehensive Breast Center; a complete diagnostic services department, including CT scan, MRI, ultrasound, general and cardiac nuclear medicine, and echocardiography; and outpatient surgical services.

The 132-acre McCandless campus boasts 21 operating rooms, six GI procedure rooms, and a large cancer center. The smaller Cranberry campus has six operating rooms/procedure rooms.

Patient Care and Clinical Activities
The UPMC Passavant Anesthesiology Division consists of 44 credentialed physicians and 101 credentialed CRNAs, translating to an approximate 14.5 OR FTE physician/43 FTE CRNA complement. The division supports the hospitals’ surgical volume and numerous outside-the-OR cases, including the EP lab, six GI procedure rooms, and a minimally invasive image-guided procedures suite. In FY17, UPMC Passavant anesthesiologists treated 25,260 cases at both the McCandless and Cranberry locations.

Anesthetizing locations may run as high as 30 daily between both campuses. All surgical subspecialties are represented, with the exception of transplant and complex pediatric surgery. The hospitals’ neurosurgical program performs both spinal and intracranial procedures. UPMC Passavant has a multispecialty robotic surgery service line.

A UPMC Passavant division of the Acute Interventional Perioperative Pain Service (AIPPS) operates under the leadership of Drs. Jonathan Waters and Charles Luke. AIPPS provides comprehensive postoperative pain management for appropriately selected patients.

Under the leadership of Drs. Ryan Ball, Stephen Esper, and colorectal surgeon Jennifer Holder-Murray, UPMC Passavant implemented a comprehensive Enhanced Recovery After Surgery (ERAS) Program positively impacting colorectal length of stay and perioperative complications. Expansion of the program to additional service lines beyond colorectal is currently underway.

Education and Training
Three anesthesiology fellowship programs (acute pain/regional anesthesiology, pain medicine, and cardiac anesthesiology) are active at UPMC Passavant. The hospital is a rotation site for senior anesthesiology residents and University of Pittsburgh and La Roche College anesthesia MSN students.
UPMC BEDFORD MEMORIAL

Overview
UPMC Bedford Memorial is a 49-bed, acute care general hospital located in Bedford County, Pennsylvania. The hospital has units for medical, surgical, obstetric, intensive care, coronary care and telemetry services, and offers a variety of diagnostic capabilities, including CT, MRI, and the region’s only digital mammography with 3D tomosynthesis. The hospital also operates a cardiac-pulmonary rehabilitation program, an outpatient procedure unit, and an ambulatory surgical unit. The emergency facilities include 24-hour, in-house coverage by Emergency Medicine physicians, a licensed heliport for emergency transport, and trauma center affiliation. The UPMC Bedford anesthesiology division consists of two physicians and five CRNAs who provide both anesthesia and surgical perioperative care.

Patient Care and Clinical Activities
In FY17, 4,435 cases were performed. The total number of cases comprised 673 inpatient OR procedures, 2,270 outpatient OR procedures, 96 inpatient GI procedures, and 1,396 outpatient GI procedures. The obstetric case count total was 307 total deliveries (208 vaginal and 99 C-section). Ninety-nine labor epidurals were administered, accounting for a 32% epidural rate.

The UPMC Bedford anesthesiology division was instrumental in the design and installation of a new GI lab/endoscopy suite on the hospital’s second floor in FY14. The number of endoscopies involving anesthesia have nearly doubled since its inception.

Education and Training
UPMC Bedford Memorial Hospital and its medical staff have committed to teaching residents from UPMC St. Margaret; medical students from Philadelphia College of Osteopathic Medicine, Lake Erie College of Osteopathic Medicine, West Virginia College of Osteopathic Medicine, and physician assistant students from St. Francis University and the UPMC Physician Assistant Program. Students can rotate through the anesthesiology, surgery, obstetrics and gynecology, emergency medicine, radiology, pathology, and family medicine services.

CHRISTOPHER SAMUEL, MD
Chief Anesthesiologist
Overview
During FY17, the Mediterranean Institute for Transplantation & Advanced Specialized Therapies/ Istituto Mediterraneo per i Trapianti e Terapie ad alta Specializzazione (ISMETT) continued to build on the success of past years. The numbers of transplants increased approximately 63% from last year, which would not have been possible without the input, hard work, and dedication from all the members of the ISMETT Department of Anesthesiology and Critical Care Medicine as well as the intensive care unit (ICU), operating room (OR), and Post-anesthesia Care Unit (PACU) nursing staff.

Clinical Activities and Patient Care
ISMETT’s clinical responsibilities are quite diverse and include OR anesthesia, 24-hour ICU staffing, and coverage of all invasive procedures in Radiology, the cardiac catheterization lab, the gastrointestinal clinical laboratory, and the PACU.

In the summer of 2015, we began to expand our facility. We added six more ICU beds for a total of 20 beds, an additional operating room, and a cardiac hybrid OR.

Thanks to the hybrid OR, we started a mini invasive interventional cardiology program, performing TAVI, Mitral clip, ASD closures, and other structural cardiology procedures on a regular basis. The National Extracorporeal Membrane Oxygenation (ECMO) Network, now called RETE RESPIRA, was maintained to centralize all patients with severe acute respiratory distress syndrome (ARDS) not responding to standard treatment. From October 2009 to present, an ECMO rescue team has been dedicated to the management of non-responsive severe ARDS emergencies. ISMETT coordinated and performed rescue actions, mainly relying upon airborne helicopter transportation provided with the support of the regional medical emergency service. Within a short time frame, ISMETT assembled a 24/7 on-call ECMO team, including one anesthesiologist, one cardiac surgeon, and one perfusionist, all experienced in ECMO technology and management. The ECMO team also manages rescue procedures at other hospitals.

During FY17, ISMETT’s Department of Anesthesiology and Critical Care Medicine, between ICU admission and major surgical procedures, treated a total of 2,242 cases. One hundred and seventy-nine (179) transplants were carried out, including 56 cadaveric kidney transplants, six living donor kidney transplants, 85 cadaveric liver transplants, two living donor liver transplants, 10 lung transplants, 17 heart transplants, and three combined kidney-pancreas transplants. Additionally, UPMC Palermo treated 920 ICU admissions, 558 cardiothoracic surgeries, 210 thoracic surgeries, 369 abdominal surgeries, and six ventricular assist device surgeries. ISMETT continued to receive patient referrals for both adult and pediatric complex surgery or ICU treatments.

Education and Training
Drs. Arcadipane and Burgio delivered lectures on heart, lung, and liver transplantation anesthesiology and critical care medicine at the University of Palermo School of Anesthesiology. Many anesthesiologists lectured at national and international meetings. Dr. Arcadipane attended the annual meetings of the Italian Society of Anaesthesiology and Intensive Care Medicine (SIAARTI) and CARACT (Congresso Nazionale di Aggiornamento in Rianimazione e Anestesia Cardio Toraco Vascolare), giving many lectures. He organized the MedTass – CARACT Congress in Palermo, which hosted many international physicians. He has also committed to lectures at many Italian congresses on ECMO issues over the last three years and into 2018. Dr. Arcadipane was elected coordinator of the SIAARTI Study Group for Cardiothoracic and Vascular Anesthesia.
Dr. Filippo Sanfilippo was recognized by the UPMC Department of Anesthesiology for excellence in the clinical teaching of residents. He is the first international recipient of this honor.

In FY17, ISMETT continued to host students and anesthesiology residents who wish to spend part of their elective time in Palermo. Residents from other Italian medical schools have also participated in ISMETT ICU and OR rotations. We also conducted an elective anesthesiology rotation and hosted residents and students from different universities and countries. ISMETT hosted visiting residents from Pittsburgh (Drs. Christopher Johnson, Joseph Williams, Brenda Satterthwaite, Michael Thompson, Peter Yeh, Joshua Knight, and Meghan Saxen), as well as Giulia Cristofalo, Giuseppe Grutta, Mariachiara Ippolito, Irene Pitò Giuseppa, Claudia Procaccianti, Vincenzo Russotto, Ignazio Sabella, Dario Scaglione, Paolo Sgarito, Costantino Terranova, Alessandra Ilaria Cardi, Tiziana Sanfilippo, Chiara Tranchina, Serena Drago, Leonard Birriolo, Anselma Isaya, Giorgia Cocorullo, and Silvia Peralta from the University of Palermo, and Drs. Alessia Bartolotta, Marilicia Mileto, Lorena Maria Novello, and Gaetano Joseph Simeo Palumbo from the University of Catania.

We continued to increase the number of courses offered to external customers by our Renato Fiandaca Simulation Center, sponsored by the Fiandaca Foundation. Our simulation center is an American Heart Association-licensed International Training Center and has conducted about 78 courses and trained more than 637 participants.

**UPMC SOUTH SURGERY CENTER**

**Overview**

UPMC South Surgery Center is a freestanding ambulatory surgery center located in the South Hills of Pittsburgh. The Center is administratively a part of UPMC Presbyterian-Shadyside Hospital. A full range of outpatient surgical services is provided in a convenient patient-centered environment. Four operating suites are available, as well as full GI screening capabilities. The South Hills campus also offers a full range of medical and surgical services, as well as diagnostic imaging, laboratory, and physical therapy and rehabilitation services.

**Patient Care and Clinical Activities**

The anesthesiology division at UPMC South Surgery consists of a group of board-certified physicians and credentialed CRNAs who also work at the main UPMC hospitals in the city of Pittsburgh. Fellowship-trained physicians belonging to the Acute Interventional Perioperative Pain Service are present on a regular basis to provide peripheral nerve blocks and ambulatory pain catheters on appropriate patients.

South Surgery Center was the first UPMC site to become enrolled in the Society for Ambulatory Anesthesia Clinical Outcomes Registry (SCOR) in 2012. This project was designed to assist anesthesiologists to track their own outcomes, compare with national benchmarks, and meet regulatory requirements. Effective December 2014, management of the registry was transitioned to the Anesthesia Quality Institute (AQI) and will become the new ambulatory module under the National Anesthesia Clinical Outcomes Registry (NACOR). The NACOR has been designated as a Qualified Clinical Data Registry by the Centers for Medicare and Medicaid Services for Physician Quality Reporting System (PQRS) reporting. With millions of cases and growing, AQI’s clinical data provides an evidence-based rationale that informs treatment choices and helps control treatment costs. This information is used by the anesthesiologists at South Surgery Center to provide state of the art anesthesia care for our patients.

In FY17, South Surgery Center provided anesthesiology services for 2,705 cases.
Overview
The UPMC Altoona Anesthesiology Department provides anesthesia services 24 hours a day for all scheduled and unscheduled cases. Altoona is staffed with 12 anesthesiologists and 39 CRNAs; an anesthesiologist and a CRNA remain in-house 24 hours a day, with backup on-call personnel available. All on-call physicians and CRNAs can be physically present in the hospital within a reasonable time frame after being called in. Anesthesia providers at the Surgery Center are scheduled to complete the elective schedule as needed. The provider is present until the last patient of the day leaves the building.

UPMC Altoona provides anesthesia to inpatients and outpatients undergoing surgery and other procedures in multiple locations. The department covers 13 operating rooms with various off-site locations: the post-anesthesia care units; the anesthesia holding room; the critical care units, the emergency department, the endoscopy suites, obstetrics (OB) (two operating rooms); labor, delivery, recovery and postpartum rooms; radiation and radiation oncology; the electrophysiology (EP), gastrointestinal (GI), bronchoscopy, interventional radiology, and neurointerventional labs; magnetic resonance imaging (MRI)/computed tomography; and the six room, on-campus Surgery Center.

Patient Care and Clinical Activities
UPMC Altoona became part of UPP (under the umbrella of the Department of Anesthesiology) on January 1, 2017. From January 1, 2017 – June 30, 2017, UPMC Altoona anesthesiology provided care for 9,376 surgical cases and approximately 16,478 patients, including 3,688 patients at the Surgery Center and 2,296 patients in the endoscopy suite.

The anesthesia caseload consisted of general surgery, cardiac, bronchoscopy, orthopedics, trauma, neurosurgery, urology, GI, EP, interventional neurolab, interventional radiology, otolaryngology, electroconvulsive therapy, healthy pediatrics, OB, and MRI procedures.

Education and Training
UPMC Altoona Anesthesiology provides education for CRNAs from the University of Pittsburgh and the Excela nurse anesthesia programs. They also teach basic skills in anesthesia to family practice residents and STAT medivac and respiratory therapy airway management skills. The department provides moderate sedation education for medical staff. Altoona Anesthesiology holds weekly meetings that include educational sessions, morbidity and mortality review, business discussions, and departmental updates.
UPMC HORIZON

Overview
UPMC Horizon became part of UPP (under the umbrella of Department of Anesthesiology) on January 1, 2016. The UPMC Horizon Anesthesiology Division consists of seven faculty members and 14 CRNAs. The division provides anesthesiology services at two sites (Greenville and Shenango Valley campuses), covering 10 main operating rooms, a C-section room in the labor and delivery unit, and six ambulatory rooms in which GI and urology cases are performed. Effective September 1, 2017 (FY18), Horizon Anesthesiology regionalized with a third hospital, UPMC Jameson; activity for the combined Horizon/Jameson division will be detailed in next fiscal year’s report.

Patient Care and Clinical Activities
During FY17, clinical anesthesiology services provided care for 11,451 surgical cases at UPMC Horizon. The caseload primarily includes outpatient adult surgical procedures, including orthopedic, urologic, gynecologic, ENT, bariatric, and general surgery. Regional anesthesia services have been expanding to provide the most up-to-date care for the orthopedic surgery patients. There are also a small number of pediatric ENT cases. In addition, UPMC Horizon is one of the only local hospitals to provide obstetric care. Approximately 1,200 patient deliveries, with 70-75% receiving epidurals, were managed at Horizon in FY17.

Education and Training
The Department of Anesthesiology provides education opportunities at Horizon. Biweekly meetings include morbidity and mortality conferences, educational sessions, and business discussions. Horizon anesthesiologists have the opportunity to teach medical students and surgery residents who rotate through Horizon Anesthesiology. In addition, airway management training is provided for STAT MedEvac paramedics who spend time in the division.

CRNAS
The Certified Registered Nurse Anesthetist (CRNA) professional staff met all patient care delivery needs in FY17 with 377 CRNA full-time equivalents. We continue to recruit strong candidates as the Department of Anesthesiology expands services to UPMC facilities beyond Allegheny County. The CRNA leadership team works closely with physician colleagues to efficiently cover all service lines. Team-focused anesthesia care ensures the best possible outcomes for all our patients.

Professional development is valued and supported. CRNAs actively participate in quality improvement projects at all levels through committee work. Clinical skills are sharpened at the Peter M. Winter Institute for Simulation Education and Research. Many CRNAs are now engaging in doctoral-level studies at various local universities with the goal of improving safety and quality.

We continue our relationship with the University of Pittsburgh’s Nurse Anesthesia Program, which is currently tied for #4 with three other institutions ranked by U.S. News and World Report. All CRNAs participate in clinical instruction; 44 nurse anesthetists graduated from the program in 2017. Mentoring programs are utilized to transition trainees into their new roles and promote a positive learning environment.

We continue to grow and prosper in a dynamic healthcare environment through a multidisciplinary team approach focused on improving the lives of our patients.

ANTIONETTE ORSINO, CRNA, MBA
Senior CRNA Director

CYNTHIA WELLS, MD
Chief Anesthesiologist

PITTSBURGH JOURNAL OF ANESTHESIOLOGY
Overview
The UPMC Pain Medicine Division, consisting of 10 faculty members, is a multidisciplinary clinical, teaching, and research endeavor spread over eight clinic locations: UPMC St. Margaret, Centre Commons in East Liberty, Oakland campus, Monroeville, UPMC Passavant, UPMC Mercy, UPMC Horizon, and Children’s Hospital of Pittsburgh of UPMC. Both outpatient and inpatient hospital treatment services are provided at each of these locations. The program is committed to the evaluation and treatment of the entire range of pain, disability, and rehabilitation problems, from infancy to old age, including end of life care. It offers an interdisciplinary team approach that includes dedicated professionals from various specialties including anesthesiology, neurology, psychiatry, nursing, occupational therapy, physical therapy, and psychology.

The treatment teams develop and coordinate individual treatment plans to: reduce pain and suffering whenever possible and assist patients in coping with any remaining discomfort; reduce disability to restore a more normal, meaningful, and satisfying life; reduce emotional distress caused by chronic pain; reduce dependency on drugs and on the healthcare system; and facilitate, as appropriate, the patient’s return to gainful employment and usual household and leisure activities.

Patient Care and Clinical Activities
During FY17, Department of Anesthesiology Pain Medicine physicians completed 49,661 outpatient visits in over 17,000 unique patients, with a comparable number of inpatient visits as well. Interventional modalities are carried out at all eight locations, including somatic and sympathetic nerve blockade, neurolytic blocks, placement of intrathecal pumps and neurostimulators, joint injections, and pharmacotherapy.

Unique and valuable assets of UPMC Pain Medicine are the Intensive Pain Rehabilitation and Fibromyalgia Rehabilitation Programs at Centre Commons in Shadyside, which provide effective therapies for conditions not requiring invasive procedures. Rehabilitative programs and services offered at Centre Commons include physical conditioning exercises, cardiovascular conditioning, coping skills training, work hardening, job-site evaluation, family counseling, relaxation therapy, stress management, biofeedback, self-hypnosis, gait and postural training, physical-capacity evaluation, work simulation, psychological counseling, and nutritional and sleep counseling.

In keeping with its mission, the UPMC Pain Medicine Program treats the entire spectrum of pain conditions, including persistent post-surgical pain, chronic back pain, complex regional pain syndrome (reflex sympathetic dystrophy), fibromyalgia, cancer pain, musculoskeletal injuries, headaches, post-herpetic neuralgia (shingles), and cumulative trauma syndromes.

In FY17, the division created a treatment outcomes tracking registry, modifying software from the Collaborative Health Outcomes Information Registry (CHOIR). At every visit, every patient reports a range of outcomes based on the NIH PROMIS system. This information is available to each provider instantaneously at the point of care to guide treatment decisions. In addition, the data is maintained on a server and merged with electronic medical record data from the former EPIC registry with suitable rigor to perform comparative effectiveness research and quality improvement projects. Within nine months of roll-out, we have collected over 25,000 surveys from 11,000 unique patients.
**Research**

The division has a robust clinical and translational research program in chronic pain (in collaboration with faculty from the Pittsburgh Center for Pain Research), funded by a variety of federal and industry grants. Details of this work and the growth of the program can be found in the description of Dr. Wasan’s research in this report. In addition, division faculty are actively engaged in mentoring other pain clinical researchers in the department. Several of these trainees have obtained independent funding.

**Education and Training**

The Division of Pain Medicine offers a one-year pain medicine fellowship that is fully accredited by the Accreditation Council of Graduate Medical Education (ACGME). The program was recently re-accredited for the maximum five year timeframe with no citations and with commendation. This is the third time the program has received this honor. UPMC has one of the largest clinical pain medicine fellowships in the country, graduating eight fellows per year. In addition, our department is the only one in the country with two NIH T32 programs in pain medicine, which train basic scientists and physicians over a two-year period in conducting basic, clinical, or translational research. The Pain Medicine Division works directly with the directors of the T32 programs to offer additional research training to the clinical pain medicine fellows if desired. We are one of the very few pain medicine divisions in the country with this physician-scientist training track.

Fellows rotate through the outpatient services at UPMC St. Margaret, Centre Commons, Oakland campus, Monroeville, and UPMC Passavant and provide inpatient consultation at UPMC St. Margaret, UPMC Shadyside, UPMC Mercy, WPIC, UPMC Passavant, UPMC Cranberry, UPMC Montefiore, and UPMC Presbyterian.
AIPPS

Overview
The mission of the Regional Anesthesiology and Acute Interventional Perioperative Pain Service (AIPPS) is the coordination and standardization of perioperative pain management for patients undergoing surgery at UPMC. AIPPS offers 24-hour perioperative pain management for orthopedic, thoracic, and urologic patients requiring peripheral and paravertebral nerve blocks.

In FY17, AIPPS managed 34,553 cases (33,830 visits), including 16,808 pre-procedure consults and 17,030 postoperative visits; total revenue was $4,633,095. The total number of nerve blocks was 23,799, an 8% increase from FY16. In FY17, 11,441 nerve blocks were performed using an ultrasound-guided technique, a 9% increase from FY16. A total of 12,715 extremity blocks were performed, including 5,575 upper extremity nerve blocks (5,076 single and 449 continuous) and 7,190 lower extremity nerve blocks (3,381 single and 3,809 continuous). During FY17, 8,457 truncular blocks were performed.

Teaching Activities
In August 2016, the division organized an ultrasound workshop for pediatric and regional anesthesiology fellows. In June 2017, the division organized the First UPMC Acute Pain Medicine & Regional Anesthesiology Fellow Improvement Practice Research Conference. Four posters and 10 oral lectures were prepared and presented by our regional anesthesiology and acute pain fellows. In addition, several members of the divisions participated in various national and international ultrasound workshops (listed below under “Publications and Presentations”).

Rotation of Fellows and Residents
Fourteen regional anesthesiology and Acute Pain fellows rotated through the different AIPPS sites. For the in-patient portion, the fellows rotated at UPMC Presbyterian, UPMC Montefiore, UPMC Shadyside, UPMC Mercy, UPMC Passavant, and Children’s Hospital of Pittsburgh of UPMC, whereas for the ambulatory portion, the fellows rotated at UPMC St. Margaret Harmarville, UPMC South Surgery Center, and UPMC Passavant (Cranberry campus) ambulatory centers. The fellowship program also included a two-week chronic pain rotation at St Margaret. Three pediatric pain fellows also rotated for a month at UPMC Shadyside.

During FY17, 10 “interns” rotated with AIPPS at UPMC Presbyterian; 12 residents rotated at UPMC Presbyterian and 13 PGY-2 residents rotated at UPMC Mercy; 15 residents rotated at UPMC Shadyside (eight PGY-3 and seven PGY-4).

Scholarly Activities
During FY17, AIPPS faculty, residents, and fellows authored three articles published in peer-reviewed publications, two case reports, three letters to the editor, nine abstracts, and eight presentations at national and international meetings. One fellows and four residents presented posters at national meetings including the annual meetings of the American Society of Anesthesiologists (ASA) and American Society of Regional Anesthesia and Pain Medicine (ARSA). Additional details can be found in the publication section of this report.
PERIOPERATIVE ECHOCARDIOGRAPHY SERVICE

Overview
The UPMC Department of Anesthesiology provides a comprehensive perioperative clinical echocardiography service and supports a very active echocardiography education program for trainees.

Transesophageal Echocardiography
Clinical services include diagnostic intraoperative transesophageal echocardiography (TEE) for all cardiac surgical patients, diagnostic intraoperative and postoperative TEE for non-cardiac surgical patients in situations of hemodynamic instability, and intraoperative TEE monitoring for patients at risk for perioperative cardiac complications undergoing high-risk non-cardiac surgical procedures. In 2017, the service faculty performed more than 2,000 comprehensive echocardiographic studies for cardiac and non-cardiac surgery. Our department has 15 cardiac anesthesiology faculty certified in perioperative advanced TEE.

Transthoracic Echocardiography
Our department also has trained expert faculty who can perform comprehensive and limited transthoracic echocardiography (TTE) for preoperative cardiac evaluation and focused cardiac ultrasound for diagnosing the etiology of hemodynamic instability and hypoxemia during the perioperative period for cardiac and non-cardiac surgical patients. A perioperative TTE consult service was established in 2016 and receives requests to perform TTE from anesthesia colleagues, hospitalists, and surgeons. TTE performed at the bedside by anesthesiologists helps to guide perioperative hemodynamic management, avoids unnecessary delays and cancellations in the operating room schedule, and improves patient outcomes.

TEE Education
All adult cardiothoracic anesthesiology fellows (four every year) fulfill 300 TEE examination requirements during their fellowship training to qualify for National Board of Echocardiography (NBE) advanced certification in perioperative TEE. Fellows receive training in advanced echocardiographic modalities such as 3D echocardiography, tissue Doppler, and myocardial deformation imaging. The UPMC Anesthesiology Residency Program has created a unique structured two-month elective rotation in basic TEE for PGY-4 residents to prepare them for basic NBE TEE certification. Our UPMC training program involves a TEE simulation course at WISER, web-based education modules, clinical training in the operating room, and weekly TEE reviews in the digital echocardiography laboratory by certified faculty. Our faculty also actively participate in interdepartmental echocardiography conferences along with Cardiology, Emergency Medicine, and Critical Care Medicine and organize several workshops for trainees and faculty.

Focused TTE education
PGY-2 residents also receive intensive training in structured focused transthoracic ultrasound during their post anesthesia care unit (PACU) rotation, completing 25 TTE examinations during their PACU rotation. Residents continue to utilize their focused TTE skills throughout their training for their elective and emergency cases. Focused TTE education is also facilitated by web-based education modules, a WISER simulation course on a TTE simulator and healthy volunteers, and several lectures related to focused TTE.

Digital Echocardiography Laboratory
A digital echocardiography laboratory is utilized for archiving all echocardiographic studies as part of a quality improvement program, allowing the education of residents and fellows in research studies related to echocardiography.
Patient Care and Clinical Activities

The Cardiopulmonary Anesthesiology Division encompasses five hospital locations: UPMC Presbyterian, UPMC Shadyside, UPMC Passavant, UPMC Mercy, and the Veterans Affairs Pittsburgh Healthcare System. Surgical procedures spanned the full spectrum of adult cardiothoracic practice: coronary artery bypass graft (CABG) surgery (including minimally invasive coronary artery bypass (MIDCAB) and off-pump coronary artery bypass (OPCAB)), conventional cardiac valve replacement and repair, transcatheter mitral valve (MitraClip) repair, atrial fibrillation ablation (MAZE) surgery, left atrial appendage exclusion procedures (Watchman; Amulet), thoracic aorta repair/reconstruction (conventional and endovascular approach), pulmonary thromboendarterectomy, repair of ventricular and atrial septal defects, and removal of cardiac tumors/myxomas, transcatheter aortic valve replacement (TAVR), pulmonary resection (conventional, robotic and minimally invasive approaches), pneumonectomy, minimally invasive and robotic esophagectomy, complex endoscopy procedures (flexible/rigid bronchoscopy, esophagoscopy), tracheal resection, and minimally invasive procedures for digestive disorders.

UPMC Presbyterian is recognized as a world leader in heart, lung, and heart-double lung transplants and is the designated site in the UPMC healthcare system for these procedures. UPMC Presbyterian is also the primary site for the surgical treatment of patients with end-stage heart failure. A variety of mechanical ventricular assist devices are used as a bridge to transplantation or for “destination” therapy (HeartMate 3®, Impella® (Abiomed), and HeartWare. Extracorporeal membrane oxygenation support (ECMO) is also used to support patients with compromised myocardial and pulmonary function.

Perioperative Echocardiography

The cardiothoracic anesthesiology faculty performs diagnostic perioperative transesophageal echocardiography (TEE) on all patients undergoing cardiac and transplant surgery. The division enjoys substantial equipment resources and has established an excellent rapport with their echocardiology colleagues. Monthly Interdepartmental Echocardiography Conferences (IDECs) are held jointly between the Divisions of Cardiothoracic Anesthesiology and Cardiology and the Departments of Cardiothoracic Surgery and Critical Care Medicine to discuss perioperative patient management and outcomes.

Adult cardiothoracic anesthesiology fellows obtain extensive experience with this technology to develop their skills in advanced diagnostic 2D and 3D perioperative TEE. In addition to their intraoperative experience performing and interpreting TEEs under the supervision of the cardiothoracic anesthesiology faculty, all fellows may choose a two-week elective to learn transthoracic echocardiography (TTE) skills in the Division of Cardiology. Each year, several cardiology and critical care medicine fellows spend time with the cardiothoracic anesthesiology faculty in the ORs for the specific purpose of improving their intraoperative TEE skills.

Perioperative TEE remains a fruitful area of research for the faculty and trainees. Dr. Kathirvel Subramaniam is the founding co-editor of and contributing author to a major anesthesiology peer-reviewed journal, Journal of Perioperative Echocardiography. During FY17, several cardiothoracic anesthesiology faculty members and fellows authored articles that were published in this journal.

Achievement of Testamur and Board Certification Status via the Advanced PTEeXAM® is strongly encouraged for current

ERIN A. SULLIVAN, MD
Division Chief
Faculty members and is required for all new faculty members who have recently completed an ACGME-accredited adult cardiothoracic anesthesiology fellowship program. Our fellowship program continues to enjoy a 100% passing rate on the first attempt, a credit to the excellent teaching efforts of our cardiothoracic anesthesiology faculty.

Faculty
The Cardiothoracic Anesthesiology Division is comprised of 30 faculty members who are experts in their subspecialty. Many faculty members achieved notoriety this past year. Drs. Michael Boisen and Kathir Subramaniam are serving as faculty mentors for a UPMC Anesthesiology Educational Grant beginning in July 2017. The primary investigator for the $8000 grant is Daniel R. Mandell, MD (PGY-4 Resident) and the title of the project is “Evaluation of Anesthesiology Resident Competence and Clinical Impact of a Structured Point-of-Care Ultrasound Training Program.” Dr. Heather Hayanga received a department seed grant for the period of August 1, 2016-July 31, 2017 for the project “Physician Disaster Preparedness Mobile Learning App.” Dr. Kathir Subramaniam was co-editor of a major anesthesiology textbook, *Anesthesia and Perioperative Care for Organ Transplantation*. Current members of the cardiac anesthesiology faculty who contributed to this effort include Drs. Michael Boisen and Wendy Haft. Drs. Esper and Subramaniam were course co-directors for the department conference “Redesigning the Perioperative Process: Prehabilitation, ERAS and Acute Pain Management.” During the April 2017 annual meeting of the Society of Cardiovascular Anesthesiologists (SCA), Drs. Theresa Gelzinis, Kathirvel Subramaniam, and Erin Sullivan moderated PBLDs. Dr. Stephen Esper participated as a workshop speaker and instructor. Dr. Erin Sullivan served as the Chair for the ASA Legislative Conference in Washington, DC and was a moderator for the State Issues Forum. She was also an invited author for articles for the ASA Newsletter and the Pennsylvania Society of Anesthesiologists newsletter *Sentinel* and was named in *Pittsburgh Magazine*’s 2017 “Best Doctors” list.

Cardiothoracic Anesthesiology faculty members were authors and co-authors of several peer-reviewed journal articles and book chapters published in major anesthesiology textbooks. Please see the publications section of this report for a full list of departmental publications.

Education and Training
The Division of Cardiothoracic Anesthesiology offers world-class opportunities for both basic and advanced training in adult cardiothoracic anesthesiology. Most post-graduate year (PGY)-3 residents receive their initial exposure to cardiac anesthesiology at UPMC Presbyterian. PGY-4 residents are offered a three-month elective in advanced adult cardiac anesthesiology. Adult Cardiothoracic Anesthesiology (ACTA) Fellows (PGY-5) have the opportunity to receive advanced training in the subspecialty beyond the PGY-4 year in an ACGME-accredited program, inclusive of: emergency and elective surgery, TEE, perfusion/ventricular assist device theory and operation, management of patients with electrophysiologic cardiac disturbances requiring ablation therapy or implantation of automated implantable cardioverter-deﬁbrillators/pacemakers, management of patients for minimally invasive implantable cardiac devices in the cardiac catheterization lab, cardiothoracic critical care medicine, and heart/lung transplantation. Fellows who successfully complete the training program are eligible to take the Advanced PTEeXAM administered by the National Board of Echocardiography. Residents and fellows receive course goals and objectives at the beginning of their clinical rotation along with a list of required reading material. Didactic programs are separate for residents and fellows and consist of intraoperative clinical teaching, lectures, and PBLDs based on topics related to cardiothoracic anesthesiology. In addition, fellows attend weekly TEE reviews and a lecture series that is moderated by the cardiac anesthesiology faculty. A mock oral exam is administered to each resident at the conclusion of the clinical rotation and to each fellow on a semiannual basis. UPMC Presbyterian hosts IDECs with the Division of Cardiology and the Departments of Critical Care Medicine and Cardiothoracic Surgery that follow an interactive evidence-based medicine format. ACTA fellows present topics of interest that are moderated by the interdepartmental faculty. A combined cardiothoracic anesthesiology faculty/fellow conference is held quarterly and includes case presentations, morbidity and mortality discussions, journal club, and quality improvement topics.

During the annual meeting of the SCA in Orlando, Florida, ACTA fellows presented four Resident/Fellow Complex Case presentations.
The Ambulatory Anesthesiology division was created in 2009 to integrate research-based patient care principles for same-day surgery into a formal clinical entity. The division’s foundation is the development of new recovery criteria, the “WAKE Score,” which outlines recovery parameters after ambulatory surgery and/or moderate sedation. The WAKE Score, authored by Drs. Brian Williams and Michael Kentor, not only predicts safe bypass of the “Phase 1 Recovery Unit” (post-anesthesia care unit [PACU]), but also predicts successful same-day discharge (i.e., no unplanned hospital admission). In August 2010, the WAKE Score was rolled out for daily clinical use en route to becoming the official recovery criteria for UPMC. This important initiative for standardizing recovery criteria system-wide is a Joint Commission-driven patient care directive, and this rollout involved top-level teamwork with many departments and committees.

The Director of Ambulatory Anesthesiology is Brian A. Williams, MD, MBA, a 1995 alumnus of the Pitt Anesthesiology Residency Program and a 1996 alumnus of the Katz Graduate School of Business and our Department’s Charles Schertz Memorial Research Fellowship. After leading the UPMC rollout of the WAKE Score in 2009-2010, Dr. Williams relocated to the VA Pittsburgh Healthcare System (VAPHS) as the inaugural Director of Ambulatory Anesthesiology, Regional Anesthesiology/Acute Pain Medicine, and Preoperative Optimization. By 2011, the WAKE Score became recovery policy at the VAPHS and the resident teaching curriculum promulgated the novel concept of “design the anesthetic to meet the WAKE Score criteria for PACU bypass.” This included initiating a new regional anesthesiology program, as well as active teaching curriculum in multimodal analgesia (MMA), multimodal antiemesis (MMAE), multimodal perineural anesthesia-analgesia (MMPNA), and multimodal total intravenous anesthesia-analgesia (MMTIVA). MMTIVA at the VAPHS continues to evolve as an important component of their evolving “Enhanced Recovery after Anesthesia and Surgery” (ERAS) program. Meanwhile, in February 2016, the national VA office (under the leadership of the current Secretary of the Department of Veterans Affairs, Dr. David Shulkin) announced that the WAKE Score was chosen as a “Gold Status” initiative. Dr. Williams was named “Gold Status Fellow for the Promising Practices Consortium Diffusion of Excellence” program. Dr. Shulkin is also an alumnus of the UPMC Internal Medicine Residency Program. The book chapter “Design the Anesthetic to Meet the WAKE Score” is now published in Dr. Shulkin’s new book Best Care Everywhere – by VA Professionals Across the Nation (U.S. Department of Veterans Affairs, June 2017, P96877, IB 10-1009).

Several important research advances in ambulatory anesthesiology (originating from the University of Pittsburgh School of Medicine Department of Anesthesiology) occurred during FY16-17. Most of these are related to the MMPNA concept described above with nerve blocks. Underwritten by funding from the Department of Defense (2010-2019) and the NIH (2008-2010), Dr. Williams’ teams developed novel four-drug nerve blocks comprised of either local anesthetic or preservative-free midazolam with the combination of clonidine-buprenorphine-dexamethasone. These four-drug combinations were shown to be non-toxic in vitro and in vivo at the concentrations studied. The team also reported (in retrospective reviews of prospective clinical pathways) on the block duration and rebound pain encountered after these block effects dissipated. These reports were published in the peer-reviewed journals Regional Anesthesia and Pain Medicine (2011-2014) and Pain Medicine (2015-2017). This preliminary work led to a new Department of Defense clinical trials grant (2015-2019) comparing plain bupivacaine with the four-drug combination (as single-injection nerve blocks) for patients undergoing primary knee or hip arthroplasty. As of this writing, 30 study patients have completed their joint replacement surgery study protocol.
In July 2015, in conjunction with the Department of Surgery and Dr. Jennifer Holder-Murray, as well as Drs. Michael Boisen and Kathirvel Subramaniam, and with the help of project manager Katie Meister, UPMC launched its Enhanced Recovery after Surgery program, commonly referred to as ERAS. The program is designed to reduce patients’ stress response to surgery, support their physiologic function, and accelerate their return to normal daily function. ERAS protocols encompass a multimodal approach to surgical care. Major components of these protocols include limiting fasting prior to surgery, intraoperative goal-directed fluid therapy, and adequate pain control while minimizing opioid use, early ambulation, early postoperative enteral nutrition, and nausea/vomiting prophylaxis. ERAS protocols are designed to reduce surgical stress and maintain postoperative physiological function, reduce rates of complications, facilitate faster recovery through early ambulation and feeding (thus reducing length of stay), and improve patient/family satisfaction.

Thus far, in six UPMC hospitals on 10 service lines, the success of ERAS has been demonstrated by reducing length of stay by two to three days, reducing patient-controlled analgesia use from >95% to approximately 16% after complex abdominal surgery, and improving same day patient discharge for minimally invasive gynecology and urogynecology surgeries. Success is achieved through evidence-based pathways utilized throughout the entire perioperative period, including in the preoperative outpatient setting.

Prior to surgery, ERAS patients receive patient education, including encouragement to abstain from drinking alcohol or using tobacco products for one month prior to surgery and to obtain good nutrition with a high protein and carbohydrate-rich diet for one week pre-op; engage in a pre-op walking program (30 min/day until day of surgery); eat a regular diet until midnight the night before surgery (unless a bowel prep is required); and drink clear liquids up until three hours prior to surgery. Patients are screened for malnutrition with supplements for seven to 10 days preoperatively if needed and for post-op nausea/vomiting risk with prophylaxis. The ERAS protocols reinforce the need for patient engagement.

Following up on the success of the ERAS protocols has been the development of the Perioperative Evaluation and Enhancement of Recovery Services (PEERS) initiative, which includes the Center for Presurgical Care (CPC). A team-based initiative led by the staff mentioned above and including project manager Mary Kay Wisniewski and Dr. Daniel Hall, this multidisciplinary approach allows the entire physician treatment team to provide patients with resources for them to train for both their surgery and their postoperative recovery. The team has built a comprehensive system regarding patients’ anesthetic and medical evaluation, nutritional evaluation, physical and cardiopulmonary therapy, weight loss, chronic pain assessment, and tobacco, drug, and alcohol cessation, as well as mental health therapy and social work support services. It opened in June of 2016 at UPMC Shadyside and recently opened a second site at UPMC Presbyterian in August of 2017.

Since its inception, ERAS has won the UPMC Quality & Safety Fair: 1st Place in Innovation Award - “ERAS” – Nursing Unit 10 North; the UPMC Presbyterian Service Excellence Award; the UPMC Shadyside Service Excellence Award; and UPMC Passavant, MAGNET Status.

FY17 was a productive year for basic research in the Department of Anesthesiology. We received a total of $4,018,410 in extramural grants, $3,755,472 of which was from the National Institutes of Health (NIH) and other federal sources. Three of our investigators (Drs. Yan Xu, Gregg Homanics, and Pei Tang) are among the top 110 NIH-funded investigators in anesthesiology, each bringing in from $419,599 to $1,011,251 in total NIH grant funding in 2016.

Department of Anesthesiology basic researchers authored 19 peer-reviewed publications in FY17. Please see the publications section of this report for a detailed list of publications.

Significant studies published during FY17 include the following:

Yan Xu, PHD  
Vice-Chair for Basic Sciences


For thousands of years, opioids have been the gold standard for the treatment of severe pain. However, side effects such as tolerance, dependence and addiction have contributed to the current epidemic of opioid abuse and overdose-related deaths in the US. Recently, it has been shown that opioid side effects can be dissociated from analgesic effects, which presents the possibility that side effects could be selectively targeted to minimize the risk of opioids. Two new studies show that mechanisms mediating the opioid side effects of tolerance, hyperalgesia, and physical dependence are mediated spinaly and can be dissociated from analgesia. These side effects can be selectively targeted by clinically available drugs without affecting their pain-relieving effects. These studies reinforce the concepts that opioid tolerance, physical dependence, and opioid-induced hyperalgesia are mediated at the level of the spinal cord and peripheral nociceptors, and that the undesirable side effects of opioids can be dissociated from pain relief and selectively targeted. Both papers also raise the exciting possibility that effective treatments might be available soon, given that drugs currently used for other indications markedly reduced opioid side effects in animals without reducing pain relief. Future translational studies could enable us to eventually eliminate suffering for untold millions of patients with chronic pain, allowing opioids to do good without causing patients negative side effects.


Toll-like receptor 4 (TLR4) is a key mediator of innate immune signaling and has been implicated in alcohol responses in animal models and human alcoholics. Members of the Integrative Neuroscience Initiative on Alcoholism (INIA-Neuroimmune) consortium participated in the first comprehensive study across multiple laboratories to test the hypothesis that TLR4 regulates excessive alcohol consumption in different species.
and different models of chronic, dependence-driven, and binge-like drinking. Although TLR4 was not a critical determinant of excessive drinking, it was important in the acute sedative effects of alcohol. Current research efforts are directed at determining which neuroimmune pathways mediate excessive alcohol drinking and these findings will help to prioritize relevant pathways and potential therapeutic targets.


Genes encoding the ρ1/2 subunits of GABAA receptors have been associated with alcohol (ethanol) dependence in humans, and ρ1 was also shown to regulate some of the behavioral effects of ethanol in animal models. Electrophysiologic studies demonstrate the presence of an inhibitory site for ethanol in the second transmembrane helix of ρ1. Our findings from mice with mutations in the ρ1 subunit indicate that the inhibitory site for ethanol in GABAA ρ1 receptors regulates acute functional tolerance to moderate ethanol intoxication. The authors note that low sensitivity to alcohol intoxication has been linked to risk for development of alcohol dependence in humans.


The structural basis for alcohol modulation of neuronal pentameric ligand-gated ion channels (pLGICs) remains elusive. The authors determined an inhibitory mechanism of alcohol on the pLGIC Erwinia chrysanthemi (ELIC) through direct binding to the pore. X-ray structures of ELIC co-crystallized with 2-bromoethanol, in both the absence and presence of agonist, reveal 2-bromoethanol binding in the pore near T237(6') and the extracellular domain (ECD) of each subunit at three different locations. Binding to the ECD does not appear to contribute to the inhibitory action of 2-bromoethanol and ethanol as indicated by the same functional responses of wild-type ELIC and mutants. In contrast, the ELIC-α1β3GABAAR chimera, replacing the ELIC transmembrane domain (TMD) with the TMD of α1β3GABAAR, is potentiated by 2-bromoethanol and ethanol. The results suggest a dominant role of the TMD in modulating alcohol effects. The X-ray structures and functional measurements support a pore-blocking mechanism for inhibitory action of short-chain alcohols.


The impact of volatile anesthetics on the immune system has been investigated at both mechanistic and clinical levels, but previous studies have returned conflicting findings due to varied protocols, experimental environments, and subject species. While many of these studies have focused on the immunosuppressive effects of volatile anesthetics, compelling evidence also exists for immunoactivation. This review provides
a balanced perspective on the anesthetic modulation of innate and adaptive immune responses as well as indirect effectors of immunity.


Pentameric ligand-gated ion channels (pLGICs) are targets of general anesthetics, but molecular mechanisms underlying anesthetic action remain debatable. We co-crystallized isoflurane with ELIC, a pLGIC from Erwinia chrysanthemi, found double isoflurane occupancies inside the pore of ELIC near T237(6') and A244(13'), and performed functional measurements to support the notion that binding at these sites renders isoflurane inhibition.


Voltage-gated sodium channels (Nav) play an important role in general anesthesia. Electrophysiology measurements suggest that volatile anesthetics such as isoflurane inhibit NaV by stabilizing the inactivated state or altering the inactivation kinetics. Recent computational studies suggested the existence of multiple isoflurane binding sites in NaV, but experimental binding data are lacking. Here, the authors use site-directed placement of 19F probes in nuclear magnetic resonance (NMR) experiments to quantify isoflurane binding to the bacterial voltage-gated sodium channel NaChBac. 19F probes were introduced individually to S129 and L150 near the S4-S5 linker, L179 and S208 at the extracellular surface, T189 in the ion selectivity filter, and all phenylalanine residues. Quantitative analyses of 19F NMR saturation transfer difference spectroscopy showed a strong interaction of isoflurane with S129, T189, and S208; relatively weakly with L150; and almost undetectable with L179 and phenylalanine residues. An orientation preference was observed for isoflurane bound to T189 and S208, but not to S129 and L150. The authors conclude that isoflurane inhibits NaChBac by two distinct mechanisms: (i) as a channel blocker at the base of the selectivity filter, and (ii) as a modulator to restrict the pivot motion at the S4-S5 linker and at a critical hinge that controls the gating and inactivation motion of S6.

The department continues to place a major focus on research training, fostering research activity among the next generation of anesthesiology investigators and physician scientists. The Director of Resident Research and the Junior Chief Resident for Research facilitate resident research and scholarly activities, and the department offers research opportunities to University of Pittsburgh medical students throughout the year, matching students with anesthesiology faculty for their scholarly projects. Our department was one of 36 in the nation selected to serve as a host site for the 2017 Foundation for Anesthesia Education and Research (FAER) Medical Student Anesthesia Research Fellowship program. Our department is one of only 15 anesthesiology departments in the nation that have NIH T32 training grants. Our department has two T32 grants, one funded by the National Institute for General Medical Sciences mainly for training physician scientists in anesthesiology and pain medicine and the other funded by the National Institute of Neurological Disorders and Stroke for pre- and postdoctoral basic scientists in pain mechanisms (see the “Research Fellowships” section for more information).
GUTSTEIN LAB

E1405 Biomedical Science Tower

LAB MEMBERS
Howard B. Gutstein, MD (PI)
Stephanie Puig, PhD (post-doctoral research associate)
Roger Lopez-Bellido, PhD (post-doctoral research associate)
Kevin Redding, MS (lab manager)
Peter Kann (technician)
Shelby Szott (student)

OVERVIEW
The research in Dr. Gutstein’s laboratory focuses on the molecular mechanisms underlying opioid tolerance.

PROJECTS
The Role of RTK Signaling in Opioid Tolerance
Inadequate treatment of chronic pain has afflicted people throughout recorded history. For centuries, opioid drugs such as morphine have been the first-line treatment for severe pain; however, over time, tolerance to opioid analgesia develops. Dr. Gutstein’s group discovered that that the clinically used epidermal growth factor receptor (EGFR; ErbB1) antagonist gefitinib (Iressa) completely reverses morphine tolerance. This project uses cutting-edge experiments that will determine whether this finding can be extended to other narcotics and lead to improved treatment and quality of life for the untold millions of patients suffering from intractable pain. These studies seek to improve our understanding of the molecular mechanisms underlying opioid tolerance. They also may lead to a completely new approach for the treatment of chronic pain.

PUBLICATIONS


CURRENT FUNDING
1R01DA036680-01: The Role of RTK Signaling in Opioid Tolerance
Role: Principal Investigator
2014 - 2019

T32 NS073548: Training in Mechanisms and Clinical Presentation of Pain
Role: Director
2012-2018
The Homanics Lab is interested in understanding the effects of alcohol on the body so that safe, effective treatments for alcohol use disorder can be developed.

PROJECTS

Epigenetic Effects of Alcohol
Epigenetic processes are molecular pathways that control gene expression. It has been long recognized that alcohol induces changes in gene expression in hundreds of genes in the brain and these neuroadaptations are thought to underlie the development of tolerance, dependence, and addiction to alcohol. We are currently investigating the effects of alcohol on epigenetic processes such as DNA methylation, histone modifications, and regulatory RNAs. We are especially interested in the possibility that alcohol-induced changes in epigenetic processes can be inherited across generations and impact alcohol drinking behavior in offspring derived from alcohol-abusing parents and grandparents.

Role of Long Noncoding RNA (IncRNA) in Alcohol Action
This project will test the hypothesis that individual IncRNAs are key regulators of alcohol drinking. We are currently in the midst of a revolution in our understanding of RNA function. Emerging results indicate that there is a plethora of RNAs produced that do not encode proteins, but instead serve important gene regulatory functions. A particularly interesting class of noncoding RNAs that are highly regulated by exposure to alcohol are IncRNAs. To define the contribution of IncRNAs to alcohol action, we are currently creating genetically engineered rodents that harbor mutations in IncRNA genes. Such animals will subsequently be studied for alterations in alcohol drinking and behavioral sensitivity to alcohol.

Exosome Research
This project investigates the hypothesis that exosomes can be harnessed as effective brain noncoding RNA/drug delivery vehicles to modulate alcohol drinking. Exosomes are nanometer-sized (~30-120 nm) liposome-like particles secreted by all cell types. Exosomes are thought to function as paracrine and exocrine communication systems via cell-to-cell transfer of exosome contents, including lipid, RNA, DNA, and protein. We are investigating the use of exosomes as delivery vehicles for noncoding RNA agonist/antagonists, for anti-inflammatory drugs, and for gene editing reagents. Exosomal cargo is being selectively delivered to brain by intranasal instillation.

Production of Genetically Engineered Animals
This project uses state of the art molecular techniques to create precisely engineered animals that harbor gain of function or loss of function mutations in genes thought to be important for the behavioral effects of alcohol. This project serves
numerous investigators that are part of a large, multi-institutional international alcohol research consortium, the Integrative Neuroscience Initiative on Alcoholism-Neuroimmune.

**PUBLICATIONS**


Rompala GR, Finegersh A, Slater M, Homanics GE (2017) Paternal preconception alcohol exposure imparts intergenerational alcohol-related behaviors to male offspring on a pure C57BL/6J background. Alcohol 60:169-178. PMCID: PMC PMC5419883


**CURRENT FUNDING**

R37 AA14022-19 (Homanics): Ethanol Mechanisms in GABAA-R Gene Targeted Mice
05/01/2015 – 04/30/2020, NIH/NIAAA

U01 AA020889-06 (Homanics): Role of noncoding RNA in alcohol action
02/20/2017 – 01/31/2022, NIH/NIAAA
**TANG LAB**

Biomedical Science Tower 3, Room 2057

**LAB MEMBERS**

Pei Tang, PhD (PI)  
Palaniappa Arjunan, PhD, Visiting Scientist  
Bogdan Ion, PhD, Post-Doctoral Associate  
Marta Wells (graduate student)

**Faculty**

Vasyl Bondarenko, PhD  
Qiang “Charles” Chen, PhD  
Tommy Tillman, PhD

**OVERVIEW**

Dr. Tang’s laboratory has focused on two related research areas. One is to determine the structures and dynamics of neurotransmitter-gated ion channels, which play a central role in neuron signaling and are targets of therapeutics. Another is to understand channel protein interactions with low-affinity drugs, particularly general anesthetics and alcohols. Various biophysical tools, including high-resolution nuclear magnetic resonance (NMR) spectroscopy and X-ray crystallography, as well as large-scale molecular dynamic simulations, have been utilized to tackle various biomedical and neuroscience questions.

**PROJECTS**

**Ketamine Inhibition of the Pentameric Ligand-Gated Ion Channel GLIC**

Ketamine inhibits pentameric ligand-gated ion channels (pLGICs), including the bacterial pLGIC from Gloeobacter violaceus (GLIC). The crystal structure of GLIC shows R-ketamine bound to an extracellular inter-subunit cavity. Here, we performed molecular dynamics simulations of GLIC in the absence and presence of R- or S-ketamine. No stable binding of S-ketamine in the original cavity was observed in the simulations, largely due to its unfavorable access to residue D154, which provides important electrostatic interactions to stabilize R-ketamine binding. Contrary to the symmetric binding shown in the crystal structure, R-ketamine moved away from some of the binding sites and was bound to GLIC asymmetrically at the end of simulations. The asymmetric binding is consistent with the experimentally measured negative cooperativity of ketamine binding to GLIC. In the presence of R-ketamine, all subunits showed changes in structure and dynamics, irrespective of binding stability; the extracellular inter-subunit cavity expanded and inter-subunit electrostatic interactions involved in channel activation were altered. R-ketamine binding promoted a conformational shift toward closed GLIC. Conformational changes near the ketamine-binding site were propagated to the interface between the extracellular and transmembrane domains, and further to the pore-lining TM2 through two pathways: pre-TM1 and the β1–β2 loop. Both signaling pathways have been predicted previously using the Perturbation-based Markovian Transmission model. The study provides a structural and dynamics basis for the inhibitory modulation of ketamine on pLGICs.

**Structural Basis of Alcohol Inhibition of the Pentameric Ligand-gated Ion Channel ELIC**

The structural basis for alcohol modulation of neuronal pLGICs remains elusive. We determined an inhibitory mechanism of alcohol on the pLGIC Erwinia chrysanthemi (ELIC) through direct binding to the pore. X-ray structures of ELIC co-crystallized with 2-bromoethanol, in both the absence and presence of agonist, reveal 2-bromoethanol binding in the pore near T237(6’) and the extracellular domain (ECD) of each subunit at three different locations. Binding to the ECD does not appear to contribute to the inhibitory action of 2-bromoethanol and ethanol as indicated by the same functional responses of wild-type ELIC and mutants. In contrast, the ELIC-α1β3GABAAR chimera, replacing the ELIC transmembrane...
domain (TMD) with the TMD of α1β3GABAAR, is potentiated by 2-bromoethanol and ethanol. The results suggest a
dominant role of the TMD in modulating alcohol effects. The X-ray structures and functional measurements support a
pore-blocking mechanism for inhibitory action of short chain alcohols.

PUBLICATIONS

Wu J, Liu Q, Tang P, Mikkelsen JD, Shen J, Whiteaker P, Yakel JL. Heteromeric α7β2 Nicotinic Acetylcholine Receptors in

411 (2016). PMCID: PMC5074538


33538; doi:10.1038/srep33538 (2016). PMCID: PMC5024337

of Isoflurane Binding to the Voltage-Gated Sodium Channel NaChBac. PNAS, 113(48):13762-13767 (2016). PMCID:
PMC5137747

Chen Q, Wells MM, Tillman TS, Kinde MN, Cohen A, Xu Y, Tang P. Structural Basis of Alcohol Inhibition of the Pentameric

Lawless MJ, Shimshi A, Cunningham TF, Kinde MN, Tang P, Saxena S. Analysis of Nitroxide-Based Distance Measurements

CURRENT FUNDING

Principal Investigator, R01GM66358-13, NIH/NIGMS, General Anesthetic Effects on Ion Channel Structures and
Dynamics, 12/1/06–04/30/17

Principal Investigator, R01GM056257-16, NIH/NIGMS, Anesthetic Sites in Transmembrane Peptides by NMR, 05/01/98–
01/31/18

Principal Investigator, TG-MCB050030N, NSF XSEDE, Structural Studies and Drug Discovery on α7-Nicotinic Acetylcholine
Receptors, 04/16–03/31/17

Co-Investigator (Yan Xu, PI), 1R01GM49202-21, NIH/NIGMS, Developing Receptor Therapeutics to Treat Chronic Pain,
04/10/15-01/31/19

Co-Investigator (Yan Xu, PI), R01GM114851-03, NIH/NIGMS, Injury Mechanisms and Systemic Immune Responses after
Cerebral Global Ischemia, 09/01/14-07/31/18

Co-Investigator (Project III), P01 GM055876-17, NIH/NIGMS, Interaction of Inhalational Anesthetics with Macromolecules
(PI: Eckenhoff); Project III: NMR Studies of Anesthetic Interaction with Ion Channels and Receptors (PI: Yan Xu), 08/01/13-
07/31/18
BASIC RESEARCH

XU LAB
Biomedical Science Tower 3, Room 2057

LAB MEMBERS
Yan Xu, PhD (PI)

Post-Doctoral Associates:
Joel Caporoso, PhD
Yali Wang, PhD
Can “Jessica” Zhang, MD

Faculty
Tommy Tillman, PhD

Undergraduate Researchers:
Devin Adell
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Staff:
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OVERVIEW
The research in Dr. Xu’s laboratory focuses on (1) receptor engineering as a new class of drugs for the treatment of chronic pain, (2) rational design of new therapeutic strategies to treat neuronal injuries during and after global cerebral ischemia, and (3) the molecular and cellular mechanisms underlying the actions of low-affinity neurological drugs such as general anesthetics and alcohols. In the first project, recent activities have been directed towards developing targeted delivery of engineered ion channels to nociceptors to treat chronic pain. In the second project, systemic immune modulation and its coupling with the central nervous system (CNS) are investigated to develop new therapies for repercussion injuries. The third project involves the 3-D structure and dynamics measurements of ion channel receptors. Dr. Xu is also interested in the biological basis of consciousness (approaching from unconsciousness to consciousness).

PROJECTS
Developing Receptor Therapeutics to Treat Chronic Pain
Pain is a complex sensation with physical and emotional components. Current approaches to treat physical pain focus on screening, optimizing, or developing drug molecules that work on existing targets in the body. The inherent limitations of these conventional approaches are twofold: First, drugs are developed around and are limited to receptors in the CNS with multiple functions. Second, most drugs are active in the brain and thus have psychoactive potential. Dr. Xu’s group is developing a new strategy to provide the peripheral nerves with designed analgesic targets. More specifically, the investigators use non-native ion channels as a form of medication. By creating “drug-able” modulations of peripheral nociceptors, they hope to treat the root of nociceptive and inflammatory pain by titrating the excitability of afferent neurons, thereby elevating the pain threshold proportional to the extent of the pain-evoking pathological conditions. Dr. Xu’s lab is engineering non-immunogenic surveillance Cl− channel receptors specifically homing for peripheral terminals of the C- and Aδ-fibers and their cell bodies in the dorsal root ganglia. These channels are designed to be silent (non-conducting) under normal physiological conditions and thus will not interfere with normal nociception. The designed channels will
either spontaneously respond to inflammation-induced changes in the peripheral tissue environment (such as tissue acidosis due to inflammation) or can be activated by small activating molecules that would otherwise have negligible or no analgesic effects. This innovative idea and bold approach will lead to the development of a fundamentally different class of pain medication that will be particularly efficacious for the management of inflammatory pain and at the same time reduce the problem of prescription drug abuse.

**Injury Mechanisms and Systemic Immune Responses after Global Cerebral Ischemia**

Cardiovascular diseases, which frequently result in cardiac arrest, remain the leading cause of death in the USA. Most patients who are successfully resuscitated after cardiac arrest die in the hospital due to delayed brain injuries. A new therapeutic concept is being developed to manipulate protective immune responses, thereby improving the long-term neurological outcomes by preventing and reversing delayed brain injuries.

This is a collaborative project which brings together two investigative teams at the University of Pittsburgh and Texas Tech University with many years of combined research experience in (1) the treatment of reperfusion injuries after global cerebral ischemia due to cardiac arrest and resuscitation, (2) mechanisms of neuronal injury and protection through systemic immune responses, and (3) systemic drug delivery to the CNS. In their search for effective treatment of global cerebral ischemia using adult stem cells, the investigators discovered a novel mechanism of stem cell protection through cell signaling instead of transdifferentiation or fusion between stem cells and host cells. Most importantly, the investigators found that this signaling process could strongly modulate the inflammation response to global ischemia and render protection to selectively vulnerable neurons by preventing pro-inflammatory damage to glial cells. The investigators use partially and completely immune-deficient mice to carefully dissect the systemic immune components that can be programmed as post-treatment strategies. They designed a way to condition bone-marrow-derived macrophagic and dendritic cells for immune reconstitution and developed CNS-targeting nanoparticles to knock down pro-inflammatory cytokine signaling using RNA interference technologies. These studies will pave the way towards ultimately identifying the most effective strategies to treat global ischemia after cardiac arrest and to bring the new discoveries from the bench top to the bedside.

**Molecular and Cellular Mechanisms Underlying the Actions of Low-Affinity Neurological Drugs**

This project focuses on in-depth investigations of the molecular nature of general anesthetic interaction with neuronal membrane constituents. Recent research efforts have combined the use of modern molecular biology techniques with various biophysical approaches, notably state-of-the-art, high-resolution, solution- and solid-state nuclear magnetic resonance (NMR), to elucidate the effects of general anesthetics on the structures and dynamics of the transmembrane segments of the human glycine receptors. The project aims to identify the structure-function and dynamics-function relationships with direct binding and dynamics analyses at the sub-molecular and atomic levels.

**Biological Basis of Consciousness**

Neurons communicate with each other dynamically, but how such communications lead to consciousness remains unclear. Dr. Xu’s group has developed a theoretical model to understand the dynamic nature of sensory activity and information integration in a hierarchical network. Their mathematical model offers mechanistic insights into the emergence of information integration from a stochastic process and suggests that patients losing consciousness under the influence of anesthesia might be the result of reduced information accessibility in the neural network, which hampers the flow of sensory information. Those findings could help shed light on precisely how changes in brain activity can lead to the loss and re-emergence of consciousness.
BASIC RESEARCH

PUBLICATIONS


CURRENT FUNDING

Principal Investigator, 1R01GM49202-20A1, NIH/NIGMS, Developing Receptor Therapeutics to Treat Chronic Pain, 04/10/15-01/31/19

Principal Investigator, 1R01GM49202-20A1, NIH/NIGMS, Developing Receptor Therapeutics to Treat Chronic Pain, Research Supplement to Promote Diversity in Health-Related Research, 07/01/16-06/30/17

Principal Investigator, R01GM114851-01A1, NIH/NIGMS, Injury Mechanisms and Systemic Immune Responses after Cerebral Global Ischemia, 09/01/14-06/30/17

Program Director, 2T32 GM075770-06, NIH/NIGMS, Research Training in Anesthesiology and Pain Medicine, 07/01/12-06/30/17

Principal Investigator (Project III), P01 GM055876-10, NIH/NIGMS, Interaction of Inhalational Anesthetics with Macromolecules (PI: Eckenhoff), Project III: NMR Studies of Anesthetic Interaction with Ion Channels and Receptors (PI: Yan Xu), 08/01/08-07/31/18

Co-Investigator (Pei Tang, PI), R01GM66358-13, NIH/NIGMS, General Anesthetic Effects on Ion Channel Structures and Dynamics, 12/1/06-04/30/17

Co-Investigator (Pei Tang, PI), R01GM056257-16, NIH/NIGMS, Anesthetic Sites in Transmembrane Peptides by NMR, 05/01/98-01-31/18
PATRICIA L. DALBY, MD
Associate Professor

PROJECTS

Patient and Family Satisfaction With “Condition O” Emergency Care Questionnaire Development

Completed University of Pittsburgh School of Medicine Scholarly Project for Hanzi Lena Zhan and Brian Slater with faculty mentor: Patricia L. Dalby, MD

“Condition O” is a single operator-dispensed batch emergency call system to activate responders for urgent situations. It was implemented for emergent fetal and/or maternal conditions in 2005 at Magee-Womens Hospital of UPMC (MWH). The program was started to overcome interdisciplinry communication barriers and emulate the success of similar medical emergency teams (METs), which are single-call systems that have been successfully used for general medical, surgical, and pediatric patients. One aim was to encourage staff to obtain extra help efficiently. We also aimed to design the system so that any staff member can call it. It is designed to help treat acute situations in which immediate action/evaluation is needed to avoid fetal and/or maternal harm. The most common situations in which it has been called are non-reassuring fetal heart rate situations and post-partum hemorrhages.

Response times and efficiency of care have improved since implementation, but concerns remain regarding the reactions of patients and their families to large numbers of responders suddenly appearing at a delicate and personal time in their maternal-fetal care. A survey questionnaire has been developed, validated, and found reliable for the assessment of mothers and their families who have experienced a “Condition O” at MWH.

Because the process of delivering emergency obstetric care with the use of a rapid response team is remarkably similar to the care delivered in the ICU, we chose to modify a validated tool known as the Family Satisfaction in the Intensive Care Unit questionnaire (FS-ICU) in order to measure patient and family satisfaction with two separate surveys following emergent obstetric crisis. During questionnaire development, the initial questionnaire was administered within 48 hours and an optional repeat administered for reliability within 24 hours or after the initial emotional reaction was over. Ninety-three percent (93%) of respondents had completed all items for each of the survey questions. Internal consistency assessed by Cronbach’s alpha was consistently high across the two surveys with \( \alpha = 0.905 \) for the patient survey (ps) and \( \alpha = 0.841 \) for the family survey (fs). The test-retest values highly correlated for both models also: with \( r = 0.80, p \lt 0.01 \) for the ps and \( r = 0.85, p \lt 0.001 \) for the fs. Subscale correlations were 0.850 and 0.806 for the patient and family models, respectively.

The questionnaire is a modality to improve patient emergency care and elicit patient concerns over their care. The Patient and Family Satisfaction Questionnaires are psychometrically sound regarding measurement of satisfaction with care and medical decision-making of patients and families involved with acute obstetrical care. To date, patients have responded positively to Condition O response team care. Last year, our Condition O response underwent review and revision by MWH committees.

Some valuable insights have been gained using this instrument to improve patient care. Further implementation of the response team and the survey is ongoing, and we plan to utilize the surveys to assess the response of the revisions.

The reevaluation process of the Condition O response at Magee was completed in FY15. All parts of the response were analyzed and the reformed response format is now being taught in a multidisciplinary simulation format. Patient and family responses utilizing the above instrument will be done after the training is complete with comparison of the survey results before and after the educational process in reaction to the new Condition O response process. Currently this is an ongoing QI investigation at MWH.
New approaches to predict, prevent, and treat acute and persistent labor-related pain are needed. It has been predicted that up to 30% of women may develop a chronic pain syndrome related to childbirth. Every woman has individual pain sensitivity and this may be predicted by their “sensory profile,” identified with Quantitative Sensory Testing (QST).

Variations in obstetric analgesia and labor-related pain may be related to a woman’s overall pain sensitivity, or it may be that thresholds of experimental pain in late pregnancy differ from those at baseline. There may be genetic coding for pain sensitivity, in which certain gene sequences have already been well-studied. In the present prospective longitudinal study, we assess the responses of healthy pregnant women to standard painful stimulation, including thermal and mechanical stimuli. In addition, we evaluate pain status and pain co-morbid traits, including sleep and mood, using validated standard questionnaires. This data is being collected in the first and third trimesters of the women’s ante partum and postpartum periods. Women are followed in the postpartum period for the development of chronic pain syndromes. Saliva or blood samples have been collected for future genetic analysis. These will be compared to the same individuals’ pain descriptors of their labor and delivery process.

Almost 180 patients have been recruited to date, but the withdrawal rate (45 women) has been high due to the time commitment and complexity of the study. Almost 60 women have completed the study. Genetic analysis has not been conducted. Preliminary analysis of the psychological and QST data has indicated an increase in the antenatal period to pressure tolerance and some possible changes in heat tolerance in the peri-partum period. Some alterations in the catastrophizing profiles of the women are also emerging for pressure and heat tolerance. In one preliminary analysis, we separated participants into vaginal delivery and cesarean section groups for the QST periods 1-2 for the heat data and saw that the vaginal delivery group showed greater heat thresholds and heat tolerance than the cesarean group during that first period. Women with lasting pain after delivery were characterized by increased mechanical pain sensitivity. Lower anxiety and depression at three month assessments were prevalent in vaginal delivery patients. Clinical variables did not yield any significant data to be included in the results. If this bears out long-term in the study, it might indicate differences in the two groups of women early in pregnancy.

Interestingly, in the labor pain and phenotype portion of the study, we found some indications of a possible role played by phenotypical differences in eye color in the labor pain response. After receiving epidural analgesia, dark-eyed subjects trended towards experiencing more pain reduction both at rest and during movement than light-eyed subjects. At present, statistical significance has not been found, but this pilot study revealed patterns between eye color and pain-related traits in pregnant women in a labor pain model.

Further investigation with larger sample sizes, including other pain models and genders, is being pursued to explore the relationship between eye color and pain phenotypes.

Dr. Inna Belfer left our department in the spring of 2015 and Dr. Dalby assumed the principle investigator role on this study. Although the study is now closed to patient recruitment, the data will continue to be analyzed for potential publication in the future.

Women in labor are commonly restricted to intake of ice chips only to prevent aspiration, a rare situation in which they may require general anesthesia for an emergent cesarean section. After the first trimester of pregnancy, gastro-esophageal sphincter tone is reduced and in labor, gastric motility is reduced, rendering aspiration of vomitus potentially
more possible. However, the recent literature reports that the actual risk of aspiration during labor is extremely low (seven in 10 million births in cases accumulated between 1979 and 1990 in the United States). The risk of aspiration has been markedly reduced with improved general anesthetic techniques due to faster-acting induction agents, better antacids, cuffed endotracheal tubes, and other improved techniques for maternal airway management. In addition, the requirement for general anesthesia has been reduced by the increased availability of regional anesthesia. Accumulating evidence suggests that nutritional restriction is not benign. The process of labor induces extreme metabolic demand associated with a doubling of cardiac output and increased respiration reminiscent of that required for extreme aerobic activity, and as such, laboring women can develop a state of accelerated starvation. This state of starvation results in the production of ketones as an alternative energy source and prolonged labor is associated with ketone production that is exacerbated by fasting.

This secondary study utilizing data from a previous study of co-investigator Manuel Vallejo looked at the progress of labor in two groups of laboring women. The women were demographically matched; one group of women followed the normal dietary restrictions of no food or drink except ice chips (traditionally kept in US labor and delivery wards), and the other group of women were supplemented in early labor with a protein shake. Certain points in labor progress were captured in the two groups and subjected to mathematical analysis.

The data was evaluated with a validated multivariable time series model using PLTTools (PLT Soft, San Francisco, CA) for NONMEM (Globomax; Ellicott City, MD). Briefly, labor progress was estimated with the equation: CD = (10-TCD)(-L1*TIME) + TCD (-L2*TIME), where CD is cervical dilation, TCD is the cervical dilation at which latent labor transitions to active labor, L1 is the exponent for the active labor term, and L2 is the exponent for the latent labor curve. Variables such as ethnicity were evaluated as X variables on the active labor rate constant, and continuous variables were evaluated as an additive variable on the active labor rate constant. This method has been found to be highly sensitive and specific in the detection of significant effects on labor progress.

**Cell Salvage in Vaginal Delivery Case Series**

Fellowship Research Endeavor

Primary Investigators: Jamie Zorn, MD, Eleni Kotsis, DO, and Jonathan Waters, MD

Co-investigators: Grace Lim, MD and Patricia Dalby, MD

Obstetrical hemorrhage is a leading cause of maternal morbidity and mortality. The increasing rate of cesarean sections, morbid obesity, and excessive use of oxytocin augmentation place many women at high risk for postpartum hemorrhage (PPH). The use of intraoperative red cell salvage has been used by many surgical subspecialties to decrease the amount of allogeneic blood and to decrease the risk of transfusion-related morbidity. The use of intraoperative blood salvage has been integrated into protocols for treatment of massive obstetric bleeding, but has not been extensively utilized for PPH after vaginal delivery. In our case series, we studied 26 patients that had cell salvage available on standby for high risk maternal bleeding, or was set up and used by obstetricians during active hemorrhage after a vaginal delivery. These documented cases occurred from 2010-2015 at MWH. Ten out of 26 patients received cell salvaged blood in this study. The average estimated blood loss was 1577 mL and the average amount of recovered blood was 359 mL. The average length of stay was 3.7 days for patients not receiving salvaged blood and 3.4 days for patients who received salvaged blood. The preliminary data shows that all 10/26 patients who received cell salvaged blood did not have any documented complications subsequent to receiving the salvaged blood, including sepsis wound healing, amniotic fluid embolus (AFE), or increased hospital stay. The reasons for blood recovery in our patients included abruptio (4/26), atony (11/26), uterine inversion (1/26), laceration (3/26), undocumented causes (3/26), HELLP (1/26), retained placenta (1/26), Jehovah’s Witness (1/26), and prior history of severe PPH (1/26). Results of this case series are consistent with findings from other series.

**Brief Report: Ultrasound-Guided Epidural Labor Analgesia in Morbidly Obese Parturients**

Ultrasound has revolutionized many anesthetic procedures such as peripheral nerve blocks and central line placement. Studies have examined the benefits of ultrasound-guided labor epidural catheter placement in various patient populations.
Although some studies have demonstrated benefits, such as confirming the correct spinal level, predicting the depth to the epidural space, decreasing the number of attempts, improving first pass success rate, and reducing the incidence of failed epidural analgesia in resident trainees, others have demonstrated no differences in these outcomes when the procedure is performed in uncomplicated patients. Particularly in obese patients, palpation of neuraxial landmarks can be difficult, and obesity is associated with increased difficulty with epidural catheter placement, longer placement times, and a higher failure rate. Ultrasound may help visualize the spine and offset these challenges, although there are few data comparing its practical application for daily use against the current standard of a palpation-based only technique.

The aim was to assess whether ultrasound-guided epidural catheter placement in morbidly obese parturients (BMI ≥40) is associated with clinically relevant and practical benefits for both the patient and provider. Our primary hypothesis was that ultrasound-guided epidural catheter placement in morbidly obese parturients reduces total time required to perform the procedure. Other outcomes measured included number of attempts, first attempt success rate, complication rates, and patient satisfaction.

Primary outcome was total time (in minutes) to successful placement of the epidural catheter for labor analgesia, defined as the sum of ultrasound or palpation time, plus epidural catheter placement time. Initial sample size was calculated based on previous work comparing time-to-placement of combined spinal-epidural anesthesia during cesarean delivery among obese patients (BMI ≥ 30) with and without ultrasound. Data were de-identified and analysis performed by independent investigator blinded to group assignment. Distribution normality of continuous data were examined using box plots and histograms.

The mean total procedure time in the ultrasound group was found to be 6.1 minutes compared to a mean of 11.0 minutes in the palpation group (P = 0.05). Although evaluating a patient with ultrasound took nominally more time than palpation (1.8 vs 0.9 min respectively; P < 0.001), it resulted in reduced epidural catheter placement time (mean 4.33 minutes using ultrasound vs. mean 10.1 minutes using palpation; P = 0.03) and significantly fewer attempts (median one attempt with ultrasound vs. five attempts with palpation; P = 0.02). Despite the reduction in time and number of attempts, ultrasound use was not associated with differences in patient anxiety or satisfaction with either the procedure itself or their overall experience. There were no differences between groups regarding complications. In the palpation group, there were two cases of transient paresthesia during epidural needle placement, one unilateral block requiring epidural catheter adjustment, and one inadvertent dural puncture resulting in a subsequent post-dural puncture headache (declined epidural blood patch). None of these complications were noted in the ultrasound group.

The study conclusions were that in morbidly obese parturients, ultrasound-guided epidural catheter insertion is associated with reduced procedure time compared to palpation alone. This finding represents practical benefits to both patient and provider. With a brief initial ultrasonographical evaluation, providers can complete epidural catheter placement in fewer attempts and reduce overall procedure time. While no significant differences were noted in patient satisfaction, this study was underpowered for the outcome of satisfaction. Although complication rates between groups did not reach statistical significance, this study was not powered for these outcomes; the fact that the complications were noted to occur only in the palpation group suggests that a larger study is warranted to evaluate whether ultrasound guidance can reduce the risk for these untoward outcomes in the morbidly obese population.
Current outcomes from cardiac arrest (CA) are often suboptimal. The research group at the Safar Center for Resuscitation Research recently established a novel concept of emergency preservation with delayed resuscitation (EPR) for victims of exsanguination CA. The concept of “emergency preservation” utilizes an ice-cold aortic flush to rapidly achieve deep hypothermia that would prevent further damage and allow time for transport and damage control surgery. Delayed resuscitation is then achieved via cardiopulmonary bypass (CPB).

While initial experiments used a canine model, Dr. Drabek’s group developed a rodent model of EPR. A miniaturized CPB circuit enables the utilization of molecular tools to define potential therapeutic targets and develop drugs that would augment the effect of hypothermic preservation. The research group initially characterized the rodent model of EPR using rapid lethal hemorrhage followed by 20 minutes of CA. Rapid induction of deep hypothermia (15°C) allowed survival from otherwise lethal insults with excellent outcomes. Extending the duration of CA up to 60 minutes resulted in intact neurologic survival, while further extension to 75 minutes was associated with high mortality and neurologic impairment in survivors and increased secondary injury cascades. The blood-brain barrier was not disrupted, even in insults that were associated with poor outcome. The delta-opioid agonist DADLE, linked to hibernation-induction agents with organ-preservation properties, failed to augment the hypothermic protection. Deeper levels of hypothermia (21°C vs. 28°C) resulted in better neurologic outcome. Surprisingly, this was associated with attenuated microglial activation, but not neuronal death. This finding shifted the group’s focus to neuroinflammation. The Drabek research team pioneered a method of selective depletion of microglia using intrahippocampal injection of clodronate, a pro-drug that depletes macrophages when injected systemically. Their current results also suggest significant regional differences in the brain’s neuroinflammatory response to CA.

Recently, the Drabek group established a normovolemic ventricular fibrillation (VF) CA model. They characterized the model and explored cerebral blood flow after asphyxial CA vs. VFCA. They also characterized early neuroinflammatory region-specific responses to various durations of VFCA. The team used fast-scan cyclic voltammetry to explore dopamine signaling establishing effective neurorehabilitation–relevant treatments to improve multidimensional recovery after VFCA. This research is being conducted in collaboration with the Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University, and Duquesne University.

The Drabek research group is currently focused on characterizing systemic and organ-specific cytokine responses to prolonged CA to identify therapeutic targets for future therapies. Novel strategies currently being tested include systemic cytokine removal by hemoadsorption or single anti-cytokine strategies to improve outcome from CA by ameliorating post-CA syndrome.

Both Dr. Drabek and his trainees have received multiple national awards, e.g. Young Investigator Award (American Heart Association), Young Investigator Award (Society of Critical Care Medicine), Young Investigator Award (European Resuscitation Council), Best of Meeting Award (International Anesthesia Research Society), etc.

Dr. Drabek’s research has been supported by Department of Anesthesiology Seed Grants and grants from the Laerdal Foundation for Acute Medicine, the Society of Cardiovascular Anesthesiologists, the American Heart Association, and the Department of Defense.
Functional connectivity magnetic resonance imaging (fcMRI) analyzes the co-variation of low frequency (< 0.1 Hz) oscillations in the MRI signal that signal communication between brain regions. These reflect spontaneous neuronal activity and are present at rest, thus allowing the study of chronic neurological states. Our lab is now applying fcMRI to two critical issues in anesthesiology: pain and post-operative cognitive dysfunction.

The primary members of our lab include Principal Investigator Jim Ibinson, MD, PhD; Co-investigator Keith Vogt, MD, PhD; and Graduate Student Chris Becker, MA. Mentorship is provided by Howard Aizenstein MD, PhD (Department of Psychiatry and PI of the Geriatric Psychiatry Neuroimaging Lab); Brian Williams, MD; and Ajay Wasan, MD.

PROJECTS
Using Functional Connectivity to Differentiate Between Pain and Resting States
In a 2011 report to the Department of Health and Human Services, the Institute of Medicine stated that “relieving pain should be a national priority,” estimating that over 116 million Americans suffer from chronic pain with costs for medical treatment and lost productivity totaling up to $635 billion yearly. We believe that a critical step towards the development of effective treatments for both acute and chronic pain is the identification of a biomarker for pain and that fcMRI may be the ideal tool to identify such biomarkers, since pain perception is a psychological phenomenon.

Previously, we identified a connectivity pattern that differentiated an acutely painful state from the non-painful resting state and resulted in abstracts that were awarded “Best of Meeting” at the 2013 International Anesthesia Research Society (IARS) Annual Meeting and “Best of Category” at the 2014 IARS meeting, and the initial development was published in Brain Connectivity. A second publication is pending that details the correlation between activity in these brain regions with pain level, bringing us closer to our goal of a biomarker. Over the past year, funding was obtained and experiments were conducted to extend this investigation to acute exacerbations of clinically-relevant low back pain. The collection of this data will finish during FY18, with publications to immediately follow.

Quantifying The Neural Correlates of Post-Operative Cognitive Dysfunction and Investigating its Link to Pre-Clinical Alzheimer’s Disease
Post-operative Cognitive Dysfunction (POCD) is a poorly understood complication of surgery and/or anesthesia that results in significant morbidity, especially in the elderly. Current evidence suggests that the rate of POCD one week post-surgery, regardless of procedure, in patients over the age of 65 ranges from 30-40%. Neither the mechanism nor the key cerebral substrates of POCD have been convincingly determined in humans. This lack of understanding hampers our ability to measure POCD’s effect on cognitive function, monitor its natural time course, and precisely quantify the effects of potential treatments. Interestingly, new research has exposed a potential link between POCD and pre-clinical underlying Alzheimer’s disease (AD). Imaging studies focusing on anatomic changes have shown mixed results, suggesting that studies of brain function are needed to guide POCD research. The current objective of this work is to generate pilot data supporting the hypothesis that functional neuroimaging is able to detect the neural correlates of POCD and quantify the changes in brain function and/or morphology over time.

For this work, we will apply our pain fcMRI pipeline to images collected before and after anesthesia. Analysis of the imaging data will focus on using machine learning techniques to integrate clinical data, including age and neuropsychological exam scores with imaging measurements of brain volume, white matter hyperintensities, and fcMRI parameters. Our experience
with the use of advanced anesthetic techniques to avoid general anesthesia and presumably reduce neuroinflammation will allow us to eventually test whether POCD improves as a result of avoiding pro-inflammatory inhalational anesthetics and routinely using anti-inflammatory medications such as systemic lidocaine. Competitive pilot funding for this investigation was obtained during the last year, and data collection has begun. Our beginning investigation into this work also lead to Dr. Ibinson’s invitation to participate as a Visiting Professor in the University of Florida’s Chairman’s Lecture Series, as well as a lecture in the University of Pittsburgh’s Alzheimer Disease Research Center’s Topics at Noon series.

PUBLICATIONS

CURRENT FUNDING
Co-investigator (5%), DoD 13232002, U.S. Dept. of Defense, Total Joint Replacement with Four-drug Nerve Block in Veterans (PI: Brian Williams) 2015-2019

Principal Investigator, 2016 Clinical and Translational Science Institute Pain Research Challenge Grant, Virginia Kaufman Endowment Fund No. 1, PainDetect: Developing Brain Imaging as a Biomarker for Pain, 2016-2017

Principal Investigator, University of Pittsburgh Physicians Academic Foundation, Investigating the Link between Pre-clinical Alzheimer’s Disease and Postoperative Cognitive Dysfunction Using Functional Neuroimaging, 2016-2017

Principal Investigator, Visn 4 Competitive Pilot Program Fund, Quantifying the Neural Correlates of POCD, 2017-2018
Dr. Lim’s research is focused on clinical obstetric anesthesia and perinatology. The goal of her work is to improve maternal, fetal, and neonatal outcomes by optimizing clinical anesthesia care. Recently, Dr. Lim’s research group has focused on identifying the potential role of puerperal pain and labor analgesia on postpartum depression (PPD) risk.

In their recent retrospective observational study, 201 women with higher improvements in pain after initiation of labor epidural analgesia were found to be associated with lower PPD scores. After adjusting for covariates, pain improvement remained a significant predictor of depression scores ($r = 0.49$, $P = 0.008$), accounting for 6.6% of the variability in PPD scores. The full model including pain, body mass index, anxiety and/or depression, perineal lacerations, and anemia explained 24% of the variability in PPD scores. They concluded that although the extent of labor pain relief by epidural analgesia predicts lower PPD scores, the relative contribution of percent improvement in pain to risk for PPD symptoms may be less than other established risk factors for depression. These data support that the clinical significance of labor analgesia in the development of PPD needs to be more clearly defined.

To further add to the understanding of the role of labor analgesia on postpartum outcomes, Dr. Lim’s research group is completing an early-phase randomized control trial that will determine the dose-response effect between labor pain, labor analgesia, and depression. They are following these women and their infants for a period of three months to assess outcomes including PPD, chronic pain, maternal-infant bonding, and parenting self-efficacy (ClinicalTrials.gov Identifier: NCT02692404).

**FUTURE RESEARCH DIRECTIONS**

In future work, baseline psychological variables, pain sensitivity, and intrapartum pain will be systematically evaluated for their relative influence on the development of PPD. A feasible study design to assess the role of labor pain improvement in PPD risk reduction will be generated. Thus, Dr. Lim and her colleagues will be able to identify the influence of labor pain on PPD risk, thereby allowing investigators to efficiently target novel pain management strategies.

Dr. Lim’s long-term goals are to expand this methodology to tailor novel and personalized labor pain management strategies to other vulnerable populations, such as parturients with opioid addictions and obesity. Her future work will build on these predictive models to identify other perinatal factors requiring optimization, and to identify effective clinical management strategies that enhance maternal-infant outcomes.

**PUBLICATIONS**


CURRENT FUNDING


Principal Investigator, University of Pittsburgh Virginia Kaufman Endowment Fund and CTSI Pain Research Challenge, Reducing the Impact of Pain on Perinatal Depression, 2016-2017

Principal Investigator, Society for Education in Anesthesia (SEAd) Grant, Residents as Teachers: Effect of a Patient Education Strategy on Resident Self-Efficacy and Maternal Outcomes (The EDUCATE Study), 2016-2017

Scholar, NIH K12, Building Interdisciplinary Research Careers in Women’s Health (PI: Yoel Sadovsky, PhD), 2016-2019

We can improve healthcare by using simulation and other state-of-the-art educational technology in the training and assessment of healthcare professionals. During the 2016-17 academic year, Dr. McIvor completed his work with master’s degree candidates and their faculty at Carnegie Mellon University to develop a screen-based simulation. The work will be taken up via a consultancy agreement with a private software developing company. He was the fourth author on a paper published in Anesthesiology that reports the outcomes from a multi-center trial of board-certified anesthesiologists’ performance during simulated crises. Dr. McIvor continues his work with a distinguished group of simulation educators/researchers in the area of assessment of practicing physicians. He is a member of the American Society of Anesthesiologists’ Simulation Education Network.

WILLIAM R. MCIVOR, MD, FASA
Professor
Dr. Wasan’s current research interests are in the areas of tracking pain treatment outcomes using electronic records, mechanism-based treatment studies of negative affect in pain, quantitative sensory testing, functional magnetic resonance imaging (fMRI), and preventing prescription opioid misuse in patients with chronic pain. Since coming to Pittsburgh in 2013, Dr. Wasan has built a clinical and translational chronic pain research program new to the department, successfully mentored several junior faculty in the department who have since obtained independent funding, obtained new external grant funding each year, and has authored over 40 new research publications.

Before coming to Pitt/UPMC at the beginning of FY14, Dr. Wasan was an Associate Professor of Anesthesiology and Psychiatry at Harvard Medical School and Director of the Section of Clinical Pain Research at Brigham and Women’s Hospital in Boston; hence, some of the below grants were awarded to his prior institutions. However, this work has continued with funding to Pitt in 2014-2017.

**PROJECTS**

**Use of Extampza ER to Modulate Pill Swallowing Difficulties in Patients with Chronic Pain**  
*Collegium Pharmaceuticals, Investigator Initiated Study Grant*  
*Funding period: 2017-2019*  
*Principle Investigator: Ajay D. Wasan, MD, MSc*

This is an investigator-initiated study to examine the role of a newly formulated opioid delivery system to address difficulties patients may encounter swallowing pain medications.

**Provider-Targeted Behavioral Interventions to Prevent Unsafe Opioid Prescribing for Acute Non-Cancer Pain in Primary Care**  
*PCORI Large Pragmatic Trials Program*  
*Funding period: 2017-2020*  
*Principle Investigator: Kevin Kraemer, MD, University of Pittsburgh Dept. of Medicine*  
*Co-investigator: Ajay D. Wasan, MD, MSc*

The main goal is implementing a health system electronic health record (EHR) strategy to change provider opioid prescribing behavior for acute musculoskeletal pain. This is a large pragmatic trial in 10,000 patients prescribed opioids for acute musculoskeletal pain. It is a provider-level, cluster randomized intervention to one of four arms. Each arm provides a different level of decision support through the EHR.

**Brain Mechanisms Underlying CBT-Related Reductions in Fibromyalgia**  
*NIH NIAMS R01 (AR064367-01A1)*  
*Funding period: 2014-2019*  
*Principle Investigator: Robert R. Edwards, PhD MSPH, Brigham and Women’s Hospital*  
*Co-investigator: Ajay D. Wasan, MD, MSc*

This work focuses on fibromyalgia (FM), which is characterized by persistent, widespread body pain, with significant evidence of altered brain processing of various stimuli. One of the few effective treatments for FM is cognitive-behavioral therapy (CBT), which has been shown to reduce pain intensity and pain-related disability, potentially via reductions in catastrophizing, an important psychosocial factor that plays a crucial role in shaping individual differences in pain-related outcomes. Our overarching goal in this study is to understand the neurobiological pathways by which CBT and reduced catastrophizing facilitate improvements in chronic pain. Such information will refine biopsychosocial models of pain,
identify potential non-responders early in treatment, and facilitate the enhancement of psychosocial interventions for chronic musculoskeletal pain. We have shown previously in a small sample that CBT reduced pain catastrophizing and produced corresponding changes in brain activation in “pain matrix” processing areas and the functional connectivity of these areas to the default mode network (DMN). In the larger, current study, participants with FM are randomized to eight weekly treatments with CBT or an education/attention control and followed up for six months. FMRI data, including functional connectivity during both a resting and evoked deep-tissue pain state, are collected at baseline, mid-treatment, and after the final treatment visit. We hypothesize that CBT will reduce catastrophizing early in treatment, resulting in adaptive changes in the brain’s responses to an externally-applied noxious stimulus. These changes will then predict subsequent changes in patients’ resting state connectivity in DMN and pain-relevant brain regions, which will underlie long-term improvements in clinical pain.

**Neuroimaging Acupuncture Effects on Brain Activity in Chronic Low Back Pain**

*NICH NCAAM P01 (1 P01 AT006663-01)*

*Funding period: 2011-2017*

*Principal Investigator: Bruce Rosen, MD, PhD, Massachusetts General Hospital*

*Co-Investigator: Ajay D. Wasan, MD, MSc*

We propose that real and sham acupuncture differentially modulate the brain’s specific intrinsic connectivity networks and alter somatotopy (the functional organization of the somatosensory cortex). Our overall goal is to evaluate whether the brain neurocircuitry subserving chronic low back pain (cLBP) responds differentially to real versus “sham” acupuncture. To test our specific hypotheses, we are employing fMRI to assess brain networks subserving both clinical and experimental pain, acupuncture stimulation, and somatotopy in cLBP patients. These measures will be performed at baseline and following seven weeks of acupuncture (ACUP), sham acupuncture with somatosensation (SHAM-sn), sham acupuncture without somatosensation (SHAM-ml), or wait list (WL). Aim 1 will characterize the pain neurocircuitry in cLBP, as well as low back SI somatotopy, and brain response to acupuncture stimuli. Aim 2 will evaluate the longitudinal effects of ACUP vs. SHAM-sn on brain networks and SI somatotopy in cLBP, while Aim 3 will evaluate the longitudinal effects of SHAM-sn vs. SHAM-ml on these same neuroimaging markers. Understanding the neural influence of somatosensation on acupuncture placebo effects will significantly impact our understanding of acupuncture and allow for development of more inert acupuncture placebos.

**Targeted interventions to Prevent Chronic Low Back Pain (LBP) in High Risk Patients: A Multi-Site Pragmatic Randomized Control Trial (RCT)**

*PCORI: Pragmatic Clinical Studies and Large Simple Trials to Evaluate Patient-Centered Outcomes*

*Funding period: 2015-2020*

*Principal Investigator: Anthony Delitto, PhD, University of Pittsburgh School of Rehabilitation Sciences*

*Co-Investigator: Ajay D. Wasan, MD, MSc*

This is a 1,500 subject RCT to evaluate whether early physical therapy + CBT prevents the transition from acute to chronic LBP. Preventing the transition from acute to chronic LBP is a crucial public health issue. LBP is the most common chronic painful condition in the United States and incurs approximately $100 billion in direct healthcare costs. A wealth of data indicates that psychosocial variables, such as high levels of pain catastrophizing or negative affect, are the best predictors of acute LBP becoming chronic. This study will compare referral of patients with LBP < three months duration to physical therapy with a cognitive-behavioral emphasis to usual care in a primary care setting.
As a National Institutes of Health (NIH) RO1 principal investigator, I will continue to work on my research project “WISP1 and TLR4 Signaling in Ventilator-induced Lung Injury (VILI)” with my two collaborators, Drs. Tim Billiar, Chair of the Department of Surgery and Bruce Pitt, Chair of the Department of Environmental and Occupational Health at the University of Pittsburgh.

Our previous studies using an unbiased genome-wide association study in a genetically diverse panel of 23 mouse strains identified WNT1-inducible signaling pathway protein 1 (WISP1) as playing an important role in a murine VILI mode. In addition, we identified that innate immune signaling via TLR4 plays a critical role in the pathogenesis of VILI and that stretch-induced WISP1 expression and its pro-inflammatory effect were TLR4-dependent.

We have been interacting with Dr. Marion Young at the NIH on mechanisms to import WISP1-null mice that she has engineered (J Biol Chem 290: 14004-14018, 2015) and have identified sources for importing αvβ3 and αvβ5 integrin mice. Although both sepsis and mechanical ventilation signal via TLR4, the molecular determinants underlying activation of TLR4 signaling in the latter sterile condition are undetermined. In this regard, we propose to study the effect of cyclic stretch on murine and human cultured respiratory epithelial cells and macrophages in the context of WISP1, integrin, and TLR4 interactions (Chang et al, PlosOne, Sept 2017, in press).

We propose to further investigate the role of WISP-1, αvβ3 and β5 integrin, and TLR4 signaling in our newly-developed and highly relevant preclinical model of (polymicrobial) sepsis and mechanical ventilation (Two-hit Model: MV+CLP-Sepsis) in intact mice. We (Li et al, Am J Resp Cell Mol Biol 47: 528-535, 2012; Chen et al, Scientific Reports 6:28841,2016) and our colleagues (Ding et al, Shock 43: 352-360, 2015) noted that the matricellular protein WISP1 contributes to TLR4-mediated sterile and infectious acute lung injury (ALI). A role for integrins in mediating WISP1 effect was apparent in the RGD-sensitive nature of cecal ligation and puncture (CLP)-induced ALI and a component that could be ascribed to WISP1-integrin β6 interaction via neutralizing antibodies. Although sepsis is the primary cause of respiratory failure requiring supportive measures of mechanical ventilation and mechanical ventilation itself may cause iatrogenic acute lung injury, few reports have combined these stimuli in a calibrated double hit model of ALI. Accordingly, we explored the role of WISP1 and integrin β5 in the underlying mechanisms of ALI during mechanical ventilation in a murine model (CLP) of polymicrobial sepsis. MyD88 to aggravate sepsis-induced lung injury.

Our results suggest that WISP1-αvβ3 integrin signaling is a critical immune modulator in TLR4 pathways in macrophages and may be an important contributor to TLR4/CD14-mediated inflammation in polymicrobial sepsis-induced lung injury. Our results also showed that mechanical ventilation with normal tidal volume increased both WISP1 production and integrin β5 expression two-fold in intact lung after CLP and signaled through TLR4-MyD88 to aggravate sepsis-induced lung injury, while mechanical ventilation with low tidal volume producing a protective effect on lung injury induced by CLP/sepsis.

Most recently, our multiple PIs (Drs. Billiar, Pitt, Turnquist, and myself) have been exploring the role of the IL-33/ST2 axis in ALI induced by the two-hit model.

**Significant Results**
We confirmed that TLR4 and CD14 are critical in transducing CLP-mediated ALI (including elevation of intrapulmonary WISP1) and demonstrated that intrapulmonary αvβ3 is increased by polymicrobial sepsis in a TLR4, CD14-dependent fashion. Comparison of cultured macrophages revealed that: a) WISP1 by itself increased release of TNF-α from RAW264.7 cells (with baseline expression of αvβ3) in an RGD-sensitive fashion; but b) primary cultures of PMø required activation of TLRs to induce de novo synthesis of αvβ3, enabling WISP1 to stimulate release of TNF. The specific requirement for β3 integrin was apparent when the effect of WISP1 was lost in PMø isolated from β3−/− mice. WISP1 enhanced TLR4-mediated
ERK signaling, U0126 (an ERK inhibitor) blocked LPS induced β3 integrin expression, and WISP1 enhanced TNF-α release.

We also showed that LPS induced upregulation of integrin β5 through the TLR4-MyD88 signaling pathway. We further demonstrated that mechanical ventilation with normal tidal volume significantly aggravated mild sepsis-induced lung injury and inflammation responses, whereas in TLR4 null mice, intratracheal administration of WISP1 antibody or integrin β5 antibody significantly attenuated lung injury. These findings were recapitulated in mouse peritoneal macrophages in vitro after LPS and WISP1 recombinant protein in a sequential stimulation. The enhanced integrin β5 expression in murine peritoneal macrophages augmented the production of cytokines and chemokines, which was accompanied in the amplified polymorphonuclear leukocyte migration into the lung. However, these enhanced inflammatory responses vanished in peritoneal macrophages obtained from TLR4 null mice, and furthermore, inhibition of integrin β5 expression by applying an integrin β5 siRNA decreased the inflammatory response.

Key Outcomes
CLP, WISP1-αvβ3 integrin, and TLR4 signaling: Collectively these data suggest that WISP1-αvβ3 integrin signaling is a critical immune modulator in TLR4 pathways in macrophages and may be an important contributor to TLR4/CD14-mediated inflammation in polymicrobial sepsis-induced lung injury.

CLP, mechanical ventilation, WISP1-αvβ5 integrin, and TLR4: These results indicate that mechanical ventilation increased both WISP1 production and integrin β5 expression two-fold in intact lung after CLP and signaled through TLR4-MyD88 to aggravate sepsis-induced lung injury.

In addition, as an editorial board member for some professional anesthesiology journals and an NIH Special Emphasis Panel review member, I have actively participated in the manuscript and grant-reviewing process. As a re-certified anesthesiologist and WISER Simulation Center instructor, I accomplish my assigned clinical duties per national guidelines and most up-to-date evidence-based practice. I also teach simulation courses for medical students and residents. I have been invited as a keynote speaker at national anesthesiology and simulation conferences in China over the past several years to greatly increase the visibility and impact of UPMC/UPSOM in China.
The Department of Anesthesiology continues to maintain its own industry-sponsored Clinical Trials Program (CTP). The self-contained program has been designed to provide, within the department, all the services necessary for faculty members, as both principal investigators and sub-investigators, to fully execute a clinical trial. Services include contract and budget negotiations, clinical research coordinator support, and Institutional Review Board (IRB) submissions. The CTP is also committed to developing new study opportunities for all department faculty members by promoting departmental resources and expertise to the pharmaceutical industry as a whole. The strong relationships with pharmaceutical companies continue to bring a significant number of potential sponsored clinical trials. In FY17, we contracted clinical trials with two new sponsors. In addition, the CTP serves as a training ground in clinical research for anesthesiology attending physicians, residents, and fellows.

To ensure satisfaction of all legal and ethical local and national requirements, the staff reviews research protocols, develops patient consent forms, verifies that studies are being conducted in compliance with federal regulations and Good Clinical Practices, and obtains proper IRB approvals. The program also manages all the financial aspects of clinical trials, including developing and negotiating budget and managing grants. Finally, the CTP’s six full-time clinical research associates and one part-time research assistant oversee the conduct of clinical trials. This oversight includes but is not limited to coordination of trial initiation, facilitation and monitoring of patients after enrollment, and study progress monitoring, with a special focus on patient safety, quality of data collection, and record keeping.

During FY17, the CTP was involved in 22 active studies, including one study that had been recruiting subjects for over six years. CTP contracted seven new clinical trials and completed 10 ongoing clinical trials. Contracted grants totaled $780,798 (direct contracted revenue, $646,902; indirect contracted revenue, $133,896) and $661,906 was collected. Over 50 faculty members were involved in clinical sponsored research at eight UPMC sites. CPT interacted with 13 different companies, one organization, and one university (AcelRx Pharmaceuticals Inc., American Heart Association, CARA Therapeutics Inc., Endo Pharmaceuticals Inc., Grifols Therapeutics Inc., Grünenthal:Janssen/Worldwide Clinical Trials, Incline Therapeutics Inc., Mallinckrodt Pharmaceuticals, Medtronic Sofamor Danek USA Inc., The Medicine Company, Mylan Specialty L.P., Octapharma USA, and Pfizer, Inc., Trevena, Inc., University of Pennsylvania).

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RESEARCH

RESEARCH FELLOWSHIPS

The department’s research fellowships provide the opportunity for individuals to work with renowned clinical and basic science investigators in a variety of disciplines. Students can explore investigative careers, while others will develop into clinician-scientists who will lead the field of anesthesiology research.

NIH T32 RESEARCH FELLOWSHIPS

Training in Mechanisms and Clinical Presentation of Pain
Program Director: Howard B. Gutstein, MD

The goal of this training program, supported by the National Institutes of Health, National Institute of Neurological Disorders And Stroke (T32NS073548), is to recruit and train the best pre- and post-PhD fellows in cutting-edge theory, techniques, and research strategies, thereby providing a foundation upon which they will be prepared to lead the next generation of pain researchers. To achieve this, this integrated training program includes a seminar series, a journal club, research presentations by trainees, two didactic courses (Pain Mechanisms and Pain Models), as well as a program to shadow pain management clinicians in multiple clinics. The overall goal of the training program has been to integrate interdisciplinary and translational aspects of the current, rich training environment in pain research at the University of Pittsburgh. In addition to exposure of trainees to fundamental principles of pain mechanisms and pain presentation, this novel program features elements (clinical experiences, multi-laboratory projects, courses) that are typically very difficult for individual investigators to support.

Three core elements of the training program are:

• Research: Multidisciplinary research projects are not only encouraged, but expected, as is exposure to clinical management of pain/pain-related problems. These integrations will be achieved through formation of multidisciplinary mentoring committees which will include at least one clinical faculty member among a four member committee.

• Theory: Trainees will participate in four required for-credit courses: Mechanisms and Clinical Presentation of Pain, Pain Journal Club, bi-weekly Current Research on Pain presentations, and Pain Models – Rationale, Testing and Interpretation, as well as the monthly Pain Seminar Series, where trainees interact with prominent pain researchers.

• Practice: Trainees will be exposed to the assessment, diagnosis and treatment of chronic pain patients through the course Pain Perspectives that will provide trainees the opportunity to shadow pain physicians as they interview, diagnose and manage chronic pain patients within the Pain Medicine Program at UPMC.

FY17 Fellows

Michael Chiang
Education/Training: BS, University of California, Berkeley, 2010
MD/PhD, Medical Scientist Training Program, University of Pittsburgh, 2013 - present

Mentor: Sarah Ross, PhD, Assistant Professor of Neurobiology and Anesthesiology

Research Overview and Current Findings

Nearly one in four Americans suffer from some form of pain. Furthermore, pain remains the leading reason why Americans enter the health care system. Despite the prevalence of the multitude of pain conditions that afflict Americans and individuals worldwide, few efficacious treatments without severe adverse effects exist. Thus, identifying novel therapeutic targets would provide the potential to improve current pain management strategies.
A critical step towards the development of new approaches to pain management relies on our understanding of the circuitry underlying pain perception. The lateral parabrachial nucleus (LPBN) receives most afferents from lamina I-II spinal projection neurons that convey noxious stimuli, implicating its role in the pain response. Despite this, the role of the LPBN in the pain response remains unclear. Therefore, elucidating the neural pathways of the LPBN that contribute to pain perception may yield new insight for the development of targeted pharmacological therapy.

Our preliminary data suggest that different LPBN pathways mediate distinct aspects of the pain experience. We used optogenetics to determine whether activation of pathways arising from the LPBN causes aversion or defensive behaviors such as analgesia and increases in locomotion. Wild-type mice were stereotaxically delivered virus encoding channelrhodopsin-2 into the LPBN bilaterally. Implantable optical fibers were subsequently secured above downstream targets of the LPBN. We found that optogenetic activation of LPBN inputs to either the central amygdala or bed nucleus stria terminalis significantly decreased the amount of time mice spent on the side of the chamber receiving optogenetic stimulation, while stimulation of projections to the periaqueductal gray resulted in increased latencies to tail flick during the tail immersion test. Together, these data suggest that the pathways that stem from the LPBN to different downstream targets may mediate distinct components of a pain response. Functionally identifying these pathways may help reveal novel aspects of these pathways and provide a foundation for the development of more specific therapeutics for acute and/or chronic pain.

In our preliminary data, we expressed channelrhodopsin-2 within a broad population of neurons within the LPBN and observed diverse connectivity throughout the brain. To determine whether these projections arise from distinct subpopulations within the parabrachial nucleus, we retrogradely labeled with cholera toxin B subunit (CTB) from densely innervated downstream targets and visualized where the signal clustered within the parabrachial nucleus. We found that retrograde labeling from the bed nucleus stria terminalis or central amygdala densely labeled the external lateral division of the parabrachial nucleus (elPBN). On the other hand, retrograde labeling from either the hypothalamus or periaqueductal gray resulted in CTB signal within more dorsal regions (dlPBN). We subsequently asked whether the same cells within either region form collaterals with these downstream areas and discovered that approximately 40% of backlabeled cells send collaterals to both the central amygdala and bed nucleus stria terminalis, whereas 20% form collaterals with the hypothalamus and periaqueductual gray.

Next, we screened for genetic mice that could provide a genetic handle on these subregions of the LPBN. We found that cells expressing the calcium binding protein (CR) localize primarily within the elPBN, whereas cells expressing dynorphin or neurokinin-1 receptor (NK1R) localize primarily within the dlPBN. Furthermore, only 15% cells expressing dynorphin or 5% expressing NK1R colocalized with CR, indicating that these genetically-defined populations (Dyn-cre or NK1R-cre) are primarily distinct and non-overlapping from CR-expressing cells. Next, we visualized the projection patterns of these largely distinct genetically-defined populations. Interestingly, we found that CR-expressing neurons project most strongly to the insula, bed nucleus stria terminalis, and central amygdala. Projections to the hypothalamus or periaqueductual gray were much sparser. Dyn-cre or NK1R-cre labeled cells within the LPBN projected most strongly to hypothalamus or periaqueductual gray, with few to no projections to the insula, bed nucleus stria terminalis, or central amygdala. This separation in projection pattern that arises from distinctly labeled subpopulations of the LPBN suggest that these populations could mediate aversion or defense behavior during the pain experience.

Publications

Grants
Ruth L. Kirschstein Institutional National Research Service Award (F30) 2016 - onward
Jane Hartung, PhD

**Education/Training:** BS, Biology, Furman University, 2011
PhD, Neurobiology, University of North Carolina, 2016

**Mentor:** Michael Gold, PhD, Professor of Neurobiology

**Research Overview**

The primary focus of my work has been to assess changes occurring in the peripheral nervous system that may contribute to migraine. A line of clinical data point to the importance of the dura as a key site in driving migraine-like pain. First, stimulation of the dura in humans results in migraine-like pain. Second, triptans, some of the most commonly prescribed abortive migraine drugs, are thought to target primary afferents. Finally, new treatments for migraine, such as anti-calcitonin gene related peptide (anti-CGRP) and anti-CGRP receptor, likely cannot cross the blood brain barrier. Therefore, my work has honed in on changes occurring in the dura that may lead to migraine.

In my first set of studies, I have been focusing on how primary afferents innervating the dura may have altered excitability following a high intensity stressor. As one well-known trigger of migraine for migraineurs is stress, we predicted that delivery of a high-intensity stressor to a rodent would result in increased excitability of dural afferents. Preliminary data in our lab has demonstrated that extended levels of stress, using a model of chronic variable stress, results in increased excitability of sensory afferents innervating the dura and that these changes are sex-dependent. Using patch clamp electrophysiology, I have been following up on these preliminary studies, assessing the effects of an acute high-intensity stressor, in this case restraint stress, on afferent excitability. Furthermore, as stress likely involves the release of norepinephrine and/or engagement of adrenergic receptors, I am looking at the involvement of norepinephrine and/or alpha and beta-adrenergic receptors in this increase in excitability.

I am also working to develop a new animal model of headache. Traumatic brain injury (TBI) affects up to 3 million Americans annually and headache is the most common persistent pain-related symptom. Furthermore, more than 80% of patients with mild TBI and headaches have experienced some sort of high intensity stress. These post-traumatic headaches (PTH) share many features with migraine. These observations also suggest that, because there are pre-clinical models of both mild TBI and stress, it may be possible to use a reverse translational, unbiased approach to identify mechanisms of PTH, if not also migraine. Therefore, these studies will test the hypothesis that TBI paired with stress will result in headache-like behaviors in animals. In these experiments, I will first test headache-linked behaviors, facial tactile allodynia and grimacing, paired with in vivo recordings of spontaneous and evoked calcium transients in dural afferents in animals with TBI with stress. Second, I will assess if dural afferent excitability is altered in animals with TBI and stress. Finally, I will measure the density and phenotype of dural immune cells and the cytokines they express in animals with TBI and stress. Results from these experiments will provide information in which dural afferents and the milieu of dural immune cells contribute to the maintenance of PTH. I recently received funding in the form of an NIH/NINDS F32 post-doctoral training grant in order to conduct these studies.

**Publications**


**Research Support**
- 07/2017-06/2019 NINDS/NIH F32 Ruth S. Kirschstein National Research Service Award
- 07/2016-06/2017 NIH/NINDS T32 Training in Mechanisms and Clinical Presentation of Pain
- 09/2015 – 06/2016 NIAMS/NIH F31 Ruth S. Kirschstein National Research Service Award

**Sarah Najjar, PhD**

**Education/Training:** BS, Biology, University of Central Florida, 2013
PhD, Neuroscience, Center for Neuroscience, University of Pittsburgh, 2014 – present

**Mentor:** Kathryn Albers, PhD, Professor of Neurobiology

**Research Overview and Current Findings**

Sensitization of sensory afferents that innervate the colon is a major contributor to chronic visceral pain. Inflammatory and pathophysiological changes in the gut epithelium play an important role in this process, particularly in inflammatory bowel disease (IBD). How changes in the epithelium impact sensory afferent excitability has proven difficult to study because of the intimate association of nerve terminals within the epithelium, e.g., mechanical stimulation of the colon, simultaneously stimulates both nerves and epithelial cells, making the relative contribution of each to action potential firing undecipherable. To overcome this limitation, I have adopted a strategy previously used by our lab to study epithelial-neuronal communication in the skin. This approach uses transgenic mice that express channelrhodopsin (ChR2), a blue light-activated cation channel, specifically targeted to epithelial cells of the colon. Using an ex vivo colon-nerve teased fiber preparation, I demonstrated that ChR2-mediated activation of colon epithelial cells is sufficient to initiate action potential firing in dorsal root ganglia (DRG) sensory neurons. Furthermore, this optogenetic activation of colon epithelial cells produced action potential firing in fibers of all functional classes (i.e., mucosal, muscular, muscular-mucosal, and serosal). Light produced complex firing patterns from fibers of these different functional classifications that mimicked patterns obtained using naturalistic stimuli (e.g., stretch). Preliminary data from these single fiber recordings show that 50.5% of colon afferents respond to light activation of the epithelium. Thus, colon epithelial cells not only provide a protective barrier, but also can drive action potential firing of primary afferents.

My current studies aim to combine the light-mediated activation of the colon epithelium with GCaMP6-mediated Ca2+ imaging of neuron cell bodies in the whole L6 DRG, which contains the majority of neurons that innervate the distal colon. GCaMP6 is a genetically encoded fluorescent Ca2+ indicator that enables quantitative analysis of neuronal responses over time. To combine these techniques, I will use Vil-ChR2 mice, which express ChR2 exclusively in epithelial cells and drive the expression of GCaMP6 in DRG neurons via AAV viral vectors. Using an ex vivo colon-nerve-DRG prep, I will image DRG neuron responses to optogenetic stimulation of the colon epithelium.

Using a Ca2+ imaging protocol, another goal of my research is to determine the mechanisms underlying epithelial-neuronal communication. My studies thus far have shown the ATP is a potentially important mediator of this communication. Data show that after incubation with a cocktail of ATP antagonists, ~70% of tested fibers had diminished responses to epithelial light activation. I also found that some afferent responses to circumferential stretch were diminished with the drug cocktail, indicating that epithelial-released ATP contributes to afferent responses to natural stimuli. Using pharmacological methods, I will investigate additional chemical mediators such as acetylcholine, glutamate, and serotonin. I performed preliminary Ca2+ imaging experiments using dissociated visceral afferents to confirm that these neurons respond to the aforementioned neurotransmitters. Though these neurotransmitters have postulated roles in visceral function, no previous studies have shown that their release from epithelial cells can evoke action potentials in colon afferents. Thus, my experiments will determine which neuroactive chemicals released from the epithelium are involved in the activation of various colon afferent types, further defining a role for the epithelium in sensory transduction. Using a model of colon...
inflammation, I will then explore how these mechanisms change in inflammatory conditions. These experiments will provide data that will help determine the best cell types to target for new treatments for IBD.

**Publications**

Makadia PA, Najjar S, Adelman P, Saloman JL, Albers KM, Davis BM. Optogenetic activation of colon epithelium produces high frequency bursting in colon extrinsic afferents (manuscript submitted to Gastroenterology).

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**NIH T32 RESEARCH FELLOWSHIPS**

**Research Training in Anesthesiology and Pain Medicine**

**Program Director: Yan Xu, PhD**

This program, supported by the National Institutes of Health, National Institute of General Medical Sciences (T32 GM075770), aims to develop clinician-scientists who will become leaders in the field of anesthesiology research by providing rigorous postdoctoral research training with an emphasis on hypothesis-driven laboratory or clinical research.

Trainees, most of whom hold a MD degree, are expected to spend at least two years in the training program and devote a minimum of an 80% effort toward their research. Most trainees are recruited from anesthesiology residency programs, but individuals from other clinical specialties may be considered if their research interest is focused on problems in anesthesiology. For trainees with a PhD degree, the research and training are specifically designed to promote a research career addressing problems in anesthesiology and provides opportunities to enhance their research training with a clinical perspective.

Although anesthesiology encompasses many branches of basic and clinical sciences, we believe that the most effective training can only be achieved through structured and focused teaching and research, utilizing the strength of existing research programs. Our T32 training faculty is multidisciplinary and includes both clinician-scientists and basic scientists as mentors in order to bridge the gap between basic science research on the bench top to clinical care at the bedside. Training faculty members with MD, MD/PhD, and PhD degrees have active, externally-funded research programs as well as excellent track records in training students.

The training program emphasizes how to conceive and develop a sound scientific research project. The didactic component of the program includes lectures, seminars, and departmental conferences. Topics include practical aspects of research from experimental design theory, literature review, biostatistics, and data analysis, to related issues of scientific writing, oral presentation skills, grantsmanship, and research integrity. Ultimately, these skills are meant to supplement the basic science laboratory experience of the trainees. The department is committed to providing the best research opportunities to help our trainees become physician scientists who will lead a successful academic career, advance knowledge in the field of anesthesiology, and successfully compete for research grants.

**FY17 Fellows**

**Phillip S. Adams, DO**

**Education/Training:** BS, Biology, Clarion University of Pennsylvania  
DO, Lake Erie College of Osteopathic Medicine  
Internship, University of Pittsburgh Graduate Medical Education  
Anesthesiology Residency, UPMC Department of Anesthesiology  
Pediatric Anesthesiology Fellowship, UPMC Department of Anesthesiology  
Pediatric Cardiac Anesthesiology Fellowship, UPMC Department of Anesthesiology  
T32 Postdoctoral Fellowship, University of Pittsburgh School of Medicine, Department of Anesthesiology
Mentor: Cecilia W. Lo, PhD, F. Sargent Cheever Chair, Department of Developmental Biology, Rangos Research Center

Research Overview
My research interests involve developmental, hemodynamic, and postoperative outcome aspects of congenital heart disease (CHD) and CHD surgery. I am looking at how non-invasive nasal nitric oxide (nNO) assessment relates to cardiac function and CHD outcomes. In addition, I am interested in post-cardiopulmonary bypass (CPB) acute kidney injury (AKI) and using near infrared spectroscopy (NIRS) assessment as a means of early detection. I have also been involved in residency training and I am investigating how a mindfulness curriculum effects trainee perception of burnout and stress.

Publications


Grants
PI, Predicting Acute Kidney Injury in Infants After Cardiopulmonary Bypass Surgery: NIRS and Biomarkers Can Make an Early Diagnosis. UPMC Department of Anesthesiology Seed Grant, 8/2016-7/2017
This project involves the perioperative monitoring of renal oximetry in infants undergoing congenital cardiac surgery with CPB. We have coupled these measurements with hemodynamic assessment and various biomarkers for AKI.

PI, Mindfulness in Anesthesiology Resident Training. UPMC Department of Anesthesiology Educational Seed Grant, 9/2016-8/2017
This project involves providing a course on mindfulness and positive behavior strategies for junior anesthesiology trainees and aims to show that it improves burnout, stress, and depression scores.

Pending Support
PI, Microvascular Functional Assessment in Patients with Congenital Heart Disease, UPP Foundation Grant, 8/2017-7/2018
This foundation grant will supply the funds necessary to obtain the VENDYS-II microvascular reactivity assessment system. Dr. Cecilia Lo mentored the preparation of this grant.

PI, Nitric Oxide Bioavailability in Complex Congenital Heart Disease. NHLBI K23 Career Development Award, 4/2018-3/2023
This career development award will support a prospective, observational study of making a comprehensive nitric oxide bioavailability analysis in children with congenital heart disease presenting for cardiac catheterization. We will also follow those who subsequently undergo surgical intervention to correlate our findings with postoperative outcomes.
RESEARCH

Joel Caporoso, PhD

Education/Training: BS, Biochemistry, Saint Vincent College
MS, Chemistry, The University of Akron
PhD, Chemistry, The University of Akron
T32 Postdoctoral Fellow, University of Pittsburgh School of Medicine, Department of Anesthesiology

Mentor: Yan Xu, PhD
Vice Chair for Basic Research, Department of Anesthesiology
Professor of Anesthesiology, Pharmacology & Chemical Biology, and Structural Biology, University of Pittsburgh

Research Overview
My current research interests include the development and evaluation of novel therapeutics to treat chronic pain. Our drug discovery approach begins with the glycine receptors, which are ligand-gated ion channels important for the sensation of pain. It was recently established that the primary component of marijuana, Δ(9)-tetrahydrocannabinol (THC), produces analgesia through potentiation of glycine receptors; however, THC also produces psychoactive side effects through interactions with other receptors. Therefore, a novel analgesic that can specifically target the glycine receptor is highly desirable. Molecular modeling allows us to screen potential lead compounds for target specificity and electrophysiology is then employed to verify their allosteric effects on the glycine receptor. Various modern nociception tests on rodent models are used to measure the in vivo analgesic effects of validated compounds. Preliminary data on one lead compound suggests it is a potent analgesic with two actions: the first against inflammation when administered alone and the second against normal nociception when administered with sub-therapeutic morphine. Further development of this drug may have a significant impact on the reduction of clinical opioid use.

Graduate Research
My previous research interests for my doctoral dissertation involved the study of ribonucleoprotein complexes through integrated methods. Various biophysical techniques such as NMR and SAXS were combined with classical biochemical methods to study the structure and binding relationship of SMRT/HDAC1 Associated Repressor Protein with Steroid Activator RNA 1.

Publications


Marsha Ritter Jones, MS, MD, PhD

Education/Training: Acute Pain and Regional Anesthesiology Fellowship, UPMC, Pittsburgh, PA, 2015
Anesthesiology Residency, University of Wisconsin Hospitals and Clinics, Madison, WI, 2013
MD, Feinberg School of Medicine, Northwestern University, Chicago, IL, 2009
PhD in Biomedical Engineering, Northwestern University, Evanston, IL, 2008
MS in Chemistry, Indiana University, Bloomington, IN, 1994
BS in Chemistry, Purdue University, West Lafayette, IN, 1991

Research Experience: T32 Postdoctoral Research Fellow, Department of Anesthesiology, UPMC, Pittsburgh, PA, 2015-2017
Preceptor: Kathryn Albers, PhD
The Role of Neurotrophic Factors in Neurogenic Inflammation and Pain

FAER Research Associate/Fellow, School of Veterinary Medicine, University of Wisconsin, Madison, WI, 2012-2014
Preceptor: Dale Bjorling, DVM, MS
Intrathecal Cannabinoids Modulation of Pain at the Spinal Cord in a Rodent Model of Cystitis Utilizing Behavioral Studies, Neurophysiology, and Immunohistochemistry

Mentor: Kathryn Albers, Professor, Department of Neurobiology

Research Overview
The immune and nervous systems work in concert to provide the body’s defense against adverse interactions. When tissue and/or nerve injury occur, locally released cytokines and neuropeptides from nerve endings induce vasodilation and activation of immune cells. In turn, immune cells release cytokines and growth factors that activate neurons. When this communication derails, neurogenic inflammation may develop. Neurogenic inflammation is known to play a role in the pathogenesis of many diseases as well as chronic pain. However, the precise mechanisms of neural-immune communication in the peripheral nervous system have not been elucidated. Modulation of the peripheral milieu shortly after injury may be a strategy to not only prevent the development of chronic pain, but also address acute pain.

The Role of Neurturin in Neural-Immune Communication
To explore the mechanisms underlying neural-immune communication, we are studying the role of neurturin (Nrtn). Nrtn, a member of the glial cell line-derived neurotrophic factor family, is a growth factor that can modulate both the immune and neural cell function. Evidence suggests that an inflammation-induced increase in growth factor signaling evokes release of calcitonin gene-related peptide (CGRP) and other peptides from primary afferents and consequently leads to stimulation of immune cells. In previous studies using mice that overexpress neurturin in the skin (Nrtn-OE mice), we found that increased levels of Nrtn caused an increase in proinflammatory cytokine expression in skin in response to Candida albicans infection and led to a faster clearance of C. albicans from the Nrtn-OE skin. To further explore the role of Nrtn as a modulator of the inflammatory response, we used the complete Freund’s adjuvant (CFA) inflammation model and examined the expression of tumor necrosis factor alpha (TNF-α) in wildtype (WT) and Nrtn-OE mice.

NrtnOE and C57BL/6 (WT) mice were injected with CFA in the hindpaws. Analysis of the hindpaws 12 hours post inoculation demonstrated that Nrtn-OE mice had increased TNF-α in response to CFA relative to WT mice. To study the effects of acute administration of Nrtn on CFA-induced inflammation, WT mice were injected with Nrtn along with CFA. The injection of Nrtn (with CFA) into the hindpaws of WT mice increased TNF-α to levels similar to that seen in NrtnOE skin. This supports a role for Nrtn as a mediator of the local immune response.
Future Directions
Neurotrophic factors may be ideal for modulation of neural-immune communication because they play a role in neural development and impact the immune response to inflammatory challenge. Future studies will elucidate the mechanisms by which Nrtn affects the immune system and how these changes impact pain and primary afferent signaling. Other neurotrophic factors will also be studied to determine their potential roles in neurogenic inflammation.

Evaluation of Cutaneous Neural-Immune Signaling Using Optogenetics
Neuropeptides such as CGRP and substance P are known to be released from nerve endings in response to inflammatory cytokines produced by immune cells, but the contribution of individual subtypes of afferents to the inflammatory process remains unknown. Sensory afferents involved in neurogenic inflammation can be categorized as peptidergic, characterized by the presence of TRPV1 receptors, and as nonpeptidergic, characterized by MrgprD receptors. We hypothesized that action potential firing in TRPV1- and MrgprD- positive afferents would evoke differential immune cell infiltration and inflammatory peptide release. In order to study these subtypes of afferents independently, we are utilizing mice that have cre recombinase- mediated targeting of channelrhodopsin (ChR2), a blue light-activated ion channel, to either TRPV1- or MrgprD- containing neurons. This allows for independent activation of these subtypes of afferents with blue light.

We have been able to demonstrate that blue light activation of TRPV1-ChR2 peptidergic sensory afferents in depilated flank skin leads to an increase in mRNAs encoding inflammatory cytokines, IL-6, IL-1β, IL-23, TNFα and NGF. This increase in mRNA expression is not observed in littermate controls (mice with the floxed ChR2 gene but without cre-recombinase) or naïve C57BL/6 mice also treated with blue light.

Future Directions
The cellular source of this increase in inflammatory cytokines remains to be elucidated. These data will be compared to parallel studies to be carried out using MrgprD-ChR2 mice. This model will be explored as a method of understanding the effects of growth factors on afferent subtypes in neural-immune communication.

Grants

Co-PI (with Drs. K. Albers and D. Kaplan), UPP Academic Foundation Research Grant, “Neurturin as a Modulator of Neural-Immune Communication,” 2016.

Keith M. Vogt, MD, PhD

Education/Training: Youngstown State University, BE, Electrical Engineering
The Ohio State University, MS, PhD Biomedical Engineering
The Ohio State University School of Medicine, MD
UPMC, Anesthesiology Residency

My past training is most notable for completing the Medical Scientist Training Program at The Ohio State University. My PhD dissertation included work on optimizing functional MRI (fMRI) as a tool to study brain function, including in subjects experiencing pain and performing hyperventilation, both of which have unique effects on the fMRI signal. This background has positioned me well for my research work during residency and my current research fellowship. I completed my anesthesiology residency (2012-2015) here at UPMC, culminating in a very rewarding experience as Chief Resident (2014-2015). I also completed six months of our program’s resident research rotation spread throughout my PGY-3 and PGY-4 years. During that time, I worked with Dr. Jim Ibinson to further develop fMRI techniques that can be used to study pain. We have authored several publications on this topic, with a focus on using functional connectivity data as a marker for the experience of pain.
At the time of writing this report, I am completing my two-year postdoctoral fellowship, and have developed a research program that explores how human memory is affected by pain during sedation with diverse anesthetic agents. Specifically, we are exploring where pain acts in the brain to enhance memory and what physiologic measurements could reveal a learned sympathetic response to aversive stimuli, despite no explicit recollection of the event. Pharmacologically distinct anesthetics have multiple effects on different aspects of memory while simultaneously modulating consciousness. This unusual psychologic milieu is particularly relevant to the experience of surgery and anesthesia, where aversive experiences may be experienced with impaired contextualization. Preliminary fMRI results reveal interacting effects for pain and midazolam on both the hippocampus and amygdala. I was fortunately just awarded a Mentored Research Training Rant from the Foundation for Anesthesia Education and Research to expand this study over the next two years and compare the effects of ketamine and midazolam using a within-subject crossover design.

I am fortunate to work with several mentors in my postdoctoral work who have contributed extensively to my experimental design and have greatly enhanced by professional development as I start my career as a junior faculty member. Julie Fiez, PhD from the University of Pittsburgh Department of Psychology has expertise in human learning under varying conditions. Lynne Reder, PhD from the Carnegie Mellon University Department of Psychology is an experienced memory researcher and has done prior work using midazolam to experimentally induce amnesia. Finally, Jim Ibinson, MD, PhD (University of Pittsburgh Department of Anesthesiology) also continues as an advisor and has been an invaluable asset, working hands-on with me to establish data acquisition techniques and monitor subjects during titration of drug doses. I am grateful for seed grant funding from the Department of Anesthesiology, which has made pilot results possible.

My non-research academic interests include resident education, patient safety, and quality improvement, and I sit on several relevant committees in the Department and in the Anesthesiology Residency Program. My clinical practice is at UPMC Mercy, and my clinical interests include obstetric and neurosurgical anesthesiology.

**Publications**


**Grants**

PI, Mentored Research Training Grant: Human memory encoding under anesthesia: how pain affects hippocampal and amygdalar contributions to memory. Foundation for Anesthesia Education & Research (FAER), 2017-2019

**RESEARCH FELLOWSHIPS**

**CHARLES W. SCHERTZ RESEARCH FELLOWSHIP**

This research fellowship offers a 12-24 month research training opportunity for graduates of an anesthesiology residency or pain medicine fellowship program who intend to pursue an academic career. The program is open to individuals who have successfully completed a four-year residency in anesthesiology and are board-certified or board-eligible. No trainees were appointed in FY17.

**SUMMER RESEARCH FELLOWSHIPS FOR MEDICAL STUDENTS**

Our department serves as a host site for the Foundation for Anesthesia Education and Research (FAER) Medical Student Anesthesia Research Fellowship (MSARF). In 2017, we were one of 36 sites selected nationwide. This program was created to encourage talented medical students to consider careers in anesthesiology research and perioperative medicine and offers medical students an eight week anesthesiology-related research experience. MSARF fellows have the opportunity to present research abstracts at the American Society of Anesthesiologists annual meeting. Past MSARF fellows have gone on to anesthesiology residencies at institutions including NYU School of Medicine, the University of Pennsylvania Perelman School of Medicine, and Massachusetts General Hospital.
The 15th annual Safar Symposium and the fifth annual Multi-Departmental Trainees’ Research Day were held on May 22-23, 2017. This yearly event honors the late Dr. Peter Safar and his wife Eva for their contributions to the scientific community and highlights current research in areas spanning the broad research interests of the department. The research day event is a collaboration between the Departments of Anesthesiology, Critical Care Medicine, Emergency Medicine, Neurological Surgery, and Physical Medicine & Rehabilitation, as well as the Peter M. Winter Institute for Simulation Education and Research (WISER).

The theme of the 2017 event was “Pediatric Neuroanesthesia, Neurocritical Care, Resuscitation, and Rehabilitation: All Roads Lead to the CNS.” Forty-seven posters were presented, as well as five oral presentations from trainees in each of the five collaborating departments. Joel Aldo Caporoso, PhD, a T32 postdoctoral scholar working with mentor Yan Xu, PhD, was the oral presenter from the Department of Anesthesiology, presenting “Two-plate Thermal Preference Test of Novel Glycine Receptor Specific Analgesics in Mus musculus.”

Marsha Ritter Jones, MD, PhD, a T32 postdoctoral scholar working with mentor Kathy Albers, PhD, won the Best Poster Award among all the posters at the symposium for “Skin Overexpression of Neurturin Upregulates TNF-α in CFA Inflammation.” Marta Wells, BS, a graduate student working with mentor Pei Tang, PhD, won the 1st place Department of Anesthesiology poster award for “Structure-Based Discovery of Novel Glycinergic Modulators.” Phillip Adams, DO, a T32 postdoctoral scholar working with mentor Cecilia Lo, PhD, won the 2nd place Department of Anesthesiology poster award for “Intraoperative Renal Oximetry Associated with Severity of Postoperative Acute Kidney Injury after infant Congenital Cardiac Surgery.”

Presentations on the first day of the symposium focused on pediatric neuroanesthesiology, neurocritical care, resuscitation, and rehabilitation. WISER director Paul E. Phrampus, MD moderated day two of the symposium, which focused on improving pediatric patient safety through simulation and featured the keynote presentation “Improving Pediatric Patient Safety Through Simulation” from Marc Auerbach, MD, FAAP, MSc, Associate Professor of Pediatrics (Emergency Medicine) and Emergency Medicine; Director, Pediatric Simulation, Yale Center for Medical Simulation; Medical Director, CT Emergency Medical Services for Children, State Partnership Grant; Associate Director of Pediatric Simulation, Department of Pediatrics; Associate Pediatric Trauma Medical Director).
The following abstract was presented as a poster at the American Thoracic Society International Conference on May 21, 2017 in Washington, DC.

**IMPAIRED PULMONARY FUNCTION AFTER CONGENITAL CARDIAC SURGERY**

Adams PS1, Corcoran TE2, Weiner DJ3, Czachowski M4, Saville A4, Walczak S5, Khalifa O5, Zahid M5, Lin J6, Domnina Y6, Blasiole B1, Callahan PM1, Nguyen KN1, Phadke AS1, Sharma M5, Sanchez-de-Toledo J6, Lo CW5

1Department of Anesthesiology, Division of Pediatric Cardiac Anesthesiology, University of Pittsburgh,
2Department of Critical Care Medicine, University of Pittsburgh,
3Department of Pediatric Pulmonology, University of Pittsburgh,
4Children’s Hospital of Pittsburgh of UPMC,
5Department of Developmental Biology, University of Pittsburgh,
6Department of Critical Care Medicine, Division of Pediatric Cardiac Critical Care, University of Pittsburgh,
7Department of Cardiothoracic Surgery, Division of Pediatric Cardiothoracic Surgery, University of Pittsburgh

**RATIONALE**

Pulmonary impairment is a major contributor to postoperative morbidity in infants with congenital heart disease (CHD) after cardiac surgery with cardiopulmonary bypass (CPB). However, the exact causes of pulmonary impairment post-CPB remain unknown. In this study, we hypothesized that the pulmonary effects of CPB may be evident from mucociliary clearance (MCC) deficits and perturbation of airway mechanics. To investigate this hypothesis, we quantitatively assessed pulmonary function in infants undergoing cardiac surgery using deflation spirometry and, for the first time, MCC scans via functional nuclear imaging of the lungs.

**METHODS**

Children < 1-year-old presenting for congenital cardiac surgery were recruited. Pulmonary function was assessed preoperatively or postoperatively in intubated infants using deflation forced vital capacity (DFVC) spirometric measurements and/or MCC scans. The MCC scan entailed using nebulized Technetium-99m sulfur colloid scintigraphy with imaging conducted over 30 minutes at the bedside with a portable gamma camera. Patient characteristics and perioperative variables were recorded. MCC rate, respiratory system compliance (Crs), respiratory system resistance, forced vital capacity, forced expiratory volume, and maximum expiratory flow (MEF) were measured and compared between the preoperative and postoperative study groups.

**RESULTS**

Twenty-two infants were recruited, 19 (five preoperative) having undergone MCC scans and 15 (seven preoperative) with DFVC (12 [four preoperative] having had both DFVC and MCC). Patients tested pre- vs. postoperatively showed no difference in age, weight, gender, cardiac function, and CPB duration. Trends towards worse spirometric parameters were detected in the postoperative group, with significant reductions observed for Crs at 2.2 [1.68-2.4] vs. 0.88 [0.54-1.2] ml/cmH2O/kg (p = 0.002) and MEF25 at 161.6% [129.9-282.7%] vs. 106.3% [73.5-119.3%] predicted (p = 0.028). MCC was also reduced post-surgically, with only 1.5% [0-7%] clearance observed in the postoperative vs. 14% [3-21%] in the preoperative group (p = 0.071). The 12 patients with both DFVC and MCC showed similar trends, but the sample sizes in the preoperative vs. postoperative groups were inadequate to find any significant correlations between DFVC parameters and MCC.

**CONCLUSION**

This is the first application of functional nuclear imaging to measure MCC in neonates and in CHD patients. Our study showed a 12.5% reduction in MCC and a 2.5-fold decrease in respiratory system compliance after congenital cardiac surgery. These findings suggest preoperative pulmonary conditioning and protective ventilation strategies intraoperatively may help to improve postoperative pulmonary function and overall outcomes.
This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017 and won the second-place best poster award from the Department of Anesthesiology.

**INTRAOPERATIVE RENAL OXIMETRY ASSOCIATED WITH SEVERITY OF POSTOPERATIVE ACUTE KIDNEY INJURY AFTER INFANT CONGENITAL CARDIAC SURGERY**

Adams PS,1 Vargas D,2 Baust T,2 Blasiole B,1 Callahan PM,2 Nguyen KN,1 Phadke AS,1 Koh W,2 Dommina Y,2 Sharma MS,3 Kellum J,2 Sanchez-de-Toledo J2

1Department of Anesthesiology; 2Department of Critical Care Medicine, 3Department of Cardiothoracic Surgery, University of Pittsburgh School of Medicine

**INTRODUCTION**

The incidence of acute kidney injury (AKI) in children after congenital cardiac surgery with cardiopulmonary bypass (CPB) is > 25% within the first 72 post-operative hours and a higher mortality rate is observed in those who develop AKI. Furthermore, infants (< one year old) show an even higher incidence (48%) of post-CPB AKI. Serum creatinine has historically been used as a metric of kidney function, but it lacks sensitivity and may be less reliable in infants. Regional tissue oxygenation (rSO2), as measured with near-infrared spectroscopy (NIRS), has gained widespread acceptance for assessing cerebral oxygenation during CPB. This real-time, non-invasive, bedside monitoring can indicate impaired tissue oxygenation. We aimed to show that intraoperative renal rSO2 could be used as a marker for post-CPB AKI.

**HYPOTHESIS**

The incidence of AKI in infants after congenital cardiac surgery with CPB will be higher for those with lower intraoperative renal rSO2.

**METHODS**

Infants < one year old presenting for congenital cardiac surgery with CPB were recruited. A renal NIRS oximetry sensor was placed on the left flank in the area corresponding to the left kidney immediately after induction of anesthesia. Renal rSO2 was recorded throughout the procedure. Neutrophil gelatinase-associated lipocalin (NGAL) was measured at baseline, immediately postop, and on postoperative days one and two. The KDIGO criteria was used to define postoperative AKI. Pertinent clinical co-variates and outcome measures were recorded.

**RESULTS**

Fifty-one infants were recruited; 29 (57%) had no AKI, 17 (33%) developed mild AKI, and five (10%) had moderate-severe AKI. There were no differences in gender, age, weight, single-ventricle status, baseline creatinine or NGAL, CPB duration, number of and duration of circulatory arrest, or average intraoperative blood pressure or central venous pressures between the three groups. Those who developed mod-severe AKI had significantly lower average (P = 0.014) and nadir (P = 0.007) intraoperative rSO2 values than both the no AKI and mild AKI groups. A drop in rSO2 by > 20% of the baseline value increased the odds of any postoperative AKI (OR 3.46, CI 1.03-11.56, P = 0.044). A drop in rSO2 by > 20% was experienced by seven (24%) in the no AKI group, six (38%) in the mild AKI group, and five (100%) of the mod-severe AKI group (P = 0.007). There were significant correlations between average intraoperative rSO2 and NGAL values immediately postop (r = -0.382, P = 0.041), on postoperative day one (r = -0.328, P = 0.039), and on postoperative day two (r = -0.345, P = 0.025).
The following abstract was presented as a poster at the 2017 spring meetings of the Congenital Cardiac Anesthesia Society and Society for Pediatric Anesthesia, March 2, 2017 and March 4, 2017, respectively, in Austin, TX.

**CONCLUSIONS**

Intraoperative average and nadir rSO2 measurements were significantly lower for those who developed moderate-severe AKI. Also, of those who developed moderate-severe AKI, 100% had rSO2 decreases of > 20% from baseline. The correlation between NGAL and intraoperative renal rSO2 indicates a significant reflection of renal injury.

**SIGNIFICANCE**

Timely interventions prompted by a decline in intraoperative rSO2 may prevent renal injury during CPB for congenital cardiac surgery and as a result improve overall outcomes.

**RESEARCH SUPPORT**

This work was supported in part by a seed grant from the Department of Anesthesiology. PSA is supported by a training grant from the NIH (T32GM075770).

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### Table 1: Baseline characteristics, intraoperative and postoperative data for infants based on degree of kidney injury defined following congenital cardiac surgery

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No AKI</th>
<th>KDIGO 1</th>
<th>KDIGO 2/3</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>19 (15)</td>
<td>10 (11)</td>
<td>1 (2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>4.3 (1-6.2)</td>
<td>3 (2-2.8)</td>
<td>3 (1-3.8)</td>
<td>0.079</td>
</tr>
<tr>
<td>BSA (m²)</td>
<td>0.89 (0.71-1.09)</td>
<td>0.9 (0.71-1.1)</td>
<td>0.9 (0.71-1.5)</td>
<td>0.064</td>
</tr>
<tr>
<td>SO2 (nadir)</td>
<td>63.9 (54.6-66.5)</td>
<td>63.9 (54.6-66.5)</td>
<td>63.9 (54.6-66.5)</td>
<td>0.77</td>
</tr>
<tr>
<td>NIRS (ng/mL)</td>
<td>13 (10-16)</td>
<td>13 (9.5-17.5)</td>
<td>12 (10-12)</td>
<td>0.61</td>
</tr>
<tr>
<td>NGAL (pg/mL)</td>
<td>3.1 (2.0-0.2)</td>
<td>3.1 (2.0-0.2)</td>
<td>3.1 (2.0-0.2)</td>
<td>0.706</td>
</tr>
</tbody>
</table>

**CONCLUSIONS**

Intraoperative average and nadir rSO2 measurements were significantly lower for those who developed moderate-severe AKI. Also, of those who developed moderate-severe AKI, 100% had rSO2 decreases of > 20% from baseline. The correlation between NGAL and intraoperative renal rSO2 indicates a significant reflection of renal injury.

**SIGNIFICANCE**

Timely interventions prompted by a decline in intraoperative rSO2 may prevent renal injury during CPB for congenital cardiac surgery and as a result improve overall outcomes.

**RESEARCH SUPPORT**

This work was supported in part by a seed grant from the Department of Anesthesiology. PSA is supported by a training grant from the NIH (T32GM075770).

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**INTRODUCTION**

Acute kidney injury (AKI) is one of the most prevalent morbidities associated with congenital cardiac surgery with cardiopulmonary bypass (CPB). An immature renal system makes infants presenting for cardiac repair even more vulnerable. We aimed to determine if intraoperative renal oximetry (rSO2), as determined by near-infrared spectroscopy (NIRS), would correlate with postoperative AKI.

**METHODS**

Fifty-one infants (<1-year-old) undergoing congenital cardiac surgery with CPB were recruited in this prospective, observational study. Renal oximetry was recorded throughout their operation. Postoperative AKI was recorded and classified as per the Kidney Disease: Improving Global Outcomes (KDIGO) criteria.

**RESULTS**

The incidence of AKI was 43.1% (22/51). Of those developing AKI, 17 (77.3%) had stage 1 (mild) AKI and five (22.7%) had stage 2 or 3 (moderate-severe) AKI. There were no significant differences in any baseline variables including age, weight, gender, creatinine, blood urea nitrogen, urinary NGAL, or surgical morbidity score classification. Baseline rSO2 did not differ significantly between those without AKI, those with stage 1, and those with stage 2/3. There were significant differences between average intraoperative rSO2, nadir rSO2, and decrease of >20% from baseline rSO2 between the groups with stage 2/3 AKI having significantly lower rSO2 values (Table 1). Cardiac ICU length of stay was longer with lower intraoperative rSO2, whether it was at baseline (r = -0.393, p = 0.005), the lowest oxygenation for the case (r = -0.309, p = 0.029), or the average throughout the whole case (r = -0.381, p = 0.006). Overall hospital length of stay was associated with lower baseline (r = -0.36, p = 0.012) and average intraoperative (r = -0.405, p = 0.004) rSO2. Days requiring mechanical ventilation were also significantly associated with lower baseline (r = -0.369, p = 0.009) and nadir (r = -0.325, p = 0.021) rSO2 values. Intraoperative renal oxygenation increases with higher mean arterial blood pressure (MAP). There were significant positive correlations between the MAP and the lowest rSO2 values recorded (r = 0.482, p = <0.001), as well as the average rSO2 for the procedure (r = 0.408, p = 0.003).

**CONCLUSIONS**

We show that low intraoperative rSO2, as measured by NIRS, is associated worse postoperative outcomes and that lower rSO2 is associated with more severe AKI. Patients with decreases in intraoperative rSO2 >20% below baseline had a higher incidence of AKI based on KDIGO criteria. Management interventions in response to intraoperative decreases in rSO2 may lead to improved postoperative outcomes.
LOW NASAL NITRIC OXIDE IN SINGLE VENTRICLE AND SYSTEMIC RIGHT VENTRICLE CONGENITAL HEART DISEASE PATIENTS

Adams PS1, Zahid M2, Khalifa O2, Feingold BD3, Lo CW2
1Department of Anesthesiology, Division of Pediatric Anesthesiology; 2Department of Developmental Biology; 3Department of Pediatric Cardiology
University of Pittsburgh School of Medicine

INTRODUCTION
Reduction in nitric oxide (NO) bioavailability is associated with heart failure. Blood measurement of NO is difficult given NO’s very short half-life (< 2 ms); however, NO produced by nasal epithelia can be non-invasively measured from the nares (nNO). We hypothesized that varying types of congenital heart disease (CHD) physiology will differentially impact nNO levels.

METHODS
Subjects had nNO measurements as per ATS/ERS guidelines. Subjects were categorized as having low or normal nNO based on published age-specific cutoff values. Prevalence of low nNO was examined by CHD physiology types.

RESULTS
Nasal NO was measured for 602 subjects (135 control, 467 CHD). Patients with any CHD had twice the odds of having low nNO compared to controls (OR 2.22, P=0.001) (Table 1). Logistic regression model examining single ventricle, systemic right ventricle (RV), and ventricular dysfunction for low nNO in CHD patients showed overall significance (P=0.006), with systemic RV having nearly twice the odds of low nNO (OR 1.84, P=0.019). The four CHD phenotypes with the highest prevalence of low nNO also had the highest prevalence of having a systemic RV (Figure 1). Heart transplant patients had the highest prevalence of low nNO (69%, P=0.001). Six of 18 transplanted patients had nNO prior to transplant and all (100%) were low.

CONCLUSIONS
Patients with CHD have lower nNO than controls. The highest odds of low nNO were observed in those with systemic RV and heart transplants. These findings suggest medications enhancing NO bioavailability may have therapeutic benefit and improve outcomes for CHD patients with low nNO.
MUCOCILIARY CLEARANCE IN INFANTS UNDERGOING CARDIAC SURGERY

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INTRODUCTION
Postoperative pulmonary complications are among the most prevalent morbidity after congenital cardiac surgery. Numerous clinical events may impair airway mucociliary clearance (MCC) and cause pulmonary complications. In this study, we investigated the hypothesis that impaired MCC may contribute to worse postoperative outcomes with the direct quantitative assessment of airway clearance in neonates and infants undergoing cardiac surgery.

METHODS
In this prospective, observational study, 19 infants with congenital heart disease (CHD) in the cardiac intensive care unit (CICU) underwent bedside MCC scans using nebulized technetium sulfur colloid with imaging via a portable gamma camera. Five were scanned preoperatively and 14 postoperatively. Patient characteristics, and pre-, intra-, and postoperative variables were recorded. MCC was quantified and analyzed relative to operative parameters.

RESULTS
There were no significant differences in patient characteristics, pre-, or intraoperative variables between the preoperative and postoperative scan groups. MCC was higher in the preoperative scan group, with very little to no clearance in the postoperative group (14% [3-21] vs. 1.5% [0-7], p = 0.07). Preoperative MCC scans showed significant negative correlations with CICU length of stay (LOS) (r = -0.965, p = 0.008), days of delayed chest closure (r = -0.894, p = 0.041), days requiring dexmedetomidine and milrinone infusions (r = -0.903, p = 0.036; r = -0.95, p = 0.013, respectively), and drain output for the first 24 postoperative hours (r = -0.917, p = 0.029). No other pre- or intraoperative variables, including gestational age, SpO2, FiO2, hemoglobin, creatinine, albumin, age or weight at surgery, cardiopulmonary bypass, cross-clamp, or circulatory arrest times were significantly associated with CICU LOS, days of delayed chest closure, days of dexmedetomidine infusion, or total drain output for the first 24 hours.

CONCLUSIONS
This is the first application of functional imaging for quantitative assessment of MCC in CHD neonates and infants after cardiac surgery. Because there is evidence of MCC preoperatively, but nearly non-existent MCC postoperatively, the inflammatory effects of cardiopulmonary bypass, as well as the effects of anesthetics and mechanical ventilation on ciliary function and mucous viscosity, likely play a large role in impairing MCC. Our MCC findings suggest an increased focus on preoperative pulmonary conditioning and protective ventilation strategies intraoperatively may improve postoperative pulmonary mechanics and overall outcomes.
This abstract was presented as a poster at the American Heart Association's Scientific Sessions, November 12-16, 2016.

MUCOCILIARY CLEARANCE DEFICIT AND REDUCED PULMONARY FUNCTION IN CONGENITAL HEART DISEASE INFANTS UNDERGOING SURGERY WITH CARDIOPULMONARY BYPASS

Phillip S. Adams, Timothy E. Corcoran, Daniel J. Weiner, Maliha Zahid, Al Saville, Stephen Walczak, Omar Khalifa, Michael Czachowski, Yuliya Domnina, Mahesh Sharma, Brian Blasiole, Patrick M. Callahan, Ivy Lin, Joan Sanchez-de-Toledo, Cecilia W. Lo

INTRODUCTION
Postoperative pulmonary complications are common after congenital cardiac surgery requiring cardiopulmonary bypass (CPB). Given the high prevalence of airway ciliary dysfunction (CD) observed in congenital heart disease (CHD) patients, we hypothesized those with CD would exhibit reduced pulmonary function post-CPB when compared to those without CD.

METHODS
We recruited 14 CHD infants (<2 years) requiring cardiac surgery with CPB. Nasal scrapes were obtained to assess respiratory ciliary motion by videomicroscopy. Either pre- or postop mucociliary clearance (MCC) scans were conducted at the bedside using technetium sulfur colloid with a portable gamma camera. Spirometry was assessed via the forced deflation (FD) technique.

RESULTS
MCC scans were conducted on 14 CHD infants (three pre- and 11 postop, most within 48 hours of surgery). MCC postop (2.8% ±4.2) was significantly less than preop (21.3% ± 7.5) (p=<0.0001), but this did not correlate with CD. Respiratory compliance postop (0.903 ml/cmH2O/kg ±0.47; n=6) was significantly less than preop (2.16 ml/cmH2O/kg ±0.53; n=7) (p=0.001), and infants with CD had significantly lower respiratory compliance (0.76 ml/cmH2O/kg vs. 1.97 ml/cmH2O/kg, p=0.012) and trend for higher resistance (81.63 cmH2O/L/sec vs. 58.38 cmH2O/L/sec, p=0.094). Comparison between the degree of CD and respiratory compliance showed a negative correlation (r=-0.52, p=0.082).

DISCUSSION
This is the first study to assess MCC in CHD infants undergoing cardiac surgery with CPB. We observed a significant postoperative depression in MCC and pulmonary compliance. While the MCC effects were not correlated with ciliary function status, the reduction in pulmonary compliance was correlated with CD. These findings illustrate the critical need to develop pulmonary therapies to improve outcomes for infants with critical CHD.

Figure 1. MCC scan conducted pre- or postoperatively in CHD patients undergoing cardiac surgery with CPB. (A) Intubated CHD infants were administered aerosolized technetium sulfur colloid and imaged over 30 min at bedside using a gamma detector camera. Note clearance is observed with a preoperative scan (B), but not in a postoperative scan (C).
This abstract was submitted to the American Heart Association Scientific Sessions Annual Meeting, November 11-15, 2017 in Anaheim, CA.

NASAL NITRIC OXIDE AND SYSTEMIC NITRIC OXIDE RESERVE STRATIFICATION OF SURGICALLY PALLIATED CONGENITAL HEART DISEASE

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INTRODUCTION
Nitric oxide (NO) plays an important role in vasoregulation. Oxygen is both a substrate for NO production and a determinant of the half-life of nitrite (pNO2-), a vascular storage form of NO, since more pNO2- is utilized during hypoxia. Hence, we hypothesized that patients with cyanotic congenital heart disease (CHD) will have low NO and pNO2-.

METHODS
CHD subjects were recruited and had epithelial-derived nasal NO (nNO) and endothelial-derived vascular NO (pNO2-) measured concurrently via chemiluminescence. nNO values were classified as low or normal based on published age-specific normative nNO values. Nasal NO and pNO2- levels were compared across groups based on stage of CHD palliation.

RESULTS
nNO and plasma pNO2- were measured in 106 subjects (28 controls, 78 CHD). There was no difference in gender or race, but controls were older (24.9 years [10-38.2] vs. 8.4 years [3.2-23.1], P=0.01) and had higher BSA (1.8 m2 [1.6-2] vs. 0.9 m2 [0.6-1.8], P<0.01). The odds of having low nNO were significantly higher for pre-Fontan single-ventricle (SV) (OR 6.7, CI 1.4-32.1, P=0.018), and transplanted patients (OR 7.6, CI 1.6-35.9, P=0.01), but not for biventricular (P=0.061) or Fontan patients (P=0.196). There were significant negative correlations between pNO2- and SpO2 (r=0.245, P=0.031) vs. deoxyhemoglobin concentration (r= -0.244, P=0.036). Pre-Fontan SV patients had the highest percentage of both low nNO and pNO2-. Fontan patients dichotomized to mostly low nNO/low pNO2- or normal nNO/higher pNO2-. Transplanted patients had the highest proportion of low nNO with higher pNO2- (Figure 1).

CONCLUSIONS
This is the first study showing a link between epithelia-derived nNO and vascular endothelial generated pNO2-. We also show that low pNO2- negatively correlated with oxygenation and cyanotic pre-Fontan patients had higher odds of having low nNO. These findings suggest nNO and pNO2- can be used as a biomarker to stratify CHD patient risk for poor vasoregulation.
SEVOFLURANE EXPOSURE AND PEDIATRIC RENAL ALLOGRAFT SURVIVAL: A RETROSPECTIVE ANALYSIS

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Renal transplantation remains a common treatment modality for pediatric patients with end-stage renal disease. Intraoperative management, specifically the use of the volatile anesthetic agent sevoflurane, has long been controversial given the potential, theoretical, risk of accumulation of the nephrotoxic byproduct of this agent, compound A. To date, little literature exists to evaluate this potential issue within the pediatric population.

Our study aimed to assess renal graft survival in pediatric patients who underwent renal transplantation from 2009-2015 at our institution, specifically regarding intraoperative sevoflurane exposure. We expected to find a difference in renal graft survival rates in patients who had exposure to sevoflurane for the maintenance of anesthesia compared to those who did not.

We performed a retrospective chart review of 93 patients over a six-year period at Children’s Hospital of Pittsburgh of UPMC focused on identifying patients who received a sevoflurane-based anesthetic during renal transplantation. In addition, those patients who had no exposure to this agent (isoflurane-based anesthetic), as well as those who received a sevoflurane-based induction of anesthesia (with maintenance achieved with alternate agent), were separately categorized. Additional data, including age, weight, duration of anesthetic, estimated blood loss, and intraoperative volume replacement were collected on each patient.

Ultimately, 10 patients could be categorized as receiving a sevoflurane only-based anesthetic, 21 patients had sevoflurane exposure during the induction of anesthesia with a different maintenance agent, and 38 patients received an isoflurane only-based anesthetic. We compared eight-year renal allograft survival curves for these groups. The results suggest that sevoflurane, rather than causing harm, may in fact have a protective effect on graft survival.

Further evaluation to assess for potential confounding variable, as well as a larger sample size is warranted.

However, our data does not support the previously held assumption that this agent is nephrotoxic and should be avoided in renal transplants.
This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017.

PDGFR-β SIGNALING CAUSES OPIOID TOLERANCE WITHOUT AFFECTING THE TRAFFICKING OF THE MOR

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INTRODUCTION
Opioids are the first line treatment for severe pain. However, their repeated administration leads to analgesic tolerance, which limits their use for the treatment of chronic pain. It is well known that clinically used opioids such as morphine mediate their analgesic effect through the mu opioid receptor (MOR). Unfortunately, mechanisms underlying opioid tolerance remain poorly understood. It has been hypothesized that tolerance could be caused by a sustained signaling of the MOR and that internalization could restore analgesia through a recycling of the receptor. However, some studies have challenged these assumptions, and the other MOR agonists used in the clinic are known to induce a high level of internalization, also eventually leading to analgesic tolerance. We recently made the groundbreaking discovery that imatinib, a specific platelet-derived growth factor receptor beta (PDGFR-β) inhibitor, prevents morphine analgesic tolerance.

HYPOTHESIS
We hypothesized that inhibition of morphine analgesic tolerance with the PDGFR-β inhibitor imatinib would not modify the levels of MOR internalization.

METHODS
Male Sprague-Dawley rats received intrathecal injections of morphine in combination with imatinib. Injections of imatinib alone or of the MOR agonist [D-Ala2,NMePhe4,Gly-ol]-enkephalin (DAMGO) (known to induce high levels of MOR internalization) were used as negative and positive controls, respectively. Levels of analgesia were measured with the thermal Tail Flick assay (TFL) 40 minutes after each injection. Spinal cords were extracted either after one or five consecutive days of injections to analyze the effect of imatinib on internalization of the MOR in relation to acute analgesia or to tolerance. Spinal cords were then co-labelled with markers for the neuronal cellular bodies (anti-NeuN, Millipore) and the MOR (anti-MOR, Abcam). Immunofluorescent images of the dorsal horn of the spinal cord were acquired using a Nikon A1 confocal microscope equipped with a 63x oil immersion objective. The average number of MORs internalized into the neurons was determined with the Imaris Software (Bitplane).

RESULTS
The co-administration of morphine and imatinib did not modify the levels of acute analgesia and did not affect the levels of MOR internalization in the spinal cord as compared to morphine-injected animals or negative controls. Repeated administration of morphine led to a decrease in the analgesic effect over time, showing that tolerance had developed. The co-administration of imatinib with morphine prevented the development of tolerance. Interestingly, the levels of MOR internalization in these animals did not differ from the animals that were tolerant to morphine. The acute and chronic DAMGO positive control groups presented high levels of analgesia and internalization.

CONCLUSIONS
In this study, we confirmed that inhibition of PDGFR-β signaling prevents morphine tolerance without affecting acute analgesia. Importantly, preventing tolerance with imatinib did not change the levels of MOR internalization in the spinal cord. This suggests that, contrary to what was previously proposed, MOR trafficking and internalization might not be involved in signaling mediating tolerance.

RESEARCH/GRANT SUPPORT
NIH- NIDA 7R01DA036680-03 (PI: Howard B. Gutstein)
FIRST RESPONDER DISASTER PREPAREDNESS MOBILE LEARNING APP

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INTRODUCTION
Mobile learning can serve to allow users access to a range of resources and distribution of new information and training in real-time. It can provide targeted, interactive information to gather knowledge, learn a skill, or solve a problem. The overall objectives of the First Responder Disaster Preparedness Mobile Learning App are to develop a prototype mobile capability to increase communication and collaboration between medical first responders, enhance education and training regarding disaster preparedness, and capture in real-time those medical first responders who are able and willing to respond to a disaster.

HYPOTHESIS
By developing a disaster preparedness mobile network, we will provide an innovative approach that will allow healthcare professionals to achieve a new level of communication and coordination in disaster scenarios while increasing their access to disaster medicine education and training.

METHODS
App design was established by researching currently available resources on the market and identifying their gaps in functionality to develop a comprehensive list of functions we used to achieve our overall objectives.

RESULTS
In coordination with the University of Pittsburgh School of Information Sciences, we developed a prototype app for proof of concept trialing beginning in April 2017.

CONCLUSIONS
With the developed app prototype, we can begin proof of concept trials in which medical first responders may complete an in-app evaluation to provide feedback that will serve to further refine the app prototype. We also plan to conduct pre- and post-educational module tests and training scenarios to reinforce learning and collect data regarding whether knowledge of disaster concepts has increased.

SIGNIFICANCE
Our app will bridge the communication gap between organizations and hospital systems and individual healthcare professionals to allow for a more coordinated, cohesive effort in preparedness, response, and recovery for disasters at local, regional, and national levels.

RESEARCH/GRANT SUPPORT
Seed Grant, Department of Anesthesiology, UPMC
This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees' Research Day on May 22, 2017.

IMPACT OF CHRONIC INTERMITTENT ETHANOL VAPOR EXPOSURE ON ABUNDANCE OF SMALL NON-CODING RNAs IN SPERM

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INTRODUCTION
Paternal environmental insults, such as exposure to chronic stress and drug abuse, can shape complex behaviors across subsequent generations. We have previously shown that paternal preconception chronic ethanol exposure alters ethanol drinking preference, sensitivity to the anxiolytic effects of ethanol, and stress responsivity in male offspring. While the heritable mechanisms responsible remain to be elucidated, several recent studies suggest that small noncoding RNAs [e.g., microRNAs, tRNA-derived fragments (tRF)] play a causal role in sperm that are delivered to the oocyte at fertilization.

HYPOTHESIS
As a first step to investigate the hypothesis that small noncoding RNAs contribute to the intergenerational effects of paternal preconception ethanol, we conducted RNAseq on sperm small non-coding RNAs from control and ethanol-exposed mice.

METHODS
Briefly, we exposed eight-week-old male C57BL/6J mice to five weeks of chronic intermittent vapor ethanol exposure (or air as a control). The average blood ethanol concentration across all weeks of the exposure was 159.21 + 10.29 mg/dl. Twenty hours following the final ethanol exposure, mice were sacrificed and motile sperm was collected from cauda epididymis to produce small RNA libraries for next generation sequencing.

RESULTS
Our findings revealed several significant changes in select microRNAs (e.g. miR-10a and miR-10b) and tRF families (e.g. tRF-Glu CTC). The most significant changes in tRF expression were validated with sperm from an independent cohort of alcohol-exposed males using rt-qPCR. In addition, recent studies suggest that tRF accumulate in sperm during epididymal maturation through fusion with extracellular vesicles known as “epididymosomes.” Interestingly, we found that ethanol-enriched sperm tRF (tRF-Glu CTC and tRF-His GTG) were also increased in epididymosomes following two or five weeks of ethanol exposure, respectively.

CONCLUSIONS
Chronic ethanol exposure alters the abundance of small non-coding RNAs in sperm.

SIGNIFICANCE
Ethanol-induced changes in sperm small non-coding RNA abundance may contribute to the effects of ethanol across generations.

RESEARCH/GRANT SUPPORT
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INTRAPARTUM PAIN IMPROVEMENT IS A PREDICTOR FOR POSTPARTUM DEPRESSION: LABOR PAIN MATTERS

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BACKGROUND
Pain is a fundamental feature of childbirth, but little is known about the potential psychological ramifications of labor pain. We aimed to identify the association between intrapartum pain relief under labor epidural analgesia, defined by percent improvement in pain (PIP) [1,2], and postpartum depression symptoms.

METHODS
We reviewed 2,491 medical records. Women who received labor epidural analgesia, who had pain assessed during labor both before and during implementation of labor epidural analgesia by 0-10 numeric rating scores, and who had depression risk assessed by the Edinburgh Postnatal Depression Scale (EPDS) and documented at their six-week postpartum visit, were included in the final analysis. Simple and multiple linear regression was used to identify the best model for assessing the association between pain improvement and depression, after adjusting for history of anxiety or depression, other psychiatric history, abuse, trauma, mode of delivery, and other maternal or fetal co-morbid diseases.

RESULTS
A total of 201 patients received labor epidural analgesia, had intrapartum pain data available, and had the primary outcome of interest. A weak but significant relationship exists between PIP and EPDS (Spearman’s \( \sigma = -0.18, P = 0.012 \)). By simple linear regression, women with higher improvements in pain are associated with lower EPDS scores (\( \beta = -0.023, F(1, 199)=12.43, P = 0.001 \)). There were no significant interactions between any a priori hypothesized interaction terms. There was no collinearity among variables. In support of the validity of the model, variables previously associated with depression were significantly correlated (body mass index, anxiety/depression, 3rd and 4th degree perineal lacerations, and anemia) and included in the final model. After adjusting for these covariates, PIP remained a significant predictor of EPDS (\( \beta = -0.022, t = -2.70, P = 0.008 \)) (Table).

CONCLUSIONS
Improvement in pain during labor under epidural analgesia is a significant predictor in the development of postpartum depression symptoms. Labor pain, alongside other established risk factors, is important to the subsequent detection of postpartum depression symptoms. Research aimed at optimization of labor pain management strategies is warranted as part of a multimodal strategy to reduce risk for postpartum depression.

REFERENCES
This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017.

POSTPARTUM PSYCHOLOGICAL DISTRESS ASSOCIATED WITH SYSTEMATIZED EMERGENCY TEAM RESPONSE DURING LABOR AND DELIVERY

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INTRODUCTION
Post-traumatic stress disorder (PTSD) and acute stress disorder (ASD) can occur after perceived traumatic childbirth. Utilization of an emergency team response (ETR) during labor and delivery has not been extensively studied as a potential risk factor for postpartum ASD and PTSD. The purpose of this pilot study was to evaluate the feasibility and acceptability of a study protocol aimed at determining the relationship between ETR and ASD and PTSD symptoms.

HYPOTHESIS
We hypothesize that a prospective observational study protocol investigating the relationship between ETR and psychological distress is feasible and acceptable to patients and providers.

METHODS
For this IRB-approved prospective observational study, participants undergoing childbirth between June 6 and July 1, 2016 were approached. Participants filled out validated questionnaires within 72 hours and at six weeks postpartum, including: ASD screening (Stanford Acute Stress Reaction Questionnaire, SASRQ); PTSD screening (Post-Traumatic Stress Disorder Checklist for Civilians, PCL, and Impact of Events Scale, IES); and measures of anxiety, social support, and pain. The primary outcome was PTSD (IES and PCL scores) at six weeks. The secondary outcome was ASD (SASRQ score) within 72 hours. Recruitment, retention rates and sample size for a fully powered study were calculated. ETR and non-ETR groups were compared by the Mann-Whitney U Test. A P-value of <0.05 was required to reject the null hypothesis.

RESULTS
Of 564 eligible women, 369 sought more information and 249 were enrolled (67.5% recruitment rate). Of enrollees, 207 completed the 72-hour questionnaires, and 125 participants completed all the study procedures (50.2% retention). Twenty women experienced an ETR (3.5% event rate). Of these, 12 enrolled in the study (60.0% recruitment rate), nine completed the 72-hour questionnaires, and eight completed the study (66.7% retention). The ETR group had higher PTSD scores in both the PCL (medians = 16, 2; U = 305.5; P = 0.08) and the IES (medians = 22.5, 20; U =298.5; P = 0.08). ASD scores were not different between groups. A sample size of 88 (44 in each group) is needed to detect an effect of ETR on postpartum PTSD as measured by IES, and a sample size of 360 (180 in each group) is required if the primary outcome is assessed by PCL (power = 80%, significance level α=0.05).

CONCLUSION
This study methodology investigating the effect of ETR on postpartum psychological distress is feasible and acceptable to patients and providers. A trend towards a relationship between ETR and PTSD symptoms is demonstrated.

SIGNIFICANCE
The effect of ETR on postpartum psychological distress is a significant question because it could inform health care providers’ ability to target high-risk women for support.

FUNDING SOURCE
NIH UL1-TR-001857 (Clinical and Translational Science Institute)
OPTOGENETIC INVESTIGATION OF EPITHELIAL-NEURONAL SIGNALING IN THE COLON

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INTRODUCTION
Functional gastrointestinal disorders and inflammatory bowel disease (IBD) affect up to 25% of the U.S. population and little is known about their pathophysiology. These painful disorders are characterized by visceral hypersensitivity that is mediated via primary afferent neurons that innervate the colon. In addition to intrinsic changes in these afferents, epithelial cells in the colon may also contribute to changes in afferent excitability and sensitivity. Colon epithelial cells are thought to release neurotransmitters such as ATP, acetylcholine, and serotonin, but how release of these substances impacts communication with colonic afferents and afferent excitability is unclear.

METHODS
We developed an optogenetic mouse model in which channelrhodopsin (ChR2) is targeted to colon epithelial cells. In this model, light stimulation and activation of epithelial cells can be achieved without the simultaneous activation of primary afferents by mechanical or chemical stimuli. An ex vivo preparation of the isolated distal colon and intact pelvic nerve was used to record activity of single fibers in response to light activation of epithelial cells. To perform pharmacological analysis in this ex vivo prep, we added antagonists to the bath solution.

RESULTS
We found that activation of the epithelium can directly initiate robust action potential firing in colonic afferents of different functional classifications. Data from these single fiber recordings show that 50.5% of colon afferents respond to light activation of the epithelium. We found that ATP is an important chemical messenger for this epithelial-driven nerve activation. Data show that after incubation with a cocktail of ATP antagonists, ~70% of tested fibers had diminished responses to epithelial light activation. We also found that some afferent responses to circumferential stretch were diminished with the drug cocktail, indicating that epithelial-released ATP contributes to afferent responses to natural stimuli.

CONCLUSIONS
Our data suggest that colon epithelial cells not only provide a protective barrier, but also can drive action potential firing of primary afferents. The assessment of the role of the epithelium in mediating afferent excitability under inflammatory conditions may provide new insight into the pathophysiology of human conditions with associated visceral pain, such as IBD. Studies to further elucidate the chemical mediators of epithelial cell-colonic afferent communication are underway. How this communication changes in response to inflammatory challenges is also being investigated.
This abstract was presented as a poster at the 15th Annual Pain Medicine Meeting, November 17-19, 2016 in San Diego, CA.

NEURAXIAL ANESTHESIA IN A PARTURIENT WITH OLMSTED SYNDROME

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INTRODUCTION
Olmsted syndrome (OS) is a rare congenital disease characterized by mutilating palmoplantar keratoderma and periorificial keratotic plaques (1). As of the last review in 2015 (2), 73 cases have been reported, with greater frequency in males (1). Patients with OS may suffer from delayed growth and laxity of joints, as well as autoamputation of the digits (1). This is the first reported case of an OS patient presenting for delivery of a fetus by Cesarean section. Neuraxial (regional) anesthesia has become the preferred method of surgical anesthesia for Cesarean sections. Therefore, it is important to explore anesthetic considerations in these patients. In addition, these patients may present for other procedures and regional anesthesia should be considered.

CASE DESCRIPTION
The patient was a 32-year-old parturient, G1P0 at 32 weeks and four days, with OS. She presented with preterm premature rupture of membranes and preterm labor, requiring an urgent Cesarean section due to nonreassuring fetal heart tones. In addition to OS, her medical history was positive for seizures, generalized anxiety, depression, asthma, chronic pain in extremities, and alopecia.

On physical exam, she was a 47 kg, 137 cm female with a gravid abdomen in a wheelchair. Airway exam was notable for a Mallampati class 3 airway with poor dentition. Hyperkeratosis was present at the oral commissures. On further evaluation, the first and second phalanges bilaterally were absent and the remaining digits were shortened. Toes were absent bilaterally and plantar surface erythema with superficial erosions was present.

The patient consented to both neuraxial and general anesthesia. In the operating room (OR), the patient was placed in the seated position on the OR table and monitors were placed. The pulse ox was placed on her ear with adequate tracing. She was draped in sterile fashion and the intervertebral spaces were easily palpated. Residents accessed the thecal sac at intervertebral space L3-L4 after two attempts. The intrathecal medication consisted of 10 µcg of fentanyl, 100 µcg of morphine, and 1.2 mL of 0.75% bupivacaine in 25 % dextrose in saline, which is a reduced dose as compared to the customary dosage. The patient was laid supine with left uterine displacement, and the Cesarean section proceeded without any complications.

DISCUSSION
Regional anesthesia has become the preferred method for surgical anesthesia for Cesarean sections because it provides benefits to both mother and fetus. Even in the case of urgent/emergent Cesarean sections, if time allows, neuraxial anesthesia is preferred. OS has many cutaneous symptoms that may affect bones, either via amputation of digits or osteoporosis (1); however, none of these exclude the patient from receiving neuraxial anesthesia. While the patient may have a short stature (about 25% of cases (3)) and will require a lower dose of intrathecal medication, there is no evidence of spinal cord abnormalities. The greater challenge in this case was finding the appropriate place to monitor pulse oximetry given the lack of digits and hyperkeratosis of other customary locations.

REFERENCES
SKIN OVEREXPRESSION OF NEURTURIN INCREASES ANTIGEN-PRESENTING CELL RECRUITMENT TO THE SKIN AND DORSAL ROOT GANGLIA AND PROVIDES RESISTANCE TO C. ALBICANS INFECTION

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Tissue inflammation and nerve injury can lead to chronic neurogenic inflammation and pain. Neurogenic inflammation involves cytokine release from nerve endings, both locally (at site of injury) and centrally, which induces vasodilation and further activation of the immune system. Changes in neurotrophic growth factors, which are known to increase sensory neuron activity, also occur in response to injury and inflammatory challenge. However, the exact role of these factors in modulating the inflammatory milieu at the site of injury remains to be elucidated. In recent studies, we determined that the growth factor neurturin (Nrtn) may regulate immune cell infiltration. In mice that overexpress Nrtn (Nrtn-OE) in the skin, an increased density of major histocompatibility complex II positive (MHC II+) antigen presenting cells (APCs) was observed in both the dorsal root ganglia (DRG) and skin when compared to wild type (WT) mice. We then tested whether this Nrtn-induced increase in APCs altered the response to an inflammatory challenge elicited by a *Candida albicans* (CA) cutaneous infection. At three days post infection, the infected skin and DRG were isolated and analyzed with immunohistochemistry (IHC) to detect MHC II+ cells. Colony forming assays (CFUs) were also conducted to assess the clearance of CA from infected skin. CFU assays showed significantly fewer colonies in Nrtn-OE skin, indicating enhanced CA clearance. IHC demonstrated a greater number of MHC II+ cells in both the skin and DRG of NrtnOE mice. In the DRG, MHC II+ labeled cells appeared preferentially adjacent to neuronal cell bodies. The increase in Nrtn and APCs was associated with faster clearance of *C. albicans* and suggests a new role for Nrtn as a modulator of inflammatory cell infiltration and the innate immune system response.

This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017 and won the Best Poster Award among all the posters at the symposium.

SKIN OVEREXPRESSION OF NEURTURIN UPREGULATES TNF-Α IN CFA INFLAMMATION

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INTRODUCTION

Pain associated with injury or infection is triggered by release of inflammatory molecules that sensitize primary afferents. How chronic inflammatory pain develops, is maintained, and alters communication between the immune and nervous systems is not clear. Changes in neurotrophic growth factors, which are known to increase sensory neuron activity, also occur in response to inflammation. Prior work in our lab has demonstrated that neurotrophic growth factors can sensitize TRPV1 channels *in vitro* and increase the calcitonin gene-related peptide current associated with capsaicin treatment. Stimulation of TRPV1 channels is known to play an important role in pain and the inflammatory response induced with complete Freund’s adjuvant (CFA). In addition, in other work in our lab, mice that overexpress neurturin in the skin, Nrtn-OE, demonstrated increased mRNA expression of proinflammatory cytokines three days after *Candida albicans* infection. Therefore, we explored whether CFA inoculation of the Nrtn-OE mice would result in increased TNF-α levels. We also wanted to determine if the observed changes were due to developmental differences in the Nrtn-OE or to the presence of Nrtn in the skin.
HYPOTHESIS
During CFA inflammation, the sensitization of TRPV1 channels by neurturin at the primary afferents will result in increased levels of TNF-α.

METHODS
CFA was injected into the plantar surface of the hind paw of Nrtn-OE and WT (C57BL/6) mice in parallel. Control mice were injected with saline. At 12 hours post injection, the hind paws were collected and analyzed using ELISA for TNF-α. We also injected neurturin with/without CFA into the hind paw of WT mice and evaluated the level of TNF-α.

RESULTS
Twelve hours post-infection, TNF-α production was significantly increased in the male Nrtn-OE mice compared to the WT mice. In the control mice without CFA, TNF-α was the same in the Nrtn-OE and WT. In animals that received CFA, injection of Nrtn into the hind paw of the WT resulted in a significant increase in TNF-α levels as compared to mice that did not receive Nrtn. In the absence of CFA inflammation, the injection of Nrtn did not result in increased TNF-α levels. This affirms that the presence of Nrtn at the primary afferents stimulated the increased TNF-α levels.

CONCLUSIONS
Neurturin expression in the skin upregulated TNF-α likely via sensitization of the TRPV1 channel. This is likely due to the presence of neurturin at the peripheral endings of the primary afferents, since injection of neurturin yielded similar results. Moreover, the presence of inflammation was necessary for the action of Nrtn.

SIGNIFICANCE
These data suggest a role for neurturin in the neural-immune communication in the inflammatory response. Elucidation of the mechanism that underlies neurturin’s effect could lead to development of new approaches to treat acute pain and chronic inflammatory pain states.

RESEARCH/GRANT SUPPORT
Support is provided by T32 GM075770 and UPP Academic Foundation Research Grant (MRJ) and NIH grant #NS033730 (KMA).
This abstract was presented as a poster at the Annual Safar Symposium/Multi-Departmental Trainees’ Research Day on May 22, 2017.

**STRUCTURAL BASIS OF ALCOHOL INHIBITION OF THE PENTAMERIC LIGAND-GATED ION CHANNEL ELIC**


1Department of Anesthesiology, University of Pittsburgh School of Medicine
2Stanford Synchrotron Radiation Lightsource

**INTRODUCTION**

Neuronal pentameric ligand-gated ion channels (pLGICs) are molecular targets of alcohols; however, the structural basis for alcohol modulation of pLGICs remains unclear. Multiple alcohol binding sites have been proposed in all three domains of pLGICs, including the extracellular (ECD), transmembrane (TMD), and intracellular (ICD) domains.

**HYPOTHESIS**

Multiple alcohol-binding sites do not contribute equally to the functional modulation of pLGICs. Certain binding sites in a certain domain, e.g. TMD, dominate the functional modulation of pLGICs by alcohols.

**METHODS**

Two-electrode voltage clamp (TEVC) measurements of *Xenopus laevis* oocytes were used to study the inhibition of ELIC, a pLGIC from *Erwinia chrysanthemi*, by a series of linear alcohols. Co-crystallization of ELIC with an ethanol analog, 2-bromoethanol (BrEtOH), in both the absence and presence of an agonist, were applied to identify multiple binding sites of ethanol. TEVC measurements on oocytes expressing ELIC, ELIC mutants, and ELIC-ECD-α1β3GABAAR-TMD chimera, were later used to study the functional relevance of the identified binding sites.

**RESULTS**

Ethanol inhibited ELIC within a pharmacologically relevant concentration range. The linear alcohols inhibited ELIC with increasing potency with a cut-off of nonanol. 2-bromoethanol (BrEtOH) was found inside the pore near T237(6′) of the TMD and three different locations in the ECD of each subunit. BrEtOH binding had a negligible effect on the overall structure of ELIC. TEVC measurement of ELIC and its mutants revealed that the ethanol inhibition of the ECD mutants are almost the same as that of wild-type ELIC, even when the ECD binding sites were blocked by the large molecular tag of 4-(chloromercuri)benzenesulfonic acid. In contrast, ethanol inhibition of ELIC T237A mutant was reduced by two-fold in comparison with wild-type ELIC. Additionally, ethanol potentiated the ELIC-ECD-α1β3GABAAR-TMD chimera, in which the ELIC TMD is replaced with the TMD of α1β3GABAAR.

**CONCLUSIONS**

Alcohols inhibit ELIC as they did on homopentameric pLGICs, such as α7nAChR and ρ1GABAAR. BrEtOH binds to multiple sites in ELIC, both in the ECD and inside the pore of the TMD. However, binding to the ECD does not contribute to the inhibitory action of ethanol on ELIC. Instead, binding to TMD dominated the inhibition of ethanol on ELIC. In summary, the X-ray crystallographic studies and functional measurements support a pore-blocking mechanism for alcohol inhibition on pLGICs.

**SIGNIFICANCE**

This is the first time that multiple binding sites of (Br)EtOH have been identified at an atomic resolution. The combined method of x-ray crystallography and function measurements can pinpoint the functional relevance of the binding sites.
THE NEURAL CORRELATES OF PAIN’S EFFECT DURING MEMORY ENCODING UNDER SEDATION WITH MIDAZOLAM

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1Department of Anesthesiology, University of Pittsburgh School of Medicine
2Department of Psychology, Carnegie Mellon University
3Department of Psychology, University of Pittsburgh

INTRODUCTION

Although midazolam’s amnestic effects are well-known, the effect that acute pain has on memory encoding under mild sedation with midazolam has not been characterized. This exploratory functional MRI (fMRI) study investigated the brain areas involved in memory encoding of items paired or not paired with painful stimuli under light sedation with midazolam compared to a saline control condition.

HYPOTHESIS

Midazolam would reduce brain activity related to memory encoding, and items paired with pain would show greater brain activation in the hippocampus and amygdala.

METHODS

Pilot data was obtained from six healthy adults (three male), with mean (sd) age 23.9 (3.4) years. Whole brain blood oxygen-level dependent (BOLD) images were acquired every second. A custom algorithm was used to optimize magnetic field homogeneity over the medial temporal lobes (MTL). A list of 90 words was played three times (random order) and subjects made classifications (e.g. alive or not) about each. Thirty of the words were consistently followed by an electrical stimulation, at a level preset by the subject to be 7/10 pain. Midazolam was then administered and the experiment repeated with new words. Memory testing occurred the next day. An event-related fMRI analysis was performed to compare the saline and midazolam conditions for brain activity during encoding of subsequently remembered words that were paired with pain, and this analysis was repeated for words not paired with pain.

RESULTS

Midazolam impaired explicit memory, but all subjects could participate in the experimental task under sedation. Greater signal change during saline was seen for pain-paired words in the right primary and secondary somatosensory cortices, bilateral insula, and anterior cingulate cortex. Interestingly, increased activity in the posterior parahippocampal gyrus was seen only for non-pain-paired words. Activation was stronger under saline (vs. midazolam) in the hippocampus and amygdala for both pain-paired and non-pain words.

CONCLUSIONS

Midazolam resulted in less activation in the hippocampus, the structure best known for explicit memory formation. Midazolam also reduced activity in the amygdala, which is activated by pain and plays a role in fear memory. The pain stimulus activated brain areas characteristically involved in pain processing, but this was attenuated under midazolam.

SIGNIFICANCE

We have demonstrated that brain activation can be detected from an event-related pain paradigm under sedation with midazolam. We further demonstrated successful imaging of the MTL memory structures, and demonstrate less activation of these areas under midazolam.

RESEARCH GRANT SUPPORT

NIH training grant T32GM075770 (PI: Yan Xu, PhD) and two Department of Anesthesiology seed grants (PI: Keith Vogt, MD, PhD)

REFERENCES

REDESIGNING THE PERIOPERATIVE PROCESS: PREHABILITATION, ERAS, AND ACUTE PAIN MANAGEMENT

November 4-6, 2016, Nemacolin Woodlands Resort, 1001 LaFayette Drive, Farmington, PA 15437

Course Director: Jonathan Waters, MD, Professor of Anesthesiology, Chief of Anesthesia Services, Magee-Womens Hospital of UPMC

Course Co-Directors:
- Kathirvel Subramaniam, MD, MPH, FASE, Associate Professor of Anesthesiology; Director of Perioperative Echocardiography
- Stephen A. Esper, MD, MBA, Assistant Professor of Anesthesiology; Chief of UPMC Perioperative Services
- Steven L. Orebaugh, MD, Professor of Anesthesiology; Co-Chair, Resident Curriculum Committee
- Lois J. Pizzi, MSN, RN-BC, Clinical Nurse Specialist, Pain Management, University of Pittsburgh School of Medicine
- Tammy Flemming, RN, CRNP, APP Supervisor Chronic Pain Division, UPP Anesthesia Department

The anesthesia provider must maintain up-to-date knowledge regarding health care delivery. This program was intended to review and update the knowledge and skills of the anesthesia provider as it relates to current professional practice. The program’s target audience was physicians involved in the perioperative process, anesthesiologists, surgeons, anesthesia residents, anesthesia fellows, pharmacists, CRNAs, SRNAs, CRNPs, anesthesia assistants, nurses, medical students and other health care professionals involved with perioperative care.

ST. THOMAS ANESTHESIOLOGY LEGAL EDUCATION (ALE) SYMPOSIUM

March 8-11, 2017, Frenchman’s Reef Resort, 5 Estate Bakkeroe, St. Thomas 00802 Virgin Islands (US)

Course Director: Raymond M. Planinsic, MD, Professor of Anesthesiology; Director, Transplantation Anesthesiology, UPMC Presbyterian; Director, Hepatic Transplantation Anesthesiology Fellowship, UPMC

Course Co-Directors:
- David G. Metro, MD, FASA, Professor of Anesthesiology; Vice Chair for Education; Vice-Chair for Faculty Affairs; Anesthesiology Residency Program Director, UPMC
- Daniel R. Sullivan, MD, JD, MBA, Associate Professor; Quality Director/Patient Safety Officer, University of Pittsburgh Physicians/Anesthesiology; Chief Anesthesiologist, UPMC Passavant
- Richard P. Kidwell, JD, Senior Associate Counsel & Director of Risk Management, Department of Patient Safety/Risk Management, UPMC

The inaugural ALE Symposium was a huge success, bringing together a combination of 50 anesthesiologists, lawyers, and CRNAs from around the country. The symposium was a first-of-its-kind program designed to improve patient safety, increase patient/provider communication, and better inform attendees on issues related to ethics and malpractice. The program culminated with a very powerful and educational mock trial.
**MedTASS/CARACT 2017**
April 6-8, 2017, Astoria Palace Hotel, Palermo, Italy

**Conference Presidents:** Antonio F. Arcadipane, MD, Chief Anesthesiologist, UPMC Palermo, Italy (IsMeTT); Medical Director, Operating Room Services, IsMeTT

Raymond M. Planinsic, MD, FASA, Professor of Anesthesiology; Director of Transplantation Anesthesiology, UPMC Presbyterian; Director, Hepatic Transplantation Anesthesiology Fellowship Program

Dr. Antonio Corcione, President, Italian Society of Anesthesiologists

The 5th MedTASS/CARACT meeting brought together over 350 anesthesiologists and intensivists from throughout Italy. This was the first time that MedTASS was held in conjunction with a national Italian medical society, signifying how the meeting has grown in importance and popularity in the Italian anesthesiology community. Simulation sessions were held as a pre-congress event and included difficult airway management, coagulation dilemmas in the operating room, and crisis management scenarios. Those in attendance praised the content of the program as relevant to their practice and look forward to future MedTASS meetings.

**UPMC CRNA CONFERENCE 2017**
April 28-30, 2017, Nemacolin Woodlands Resort, 1001 LaFayette Drive, Farmington, PA 15437

**Course Director:** Timothy R. Lyons, CRNA, MSN, MBA

The anesthesia provider must maintain up-to-date knowledge regarding health care delivery. This program was intended to review and update the knowledge and skills of the anesthesia provider as it relates to current professional practice.

**FIRST UPMC ACUTE PAIN MEDICINE & REGIONAL ANESTHESIOLOGY FELLOW IMPROVEMENT PRACTICE RESEARCH CONFERENCE**
June 3, 2017, UPMC Shadyside, Herberman Conference Center, 5230 Centre Ave, Pittsburgh

**Course Directors:** Jacques E. Chelly, MD, PhD, MBA, Program Director, Regional Anesthesiology & Acute Pain Medicine Fellowship, UPMC; Professor, University of Pittsburgh School of Medicine Department of Anesthesiology and Orthopedic Surgery

Bruce Ben-David, MD, Clinical Professor of Anesthesiology; Director of Pain ERAS, UPMC Department of Anesthesiology

This free program was provided for anesthesiologists, trainees, CRNAs, and SRNAs both inside and outside of UPMC. The goal of the event was to give attendees a clear understanding of approaches to manage perioperative pain in different type of patients, how regional anesthesia and multimodal approaches apply to surgical patients, including those undergoing total joint replacement, and how to optimize outcomes in surgical patients, as well as provide updates in the pharmacology of local anesthetics and nerve blocks in patients undergoing surgery.


The ninth edition of *Smith’s Anesthesia for Infants and Children* by Peter J. Davis, MD and Franklyn P. Cladis, MD was published in December of 2016. The book, originally written by distinguished pediatric anesthesia pioneer Dr. Robert Smith, is referred to as “the bible” of pediatric anesthesia. Etsuro K. Motoyama, MD maintained the legacy and spirit of the book when he edited and co-edited the book’s fifth through eighth editions. Drs. Davis and Cladis dedicated the ninth edition to Dr. Motoyama.

Department authors Drs. Brian Blasiole, Barbara W. Brandom, James G. Cain, Thomas M. Chalifoux, Denise M. Hall-Burton, Andrew Herlich, James W. Ibinson, Robert Scott Lang, Etsuro K. Motoyama, Erica L. Sivak, Keith M. Vogt, and Susan Woelfel contributed to the textbook.


**PUBLICATIONS**


The textbook *Anesthesia and Perioperative Care for Organ Transplantation* (1st edition, 2017) was published. The book was edited by department faculty members Kathirvel Subramaniam, MD, MPH, FASE and Tetsuro Sakai, MD, PhD, FASA and contains chapters written by numerous current and former faculty, residents, and fellows:

- Chapter 6: Anesthetic Management of Donor Organ Retrieval in a Multiorgan Donor, Wendy A. Haft and Andrew Walter Murray
- Chapter 9: Anesthetic Management for Lung Transplantation, Michael L. Boisen, Andréa R. Xavier, and Kathirvel Subramaniam
- Chapter 10: Postoperative Critical Care of Lung Transplant Patients, J. Mauricio Del Rio, Mani A. Daneshmand, and Matthew G. Hartwig
- Chapter 15: Perioperative Management of Pulmonary Hypertension, Soheyla Nazarnia
- Chapter 17: Perfusion Management for Thoracic Transplantation Surgery, Justin N. Tawil, Sarah Zygmuncik, and Kathirvel Subramaniam
- Chapter 18: Anesthesia for Noncardiac Surgery Following Thoracic Organ Transplantation, Joshua S. Baisden
- Chapter 28: Liver Transplantation Anesthesiology, Tetsuro Sakai
- Chapter 32: Acute Liver Failure: Perioperative Management, Shushma Aggarwal, George V. Mazariegos, and Deanna Blisard
- Chapter 34: Renal Dysfunction in Hepatic Failure, Ibtesam A. Hilmi and Ali R. Abdullah
- Chapter 37: Simulation: In Anesthesia for Liver Transplantation, Shushma Aggarwal, Charles D. Boucek, and Daniela Damian
- Chapter 46: Anesthesia for Composite Tissue Allografts, Raymond M. Planinsic


Summer 2016

Stephen A. Esper, MD, MBA received funding from the American Heart Association for a two-year GRA Mentored Clinical & Population Research Award titled “A Pilot Study in Feasibility and Safety: Point of Care Testing with Thromboelastography for Blood Product Transfusion.”

Grace Lim, MD received a Building Interdisciplinary Research Careers in Women’s Health (BIRCWH) in Pittsburgh NIH K12 scholar award. This mentored career-development program connects BIRCWH scholars to senior faculty with shared research interest in women’s health and sex-differences research. She was also appointed Director of Obstetric Anesthesiology at Magee-Womens Hospital of UPMC.

Michael Schnetz, MD, PhD was accepted into the FAER Resident Scholar Program, which provides selected anesthesiology residents with the opportunity to attend the annual American Society of Anesthesiologists meeting.

The University of Pittsburgh Anesthesiology Interest Group (AIG) was selected by the American Society of Anesthesiologists Medical Student Component as winner of the 2015-2016 Outstanding AIG Student Chapter Award. This award distinguishes the group as one of the top AIGs in the nation.

William Simmons, MD received the National Medical Association (NMA) Scroll of Merit “in recognition of his leadership and promotion of wellness, healthcare equality, medical education, and efforts towards increasing the pipeline of minority students entering medicine.” Dr. Simmons received the award, the NMA’s highest honor for merit, at the Annual NMA Convention and Scientific Assembly in Los Angeles, CA on July 30th, 2016. The honor was followed by a “Special Congressional Commendation of Recognition” of the award.

Five researchers received department seed grant funding for the period of August 1, 2016 – July 31, 2017.

- Phillip Adams, DO: “Predicting Acute Kidney Injury in infants after Cardiopulmonary Bypass Surgery: NIRS and Biomarkers Can Make an Early Diagnosis”
- Philip Carullo, MD: “The Essophoclude Medical Device: Providing Temporary Occlusion of the Esophagus in Patients Requiring Emergent Intubation”
- Heather Hayanga, MD: “Physician Disaster Preparedness Mobile Learning App”
- Marsha Ritter Jones, MD, PhD: “Evaluation of Cutaneous Neural-Immune Signaling Using Optogenetics”
- Keith Vogt, MD, PhD: “Imaging the Modulation of Long-Term Memory by Pain and Sedation with Midazolam”

Kirsten Radaker, CRNA, MSN accepted the position of CRNA Assistant Clinical Director of UPMC Mercy.

The following investigators were awarded UPP Foundation Grants:

- James W. Ibinson, MD, PhD: “Investigating the Link between Pre-clinical Alzheimer’s Disease and Postoperative Cognitive Dysfunction Using Functional Neuroimaging”
- Murat Kaynar, MD, MPH: “Aerobic Glycolysis and Long-Term Outcomes from Sepsis”
- Marsha Ritter Jones, MD, PhD: “Neurturin as a Modulator of Neural-immune Communication”

Ibtesam A. Hilmi, MB CHB, FRCA was promoted to Professor of Anesthesiology.
The department lost several esteemed alumni and colleagues during FY 2017.

The UPMC Presbyterian neurosurgery and neuroanesthesia group lost three key members. Patricia L. Swedlow, a long time former department CRNA, passed away on August 19, 2016 in Lansing, Michigan. Pat worked as a CRNA at UPMC Presbyterian from 1967 until she retired in 1995 and specialized in neuro and transplant anesthesia. She trained many anesthesiology students over the course of her career. Pioneering neuroanesthesiologist Maurice S. Albin, MD, MSc died on July 2, 2016, and the groundbreaking neurosurgeon Peter Jannetta, MD passed away earlier in 2016. The influence of these clinicians fostered the growth of our neuroanesthesia team and they will be missed by their many trainees and colleagues.

Dr. Bulent Kirimli, Professor Emeritus of Anesthesiology, passed away in April of 2017. Dr. Kirimli was invited by Dr. Peter Safar in the early 1960’s to help pioneer and further the cardiopulmonary resuscitation sciences. His work was recognized both nationally and internationally. Throughout his career at the University of Pittsburgh, he touched many lives as a physician and faculty member, in addition to being a wonderful father to his family. His positive impact was felt by many, including fellow colleagues, students, and patients here in the United States as well as in Turkey.

William Simmons, MD received the 2016 Humanitarian Award from Allen Place Community Services, Inc. “for exemplary actions which equip and inspire minority youth to enter and succeed in the medical and health science profession and for unwavering dedication to the mission of providing health and wellness to the underserved citizens in our community.” The city of Pittsburgh honored Allen Place for their community work with a proclamation and designation of September 25, 2016 as Allen Place Day. In turn, Allen Place honored Dr. Simmons as one of the five people that they attribute as instrumental in their success in their community outreach and providing needed benefit to the community at their annual Senior PROM event.
Calin Gorun-Gorunescu, MD won a UPMC Richard L. Simmons, MD Speak Up for Safety Award. The award honors the dedication of Dr. Richard Simmons (Distinguished Service Professor, Chairman Emeritus, and Vice Chair for Surgical Research, Department of Surgery and Medical Director, UPMC) to improving the quality of healthcare and patient safety and is given to those who embody those values.

Rita M. Patel, MD received the 2016 Society for Education in Anesthesia (SEA)/Duke Award for Excellence and Innovation in Anesthesia Education for her significant contributions to advancing anesthesia education over the course of her career. The award was presented at the 2016 SEA Fall Meeting in Chicago on Friday, October 21, 2016.

Tetsuro Sakai, MD, PhD was elected by the University of Pittsburgh School of Medicine Executive Committee of the Faculty as a member of the Non-Tenured Faculty Promotions and Appointments Committee for a three-year term.

Kristin M. Ondeko Ligda, MD was nominated for the American Medical Association’s Women Physicians Section’s Inspirational Physician Recognition Award for her work representing women in medicine and anesthesiology.

Michael P. Mangione, MD received the VA Pittsburgh Healthcare System Chief of Staff’s Award for Clinical Excellence.

Work by Drs. Nicole Verdecchia, Vladyslav Melnyk, and Steven L. Orebaugh was chosen as a “top 5” abstract for the Annual New York School of Regional Anesthesia (NYSORA) Symposium on Regional Anesthesia, Pain and Perioperative Medicine (Verdecchia N, Vladyslav Melnyk V, Joseph E. Pichamuthu JE, David A. Vorp DA, Orebaugh SL. The Physical Relationship of the Sciatic Nerve and its Paraneural Sheath).

Robert Boretsky, MD presented the Harvard Point of Care Ultrasound Workshop held at Boston Children’s Hospital on October 1-2, 2016.

Gregg E. Homanics, PhD was appointed an Associate Editor of the journal Genes, Brain and Behavior, the official journal of the International Behavioural and Neural Genetics Society.

Carolyn Garver, RN, CRNP, MSN received the Penn State College of Nursing Shirley Novosel Distinguished Alumni Award.

Tammy Flemming, CRNP was nominated for a Cameos of Caring Award (Advanced Practice Nurse-Clinical) at UPMC Passavant.

Anthony T. Silipo, DO was elected to the Society for Airway Management membership committee.
AWARDS, ACCOLADES, AND NEWS

Richard Hubbard, MD was featured in an article in the November 2016 edition of the UPMC publication First Friday. The story highlights Dr. Hubbard’s impressive charity work in Bangladesh. In addition, some of the children involved in his charity appeared on the front cover of the magazine. The Daily Star, the largest English-language newspaper in Bangladesh, also published an article written by Dr. Hubbard about his research with Dr. Kamal Choudhury at the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders on Respiratory Distress Syndrome in premature babies.

Scott A. Brancolini, MD, MPH lectured at the Association of Anesthesiology Subspecialty Program Directors Pain Medicine Breakout session at the 2016 Society of Academic Anesthesiology Associations meeting, November 11-12 in Chicago, IL. The title of his presentation was “Introducing a Pain Medicine Fellowship Educational Resource: The Association of Pain Program Directors’ New Website.” He was also elected Secretary/Treasurer of the Association of Pain Program Directors.

Chad Artman, CRNA and Lynette Sikora, CRNA were honored at the 2017 Cameos of Caring Award Gala, which honors exceptional bedside nurses who work at acute care hospitals.

Tomas Drabek, MD PhD served on the American Society of Anesthesiologists (ASA) Abstract Review Subcommittee on Experimental Neurosciences and on the ASA Abstract Review Subcommittee on Experimental Circulation for the 2017 Governance Year (October 2016-October 2017).

The department welcomed Joseph Dailey, CRNA, MSN to the position of CRNA Assistant Clinical Director of Magee-Womens Hospital of UPMC.

Douglas Bentley, MD; Erica Coffin, MD; Adam D’Souza, MD; Sean A. DeChancie, DO; Brian Gierl, MD; John J. Hache, MD; Patrick Hackett, MD; Gregory Halenda, MD; William Scott Jones, MD; Charles Lin, MD; Tran Nguyen, MD; Raj Padalia, MD; Kelly Peretich, MD; Eric Ponte, MD; Faith Ross, MD; and Hazel Werlhof, MD all passed the National Board of Echocardiography basic perioperative transesophageal echocardiography (TEE) examination. The test allows physicians to test and demonstrate their knowledge of basic non-diagnostic perioperative TEE monitoring based on an objective standard. Kathirvel Subramaniam, MD, MPH; Michael Boissen, MD; Theresa A. Gelzinis, MD; and Stephen M. McHugh, MD organized a department “TEE boot camp” to help residents and faculty prepare for the exam.

Raymond M. Planinsic, MD presented “Anesthesiology Concerns in Liver Transplantation” at the Starzl Transplant Institute Internal Grand Rounds on November 18, 2016.

Jacques E. Chelly, MD, PhD, MBA presented “Auriculotherapy for Anesthesia” on December 10 as part of the Paris XIII Medical School Auriculotherapy Certificate program.

The article “Stepping off the Path to Hell” in the Fall 2016 issue of PittMed magazine featured interviews and quotes from Stephen A. Esper, MD, MBA; Howard B. Gutstein, MD; Michael P. Mangione, MD; and Ajay D. Wasan, MD, MSc.

Jacques E. Chelly, MD, PhD, MBA won a GlobalPittsburgh Immigrant Entrepreneur Award in the category of Affiliates of Middle and Large Companies on December 14, 2016.

R. Scott Lang, MD and Monique Saxon MSN, CRNA were presented with excellence awards at the University of Pittsburgh Nurse Anesthesia Program graduation ceremony from the fall Class of 2016 on December 17, 2016 at The University Club. Dr. Lang received the Stephen C. Finestone Memorial Award for Excellence in Clinical Instruction and Ms. Saxon received the Mary DePaolis-Lutso Award for Excellence in Clinical Instruction.
Trent D. Emerick, MD, MBA was elected to the University of Pittsburgh Physicians Board of Directors for the January 2017-December 2018 term.

Theresa A. Gelzinis, MD was appointed to the editorial board of the *Journal of Cardiothoracic and Vascular Anesthesia* for a three-year term, effective January 1, 2017.

Jacques E. Chelly, MD, PhD, MBA was reappointed to the University of Pittsburgh School of Medicine Committee for Tenured Faculty Promotions and Appointments for a second three-year term of service beginning January 1, 2017.

Brian A. Williams, MD, MBA was accepted into the 2017 Advanced Faculty Leadership Academy. This year-long professional development program offered by the University of Pittsburgh Office of Academic Career Development is designed for mid-career and senior faculty members to cultivate transformative academic leaders through shared leadership training.

John P. Williams, MD was elected to the Royal Society of Medicine in London, UK. The Royal Society of Medicine, one of the oldest of the medical societies, is one of the UK’s major providers of postgraduate medical education and promotes an exchange of information and ideas on the science, practice and organization of medicine.

The University of Pittsburgh Center for Medical Innovation awarded a grant to Philip Carullo, MD and Youngjae Chun, PhD (Assistant Professor, Department of Industrial Engineering) for the project “The Esophocclude - Medical Device for Temporary Occlusion of the Esophagus in Patients Requiring Emergent Intubation.”

Charles A. Buffington, MD was appointed Professor Emeritus in the University of Pittsburgh School of Medicine.

Richard McHugh, MD was appointed “Clinician Emeritus.” University of Pittsburgh Physicians grants only one or two of these titles per year system-wide.

Tomas Drabek, MD, PhD was appointed to the Society for Critical Care Medicine Scientific Review Committee for a three-year term, 2017–2020.

William Simmons, MD was interviewed by *Pittsburgh Urban Media* for their Black History Month celebration issue. Julianna Watenpool, CRNA received the Children’s Hospital of Pittsburgh of UPMC Patient Safety Award. Julianna was recognized for developing an MRI Safety Checklist for her anesthesiology colleagues.

Tetsuro Sakai, MD, PhD was interviewed by the editor of the journal *Seminars in Cardiothoracic and Vascular Anesthesia* (SCVA) for their March 2017 Podcast: Noteworthy Literature Published in 2016 for Abdominal Organ Transplantation Anesthesiologists: Liver. Sakai T and Zelliro J.
Rita M. Patel, MD received the Accreditation Council for Graduate Medical Education (ACGME) Parker J. Palmer Courage to Lead Award. The award celebrates Designated Institutional Officials/Associate Deans for Graduate Medical Education who demonstrate excellence in leading their institution’s graduate medical education enterprise. The award was presented to Dr. Patel in March 2017 at the ACGME Annual Educational Meeting.

Kristin Ondecko Ligda, MD was named as one of the “Top 40 Physicians Under 40” by the Pennsylvania Medical Society. She was one of only two anesthesiologists in the state and one of only three physicians in the entire UPMC Health System who were nominated for this award. Dr. Ondecko Ligda was honored for this distinction at the Allegheny County Medical Society Foundation's Celebration of Excellence Awards Gala on March 4, 2017.

The American Society of Anesthesiologists (ASA) Practice Management meeting is considered the premier business event for physician anesthesiologists and practice administrators and among ASA-sponsored events is second only in attendance to the ASA's Annual Meeting. This year's ASA Practice Management meeting was held January 27-29, 2017 in Grapevine, TX.

Our department was well represented in the event’s poster and poster presentation sessions, showing seven of the 24 posters accepted to the program and three of the six posters selected for presentation. For the sixth consecutive year, the UPMC team was successful in the award portion of the program, receiving the first place award in the poster session for “Benchmarking Clinical Productivity for Non-Operating Room Anesthesia Cases.” David F. Nelson, MD, MBA was recognized for Best Poster by a Resident or Fellow for “Creating a System-wide Room Running Cap in a Large Multi-Hospital System,” co-authored with Drs. Robert Boretsky, Trent Emerick, Andrius Giedraitis, and Mark Hudson. His work won not only the “best resident poster” award, but also the second place Foundation for Anesthesia Education and Research award at the meeting.

Posters selected for the program included:

- Giedraitis A, Fleming T, Hudson M, Nelson D, Emerick T, “Reconsultation of Chronic Pain Patients at a Large, University-based Hospital” (poster)
- Hundley H, Hudson M, Emerick T, “Outpatient Chronic Pain Clinic Scheduling Efficiency Analysis” (poster)
- Hundley H, Hudson M, Emerick T, “Development of a Personalized Smart Schedule in an Outpatient Chronic Pain Clinic Through Use of a Gantt Diagram” (poster)
- Muller IR, Stelzer SR, Adams DC, Hudson ME, Tsai MH, “A Potential Association Between Burnout Rates and Operating Margins for Anesthesiologists” (poster)
- Nelson D, Boretsky R, Emerick T, Giedraitis A, Hudson M, “Creating a System-wide Room Running Cap in a Large Multi-Hospital System” (poster presentation & second place FAER Award and first place Resident/Fellow Award winner)
- Giedraitis A, Emerick T, Nelson D, Hudson M, “Anesthesia Labor Costs at Different Hospitals within a Large Multi-Hospital Health System” (poster presentation)
- Tsai MH, Breidenstein MW, Marnanides AP, Hudson ME, Maktabi MA, “Benchmarking Clinical Productivity for Non-Operating Room Anesthesia Cases” – Poster Presentation” (first place FAER Award, collaboration with the University of Vermont)
National Nurse Anesthetists Week was celebrated on Jan. 22-28, 2017. Our CRNAs, who mark this annual occasion by giving back to the community, kicked off several charity initiatives:

- **UPMC Presbyterian CRNAs** collected gently used jeans for their annual “Jeans for Teens” charity drive. They also hosted their fifth annual Peer Appreciation Reception, providing donuts and coffee to thank all their colleagues – everyone ranging from anesthesia techs, residents, faculty, and administrative and housekeeping staff.

- **CRNAs at St. Margaret** donated their time and money to the Wounded Warrior Patrol Family Outing at Seven Springs Ski Resort on February 26-March 3, 2017 and recruited volunteers from the department.

- **Children’s Hospital of Pittsburgh of UPMC (CHP) CRNAs** coordinated a Mexican dinner at CHP’s Ronald McDonald House, adjacent to the hospital. Ronald McDonald House provides housing to families with critically ill children. Patients and their families were treated to a dinner including a taco/fajita bar, a nacho bar, and an ice cream sundae bar, all of which was funded and prepared by the CHP nurse anesthetists. They also hosted an ice cream social for all members of the care team in the OR and PACU.

Student nurse anesthetists and CRNAs also staffed tables throughout the various UPMC hospitals to educate visitors about their profession.

**Richard A. Henker, PhD, RN, CRNA, FAAN** was given the 2016-17 Sheth Distinguished Faculty Award for International Achievement in recognition of his academic and professional contributions to furthering international education in nursing. The University Center for International Studies presented the award at their ceremony on April 5, 2017.

**Jacques E. Chelly, MD, PhD, MBA** was named Program Director of the Regional and Acute Pain Medicine Fellowship Program. Dr. Chelly is the founding director of the program and initially implemented the fellowship at UPMC in 2003 and transformed and developed the program into one of the largest, most prestigious in the country.

The article “Staff-led group yields productivity gains” in the April 13, 2017 issue of University Times spotlighted the efforts of a University of Pittsburgh staff-led effort to support and increase productivity for administrators who use a new research management software. Leading the way in this initiative are our department staff members Beverly Savage and Yvonne Brewster.

**Sanford M. Littwin, MD** presented the grand rounds lecture “Perioperative Management: Efficiency and Enterprise vs. Patient Care and Quality” at Rutgers-New Jersey Medical School on April 19, 2017.
AWARDS, ACCOLADES, AND NEWS

Spring 2017

The National Institutes of Alcohol Abuse and Alcoholism of the National Institutes of Health extended support for the project “Role of Noncoding RNA in Alcohol Action” (PI: Gregg E. Homanics, PhD) until January 31, 2022. This $2,345,078 award will enable Dr. Homanics to test the contribution of alcohol-induced changes in brain levels of noncoding RNAs on alcohol drinking in animal models.

Shushma Aggarwal, MD; Cheryl D. Bernstein, MD; Franklyn P. Cladis, MD; Peter J. Davis, MD; Andrew Herlich, DMD, MD; Steven L. Orebaugh, MD; Jerome Parness, MD, PhD; Doreen E. Soliman, MD; Erin Sullivan, MD; and Ajay D. Wasan, MD were named in Pittsburgh Magazine’s 2017 “Best Doctors” list. The list is compiled by Best Doctors® and derived from the Best Doctors in America® database, which includes the names and profiles of more than 50,000 of the best doctors in the United States. Physicians are included in the database after an exhaustive peer review. Drs. Aggarwal, Herlich, Orebaugh, Parness, Sullivan, and Wasan were named Best Doctors in the specialty of anesthesiology; Drs. Cladis, Davis, Herlich, Parness, and Soliman were named Best Doctors in the specialty of pediatric anesthesiology; Dr. Bernstein was named in the specialty of neurology; and Dr. Wasan was named in the specialty of psychiatry.

Keith M. Vogt, MD, PhD was awarded a FAER Mentored Research Training Grant for his project, “Human Memory Encoding Under Anesthesia: How Pain Affects Hippocampal and Amygdalar Contributions to Memory.”

Jennifer Letzelter, CRNP completed her American Nurses Credentialing Center pain management nursing certification.

The National Institute of General Medical Sciences (NIGMS) of the National Institutes of Health (NIH) awarded a third five-year term of a National Research Service Award Institutional Research Training Grant (T32 grant) to our department. The program, entitled “Research Training in Anesthesiology and Pain Medicine,” is directed by Professor Yan Xu, PhD, Vice Chair of Basic Sciences. The training faculty consists of 35 leading scientists in anesthesiology and related disciplines, including critical care medicine, surgery, computational & systems biology, neurobiology, and cognitive neuroscience. By providing rigorous and programmed training, with an emphasis on hypothesis-driven basic or clinical research, the training program aims to train clinician scientists to become future academic leaders of our specialty.
### Fiscal Year 2017 at a Glance

<table>
<thead>
<tr>
<th>Category</th>
<th>Figures</th>
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<tbody>
<tr>
<td>Total Anesthesiology Cases</td>
<td>306,416</td>
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<tr>
<td>Non-Pain Cases</td>
<td>222,202</td>
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<tr>
<td>Chronic &amp; Acute Pain Visits</td>
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<tr>
<td>Obstetric Deliveries</td>
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<td>Faculty Full-Time Equivalents (FTEs)</td>
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<td>Total ORs Covered</td>
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<td>Total Anesthetizing Locations</td>
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<td>Residents &amp; Fellows</td>
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<td>Active Clinical Trials</td>
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