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PITTSBURGH JOURNAL OF ANESTHESIOLOGY
MESSAGE FROM THE CHAIR

Welcome to the inaugural edition of the *Pittsburgh Journal of Anesthesiology*. Spearheaded by the tireless efforts of Dr. Tetsuro Sakai, this journal highlights the innovative clinical, educational, research, and service activities of our department. Fiscal year 2016 has been a time of tremendous change and opportunity for us. Under the expert direction of Dr. Mark Hudson, our clinical activities attained even greater efficiency as we maintained our volume of about 300,000 cases for the year. We also welcomed the UPMC Horizon practice into our group and celebrated the appointment of Timothy Lyons as Senior CRNA Director for the UPMC system. Dr. Stephen Esper spearheaded the successful adoption of Enhanced Recovery After Surgery (ERAS) protocols throughout the system. Under the leadership of Dr. David Metro, our educational efforts have been widely recognized. Our innovative Clinical Base Year Anesthesiology rotation, under the dynamic leadership of Dr. Sakai, resulted in every intern attending the American Society of Anesthesiologists’ annual meeting. My first ASA meeting as Chair was spent attending a record number of resident and medical student research presentations. Later in the year, our residents swept all of the first place awards at the Pennsylvania Anesthesiology Residents’ Research Conference. The year culminated with a spectacular performance in the residency match.

We continue to set the standard for academic and clinical accomplishments by anesthesiology residents. Under the expert guidance of Drs. Jonathan Waters and Yan Xu, our clinical and basic research programs continue to be among the finest in the world. We are one of only two anesthesiology departments in the nation to have multiple NIH T32 training grants. Our mission trips remain extremely popular with both the residents and the faculty and local community service activities by department members are many and vibrant.

I would like to thank all our department staff, faculty, residents, and fellows for their exemplary performance and activities over the year. I also wish to thank our colleagues and friends both within and outside Pittsburgh for their collaboration and strong support. Working together, all things are possible!
MESSAGE FROM THE EDITOR-IN-CHIEF

It is a distinctive pleasure to present the inaugural 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 visual vehicle showcases the contributions and various accomplishments of our department members in the field of anesthesiology under the leadership of our chair, Dr. Howard Gutstein. 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 cover page features our four past tenured department chairs: Peter Safar, MD (1961-1979), Peter M. Winter, MD (1979-1996), Leonard L. Firestone, MD (1996-2001), and John P. Williams, MD (2001-2013), and our current chair, Howard B. Gutstein, MD. They represent our rich history over the last half-century. 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 upmost gratitude to the individual authors whose hard work, dedication, and timely submissions have expedited the production of this inaugural edition. Thank you to Dr. Gutstein and the members of the department’s Executive Steering Committee who graciously approved production of the *PJA*. I also thank Keith M. Vogt, MD, PhD (T32 scholar and faculty member in our department) for his vision and constructive critique. Production of this issue of the *PJA* was made possible with scholarly grants provided to the department by visiting physicians from Japan, especially from Toyama Prefectural Central Hospital, Toyama, Japan (Kenich Ogura, MD, PhD). Finally, I can’t fully express my thanks enough to Christine Heiner (Scientific Writer, Department of Anesthesiology/Department of Surgery, University of Pittsburgh School of Medicine) for her editorial and graphic design work (with valuable guidance and help from Pitt Communications Services). Without her dedication and effort, this journal could certainly not have been published.

I sincerely hope you enjoy the inaugural edition of the *Pittsburgh Journal of Anesthesiology*!
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Manisha Loomba Trivedi, MD - Clinical Assistant Professor
Keith Vogt, MD, PhD – Postdoctoral Scholar
Anne C. Ward, DO - Clinical Assistant Professor

UPMC PASSAVANT
Ryan D. Ball, MD – Clinical Assistant Professor
Albert J. Carvelli, MD – Clinical Assistant Professor
Rajani Chuensumran, 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 - Visiting Clinical Associate Professor
James V. Kunkel, MD - Clinical Assistant Professor
Stuart Charles Law, MD - Clinical Assistant Professor
Donna M. Lucas, MD - Clinical Assistant Professor
Charles B. Luke, MD – Clinical Assistant Professor
Bharati Parikh, MD – Clinical Assistant Professor
Vimala Ramesh, MD - Clinical Assistant Professor
Daniel Sullivan, MD, JD, MBA – Associate Professor, Chief Anesthesiologist
Katherine B. Szabo, MD - Clinical Assistant Professor

UPMC BEDFORD MEMORIAL HOSPITAL
Christopher J. Samuel, MD – Clinical Assistant Professor; Chief Anesthesiologist
Nasr Yazigi, MD – Clinical Instructor

UPMC HORIZON – SHENANGO VALLEY AND GREENVILLE
Lakshmi Digumarthi, MD – Clinical Assistant Professor
Mohan Ettyreddy, MD – Clinical Assistant Professor
Suvir Kovoor, MD – Clinical Assistant Professor
Andy Nassif, MD – Clinical Assistant Professor
Chandresh Shah, MD – Clinical Assistant Professor
Donna Spratt, MD – Clinical Assistant Professor
Jun Wang, MD, PhD – Clinical Assistant Professor
Cynthia M. Q. Wells, MD – Clinical Assistant Professor; Chief Anesthesiologist

UPMC MONOROEVILLE SURGERY CENTER
Elliott Weinstock, MD – Clinical Assistant Professor; Chief Anesthesiologist
Jessica Peretin, MD – Clinical Assistant Professor

BASIC RESEARCH
Howard B. Gutstein, MD - Peter and Eva Safar Professor and Chair, Department of Anesthesiology
Gregg E. Homanics, PhD – Professor
Pei Tang, PhD – Professor
Yan Xu, PhD – Professor

UPP RESEARCH COLLABORATORS
Miroslav Klain, MD – Professor Emeritus
Etsuro K. Motoyama, MD – Professor Emeritus
Jan Smith, MBCHB - Clinical Professor; Clinician Emeritus

PETER M. WINTER INSTITUTE FOR SIMULATION, EDUCATION, AND RESEARCH (WISER)
Paul E. Phrampus, MD – Assistant Professor; Director, WISER

FACULTY RESOURCE POOL
Vladislav I. Shick, MD – Clinical Assistant Professor
DEPARTMENT HISTORY

History of the Department of Anesthesiology at the University of Pittsburgh and UPMC

Christine M. Heiner, BA, Scientific Writer, Department of Anesthesiology/Department of Surgery
Andrew Herlich, DMD, MD, FAAP, Professor and Special Assistant to the Chair for Academic and Faculty Affairs, Department of Anesthesiology
Jan D. Smith MBChB, FRCP (Lon) DTM&H, FACP, Clinical Professor and Clinician Emeritus, Department of Anesthesiology
Howard B. Gutstein, MD, Peter and Eva Safar Professor and Chair, Department of Anesthesiology

The University of Pittsburgh School of Medicine and UPMC have always been at the forefront of groundbreaking advances in the field of anesthesiology. Many world-renowned clinicians and researchers from Pittsburgh have made their mark in the specialty as well as the broad field of medicine. Their contributions have enabled us to flourish into one of the best anesthesiology departments in the nation.

1930s: Mercy Hospital Establishes an Anesthesiology Department
Mercy was Pittsburgh’s largest surgical hospital in the late 1800s and early 1900s; many training surgeons considered it the city’s best. Advances in the practice prompted Mercy to establish a formal anesthesiology department in the 1930s. Mercy became affiliated with the Pitt School of Medicine (at that time known as Western Pennsylvania Medical College) in 1901. Until 1937, practically all instruction in clinical surgery and anesthesiology at the college was carried out at Mercy under the direction of Dr. John Jenkins Buchanan, one of the fathers of modern surgery in Pittsburgh. Early Mercy anesthesiologists tested and studied new drugs, devices, and techniques before they became common practice in the medical profession. The carbon dioxide absorption technique, which paved the way for cyclopropane, is cited as the biggest advancement at Mercy during this era. The Mercy anesthesiology department also implemented the use of bedside oxygen tents.

1940s: Dr. Leonard Monheim and Dental Anesthesiology at Pitt
Leonard M. Monheim, DDS, an internationally known dentist, author, lecturer, scholar, educator, and research clinician, graduated from Pitt’s School of Dental Medicine in 1933 and trained under physician anesthetists Drs. Frances Foldes and George Thomas, both who would later become integral figures in our department’s history. In 1938, Dr. Monheim joined the staff at Presbyterian Hospital as its only on-site, full time anesthesiologist. He was actually the only trained anesthesiologist at Presby for many years.

From 1942 to 1946, Dr. Monheim served in the US Army and was stationed in the Philippines, where he taught intravenous deep sedation techniques called chemamnesia to Army Corpsmen. He founded the Pitt dental school’s Department of Anesthesiology in 1949, the first in any dental school in the US, and developed a general anesthesiology residency there for dentists.
Dr. Monheim’s major academic mission had been upgrading dental anesthesia by stressing the medical evaluation of patients and training dentists to perform resuscitation and prevent emergencies. At Presby, he became the backbone of the coordination of OR anesthesia services. These experiences and his work with nurse anesthetists and oral surgery and dental residents contributed to his reputation as a superb teacher and supervisor of anesthesia personnel. His long association with the Pitt medical school and its affiliated hospitals culminated in his service as President of the Medical Staff at Presbyterian Hospital.

1950s: Dr. Joseph Marcy at Children’s Hospital of Pittsburgh

An anesthesiology department was established at Children’s Hospital of Pittsburgh in 1955 and Joseph H. Marcy, MD, who trained at the University of Pennsylvania, became its first chief of pediatric anesthesiology and the first physician anesthesiologist affiliated with Pitt. Anesthesiology was still a young clinical discipline at that time, and the specialty of pediatric anesthesiology advanced significantly under Dr. Marcy’s direction. His establishment of routine tracheal intubation, monitoring of vital signs, and fluid administration are all credited with greatly reducing pediatric deaths during surgeries. As a direct result of these innovations, healthy infants today very rarely die as a result of anesthesia.

Dr. Marcy retired from Children’s in 1984. In 1992, he received the American Academy of Pediatrics Robert M. Smith Award in recognition of his important contributions to the fields of pediatric anesthesiology and pain management, joining a legacy of only 16 individuals at that time to receive the honor. In 2013, the Pitt Department of Anesthesiology established an Endowed Chair in Pediatric Anesthesiology named in recognition of Dr. Marcy, a position held by our current Chief Anesthesiologist at Children’s, Dr. Peter Davis.

1950s-1960s: Drs. Frances Foldes and Ephraim Siker at Mercy Hospital

In 1947, Francis F. Foldes, MD was recruited from Massachusetts General Hospital to further develop the anesthesiology department at Mercy. He established a residency program, a research laboratory, and the first myasthenia gravis clinic in this part of the United States. Under his leadership, the hospital pioneered clinical pharmacology. The first time naloxone, the principal narcotic antagonist, was administered to a human being was at Mercy Hospital. He introduced and popularized succinylcholine, one of the standard muscle relaxants used in anesthesia practice today, in North America.

His research, including groundbreaking work on muscle relaxants, had a huge impact on the practice of anesthesiology and surgery. Dr. Foldes was awarded many honors, including the Distinguished Service Award and the Award for Excellence from the American Society of Anesthesiologists (ASA). He was the first American to serve as President of the World Federation of Societies of Anesthesiologists and as Chairman of the Medical Advisory Board of the Myasthenia Gravis Foundation.

In 1960, Ephraim S. Siker, MD succeeded Dr. Foldes as Chair at Mercy. Dr. Siker is credited with using one of the first halothane anesthetics in the US. He also invented a mirror blade laryngoscope that is still used today. This laryngoscope has a copper jacket that conducts heat away from the mirror, minimizing fogging by the patient’s breath and helping to prevent injury in cases of difficult intubation. Dr. Siker served as President of the Pennsylvania Society of Anesthesiologists and the ASA and Director of the American Board of Anesthesiology. In 1972, he was chosen by then President Nixon to lead a medical team during his visit to China. He received the ASA’s Distinguished Service Award, trained several future academic chairs of anesthesiology departments, and served as Executive Director of the Anesthesia Patient Safety Foundation. We established the “E.S. and Eileen Siker Chair of Anesthesiology” in 2012 in recognition of his contributions and influence.
1961-1978: Dr. Peter Safar

The arrival of Dr. Peter Safar, then only 36 years old, from Baltimore City Hospital in 1961 initiated the most significant revolution in the history of our department.

Prior to Dr. Safar’s arrival, anesthesiology was not yet an official department at the University. It was loosely directed by the leading anesthesiologists at Pitt’s affiliated hospitals: Drs. Foldes at Mercy, Marcy at Children’s, Robert Patterson at Allegheny General Hospital (AGH), and George Thomas. Dr. Thomas was part-time clinical chairman of the Anesthesia Division within the Department of Surgery and the titular Professor and Chairman of Anesthesiology at Pitt; he was also the Chief of Anesthesiology at St. Francis, Presbyterian, and Eye and Ear hospitals, as well as a consultant to Magee-Womens Hospital. He visited the University hospitals occasionally and was about to retire. All of these anesthesiologists held clinical teaching appointments at Pitt, but none worked at the University or its hospitals. The “University” hospitals (Presbyterian, Eye and Ear, Children’s, Magee-Womens, VA, and Montefiore hospitals) had separate goals, administrations, loyalties, and staff. Anesthesia at the hospitals was administered by nurse anesthetists and dental anesthesia graduate students under the supervision of essentially three anesthesiologists: Dr. Marcy at Children’s, Dr. Monheim at Presbyterian, and Dr. Walter Bauer at Eye and Ear Hospital. Anesthesiology residency programs existed only at Mercy and AGH.

Dr. Peter Safar established Pitt’s first Department of Anesthesiology and Critical Care Medicine and became its Inaugural Chair, uniting all these affiliated leaders and programs to form the largest department of its kind in the country. He also brought with him several colleagues who were instrumental in helping to bolster the new academic department. He appointed Dr. Leroy Harris our very first Anesthesiology Residency Program coordinator in 1961-1962. Drs. Warren Holtey and Ruben Tenicela (both who came with Dr. Safar from Baltimore), Herb Kunkel, S. Lowery, Sam Milai, and Oscar Kantt became our first six residents. The Anesthesiology Residency Training Program was approved by the AMA in 1962-63 under Dr. Safar’s leadership. Dr. Safar also brought with him Dr. Steve Galla and appointed him our first Director of Anesthesiology Research.

Impressed by the need for competent technical help for prolonged artificial ventilation during the polio epidemics in Baltimore, Dr. Safar recruited Mr. Gilbert Davis, a respiratory therapist from Chicago, who set up practical training for nurses and future therapists, recruited mainly from among the orderlies. He equipped Presbyterian’s respiratory therapy services from scratch. A one-year Presbyterian-based respiratory therapy clinical training program, plus an optional year of internship, became the first respiratory therapy school in Pennsylvania and one of the first six AMA-approved schools in the nation. The first trainee from this program was Mr. Bela Eross.

Dr. Safar established one of the first multidisciplinary ICUs in the US and initiated an internationally-recognized ICU fellowship program. Leaders in its development included Dr. Clara Jean Ersoz, Dr. Ake Grenvik (recruited from Sweden), and Dr. Stephen Kampschulte, who established the first pediatric ICU in Pittsburgh. Later, Dr. Safar and his colleagues Drs. Max H. Weil and William Shoemaker from Los Angeles were instrumental in founding the multidisciplinary Society of Critical Care Medicine. As a founding member of the Club of Mainz, Dr. Safar and his colleagues from Germany and other nations helped found the World Association for Disaster and Emergency Medicine.

Regarded as the “father of CPR,” Dr. Safar pioneered research on mouth-to-mouth resuscitation. His close friendship with Asmund Laerdal led to the development of the “Resusci-Anne” mannequin, which became widely used as a CPR training tool. In 1968 Dr. Safar co-authored the first widely-accepted CPR instruction manual.

As a founding member of the American Heart Association’s CPR Committee and the National Research Council’s Committee on Emergency Medical Services, Dr. Safar played an important role in the organization of emergency units and in establishing national guidelines to set up such agencies. During his tenure, nationwide emergency medical service standards were in dire need of reform. Inadequately equipped ambulances were run independently by volunteer fire-
fighters, funeral directors, and employees of private companies who were not medically trained. Many patients died en route to the hospital. In 1967, Peter Safar collaborated with Phil Hallen, president of the Maurice Falk Medical Fund, James McCoy Jr., founder of the Hill District’s Freedom House Enterprise Corporation, and Morton Coleman, an aide to the Pittsburgh mayor and part-time social work professor at the University of Pittsburgh, to start the Freedom House Ambulance Service in Pittsburgh’s Hill District. Uneducated, unemployed African American men were recruited and formally trained by Gerald Esposito, Donald Benson MD, and later Nancy Caroline, MD to staff the ambulances. The project tested Dr. Safar’s ideas for pre-hospital emergency care, provided better job opportunities to unemployed African Americans, and improved services in a minority neighborhood. The Freedom House crew were the nation’s first paramedics. Hallen, Safar, McCoy, and Coleman’s experiment conceived a whole new profession – the EMT. Freedom House helped set national standards for ambulance design and equipment and for training emergency medical technicians and paramedics.

After stepping down as Chair to focus on research in 1976, Dr. Safar founded the International Resuscitation Research Center, which investigated secondary injuries that occur after traumatic brain injury, cardiopulmonary arrest, and severe hemorrhage. The institute was renamed in his honor as the Safar Center for Resuscitation Research in 1994.

Dr. Safar was nominated three times for the Nobel Prize in medicine in 1990, 1992, and 1994. He was a member of Physicians for Social Responsibility and the International Physicians for Prevention of Nuclear War, as well as an advisor for Army and Navy casualty
care research programs. In 1999, he was awarded the “Cross of Honor,” Austria’s highest civilian honor, for his service in the field of medicine. Our endowed Chair position is named in honor of Dr. Safar and his wife Eva.

Also notable during the Safar era in the early 1970s is that Mr. Jerome Cochran served as department administrator. Mr. Cochran would go on to become Executive Vice Chancellor of the University of Pittsburgh.

**CRNA Program**

CRNA training programs had been long established at St. Francis and Mercy hospitals; however, the foundations of Pitt’s Nurse Anesthesia Program can be traced to the individual hospital nurse anesthesia training programs in the late 1950s at Presbyterian and Montefiore Hospitals. These two hospital programs merged in 1972 to form the University Health Center of Pittsburgh School of Anesthesia for Nurses. Under the direction of Mary DePaolis-Lutzo and Dr. Stephen Finestone, the program gained national recognition as one of the finest certificate nurse anesthesia programs. In 1989, the Health Center program joined the University of Pittsburgh School of Nursing and graduated the first class of MSN-prepared nurse anesthetists in 1991. The program continues to use the diversity of clinical sites established by the certificate program joined with the strength of the academic curriculum in advanced practice nursing to strive to educate the highest quality nurse anesthesia practitioners. Pitt’s Nurse Anesthesia Program has since grown into one of U.S. News & World Report’s top ranking graduate programs.

**1968-1976: Dr. Robert Hingson**

Robert A. Hingson, MD was a renowned humanitarian and innovator both inside and outside the field of anesthesiology. Before coming to Pitt, he was known for his role in introducing peridural analgesia during labor and delivery and developing continuous caudal anesthesia. He worked at Philadelphia Lying-In Hospital and the University of Tennessee School of Medicine, where he established their first department of anesthesiology and reversed the trend of newborn deaths. Dr. Hingson was the first Professor of Anesthesiology at Western Reserve University School of Medicine and Director of Anesthesia at the University Hospital of Cleveland. There, he developed a portable anesthesia machine, nicknamed the Western Reserve Midget, that provided instantaneous anesthesia for dentistry, obstetrics, and surgery. His machine was also adapted as a ventilator for resuscitation by firemen, military personnel, and rescue workers.

Dr. Hingson is most famous for inventing the jet injector for mass immunization, which enabled more efficient mass inoculation without the need for needles and syringes. This was an important feature, as it did not frighten children undergoing vaccination nearly as much as needles. Dr. Hingson’s high-velocity, microjet, injectable apparatus underwent extensive experimentation in anesthetic administration and later for vaccination and was first used clinically with local anesthetics, ephedrine, insulin, and penicillin. Production-line immunization began in 1956 when the Hingson team inoculated children with the Salk vaccine in Cleveland, Ohio. Eventually more than 300,000 patients were immunized via jet injection, primarily against polio and influenza.

In 1958, Dr. Hingson and his team inoculated some 90,000 people throughout Asia and Africa against typhoid, cholera, and polio. These large-scale medical missions led him to establish the Brother’s Brother Foundation (BBF), which he led from 1958-1982. Dr. Hingson was Chief Anesthesiologist at Magee-Womens Hospital from 1968 to 1973 and left academic anesthesiology in 1973 to devote his full time to BBF. Still based in Pittsburgh, BBF has provided over $4 billion of medical supplies, pharmaceuticals, textbooks, food, seeds, and other humanitarian supplies to people around the world in 149 countries since 1958. The agency is now directed by Dr. Hingson’s son, Luke.

Dr. Hingson was a Professor of Public Health at Pitt from 1973-1982 when he retired. Over the course of his career, he authored or co-authored over 150 scientific publications and was nominated for a Nobel Peace Prize.

**1979-1996: Dr. Peter Winter**

Dr. Safar stepped down as Chair in 1978 and Drs. R. Brian Smith and later D. Ryan Cook served as interim chairs until 1979, when Peter M. Winter, MD became the second Chair of the Department of Anesthesiology and Critical Care Medicine, leading another revitalization. Throughout his influential career, Dr. Winter devoted himself to the recruitment and development of future researchers and clinicians, promoting excellence in patient care and the development of anesthesiology subspecialties (especially the field of transplantation anesthesiology), teaching, and innovation and helping to
make Pitt one of the nation’s top research and academic institutions. During his tenure as chair, anesthesia-related deaths decreased to almost zero. Many seriously ill patients who might previously have been lost or permanently disabled were revived through the use of pioneering life-support methods that Dr. Winter promoted. His leadership played a crucial role in many of the University’s notable accomplishments in transplant, neurological, and cardiac surgery. By emphasizing the multidisciplinary cooperation required for those breakthroughs, Dr. Winter called attention to the crucial roles of the anesthesiologist and intensivist.

Dr. Etsuro Motoyama, a distinguished pediatric anesthesiologist, pulmonary physiologist, and NIH-funded investigator, was recruited from Yale to become our first Vice-Chairman for Research. He was later joined by Dr. Leonard Firestone from Massachusetts General Hospital and Dr. Yan Xu from the University of California at San Francisco. An accomplished researcher who has made significant contributions to the field of anesthesia mechanisms, Dr. Xu developed into a dedicated educator and mentor with a high priority to advance the careers of the next generation of academic anesthesiologists and eventually became our Vice Chair for Basic Research. Dr. Winter allowed the creation of tenured and tenure-track faculty positions for PhD investigators in the department, allowing recruitment of the most talented PhD scientists to both join the research program and hold secondary appointments in basic science departments in the medical school. The program has since expanded to include multiple NIH-funded investigators who use advanced molecular biology, structural biology, computational biology, and molecular genetic techniques to study the molecular and cellular mechanisms of general anesthesia.

Under Dr. Winter’s leadership, we became one of the first anesthesiology departments to invest in training with human simulation, acquiring a full-sized computerized simulator and establishing a simulation center. Drs. Rene Gonzeles and John J. Schaefer III brought the first human simulators to UPMC. In 2001, the facility was named The Peter M. Winter Institute for Simulation, Education, and Research, or “WISER,” in honor of Dr. Winter. WISER has since grown into a health system-wide training center, utilizing simulation-based education to provide a safer environment for patients of UPMC and its affiliates.

During Dr. Winter’s tenure, the “University hospitals” began evolving into what is known today as UPMC. In 1986, they were consolidated under the management of the University of Pittsburgh Medical and Health Care Division, renamed “University of Pittsburgh Medical Center” or UPMC in 1990. Southside Hospital became part of UPMC in 1996; Passavant, Shadyside, and St. Margaret hospitals joined UPMC in 1997, and Children’s became part of UPMC in 2001. The growth of UPMC throughout this era caused subsequent expansion in the department, as it began to provide services and extend its influence to new clinical sites.

It was also during Dr. Winter’s tenure that we lost a valued alumnus. Charles W. Schertz, MD was a resident and later a faculty member. He served as an attending anesthesiologist and a member of the cardiac anesthesiology division at Presbyterian Hospital, where he was recognized as an outstanding clinician, teacher, and investigator. In 1990, Dr. Schertz tragically died in an avalanche while climbing the world’s seventh-highest mountain on the Nepal-Tibet border. Dr. Winter and the department established a research fellowship to honor Dr. Schertz’s memory in 1990.

Sadly, Dr. Winter passed away just this past year on May 14, 2016 at the age of 81.
DEPARTMENT HISTORY

1996-2001: Leonard L. Firestone, MD

Dr. Winter stepped down as Chair in 1996 and Leonard L. Firestone, MD took the helm until 2001 and led the department through significant development and expansion. In 1996, we took over services at UPMC Beaver Valley (formerly Aliquippa Hospital), marking the first departmental extension outside the Pittsburgh metro area and Allegheny County. Dr. Jan Smith served as Chief of Anesthesiology and Medical Director there and was assisted by Drs. Carol Rose, David Wilks and Robert Krohner. We also started a cardiac anesthesiology program at UPMC Lee Regional, led by D. Van Riper, MD, to facilitate the initiation of an open-heart surgery program in Johnstown, PA in 1988. In 1999, we ventured into international territory with the start of anesthesiology services at IsMeTT in Palermo, Italy.

Dr. Firestone catalyzed notable growth in basic science research. He conducted innovative research on anesthetic mechanisms and recruited outstanding scientists. By the end of his tenure in 2001, we ranked first in the United States among anesthesiology departments in terms of funding received from the NIH.

2001-2013: John P. Williams, MD

John P. Williams, MD successfully guided the department through a period of unprecedented growth as UPMC and its health plan blossomed into an integrated delivery and financial system. In 2002, the Department of Critical Care Medicine (CCM) and the Department of Anesthesiology split to become two separate departments. Dr. Williams assisted in developing the new CCM department at Pitt, which was also the first CCM department in the country, led by inaugural Chair Mitchell P. Fink, MD.

Dr. Williams continued to develop and broaden our research efforts. Under his leadership, the research program grew to include the molecular mechanisms and genetics of pain. Our long-standing ranking as one of the top anesthesiology departments in the nation in NIH-funded grants continued. Dr. Williams also established the Pittsburgh Center for Pain Research, further solidifying our ranking as one of the top academic anesthesiology departments in the nation.

Educational programs greatly expanded under the direction of Rita M. Patel, MD, who first came to Magee-Womens Hospital in 1984 to pursue an Obstetrical Anesthesiology Fellowship. Since then, she has served the department, Pitt’s medical school, and UPMC as a renowned anesthesiologist and educator. Dr. Patel became Director of the Anesthesiology Residency Program and built the program from the ground up into what many consider one of the top five residencies in the country. During this time, she was a finalist for the ACGME Parker J. Palmer Courage to Teach Award, given to the top 2% of program directors in the country. Dr. Patel would go on to progressively advance into educational leadership positions at the University, hospital, and national levels. She went on to become not only Vice Chair of Education in our department, but also Assistant and then Associate Dean for Graduate Medical Education for the University of Pittsburgh School of Medicine, the Accreditation Council for Graduate Medical Education (ACGME) Designated Institutional Official (DIO) for UPMC, as well as UPMC’s National Residency Matching Program DIO. Through these roles, she came to oversee 170 programs and 1,700+ residents in the UPMC system and mentor a cadre of outstanding clinician educators.
Mark E. Hudson, MD, MBA, who first joined our department as a member of Presby’s cardiac anesthesiology team in 1993, developed into an expert in innovative operational management and healthcare economics during this era. After serving as Director of Quality Assurance, Chief Anesthesiologist, and then Chair at UPMC Shadyside, he joined the department’s executive administrative team as Vice-Chair for Clinical Operations, overseeing all anesthetic sites and divisions throughout the health care system. Later, Dr. Hudson advanced into progressively larger management roles, first as Executive Vice Chair of the department and then Executive Director for Anesthesia Services for UPMC. Over the years, his leadership has resulted in a markedly more uniform department structure across all sites, improved clinical productivity per FTE, and a decrease in required system investment.

Our clinical sites further increased during this time. Mercy Hospital, although long affiliated with Pitt, did not officially become part of UPMC until 2008, and we officially began providing anesthesia services there in 2009. We also integrated UPMC Bedford, East, McKeesport, Northwest, and Passavant into our group during the Williams era. Our international arm was bolstered as anesthesiology services extended to UPMC Beacon Hospital in Dublin, Ireland, where Dr. Jan Smith later served as Associate Medical Director.

2015-Present: Howard B. Gutstein, MD

Dr. Marshall Webster served as Interim Chair from 2013 until September of 2015 when Howard B. Gutstein, MD was formally appointed as our new Chair. Dr. Gutstein was previously a Professor in the Department of Anesthesiology and Pain Management at the University of Texas-MD Anderson Cancer Center, with a secondary appointment in the Department of Biochemistry and Molecular Biology. He is a very accomplished researcher, primarily investigating the molecular mechanisms underlying the development of opioid tolerance and dependence and the interactions between pain and analgesic signaling. Under the leadership of Dr. Gutstein, a successful physician scientist fully committed to advancing anesthesia-related research, we are poised to achieve an even higher level of excellence and enter the next era of even greater success.

Over the decades, the University of Pittsburgh/UPMC Department of Anesthesiology has blossomed into one of the largest and best anesthesiology departments in the nation. When Dr. Safar arrived in Pittsburgh to start the department, only three physicians and 70+ nurse anesthetists managed all anesthesia services. Today, we serve 17 clinical sites, manage nearly 300,000 cases a year, and are staffed with more than 150 faculty physicians and over 350 CRNAs. Our ACGME-accredited residency program is now widely considered one of the best in the nation. We now host eight fellowship training programs: ACGME-accredited fellowships in adult cardiothoracic, pediatric, and obstetric anesthesiology, as well as anesthesiology critical care medicine and pain medicine; we also offer fellowships in hepatic transplantation anesthesiology, neuroanesthesiology, and acute pain and regional anesthesiology, one of the largest US programs in the specialty. Today, we train about 120 residents and clinical fellows every year. We also host two NIH T32 research fellowships to train pain researchers and physician scientists to become the next generation of leading researchers and physicians in academic anesthesiology.

Many illustrious individuals started their careers in the Pitt/UPMC Department of Anesthesiology, making their mark in the field and other medical specialties and shaping us into the success we are today. As we begin our next era of excellence, we reflect on the tremendous accomplishments of all the innovators who came before us.
### CHIEF ANESTHESIOLOGISTS AT UPMC AND AFFILIATED HOSPITALS

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<th>HOSPITAL</th>
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<td><strong>UPMC Mercy</strong></td>
<td>Francis Foldes</td>
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<td>Richard Kuwik (interim)</td>
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<td><strong>Children’s Hospital of Pittsburgh of UPMC</strong></td>
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<td><strong>Magee-Womens Hospital of UPMC</strong></td>
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<td>Kelly T. Shannon (interim)</td>
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<td><strong>Current</strong>: Jonathan H. Waters</td>
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<td><strong>UPMC Eye and Ear Hospital</strong></td>
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<td><em>Eye and Ear Hospital became Eye and Ear Institute Pavillon of Montefiore Hospital in 1990-1991</em></td>
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<td><strong>VA Pittsburgh Healthcare System</strong></td>
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<td><strong>Current</strong>: Michael Mangione</td>
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<td><strong>UPMC Montefiore</strong></td>
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<td>W. David Watkins</td>
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<td>Montefiore was integrated into Presbyterian in 1990-1991</td>
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<tr>
<td><strong>UPMC Presbyterian</strong></td>
<td>Leonard Monheim</td>
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<td>Peter Safar</td>
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<td></td>
<td>David Torpey</td>
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<td></td>
<td>Maurice Albin</td>
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<td>R. Brian Smith</td>
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<td>Les Cronou</td>
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<td>Achiel Bleyaert</td>
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<td>Jose Marquez</td>
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<td>Jan Smith</td>
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<td>Barbara De Riso</td>
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<td>Phil Lebowitz</td>
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<td>John P. Williams</td>
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<td></td>
<td><strong>Current</strong>: Joseph Quinlan</td>
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<td></td>
<td><strong>Current</strong>: Shawn T. Beaman, MD (interim)</td>
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<tr>
<td><strong>UPMC Shadyside</strong></td>
<td>Jack Scott/William Stept</td>
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<td></td>
<td>Richard Feduska</td>
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<td>Mark Hudson</td>
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<td></td>
<td><strong>Current</strong>: Robert Boretsky</td>
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<tr>
<td><strong>UPMC Southside</strong></td>
<td>Raymond Schwartz</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Michael Kentor</td>
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<tr>
<td><strong>UPMC Pain Medicine</strong></td>
<td>Ruben Tenicela</td>
</tr>
<tr>
<td></td>
<td>Brett Stacey</td>
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<tr>
<td></td>
<td>Doris Cope</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Ajay Wasan</td>
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<tr>
<td><strong>UPMC South Surgery Center</strong></td>
<td>Chein-Kuo “Jason” Kao</td>
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<tr>
<td></td>
<td>Saryu Desai</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Gregory Godla</td>
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<tr>
<td><strong>UPMC Beaver Valley</strong></td>
<td>Jan Smith</td>
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<td></td>
<td>*UPMC scaled back services at this hospital in 2000</td>
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<tr>
<td><strong>IsMeTT</strong></td>
<td>Victor Scott</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Antonio Arcadipane</td>
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<tr>
<td><strong>UPMC Beacon Hospital</strong></td>
<td>John Magner</td>
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<tr>
<td></td>
<td>*UPMC sold Beacon in 2014</td>
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<tr>
<td><strong>UPMC Passavant</strong></td>
<td><strong>Current</strong>: Dan Sullivan</td>
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<tr>
<td><strong>UPMC McKeesport</strong></td>
<td>Evelyn Tirol Gonzalez-Abola</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Michael Kentor</td>
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<tr>
<td><strong>UPMC St. Margaret</strong></td>
<td>Paul Shay</td>
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<tr>
<td></td>
<td><strong>Current</strong>: Jay Roskoph</td>
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<tr>
<td><strong>UPMC Horizon</strong></td>
<td><strong>Current</strong>: Cynthia Wells</td>
</tr>
<tr>
<td><strong>UPMC Northwest</strong></td>
<td>Darren Loughran</td>
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<td></td>
<td><em>The department stopped providing services at Northwest in 2015</em></td>
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</table>
## ADMINISTRATIVE LEADERSHIP

<table>
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<tr>
<th>ROLE</th>
<th>NAMES</th>
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<tr>
<td>Chair</td>
<td>Peter Safar &lt;br&gt; R. Brian Smith (interim) &lt;br&gt; D. Ryan Cook (interim) &lt;br&gt; Peter Winter &lt;br&gt; Leonard Firestone &lt;br&gt; John P. Williams &lt;br&gt; Marshall W. Webster (interim) &lt;br&gt; <strong>Current</strong>: Howard B. Gutstein</td>
</tr>
<tr>
<td>Vice-Chair</td>
<td>Etsuro K. Motoyama &lt;br&gt; W. David Watkins &lt;br&gt; <strong>Current</strong>: Mark E. Hudson (Executive Vice Chair)</td>
</tr>
<tr>
<td>Vice-Chair for Clinical Operations</td>
<td>Jan Smith &lt;br&gt; <strong>Current</strong>: Mark E. Hudson</td>
</tr>
<tr>
<td>Vice Chair for Education</td>
<td>Robert Willenkin &lt;br&gt; Rita M. Patel &lt;br&gt; <strong>Current</strong>: David G. Metro</td>
</tr>
<tr>
<td>Vice Chair for Faculty Development</td>
<td>Andrew Herlich &lt;br&gt; <strong>Current</strong>: Rita M. Patel</td>
</tr>
<tr>
<td>Research Leadership</td>
<td><strong>Director, Anesthesiology Research</strong>: Steve Galla &lt;br&gt; <strong>Vice Chair, Science and Research</strong>: Etsuro K. Motoyama &lt;br&gt; Leonard L. Firestone &lt;br&gt; <strong>Vice Chair for Basic Research</strong>: Yan Xu &lt;br&gt; <strong>Vice Chair for Clinical Research</strong>: Jacques E. Chelly &lt;br&gt; <strong>Current</strong>: Jonathan H. Waters</td>
</tr>
<tr>
<td>Residency Program Director</td>
<td>Roy Harris &lt;br&gt; D. Ryan Cook &lt;br&gt; David H. Wilks &lt;br&gt; Andrew Herlich (interim) &lt;br&gt; Charles Buffington &lt;br&gt; Rita M. Patel &lt;br&gt; <strong>Current</strong>: David G. Metro</td>
</tr>
<tr>
<td>Medical Student Programs Director</td>
<td>Paul Berkebile &lt;br&gt; Peter Waterman &lt;br&gt; Julie Tome &lt;br&gt; <strong>Current</strong>: Michael Mangione</td>
</tr>
<tr>
<td>Nurse Anesthetist Education Program Director</td>
<td><strong>CRNA Director</strong>: Mary DePaolis-Lutzo &lt;br&gt; Elizabeth Monti &lt;br&gt; <strong>Current</strong>: John M. O'Donnell &lt;br&gt; <strong>Physician Director</strong>: Stephen C. Finestone &lt;br&gt; Andrew Herlich &lt;br&gt; Jay Roskoph &lt;br&gt; <strong>Current</strong>: Theresa Gelzinis</td>
</tr>
<tr>
<td>Senior CRNA Director</td>
<td>Ella Thomas &lt;br&gt; Brent Dunworth &lt;br&gt; <strong>Current</strong>: Tim Lyons</td>
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</table>
In addition to the educational endeavors in which departmental 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.

GRAND ROUNDS

Under the direction of Dr. Charles Boucek, Director of the Grand Rounds Program and Dr. Rita M. Patel, Vice Chair for Faculty Development, the Anesthesiology Grand Rounds series continued, along with the many program features convenient for faculty, fellows, residents, and medical students in the department. The program allows viewing of digitally-recorded presentations online from any computer with internet access. Included with the presentations are multiple-choice questions for review and an evaluation form. In addition, review of modules allows for continuing medical education (CME) credit and the modules are kept online indefinitely as an educational resource.

The Grand Rounds Advisory Committee, which includes Drs. Jonathan Waters, Peter Davis, Michael Mangione, Jan Smith, David Metro, and Charles Boucek, as well as staff members William Thomson, Cody Clarke, and Barb Chismar, continued to assist with the organizational and educational aspects of Grand Rounds, providing input for speakers and topic suggestions. 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 (ISER) website hosts the recorded modules as enduring material.

In 2015-2016, approximately 190 faculty members viewed 30 presentations. Journal Clubs, organized by Dr. James Ibinson, are held monthly from September through May with great involvement from the Residency Program, and the department hosts lectures from visiting professors on various topics (names and topics can be found on the next page). Both the Journal Clubs and visiting professor lectures are integral to the success of the Grand Rounds series.

AMERICAN SOCIETY OF ANESTHESIOLOGY (ASA)

An impressive group of medical students, residents, fellows, and faculty members from the department participate in ASA every year. The 2015 meeting was held from October 24-28 in San Diego, California. Residents, fellows, and faculty members delivered 47 presentations, which included 24 resident presentations on original research and medically challenging cases. Additionally, 15 faculty members and three residents served on ASA and ASA-related committees. Many from our department also 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 (PBLDs), 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>
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<tbody>
<tr>
<td>September 3, 2015</td>
<td>Ezeldeen Abuelkasem, MBCh, MSc*, Daniel Mandell, MD*, Michael Schnetz, MD, PhD*</td>
<td>Journal Club 1</td>
</tr>
<tr>
<td>September 10, 2015</td>
<td>William McIvor, MD*</td>
<td>High Fidelity Simulation in the Maintenance of Certification in Anesthesiology Process</td>
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<tr>
<td>September 10, 2015</td>
<td>Theresa Gelzinis, MD*</td>
<td>Anesthesia for Patients with VADs Undergoing Non-cardiac Surgery</td>
</tr>
<tr>
<td>September 17, 2015</td>
<td>Jacques E. Chelly, MD, PhD, MBA*</td>
<td>Acute Interventional Perioperative Pain Medicine: Past, Present, and Future</td>
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<tr>
<td>October 1, 2015</td>
<td>Vladyslav Melnyk, MD*, Douglas Curphey, MD*</td>
<td>Journal Club 2</td>
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<tr>
<td>October 8, 2015</td>
<td>Kristin Ondeko Ligda, MD*</td>
<td>In-Flight Medical Emergencies: What You Need to Know at 35,000 Feet</td>
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<tr>
<td>October 8, 2015</td>
<td>Patrick Forte, MD*</td>
<td>Resident Selection</td>
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<tr>
<td>October 15, 2015</td>
<td>Diana DeAndrade, MD*, N. Tran H. Nguyen, MD, MPH*, Ragini Gupta (UPSOM Medical Student)</td>
<td>ASA Rehearsals</td>
</tr>
<tr>
<td>November 5, 2015</td>
<td>Alex Dressler, MD*, Rachel Hadler, MD*, Eugene Raggi, MD*</td>
<td>Journal Club 3</td>
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<tr>
<td>November 12, 2015</td>
<td>Catalin Ezaru, MD*</td>
<td>Obstructive Sleep Apnea in the Surgical Patient</td>
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<tr>
<td>November 19, 2015</td>
<td>Randy Legault, DO Department of Anesthesiology University of Kentucky</td>
<td>Pulmonary Hypertension and Anesthesia</td>
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<tr>
<td>December 3, 2015</td>
<td>Ian Brotman, MD*, Sara Straesser, MD*, Lieu Tran, MD*</td>
<td>Journal Club 4</td>
</tr>
<tr>
<td>December 10, 2015</td>
<td>John R. Holmes, DMP Diagnostic Medical Physicist Radiation Safety Office University of Pittsburgh</td>
<td>Radiation Safety for Anesthesiology</td>
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<tr>
<td>December 17, 2015</td>
<td>J. Peter Rubin, MD UPMC Professor &amp; Chair, Department of Plastic Surgery Professor of Bioengineering, University of Pittsburgh</td>
<td>Plastic Surgery and the Science of Adipose Stem Cells</td>
</tr>
<tr>
<td>January 7, 2016</td>
<td>Anna Carpenter, MD*, Daniel Springer, MD*</td>
<td>Journal Club 5</td>
</tr>
<tr>
<td>January 14, 2016</td>
<td>Umamaheswar Duvvuri, MD, PhD Director of Robotic ENT Surgery; Assistant Professor of Otolaryngology, University of Pittsburgh</td>
<td>Robotic Head &amp; Neck Surgery: What’s New?</td>
</tr>
<tr>
<td>January 14, 2016</td>
<td>Max Fedor, MBA Director, Coulter Translational Research Partners II Program</td>
<td>Center for Medical Innovation and Coulter TP2 Program</td>
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<tr>
<td></td>
<td>Alan D. Hirschman, MD Professor, Bioengineering, University of Pittsburgh</td>
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<td>Executive Director, Center for Medical Innovation</td>
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<tr>
<td>Date</td>
<td>Speaker(s)</td>
<td>Topic</td>
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| January 21, 2016 | Holger Eltzschig, MD, PhD  
Professor of Anesthesiology, Medicine & Immunology; Director, Organ Protection Program; Chief, Anesthesia Service for Oncologic Surgery, Department of Anesthesiology, University of Colorado School of Medicine | Perioperative Organ Protection                                                          |
| January 28, 2016 | Linwah Yip, MD  
Associate Professor, Division of Surgical Oncology and Endocrine Surgery, UPMC | Anesthesia During Parathyroidectomy                                                      |
| February 4, 2016 | Viji Kurup, MD  
Director, Departmental Education Associate Professor Department of Anesthesiology, Yale University School of Medicine | Journal Club 6: Jeopardy                                                                 |
| February 18, 2016 | Evan Kharasch, MD, PhD  
Russell D. & Mary B. Shelden Professor of Anesthesiology, Washington University in St. Louis, Department of Anesthesiology; Director for Center for Clinical Pharmacology, St. Louis College of Pharmacy & WUSM | Integrating Evidence and Efficiency in an Anesthesia Residency Curriculum               |
| February 25, 2016 | Andrius Giedraitis, MD, MBA*  
Kaarin Michaelsen, MD, PhD*  
Elizabeth Ungerman, MD* | Methadone; Pharmacology and Perioperative Application                                    |
| March 3, 2016 | Ashutosh Jadhav, MD  
Assistant Professor of Neurology and Neurological Surgery, University of Pittsburgh | Endovascular Therapy for Acute Ischemic Stroke                                          |
| March 10, 2016 | Randall Flick, MD, MPH  
Associate Professor of Anesthesiology & Pediatrics; Medical Director, Mayo Clinic Children's Center, Rochester, MN | Anesthetic Related Neurotoxicity in Young Children, or Will Anesthetic Exposure Make Your Patient Stupid? |
| March 10, 2016 | David L. Brown, MD, FACHE  
CEO and Founder, Curadux LLC. Austin, TX & Hayward, WI | Advanced Illness in Critical Care: Standing between Life & Death – A Personal & Professional Perspective |
| March 17, 2016 | James Cain, MD, MBA, FAAP*  
Kathleen Coy, MD* | ACGME's Next Accrediting System, Milestones & Clinical Learning Environment Review       |
| March 24, 2016 | Robert Pearce, MD  
Chairman, Dept. of Anesthesiology University of Wisconsin | How do General Anesthetics Block Memory?                                                 |
| May 5, 2016 | Kelsey Bauer, MD*  
Nicole Verdecchia, MD* | Journal Club 9                                                                           |
| May 19, 2016 | Mitchell Tsai, MD, MMM  
Associate Professor of Anesthesiology, Fletcher Allen Health Care, University of Vermont College of Medicine | OR Management Rebooted: Going from the ABCs to the DSS                                  |
| May 26, 2016 | Mark D. Neuman, MD, MSc  
Assistant Professor, Department of Anesthesiology and Critical Care University of Pennsylvania | Improving Outcomes for Older Adults with Hip Fracture: Early Lessons from the REGAIN Trial |
The UPMC Anesthesiology Residency Program is fully-accredited by the ACGME to provide training and education in anesthesiology leading to American Board of Anesthesiology (ABA) certification. 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 our 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 in 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 2016 (a complete list with graduation plans is provided at the end of this section). As in previous years, academic year 2015-2016 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’ curriculum, 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. The Resident Education Committee has incorporated the new ACGME-defined “milestones” into the curriculum and has developed assessment tools. Special lectures, presentations, and educational sessions were included in the curriculum on anesthesiology billing, practice management, ethics, patient care, and systems-based practice.

The academic year was also notable for the continuation of our excellent didactic program. The committee coordinated core topics for the 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. Colleen Moran, case-management sessions are presented in American Society of Anesthesiology problem-based learning discussion (PBLD) 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. Again this year, a monthly journal club was included in the Grand Rounds curriculum under the direction of Drs. James Ibinson and 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.

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 addition to regular attendance at lectures and grand rounds, a standard requirement in the residents' curriculum is participation in at least one session of the Clinical Procedures Course sponsored by the University of Pittsburgh School of Medicine. This allows them the opportunity to teach medical students in a traditional classroom setting in addition to clinical teaching during the medical student clerkships and electives.

We are pleased to announce that in the 2015-16 year, for the third year in a row, all of our graduating residents passed their ABA written boards on the first attempt. This passing rate is a clear indicator of the success of our educational programs and the faculty members that participate in them.
Many resident courses are conducted at the Peter M. Winter Institute for Simulation Education and Research (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 year, residents were able to 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 their subspecialty rotations in regional, obstetric, and liver transplantation anesthesiology.

One result, as measured by simulation, was an improvement in residents’ management of difficult airways. There is also an introductory program that 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 provides 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.

EVALUATION AND COMPETENCE
The Evaluation and Competence Subcommittee, chaired by Dr. James Cain, 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 must be 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.

HONORS
The residents chose Dr. Heather Hayanga to receive the 2016 Dr. Leroy Harris Award for Excellence in Teaching. Dr. Metro presented outgoing PGY-4 resident Dr. Anne Kamarchik with our Mark H. Gilliland, MD Award for Best Clinical Resident. This annual award honors the memory of a former chief resident in anesthesiology. The residents introduced a new award, the Trainee-to-Trainee Award, to Dr. Daniel Ford.

PARRC
The Anesthesiology Residency Program attended the 10th annual Pennsylvania Anesthesiology Resident Research Conference (PARRC) in Hershey, PA on May 14, 2016, which was sponsored by Penn State Hershey Medical Center. PARRC is an opportunity for residents and faculty to learn about current cutting edge research by anesthesiology residents from all eight programs across the state of Pennsylvania. Both original research and case reports were submitted in both oral presentation and poster categories, representing scholarly activities performed at each institution. UPMC was represented by nine residents who gave oral presentations and five who presented posters. UPMC Anesthesiology was the most awarded program in the state, winning all available first place awards at the competition.
1st place: Original Research – Oral  Adam J. D’Souza, MD (PGY-4), Brian Frankowski, William Federspiel, PhD: “Oscillating Fibers as a Mode for Active Mixing in Hollow Fiber Membrane Oxygenators”

1st place: Original Research – Poster  Daniel Mandell, MD (PGY-2): “Institutional Tissue Plasminogen Activator Policy for Intraoperative Pulmonary Thromboembolism during Liver Transplantation”

1st place: Case Report – Oral  Bryant F. Bunting, DO (PGY-4): “Suspected Malignant Hyperthermia in the Setting of Hypothermic Circulatory Arrest for Type A Aortic Dissection Repair”

1st place: Case Report – Poster  Jessica M. Cassavaugh, MD, PhD (PGY-3): “Multiple Anesthetics for a Patient with Stiff-Person Syndrome”

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 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.

The residency program curriculum has included resident system-based practice projects since 1996 under the direction of Dr. Rita M. Patel. A systems-based practice project is required of every PGY-4 resident. This project consists of identifying a system-wide problem/issue and addressing it by conducting appropriate research, writing a paper, and presenting an executive summary to the department’s Executive Steering Committee. The paper is reviewed by the Vice Chair for Education and both the paper and presentation are evaluated. The resident receives written feedback on the paper from the Vice Chair for Education and oral feedback on the presentation by the Executive Steering Committee immediately at their conclusion. Upon completion, these projects represent complete investigations and potential solutions to departmental and system-wide clinical issues.

The department’s experience regarding the contributions of our senior residents’ systems-based practice projects to patient care was published in the Journal of Clinical Anesthesia (September 2015, Volume 27, Issue 6, Pages 451–456).

SUMMARY

Excellent clinical teaching and experience combined with a high volume and diversity of cases has always been a prominent feature of the program. Residents complete subspecialty rotations in pediatric, obstetric, and general anesthesiology, as well as critical care medicine and pain medicine. The program provides additional training in the management of advanced medical and surgical cases in subspecialty areas including cardiac, neuro, thoracic, liver transplantation, and regional/ambulatory anesthesiology, as well as in the PACU.

Our residency program continues to be nationally renowned for the quality of education provided, diversity and volume of clinical cases, and resident performance.
HISTORY
The UPMC Anesthesiology Residency Program first offered a clinical base year (CBY) program during the 2005-2006 academic year. Prior to that, the program only offered advanced positions for residents after they completed an internship in another department or program. Although anesthesiology residency programs had offered post-graduate year (PGY)-1 training in the past, our department was one of the first of our peers to integrate a PGY-1 year into the residency as part of a recent movement to make all anesthesiology residency programs categorical.

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 rotation schedule trained six highly competitive interns (Figure 1). Development of the program would not have been possible without the generous support of the UPMC Departments of Emergency Medicine, Medicine, Pediatric Emergency Medicine, and Surgery. In particular, the support of the following faculty members during the development and initial years of the program was invaluable:

- Dr. Raquel Buranosky, Internal Medicine Program Director
- Dr. Jacques Chelly, former Director of the Anesthesiology Acute Interventional Perioperative Pain Service
- Dr. Patrick Forte, Director of the Preoperative Evaluation Clinic at UPMC Presbyterian/Montefiore
- Dr. Kenneth Lee, Surgery Program Director
- Dr. Julie McCausland, Emergency Medicine faculty
- Dr. Raymond Pitetti, Pediatric Emergency Medicine Program Director
- Dr. Mark Schmidhofer, Division of Cardiology
- Dr. Shanta Zimmer, Internal Medicine Program Director

PRESENT PROGRAM
Over the last decade, the Anesthesiology CBY has grown to train 12 PGY-1 residents in 2015-2016 (Figure 2) and 15 are slated for 2016-2017. Dr. Beaman has served as director of the program since the 2006-2007 academic year. The anesthesiology, acute pain, emergency medicine, inpatient internal medicine, and pediatric emergency medicine foundational rotations have endured throughout the history of the program.

The gradual shaping of the program and inclusion of new and innovative rotations has continued to increase its competitiveness. With the support of Drs. Jonathan Waters (Department of Anesthesiology), Mark Yazer (Department of Pathology), Thomas Chalifoux (Department of Anesthesiology), and Franklin Bontempo (Division of Hematology & Oncology), the current CBY residents spend a month learning clinical transfusion medicine and coagulopathy management.
Drs. Jonas Johnson and Robert Ferris now host the anesthesiology interns on the Head & Neck Surgery Service, during which they learn perioperative surgical management and basic surgical techniques. The experience the interns gain in the management of tracheostomies and patients having undergone airway surgery is invaluable for a future anesthesiologist.

Over the early history of the program, it quickly became apparent that the original cardiology elective under the direction of Dr. Mark Schmidhofer was integral. It is now a very educational and popular compulsory rotation. PGY-1 anesthesiology residents now obtain their critical care medicine introduction in the medical ICU at UPMC Presbyterian and in the cardiovascular ICU at UPMC Mercy.

### Figure 1: Clinical Base Year 2005-2006

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Anesthesiology Clinical Base Year (PGY-1)

<table>
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<tr>
<th>Anes - Anesthesiology</th>
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<th>Med - Medicine</th>
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<tr>
<td>CCM - Critical Care Medicine</td>
<td>ED - Emergency Department</td>
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</tbody>
</table>

*Elective rotation: *App - Anesthesiology Professional Practice
*:Blood - Hemostasis & Hemotherapy
*:Cardio - Cardiology
*:Cardiac Intensive Care Unit (PICU)
*:Cardiovascular ICU (Mercy)
*:Emergency Medicine (PUM)
*:Emergency Medicine (UCSP)
*:Internal Medicine (MHI)
*:Medical ICU (PUM)
*:Peds - Pediatric Unit
*:Pediatric Emergency Medicine (UCSP)
The Anesthesiology Professional Practice (APP) rotation for our clinical base year (PGY-1) residents was created in 2014 and has grown stronger each year since. This is a dedicated one-month non-clinical rotation in which our new physician trainees are exposed to many broader 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 the following content areas, including:

- 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

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, shadow the charge anesthesiologist at UPMC Presbyterian, and learn insightful things about themselves and how they interact with others.

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

This unique rotation is a highlight of our residency training program that has no parallel elsewhere. The APP experience lays a strong foundation for our residents' subsequent clinical anesthesiology training, and is extremely well-liked by the two classes 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 chosen practice environment. 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. This year’s interview season started in September with the opening of the Electronic Residency Application Service. 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 FY16, we received 1,048 applications for 17 positions, 15 categorical and two advanced. After initial screening, applicants were offered interview spots, with a target of 16 applicants per interview day. There were 13 interview days throughout the season from mid-October through late January. One of the days was reserved for applicants with a strong interest or background in research. The 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 Department 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, Selection Committee Chair, and two other attendings, while the other half were given a tour of UPMC Presbyterian and Montefiore. After a lunch break attended by current residents, the groups were switched in the afternoon. In FY16, we interviewed 203 applicants for the 17 positions. After the final interview day, the entire Resident Education Committee met to review each applicant and assign a numerical score. All members of the committee and all 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 18, 2016.

Our submitted rank list contained 193 applicants; we matched four of our top five and seven of our top 13 and filled under 50. As in past years, after the match, we sent surveys to the top 100 applicants who did not match with us asking them to compare multiple aspects of our program to the program that they ultimately matched into. The information we gain from these surveys helps us to make changes to the interview process and perhaps changes to the program itself.

2016 MATCH RESULTS

**Categorical Four-year Positions**
Douglas Adams, MD, Thomas Jefferson University
Daniel Bintrim, MD, University of Pittsburgh School of Medicine
Anusari Dewasurendra, MD, University of Pittsburgh School of Medicine
Luke Doney, DO, Lake Erie College of Osteopathic Medicine
Michael Gemma, MD, Wright State University
Lindsay Hahn, MD, MSEd, Hofstra University
Maciej Klosowski, MD, Thomas Jefferson University
Sofiane Lazar, MD, Temple University
Donald Miller, MD, Penn State University

**Advanced Three-year Positions**
Sean McDermott, MD, University of Pittsburgh School of Medicine
Wen Xu, MD, Washington University in St. Louis

Kelsey Mitchell, MD, MPH, State University of New York Upstate
Claudia Mulock, MD, Drexel University
Kevin Pardo, MD, University of Southern California
Kate Petty, MD, Wayne State University
Christopher Smith, MD, Northeast Ohio Medical University
Michael Sypert, DO, Ohio University of Osteopathic Medicine
2015-2016 RESIDENTS

PGY-1

Marshall Bahr, MD
Philip Carullo, MD
Nathan Hoaglund, MD
Hayden Hundley, MD MPH
Andrea Ibarra, MD
Brandy Johnson, MD
Patrick Kennedy, MD
Evan Lebovitz, MD
Courtnay Mechling, MD
Shawn Palmer, MD
Brandon Staub, MD MS
Chelsey Woodrum, MD

PGY-2

Ezeldeen Abuelkasem, MBBCh
Kelsey Bauer, MD
Ian Brotman, MD
Anna Carpenter, MD
Kathleen Coy, MD
Douglas Curphey, MD
Diana DeAndrade, MD
Alex Dressler, MD
Andrius Giedraitis, MD MBA
Daniel Mandell, MD
Vladyslav Melnyk, MD
Kaarin Michaelsen, MD PhD
Eugene Raggi, MD
Michael Schnetz, MD PhD
Daniel Springer, MD
Sara Straesser, MD
Lieu Tran, MD
Elizabeth Ungerman, MD
PGY-2, CONTINUED

Nicole Verdecchia, MD

PGY-3

Bryce Bernard, MD
Jessica Cassavaugh, MD, PhD
Youngeun Cho, MD
Meghan Cohen, MD
Zachary Cohen, MD
Courtney Garbee, DO

Melanie Hodge, MD
Richard Hubbard, MD
Andrew Hulme, MD
Joshua Knight, MD
Derek Lauter, MD
David Nelson, MD, MBA

Lauren Parker, MD
Rachel Pool, MD
Daniel Ripepi, MD
Daniel Sandusky, MD
Brenda Satterthwaite, MD
Lindsay Stollings, MD

Michael Thompson, DO
Peter Yeh, MD
### GRADUATING RESIDENTS - JUNE 2016

<table>
<thead>
<tr>
<th>Name</th>
<th>Post-grad Employment</th>
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<tr>
<td>Douglas Bentley</td>
<td>Regional Anesthesiology Fellowship, UPMC</td>
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<tr>
<td>Bryant Bunting</td>
<td>Cardiothoracic Fellowship, UPMC</td>
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<tr>
<td>Andrew Clary</td>
<td>Pain Medicine Fellowship, UPMC</td>
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<td>Erica Coffin</td>
<td>Obstetric Anesthesiology Fellowship, UPMC</td>
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<tr>
<td>Jerry Dong</td>
<td>Pediatric Anesthesiology Fellowship, Arkansas Children’s Hospital</td>
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<tr>
<td>Adam D’Souza</td>
<td>Pediatric Anesthesiology, Children’s Healthcare of Atlanta (Georgia)</td>
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<tr>
<td>Gregory Halenda</td>
<td>Pediatric Anesthesiology Fellowship, University of Cincinnati</td>
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<tr>
<td>Christopher Howson</td>
<td>Pain Medicine Fellowship, Wisconsin</td>
</tr>
<tr>
<td>Christopher Johnson</td>
<td>Critical Care Anesthesiology Fellowship, UPMC</td>
</tr>
<tr>
<td>Anne Kamarchik</td>
<td>Pediatric Anesthesiology Fellowship, UPMC</td>
</tr>
<tr>
<td>Gerhardt Konig</td>
<td>Magee-Womens Hospital of UPMC Faculty Position, part time University of Pittsburgh faculty</td>
</tr>
<tr>
<td>Mary Margaret Lim</td>
<td>Cardiothoracic Fellowship, UPMC</td>
</tr>
<tr>
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<tr>
<td>Ngoc Tran Nguyen</td>
<td>Pediatric Anesthesiology Fellowship, Medical College of Wisconsin</td>
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<tr>
<td>Raj Padalia</td>
<td>Pain Medicine Fellowship, Tampa Bay, Florida</td>
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<tr>
<td>Alexander Preus</td>
<td>Critical Care Medicine Fellowship, UPMC</td>
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<td>Nicholas Schott</td>
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<td>Maciej Klosowski, MD</td>
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<td>Sofiane Lazar, MD</td>
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**2016-2017 INCOMING RESIDENTS**

**PGY-1**
- Douglas Adams, MD
- Daniel Bintrim, MD
- Anusari Dewasurendra, MD
- Luke Doney, DO
- Michael Gemma, MD
- Lindsay Hahn, MD
- Maciej Klosowski, MD
- Sofiane Lazar, MD
- Kelsey Miller, MD
- Kevin Pardo, MD
- Kate Petty, MD
- Christopher (Tyler) Smith, MD
- Michael Sypert, DO

**PGY-2**
- Jonah Abraham, MD
- Steven Bartels, MD
- Luke Davanzo, MD
- Eric Magda, MD
- Liora Yehushua, MD
RESIDENT LEADERSHIP, 2015-2016

Chief Positions
Chief Resident: Christopher Howson
Associate Chief Resident: Andrew Clary
Associate Chief Resident: Margaret Lim

Junior Chief Positions
Advocacy: Zach Cohen
Zach coordinated resident involvement in professional society and physician advocacy conferences, events, and activities. He regularly updated residents on active political issues and coordinated resident efforts in communicating with government officials.

Education: Lauren Parker and Rachel Pool
Lauren and Rachel worked to improve clinical teaching, didactics, and other aspects of resident education. They participated regularly in the resident education committee (REC) and the curriculum subcommittee of the REC, including improving the lecture/PBLD content and improving the feedback process. They encouraged other residents to participate in the REC committee and collected input from residents for improvements to education.

Journal Club & Grand Rounds: Andrew Hulme
Andrew coordinated monthly journal club sessions, including assigning residents to groups, assisting residents in choosing and analyzing articles, and developing their presentations. He coordinated resident Grand Rounds practice presentation sessions prior to major conferences. Andrew also assisted the grand rounds faculty coordinator with invited speakers as needed.

Patient Safety/Quality Improvement: Derek Lauter and Mike Thompson
Derek and Mike worked with clinical site and departmental quality assurance/improvement committees, participated in the resident patient safety committee, and facilitated resident submission of cases for review by this committee. They were available to assist residents with creating morbidity and mortality presentations.

Recruitment: Josh Knight, David Nelson, and Brenda Satterthwaite
Cooperatively, Josh, David, and Brenda coordinated the location of and current resident attendance at pre-interview dinners, and also managed communications with applicants and helped plan interview days.

Scholarly Activity (Research): Jess Cassavaugh and Richard Hubbard
Jess and Rich coordinated resident research and other scholarly activity. They facilitated matching faculty and residents to work on projects of mutual interest. They coordinated participation in the resident research rotation and presentation of resident work at conferences. Jess and Rich also coordinated the resident poster review committee.

Social Activities: Meghan Cohen and Peter Yeh
Meghan and Peter were responsible for announcing and coordinating resident participation in department events. They also planned a variety of social events throughout the year.

Technology: Bryce Bernard
Bryce developed novel multimedia content and helped maintain the accuracy of the residency section of the department’s website. He provided technical assistance to other junior chiefs as needed.

Committee Representatives
System-Wide Quality Improvement: Christopher Howson
Compensation and Benefits Subcommittee: David Nelson
Pennsylvania Society of Anesthesiology (PSA) Resident House of Delegates: Zach Cohen
American Society of Anesthesiologists Resident House of Delegates: Andrew Hulme
IV Standardization and Drugs Taskforce: Mike Thompson
Recruitment, Orientation, Activities, and Retention Committee: Christopher Howson
Resident Patient Safety Committee (PGY-2): Anna Carpenter and Alex Dressler
Resident Patient Safety Committee (PGY-4): Greg Halenda and Margaret Lim
Medical Student Anesthesiology Interest Group: Richard Hubbard (Resident Advisor)
PSA Resident House of Delegates President Elect: Zach Cohen
RESIDENT SOCIAL ACTIVITIES

PGY-2 residents spending a day at the Peter M. Winter Institute for Simulation, Education, and Research (WISER) in preparation for their first clinical day.

Residents lose a friendly game of sand volleyball to their attendings at the Annual Residency Welcome Picnic.
Work hard, play hard. Residents and faculty enjoy a Saturday by attending the Program Annual Review by day and a game at PNC Park by night. Go Buccos!

Resident white water rafting trip!
The band Bropofol plays in front of a packed house. Special thanks to our PGY-3 residents Andy Hulme (bass), Josh Knight (lead guitar), and Dave Nelson (drums) for a great show!

PGY-1 residents huddle up for a quick picture during their Anesthesiology Professional Practice rotation - a four week curriculum that culminated with the entire class traveling to the ASA Annual Meeting in San Diego!
EDUCATION

RESIDENT SOCIAL ACTIVITIES

ASA 2015 IN SAN DIEGO
Dr. Zachary Cohen (left) was elected to be the following year’s President of the Pennsylvania Society for Anesthesiologists Resident Component!!

Residents and faculty spend an evening as representatives for the Pennsylvania Society of Anesthesiologists with Pennsylvania House of Representatives Democratic Leader Frank Dermody and Pittsburgh’s Mayor Peduto.
Residents enjoying a post application dinner dessert

Residents planned an off-campus event to celebrate Physician Anesthesiologist Week.

Dr. Gelzinis’ annual Halloween party.
The department offers an ACGME-accredited Adult Cardiothoracic Anesthesiology (ACA) Fellowship Program with a one year clinical training length and four fellow positions. Graduates of ACGME-accredited anesthesiology residency programs who seek advanced training in the management of patients presenting for cardiac, thoracic, and vascular surgery are invited to apply. The 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 quality of leadership, organization, record of scholarship, and the dedication of one morning each week for teaching. The fellowship program transitioned into the Next Accreditation System (NAS), with a self-study visit scheduled for April 22, 2022.

Education/training occurs at UPMC Presbyterian, UPMC Shadyside, and UPMC Passavant. An elective rotation is also available at ISMETT located in Palermo, Sicily. ACA 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 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, ACA 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 that is held jointly with cardiothoracic anesthesiology, cardiology, cardiac surgery, and critical care medicine fellows and faculty. A combined ACA faculty and fellow conference is held quarterly and includes case presentations, morbidity and mortality discussions, journal club, and quality improvement topics. Fellows also attend weekly cardiothoracic surgery education sessions and grand rounds.

Fellows are encouraged to submit their 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 four years and have received recognition for outstanding presentations.

### ACA Fellow Post-graduation Plans

<table>
<thead>
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<tbody>
<tr>
<td>Julie DeVore, DO, MPH</td>
<td>Private practice with Excela Health System in Pittsburgh, PA</td>
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<tr>
<td>Daniel Ford, MD</td>
<td>Private practice with Jefferson Regional Medical Center in Pittsburgh, PA</td>
</tr>
<tr>
<td>Andrew Gentilin, MD</td>
<td>Private practice in Charleston, WV</td>
</tr>
<tr>
<td>Travis Schisler</td>
<td>Private practice in Vancouver, BC</td>
</tr>
</tbody>
</table>
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, Miro Klain, and Jim Snyder. The spirit of those leaders is still alive and the majority of our faculty work in the 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 CCM. In addition, it is a 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 residency in an accredited anesthesiology program. Fellows are exposed to a variety of critically-ill patients in the diverse ICUs within UPMC. In addition to clinical care, fellows are exposed to research opportunities with 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 their research through second- or third-year NIH T-32 training grants. With abundant and excellent resources, faculty, facilities, and patient volume and variety, the Anesthesiology CCM Fellowship Program provides exceptional experience and education in the field.

In FY15, Dr. Kaynar received his first R01 grant on the role of zinc and other trace elements in the resolution of inflammation. He planned to have trainees work within pre-clinical models with the support of his grant. A Department of Anesthesiology seed grant helped him to achieve this success. Dr. Kaynar received a UPP grant to further his project on the same theme. In FY16, another CCM anesthesiologist, Dr. Hernando Gomez, received a NIH K08 grant to study the role of mitochondrial dysfunction on acute kidney injury.

The number of applicants to critical care anesthesiology programs has been decreasing nationally over the last 10 years. After discussions with Drs. Rita M. Patel, David G. Metro, Mark Hudson, and Derek Angus, the visibility of CCM/Anesthesiology as a career choice has been enhanced through the following efforts:

- A CCM interest group was established within the School of Medicine in addition to the fourth-year medical school elective
- The number of medical school scholarly project mentors was increased (Drs. Dalby, Gomez, Phillips, and Kaynar were added)
- Anesthesiology residents participate with fellows in the CRISMA research seminars in the Department of CCM to expose them to research opportunities
- Communication was increased with national program director organizations to provide information regarding the CCM Fellowship Training Program at UPMC
- Cooperation between the Departments of Anesthesiology and CCM to identify prospective faculty from members of the training program. We recruited Dr. John Wallisch as a faculty member in both departments.
- In collaboration with Dr. Erin Sullivan, Program Director of the Adult Cardiothoracic Anesthesiology Fellowship Program, ICU-based transthoracic echocardiogram and transesophageal echocardiogram (TEE) has been incorporated to assess the pathophysiology of the critically-ill.
Journal club presentations were united between the Departments of Anesthesiology and Critical Care Medicine; the first combined journal club led by Sean DeChancie, DO was a success.

All of these efforts led to the fourth consecutive year of filling all four anesthesiology CCM fellow positions in academic year 2015-16, with a fellow mix from internal and external candidates. We received 68 applications and interviewed 20 applicants for the four positions. We are also recruiting for the 2016-17 academic year towards filling all four positions. We are proud of our graduating fellows; all of them decided to accept academic faculty positions. We also recruited Dennis Phillips, DO as our Associate Program Director and Dr. DeChancie as the Director for Anesthesiology CCM Outreach. Dr. Gomez is overseeing fellow scholarly research and Dr. Phillips started to work on the critical care unit as an intensivist.

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

**Summary of Post-doctoral Fellows and Activities**
Fellows successfully completed the 12-month ACGME-accredited education program in CCM anesthesiology and performed the following additional activities

- New program in bedside TEE use in the ICU
- New quality improvement (QI) project on the value of bedside TEE in decision making on improved patient outcomes
- New QI project on the value of translating intra-operative variables (such as tidal volume) on improved post-operative outcome variables (such as length of hospital stay). This project has also been very fruitful that it is becoming a platform for residents in anesthesiology to do scholarly projects on “big data” in healthcare.
- Effect of post-cardiac arrest cooling on improved neurological outcomes

Competency-based evaluations of all the fellows by the faculty improved from the fall to the spring semester.

We initiated a new program in the use of TEE in the ICU setting to help practitioners make decisions and increase educational opportunities for fellows to be trained in this technology. TEE has been well-established in the operating room as a valuable decision-making tool and became an integral part of the cardiac anesthesiology program.

**Anesthesiology CCM Fellow Post-graduation Plans**

<table>
<thead>
<tr>
<th>Name</th>
<th>Future Plans</th>
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<tbody>
<tr>
<td>John Wallisch</td>
<td>Anesthesiology and Critical Care, UPMC</td>
</tr>
<tr>
<td>Rachel Hadler</td>
<td>Fellow, Palliative Medicine, NYU</td>
</tr>
<tr>
<td>Patrick Hackett</td>
<td>Anesthesiology and Critical Care, Maine Medical Center</td>
</tr>
<tr>
<td>Edward Yang</td>
<td>Anesthesiology and Critical Care, NYU</td>
</tr>
</tbody>
</table>

**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
FELLOWSHIP PROGRAMS

RAYMOND M. PLANINSIC, MD
Director

sufficient qualification to become a Director of HTA in other major medical centers, thus joining the vast alumni of this highly-successful fellowship program.

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 (PUH) has an extraordinarily busy neurosurgical service, performing over 4,000 cases per year. 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).

BRIAN GIERL, MD
Director

In addition to adult neurosurgical cases at PUH, 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 department of Neurological Surgery, work within the Safar Center of Resuscitation Research, or with members of the neuroanesthesiology division at PUH. The division director is working on an NIH grant involving functional MR imaging.

Monthly neuroanesthesiology division meetings are held at PUH as part of the weekly PUH anesthesiology conferences. Anesthesiology Grand Rounds are held weekly. Additionally, there are weekly stroke conferences and the neurosurgical department meetings, including morbidity and mortality.

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 the fellows progress, they will also 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.
OBSTETRIC ANESTHESIOLOGY

The Department of Anesthesiology at Magee-Womens Hospital of UPMC (MWH) offers a PGY-5 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 educational participation is given 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. A nationally-recognized Maternal-Fetal Medicine Department, Neonatology Department, and the Magee-Womens 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. One month elective opportunities are offered, either in a unique combined neurology and transfusion medicine elective or a regional anesthesia elective. Opportunities for other elective development are possible if a fellow has a particular interest in a specific field of medicine. Each fellow is offered one elective month. International visitation and teaching opportunities for interested fellows are encouraged, but not part of the program.

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 PBLDs at major anesthesiology meetings. Meetings at which 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 local meetings.

In June 2015, the OB Anesthesiology Fellowship program underwent a three-year site review by the ACGME, which followed its initial accreditation in 2012. The ACGME granted the program continued accreditation through April 2022.

Dr. David Seng completed his fellowship in June 2015 and joined the Department of Anesthesiology Faculty as an Assistant Professor at Magee-Womens Hospital of UPMC in July 2015. Dr. K. Grace Lim joined the Department of Anesthesiology faculty in 2014 and became a post-doctoral scholar as a T32 fellow in January 2015 for a two-year period. Current fellows Drs. Eleni Kotis and Jamie Zorn are anticipated to graduate in June 2016 and have obtained positions in institutions with a need for specialization in OB anesthesiology.
The department is proud to offer trainees a top-ranked highly competitive ACGME-accredited Pain Medicine Fellowship Program. Many exciting developments occurred in FY16, culminating with the American Academy of Pain Medicine awarding the program with a Pain Medicine Fellowship Excellence Award for 2016. This prestigious honor was awarded to only four fellowships in the country, positioning our Pain Medicine Fellowship as a top five-ranked national program. Our program 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, a world-renowned pain medicine clinician and researcher who joined the faculty as Vice Chair for Pain Medicine in the fall of 2013, 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 on a daily basis. 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 provides fellows the opportunity to participate in a unique group-based therapy program designed for fibromyalgia patients, which is exclusively managed by 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 2015, the Pain Medicine Fellowship interviewed 62 applicants over the course of three days; our 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; 273 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 our 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, clinical-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 of time and receive more extensive
training by completing a one-year fellowship followed by a 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), acute pain (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 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 Program Director Dr. Scott Brancolini have made multiple changes to the overall
curriculum for the 2015-16 academic year. An important and major update to educational content was the formal
development of a Key Word Database Bank to help the fellows study and prepare for their In-Training and Pain
Medicine Board exams. Dr. Brancolini spearheaded a Quality Improvement (QI) project to study and assess changes
in fellow confidence while developing this Key Word Database. All fellows participated in this project, along with
five 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 develop a Pain Medicine Review Book. To
date, a 100 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 and have greatly improved over the
past three years since the exam was first conducted. The most recent board certification pass rate in the primary
specialty of anesthesiology was 100% on the written exam.

The following highlights more exciting changes to the Pain Medicine Fellowship Education Programs. The Pain
Medicine Grand Rounds lecture series under Dr. Brancolini’s direction was revised to incorporate more topics
requested by fellows. Lectures with higher evaluations were given higher priority; lower evaluated lectures were
either eliminated or improved. The Pain Medicine fellows were once again given a revised all day orientation
conducted by Dr. Brancolini. Also new to the past academic year was Dr. Brancolini’s Pain Medicine monthly
curriculum of 19 lectures that is given on a monthly repeating cycle to all fellows, rotating residents, and medical
FELLOWSHIP PROGRAMS

students. The fellows’ annual Pain Research Course was also redesigned to better match the fellows’ prior requests. Changes were also made to our 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.

The UPMC Pain Medicine Fellowship also made improvements to its overall rotation schedule with the recent addition of two new faculty members. Beginning in July 2015, all fellows now complete a four week Acute Pain Medicine rotation under the direction of Dr. Manisha Trivedi. Dr. Trivedi, also a Chronic Pain Medicine faculty member, is uniquely skilled and knowledgeable about the administration of regional blocks and the overlay between the fields of chronic and acute pain. The rotation addition has proved to be very successful; fellows consistently are pleased with the variety of interventional procedures in which they participate. Also new to the Oakland Pain Medicine rotation is the addition of Dr. Trent Emerick. Both Drs. Hache and Emerick have enhanced the quality of this rotation by greatly increasing the number and volume of implantable device procedures. In particular, Dr. Emerick has both grown the cancer pain rotation at our Center Commons office and developed a new center for Head and Neck Pain, where specialty advanced interventions are taught to the pain medicine fellows.

All fellows are required to participate in research projects during their elective time and develop systems-based practice projects. Dr. Brancolini oversees this project and the Pain Medicine faculty participates in and supervises all projects.

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 new to the Pain Medicine fellowship in the past year was the formation of the Pain Medicine Patient Safety Committee. Meeting weekly under the direction of Dr. Brancolini, fellows are required to present each week a patient safety case study. In these group discussions, elements of patient safety, “near miss” situations, and root cause analyses are reviewed.

During the 2015-16 academic year, fellows gave presentations, presented posters, authored peer-reviewed articles, completed QI projects, and presented a total of eight systems-based practice projects.

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.
PITTSBURGH JOURNAL OF ANESTHESIOLOGY

Pain Medicine Fellow Post-graduation Plans

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<th>Name</th>
<th>Future Plans</th>
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<tbody>
<tr>
<td>Rany Abdallah, MD, PhD</td>
<td>Temple University as Anesthesia and Chronic Pain Faculty</td>
</tr>
<tr>
<td>Latrice Akumoaoh, MD</td>
<td>To be determined</td>
</tr>
<tr>
<td>Pallavi Gupta, MD</td>
<td>Pain medicine private practice, location TBD</td>
</tr>
<tr>
<td>Soon Jung, MD</td>
<td>Lehigh Valley Hospital Dept. of Anesthesia Div. Pain Management</td>
</tr>
<tr>
<td>Jaymin Patel, MD</td>
<td>Emory University in Atlanta, Department of Orthopedic Surgery</td>
</tr>
<tr>
<td>Sokpoleak So, MD</td>
<td>Private practice in Danbury, Connecticut</td>
</tr>
<tr>
<td>Rehan Waheed, DO</td>
<td>Interventional Pain Practice in Hagerstown Maryland</td>
</tr>
<tr>
<td>Joshua Wert, DO</td>
<td>Staffing at St. Luke’s Hospital pain clinic in Tamaqua, Pennsylvania</td>
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PEDIATRIC ANESTHESIOLOGY

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.

The American Board of Anesthesiology (ABA) continues to offer sub-specialty certification in pediatric anesthesiology. Dr. Franklyn Cladis participated in the question-writing process for the inaugural exam and continues to write questions for the test. All of the faculty members at Children’s Hospital of Pittsburgh of UPMC (CHP) have taken and passed the ABA Certifying Exam for Pediatric Anesthesiology. All of the 2015-2016 fellows that took the Part 2 ABA “oral examination” passed the test and are now board-certified anesthesiologists.

In addition to board certification, all pediatric fellowship programs now nationally participate in a pediatric anesthesiology match through the National Residency Matching Program. Over 90 candidates apply for nine ACGME-approved positions each year in the UPMC Pediatric Anesthesiology Fellowship Program. The program is now getting ready for the fifth year in the match. Next year, pediatric anesthesiology fellowships will begin using 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 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 was appointed as a Junior Part Two Examiner for the ABA three years ago and was a co-editor of the eighth edition of the textbook Smith’s Anesthesia for Infants and Children. He is actively editing the ninth edition of this textbook, which is due out in the winter of 2016. In addition, he serves on the board of directors for the Society for Education in Anesthesia (SEA) and he is the immediate past Chair of the SEA Research Committee. 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).

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

FRANKLYN CLADIS, MD
Director
The Pediatric Pain Medicine Service continues to significantly augment fellows’ experience with peripheral nerve blocks. The ACGME requires a minimum of eleven peripheral nerve blocks. Each pediatric fellow performs on average 60-70 peripheral nerve blocks; the service provides approximately 2,500 pediatric peripheral nerve blocks per year and is one of the busiest pediatric regional services in the country.

Pediatric anesthesiology fellows have a one month critical care experience in the cardiac ICU (CICU) rather than in the pediatric ICU. They must complete a two month cardiac anesthesiology rotation prior to the CICU rotation. The cardiac anesthesiology rotation prepares them with the 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 care to 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 graduate having managed anesthesia for two to three pediatric liver transplants on average. We insure that each fellow has 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 of the fellows have graduated having managed anesthesia for two to three liver transplants.

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<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Francina Del Pino, MD</td>
<td>Valley Anesthesia Associates (Phoenix Children’s Hospital, Phoenix AZ)</td>
</tr>
<tr>
<td>Yukili Elliott, MD</td>
<td>Alaska Regional Medical Center, Anchorage, Alaska</td>
</tr>
<tr>
<td>Ali Hassanpour, MD</td>
<td>Texas Children’s Hospital (Baylor), Houston, TX</td>
</tr>
<tr>
<td>Saifeldin Mahmoud, MD</td>
<td>Einstein Medical Center of Philadelphia, Philadelphia PA</td>
</tr>
<tr>
<td>Brent McNew, MD</td>
<td>Anesthesia and Pain Consultants in Johnson City, TN</td>
</tr>
<tr>
<td>Keric Menes, MD</td>
<td>Kapiolani Medical Center for Women’s and Children’s Hospital, Hawaii</td>
</tr>
<tr>
<td>Brett Moses, MD</td>
<td>St. Clare’s General Hospital, Denville, New Jersey (private practice)</td>
</tr>
<tr>
<td>Anne Penaco, MD</td>
<td>Anesthesiology Consultants, Inc. Las Vegas, NV (group practice)</td>
</tr>
<tr>
<td>Michael Kyle Ritchie, MD</td>
<td>West Virginia University, Morgantown, West Virginia</td>
</tr>
</tbody>
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**PEDIATRIC CARDIOTHORACIC ANESTHESIOLOGY**

**PATRICK M. CALLAHAN, MD, Director**

The Pediatric Cardi thoracic Anesthesia Fellowship program offers advanced training in the anesthetic management of patients with congenital heart disease and includes surgical and nonsurgical intervention, as well as critical care management. The program allows two pathways for entry into the system. One path is devoted to the fellow applicant that has completed an approved pediatric anesthesiology fellowship and the other is for the fellow applicant that has completed an approved adult cardiac anesthesiology fellowship.

The program training length is six to 12 months, depending on the pathway of entry. Research opportunities are available to interested fellows. Fellows entering the program can complete the program in six months, whereas the adult cardiac anesthesiology fellow would spend at least three to six months of training in general pediatric anesthesiology prior to completing six months of training in pediatric cardiac anesthesiology.

The program trained one fellow in academic year 15-16, Phillip Adams, DO. More information about his work can be found in his T32 fellowship section in the Research section later in this report.
REGIONAL ANESTHESIOLOGY
JONATHAN H. WATERS, MD, Director

The Acute Pain and Regional Anesthesiology 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. Faculty members of the Acute Pain and Regional Anesthesiology Division select fellows on the basis of written applications, academic records, documented performance, and interviews.

Fourteen acute pain and regional anesthesiology fellows were trained from July 2015 through the end of June 2016. Fellows rotated at UPMC Presbyterian, UPMC Montefiore, UPMC Shadyside, UPMC Mercy, UPMC Passavant, Children’s Hospital of Pittsburgh of UPMC, and the UPMC Harmar and UPMC South surgery centers.

In FY16, the regional fellows helped complete 15,846 blocks.

FELLOW SCHOLARLY ACTIVITY

Chief Fellowship Scholarly Officers
In 2014, Dr. Tetsuro Sakai formed the Chief Fellowship Scholarly Officers (CFSOs) to increase scholarly activity among the clinical fellows within the University of Pittsburgh Department of Anesthesiology. After serving as the CFSO for the pediatric anesthesiology fellows in 2014-2015, I was honored to continue on as Co-director for the CFSOs.

The aim of the program is to increase fellow scholarly activity through early introduction to scholarly projects within each subspecialty and to facilitate submission to and presentation at academic conferences.

2015-2016 CFSOs
Julie DeVore, DO, MPH
Rachel Hadler, MD
Eleni Kotsis, DO
Rany Abdallah, MD, PhD
Ali Hassanpour, MD
Luca LaColla, MD

Through the efforts of our CFSOs, many of this year’s anesthesiology fellows have contributed scholarly works in their respective subspecialties.

Due to the brevity of clinical anesthesiology fellowship training and the lack of physician scientists matriculating into academic careers, the Department of Anesthesiology has been working towards the creation of a scholarly training program designed to facilitate a trainee’s development into a clinical master and independent investigator. Details about the Pittsburgh Academic Anesthesiology Scholar Track (PAAST) were presented at the Society for Education in Anesthesia Spring meeting in Baltimore, MD, June 3-5, 2016.
On Friday, June 10th, the UPMC Anesthesiology resident and fellow classes of 2016 celebrated their graduation at the University Club in Oakland, PA. Anne Kamarchik, MD was honored with the Mark H. Gilland, MD award for the Best Clinical Resident. Nick Schott, MD and Gerhardt Konig, MD were recognized as the Best Resident Scholars. Anesthesiology attendings were also recognized for their dedication to resident and medical student education. Heather Hayanga, MD, a cardiac anesthesiologist at UPMC Presbyterian who joined the department this past academic year, was presented with the Leroy Harris Award for Excellence in Teaching. Ryan Romeo, MD from Magee-Womens Hospital of UPMC 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; Franklyn Cladis, MD; Trent Emerick, MD; Stephen Esper, MD; Daniel Ford, MD; Robert Lawler, MD; Charles Lin, MD; Li Meng, MD; Steven Orebaugh, MD; Beverly Pearce-Smith, MD; Hulimangala Rakesh, MD; Anthony Silipo, DO; and Keith Vogt, MD, PhD.

The event marked the end of four years of hard work for our 20 resident graduates. They collectively delivered anesthetics to 26,070 patients, 2,900 of which were children; assisted 5,047 mothers in childbirth, including 3,522 vaginal deliveries and 1,525 C-sections; performed 6,484 peripheral nerve blocks; and conducted medical missions in Bhutan, Guatemala, Zambia, and Vietnam. They all have great career paths ahead of them. Eighteen graduates will pursue further fellowship training in subspecialties including pediatric, adult cardiothoracic, regional, and obstetric anesthesiology, critical care medicine, and pain medicine. One resident will become an attending within the UPMC system and another will join a private practice group in Orlando, FL.

Congratulations to the UPMC Anesthesiology resident and fellow classes of 2016 and good luck in all your future endeavors!
The Department of Anesthesiology medical student programs are recognized nationally as among the best in the nation. Under Dr. Mangione’s leadership, faculty members continued their enthusiastic participation in clinical teaching during the anesthesiology clerkship and in the electives offered by the Department in academic year 2015-2016. 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 Drs. Kristin Ondecko Ligda and Grace Lim. Students learned how to assess back pain and 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. Thomas Fuller and Lauren Tennyson (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 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, although a change was made towards the end of the calendar year in there are now separate grades for anesthesiology and surgery. The curriculum for the anesthesiology portion is well established. Thanks to the teaching efforts of the faculty, this course enjoyed another very successful year, as evidenced by excellent evaluations and feedback. Over the past four years, composite evaluations indicate that 85% of medical students agree or strongly agree that the overall quality of the clerkship is excellent.

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-Womens 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 McIlvor 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.

Students continue to give excellent evaluations of the quality of the clerkship. Eighty-eight percent (88%) of the medical students for the 2015-16 academic year rated the clerkship as outstanding or good.

**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 Wells. 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.

- **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.

A total of 29 students participated in our electives; 26 took the general anesthesiology course and three took the pain medicine course. 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 33 sites nationwide selected to host trainees as part of the 2015 Foundation for Anesthesia Education and Research (FAER) Medical Student Anesthesia Summer Research Fellowship (MSARF) program and will again serve as a host site (one of 37) in the summer of 2016. 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. The department has hosted at least one student every summer since 2008 and a total of 15 students have participated in the fellowship. 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.

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 2015-16.

<table>
<thead>
<tr>
<th>Mentor</th>
<th>Student</th>
<th>Project</th>
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<tr>
<td>Ibtesam Hilmi, MD</td>
<td>Brian Guedes</td>
<td>Quality of Clinical Outcomes in Patients with and without Dialysis Treatment Prior to Renal Transplantation</td>
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<tr>
<td>William McIvor, MD</td>
<td>Ari Filip</td>
<td>Categorizing Feedback from Standardized Confederates during MOCA Simulation Courses</td>
</tr>
<tr>
<td>William McIvor, MD</td>
<td>Isabela Negrin</td>
<td>SALT in the Third and Fourth year Medical Student Anesthesiology Curriculum</td>
</tr>
<tr>
<td>Kathirvel Subramanian, MD</td>
<td>Sergio Hernandez</td>
<td>Predictors of Significant Postoperative Bleeding after Heart Transplantation</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>
<tr>
<td>Jonathan Waters, MD</td>
<td>Megan Milne</td>
<td>Blood Coagulation Properties in Women Immediately Following Childbirth</td>
</tr>
</tbody>
</table>
The Anesthesiology Interest Group (AIG) that was formed by two third-year University of Pittsburgh medical students (Karen Lynn and Jerome Lee) 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 Dan Bintrim and Ragini Gupta, 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 in connection with 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.

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 2016 Specialty Night took place on May 17th.

Five UPSOM students (Class of 2016) matched into anesthesiology residencies:
- Dan Bintrim, UPMC, Pittsburgh PA
- Ansurari Dewasurendra, UPMC, Pittsburgh PA
- Sean McDermott, UPMC, Pittsburgh PA
- Andy Lee, University of Washington, Seattle, WA
- David Lehman, Emory University, Atlanta GA

Comprising data from 11 classes between 2006 and 2016, a total of 92 medical students entered the anesthesiology match. The overwhelming majority (99%, 91/92) matched successfully. Half of these medical students matched into residency programs ranked in the top ten by US News & World Report, a list which includes our own residency program, into which 24 medical students matched. Over 80% of these medical students matched into programs ranked in the top 25.

The “Best Student in Anesthesiology Award” was presented to Dan Bintrim at the UPSOM Alumni Luncheon on May 20, 2016. This prize is awarded annually by our faculty to an outstanding student in the UPSOM graduating class in recognition of the student’s excellent clinical performance during our required clerkship and electives.

This year, the Department of Anesthesiology awarded the Peter M. Winter Award for Excellence in Medical Student Teaching to Dr. Ryan Romeo, 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 built one of the nation’s largest academic departments of anesthesiology.
Dr. Michael Mangione was nominated for the Golden Apple Award. Each year this award is given by the graduating Pitt Med class to the faculty member they believe has contributed most to their experience as they transition from medical student to physician.

Dr. Rita M. Patel is a member of the UPSOM Executive Committee. Dr. William McIvor 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. Dr. Patricia Dalby served on the UPSOM Admissions Committee.

Faculty members Drs. Charles Boucek, Patricia Dalby, William McIvor, David Metro, Joseph Quinlan, Ryan Romeo, and Williams Simmons 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 presented at the 11th Annual Pennsylvania Anesthesiology Resident Research Conference on May 14th, 2016 in Hershey, PA.

SURGICAL RESECTION OF A LEIOMYOSARCOMA INVOLVING ATRIAL RECONSTRUCTION, CARDIOPULMONARY BYPASS, AND EX-VIVO LIVER RESECTION AND REIMPLANTATION

Bryant F. Bunting, DO\(^1\); J. Wallis Marsh, MD\(^2\); Lawrence M. Wei, MD\(^2\); Christopher B. Hughes, MD\(^2\); Theresa A. Gelzinis, MD\(^1\)
Departments of Anesthesiology\(^1\) and Surgery\(^2\), University of Pittsburgh and UPMC

BACKGROUND
Leiomyosarcomas are rare malignant tumors with a small subset described as leiomyosarcomas of vascular origin. Due to the questionable effectiveness of chemotherapy and radiation, surgical resection with negative margins is the treatment of choice. Resection is often difficult due to the predominant involvement of the vena cava and extension into the vasculature of other organs, including the liver and heart. We present a case of a leiomyosarcoma extending from the intrahepatic inferior vena cava (IVC) into and involving the wall of the right atrium (Figure 1), requiring cardiopulmonary bypass (CPB) for atrial and IVC reconstruction, as well as liver explantation and intrahepatic IVC tumor resection.

CASE
A 53-year-old woman who presented to our institution with an intrahepatic IVC mass extending into the right atrium underwent a coordinated surgery involving CPB, atrio caval reconstruction, ex-vivo re-section of the IVC and liver, venovenous bypass, and eventual liver reimplantation.

RESULTS
The patient underwent this complicated surgical procedure without intraoperative complications and was discharged home on postoperative day 9. She continued to do well 12 months postoperatively without evident recurrent intra-abdominal disease on surveillance imaging studies.

CONCLUSION
Surgical resection of a vascular leiomyosarcoma (Figure 2) involving the wall of the right atrium requiring atrio caval reconstruction, as well as ex-vivo liver resection and reimplantation, led to a successful outcome at >12 months follow-up. This procedure was possible through coordinated perioperative planning and intraoperative cooperation of a multi-disciplinary team.
This abstract was presented as a poster at the American Society of Anesthesiologists Meeting, San Diego, CA, October 24-28th 2015 and as a podium presentation at the 11th Annual Pennsylvania Anesthesiology Resident Research Conference, Hershey, PA, May 14th, 2016.

SUSPECTED MALIGNANT HYPERTHERMIA IN THE SETTING OF HYPOTHERMIC CIRCULATORY ARREST FOR TYPE A AORTIC DISSECTION REPAIR

Bryant F. Bunting, DO; Stephen M. McHugh, MD; Joshua Knight, MD
Department of Anesthesiology, University of Pittsburgh, UPMC

BACKGROUND
Malignant hyperthermia (MH) is well known in the field of anesthesiology and is taught to be diagnosed based upon the presentation of classic signs and symptoms in the setting of a triggering agent. Classic signs include respiratory acidosis/hypercarbia, muscle rigidity, and hyperthermia, among others. However, these signs may be obscured or present in a non-classical way during complex surgical cases.

CASE PRESENTATION
A 59-year-old male with a history of obstructive airway disease presented to an outside hospital with sudden onset of intense generalized abdominal pain, resulting in the diagnosis of an acute Type A aortic dissection. The patient was electively intubated prior to transfer to our facility. Upon arrival to the ICU, the patient was extremely difficult to ventilate secondary to poor compliance and was subsequently taken urgently to the OR for induction of general anesthesia and further evaluation.

Despite initiation of general anesthesia via scopolamine, isoflurane, and vecuronium, difficulty with ventilation persisted and fiberoptic bronchoscopy was performed and was notable for tracheobronchomalacia (TBM). Further adjustments to ventilation settings were minimally successful. Arterial blood gas analysis results indicated severe respiratory acidosis (7.04/89.3/224/22.9/-11) in addition to hyperkalemia (7.3mEq/L). A diagnosis of MH was considered despite the initial sign of decreased pulmonary compliance on arrival and prior to the known administration of a triggering agent. Cardiopulmonary bypass (CPB) and hypothermia were initiated in preparation for circulatory arrest. Use of succinylcholine for intubation was confirmed through telephone conversation with the intubating physician at the outside hospital. Upon discussion with the perfusionist, it was noted that high sweep speeds were required to maintain a physiologic PaCO2, which confirmed a hypermetabolic state and not intrinsic lung disease as the source of the patient’s hypercarbia. With this information, the diagnosis of MH was made. Conversion to a total intravenous anesthesia (TIVA) technique was initiated, dantrolene was promptly administered, and a complete anesthesia machine flush was performed while the patient was maintained on CPB. Deep hypothermic circulatory arrest proceeded as planned for repair of the aortic arch.

With completion of arch repair, cessation of circulatory arrest, and re-initiation of CPB, it was noted that the required sweep speeds had normalized. Arterial blood gas analysis showed a lack of acidosis, as well as potassium within normal limits. Urine myoglobin, tested prior to circulatory arrest, was subsequently found to be >8750mcg/L (normal range:<25mcg/L).

DISCUSSION
In this case, a few challenges made the diagnosis of MH more difficult. First, the patient had known but poorly quantified obstructive airway disease and presented to us already intubated and in some respiratory compromise. Poor compliance, though noted, was not immediately attributed to hyper-rigidity and MH. Further clinical evaluation also revealed TBM, which certainly could be seen as contributing to both his poor respiratory mechanics as well as his severe respiratory acidosis. Once general anesthesia had been induced, cooling was initiated, which negated the possibility of discovering a hyperthermic response. Eventually, CPB was instituted, which replaced the patient’s pulmonary system in providing oxygenation and ventilation. The discovery of a greatly increased sweep speed requirement on CPB to maintain a physiologic PaCO2 proved to be the crucial piece of information confirming a hypermetabolic state as the source of his hypercarbia. Further support for the diagnosis of MH in our case includes the resolution of our patient’s severe mixed acidosis and decreased sweep speed requirement with administration of dantrolene, and grossly elevated urine myoglobin.
THE ESOPHOCCLUDE MEDICAL DEVICE: PROVIDING TEMPORARY OCCLUSION OF THE ESOPHAGUS IN PATIENTS REQUIRING EMERGENT INTUBATION

P. Carullo\textsuperscript{1}, T. Sakai\textsuperscript{2}, Y. Chun\textsuperscript{3}

\textsuperscript{1}UPMC, Department of Anesthesiology \textsuperscript{2}University of Pittsburgh School of Medicine, Department of Anesthesiology \textsuperscript{3}University of Pittsburgh Swanson School of Engineering, Department of Industrial Engineering

Gastric aspiration is a devastating complication. Although it can occur at any time during a hospital course, it remains of highest concern when performing emergent intubation for surgical and medical interventions. In these clinical environments, rapid sequence induction remains the standard of care along with the use of aspiration reduction techniques such as nasogastric tube placement, gastric emptying drugs, awake fiber-optic intubation, and cricoid pressure. Anesthesiology resident Philip Carullo imagines a safer and more secure way of protecting the lungs.

As a fourth year medical student at the University of Chicago, Carullo witnessed an attending anesthesiologist cancel an elective surgical case because the patient forgot to fast. Rescheduling the surgery was the safest choice, but it sparked his interest in thinking of ways to physically prevent gastric contents from entering the lungs. He spent several months during a fourth year research block conducting literatures review on existing intellectual property for esophageal devices and reading about current methods of esophageal delivery. By the time he finished medical school, he had a blueprint for a novel medical device.

Upon entering the anesthesiology residency at the UPMC, Carullo met with Dr. Tetsuro Sakai, Director of Scholarly Development for the Department of Anesthesiology. Sakai is a national leader in mentoring resident physicians and helping them accomplish their research goals. Previously a cardiothoracic surgeon in Japan, he later completed a residency in anesthesiology at UPMC where he has proven to be a strong asset for the residency program ever since. Carullo also met with Dr. Youngjae Chun from the University of Pittsburgh’s Swanson School of Engineering. Chun is an expert in biomechanical engineering with the use of nanotechnology and has worked on a variety of neurosurgical, orthopedic, and airway related devices.
Working together, Carullo, Chun, and Sakai are developing a medical device that would provide temporary occlusion of esophagus. With the use of strong but flexible metals, they are creating a self-expanding material that will be swallowed prior to induction and later activated in the esophagus. Once activated, it will mechanically block flow from the stomach to the lungs. After breathing tube placement, the device is easily removed. Not only could this device be used prior to induction, it can be placed early on in patients where eventual intubation is anticipated. What makes this device novel compared to standard of care techniques is that it is swallowed, not manually inserted into the esophagus and the procedure itself takes 20 seconds from start to finish. The aim of the device is to provide the fastest and most secure way of protecting against aspiration in emergency inductions.

So far, Carullo, Chun, and Sakai have secured several seed grants from the University of Pittsburgh and the Center for Medical Innovation, an affiliation that connects UPMC physicians with Swanson engineers to solve important clinical problems. Their seed grants will run through 2017, after which they hope to begin clinical testing of the device.

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EVALUATING THE EFFICACY OF FLUOROSCOPY SIMULATION FOR INCREASING PROFICIENCY IN COMMON INTERVENTIONAL SPINE PROCEDURES IN ANESTHESIOLOGY RESIDENTS

Clary AC, Brancolini SA
Department of Anesthesiology, University of Pittsburgh School of Medicine

INTRODUCTION
Simulation training continues to prove useful in interventional procedures, but little evidence exists for its efficiency in teaching trainees fluoroscopy skills. In this study, five scenarios of commonly performed interventional pain procedures were evaluated in two groups, with pre- and post-tests identifying landmarks, needle location, and trajectory. The aim of the study was to assess whether simulation training given to anesthesiology residents improved fluoroscopic skills and procedural performance.

HYPOTHESIS
Fluoroscopy skills learned by anesthesiology resident simulation can provide a measurable educational opportunity that improves procedural skill in the field of pain medicine.

METHODS
Five scenarios involving interlaminar epidural steroid injections, medial branch blocks, caudal blocks, lumbar sympathetic blocks, and celiac plexus were attempted and evaluated in two groups of eight anesthesiology residents. Both groups initially received a pre-test and scored on a “Yes” or “No” scale for needle targeting, spinal level identification, and trajectory in each scenario. The study group (n=8) was given a 10 minute tutorial and simulation with descriptions of needle placement and structural identification under live fluoroscopy. Alternatively, the control group (n=8) took an equivalent duration break between tests. A facilitator recorded scores for all scenarios. Upon data collection, analysis was performed using a paired t-test.

RESULTS
No differences were found in the pre-test performances between the study and the control groups (63% ± 20.8% vs 62% ± 14.6%) The study group had a statistically significant increase in the post-test compared to the pre-test (76% ± 22.7% vs 62 ± 14.6, p=0.011.)

CONCLUSION
The use of fluoroscopy simulation for fluoroscopy training improves anesthesiology resident procedural performance. This was accomplished in the setting of commonly performed interventional pain scenarios with no patient risk.

REFERENCES
COST ANALYSIS OF DESFLURANE VERSUS SEVOFLURANE
Meghan Cohen, MD; Brian Gierl, MD; Qiyao Wang; Fadnis Shalaka
Department of Anesthesiology, UPMC

Two volatile gases commonly utilized in anesthetic practice are desflurane and sevoflurane. These anesthetics are best known for their characteristic ability to allow faster emergence from anesthesia, with desflurane commonly thought to provide the quickest emergence. The final costs of each of these anesthetics consist of two components: the intrinsic cost of the gas itself and the resource utilization cost based upon the patient’s time spent in the operating room. The goal of this analysis was to determine if the higher intrinsic cost of desflurane was offset by a faster emergence and thus lower resource utilization cost.

In the data set, there were 584 cases in the desflurane group and 645 cases in the sevoflurane group. Each case had no significant difference in distribution of “ASA class,” “total anesthesia time,” and “operation time.” Exclusion criteria included trauma cases, cardiac cases, and any case that included a tracheotomy or transfer to the ICU following the procedure. Results of a one-sided, two-sample t-test confirmed that the intrinsic cost of desflurane was significantly higher than that of sevoflurane. A one-sided, two-sample t-test was also utilized to show that there was no statistically significant difference in emergence times between desflurane and sevoflurane.

Given this data, we are able to conclude that desflurane had a higher intrinsic cost. Additionally, because there was no difference between emergence times with the two anesthetics, there was no difference in resource utilization cost. Therefore, desflurane had a higher overall cost of use than sevoflurane.

This abstract was presented as a poster at the annual meeting of the American Society of Anesthesiologists, San Diego, CA, October 24-28, 2015.

ACUTE PAIN MANAGEMENT AND PERIPHERAL NERVE BLOCKADE IN PATIENT WITH COMPLEX REGIONAL PAIN SYNDROME I
Zachary Cohen, MD and Kristin Ondecko Ligda, MD
UPMC Department of Anesthesiology

Acute pain management in a patient with Complex Regional Pain Syndrome I presents a perioperative challenge when the affected extremity is the operative extremity. This patient had a multi-year history of inflammation, burning pain sensations, painful movement, and vasomotor dysfunction of her left lower extremity. She had an unknown insult to the lateral foot that progressed over several weeks into a painful wound, for which she presented for multiple incisions and drainages with inpatient antibiotics and wound vacuum therapy. Peripheral nerve blockade (sciatic and saphenous) and multimodal analgesia were performed with successful relief of pain intensity in the perioperative period.

This case report was submitted to the American Society of Anesthesiologists Annual Meeting, Chicago, IL, October 22-26, 2016.

INTRAOPERATIVE RHABDOMYOLYSIS AND MYOGLOBINURIA IN A PROLONGED MULTISTAGE SPINAL PROCEDURE
Alex M. Dressler, MD and Charles J Lin, MD
UPMC, Department of Anesthesiology

A 32-year-old male with a past medical history of failed back syndrome was scheduled for a two day staged spine surgery, most notably, T4-pelvis fusion on the second day. The first stage was completed uneventfully. On the second day of surgery, the patient demonstrated gross hematuria at the completion of a seven hour surgery after receiving cell salvage blood and autologous transfusion of packed red blood cells (RBCs), fresh frozen plasma, and cryoprecipitate. The urinalysis demonstrated 4+ blood and no urine RBCs. Creatine phosphokinase peaked at 2354. The diagnosis was rhabdomyolysis causing myoglobinuria. The postoperative course was uneventful.
This case was presented at the 41st Annual Regional Anesthesiology and Acute Pain Medicine Meeting, March 31-April 2, 2016 and was submitted to the American Society of Anesthesiologists Annual Meeting, Chicago, IL, October 22-26, 2016.

PERIPHERAL NERVE BLOCKADE AS PERIOPERATIVE ANESTHETIC AND PAIN MANAGEMENT OF PATIENT WITH SEVERE AORTIC STENOSIS FOR CHARCOT FOOT RECONSTRUCTION

Alex M. Dressler, MD and Kristin M. Ondcko Ligda, MD
University of Pittsburgh, Department of Anesthesiology

INTRODUCTION
Both normal and bicuspid aortic valves can increasingly calcify and stenose with age. The pooled prevalence of aortic stenosis (AS) is 12.4%; the prevalence of severe AS is 3.4% in the United States and Europe, and the percentage is increasing yearly (1). AS is divided into the following stages: patients at risk for AS (stage A), progressive hemodynamic obstruction (stage B), severe asymptomatic AS (stage C), and symptomatic AS (stage D). The degree of AS is characterized by transaortic maximum velocity or mean pressure gradient. These categories can be utilized if the patient has a normal transaortic volume flow. Subcategories under stage D exist for patients with coexisting low flow as a result of low left ventricular ejection fraction (LVEF) (D2) and left ventricular dysfunction with normal LVEF (D3). Peak aortic valve velocity of >4 m/s or mean aortic valve gradient >40 mmHg indicates poor prognosis (2).

CASE
A 62-year-old female with a past medical history of AS (previously deemed moderate at last evaluation in 2011), cerebrovascular accident without residual deficit, hypertension, hyperlipidemia, poorly controlled insulin-dependent diabetes, and morbid obesity presented for Charcot foot reconstruction. Further cardiac testing was ordered to evaluate her current condition, as she had been lost to follow up after previous evaluations. Lexiscan stress test showed mild reversible defect consistent with ischemia in the apical inferior segment and mid-inferior segment, LVEF 53%, and mild hypokinesis in the apical inferior segment and inferior wall. Transthoracic echo (TTE) showed moderate concentric left ventricular hypertrophy, mild systolic left ventricular systolic dysfunction, basal anterior segment, mid-lateral segment, and mid-posterior segment hypokinesis of left ventricle, as well as mild enlargement of left atrium with associated mitral annular calcification and regurgitation. TTE also showed estimated LVEF of 40-45%, severe AS with an AV peak gradient of 93 mmHg and valve area estimated at 0.7 cm² with an AV peak velocity of 4.82 m/s. Patient did not desire valvular surgery at that time as her severe AS was asymptomatic. After discussion with surgeon, surgery was deemed necessary to prevent ulcer formation and infected wounds in her foot. Surgery was modified to only the essential procedure. Patient received saphenous nerve block injection with ultrasound-guided continuous sciatic catheter. The patient tolerated the procedure well and received minimal intraoperative sedation. She was discharged from hospital on post-operative day 3.

DISCUSSION
As the population ages and comorbidities increase, patients may not elect valvular repair despite the presence of severe AS. Patients may present for surgeries to minimize the effects of future morbidity and preserve mobility. In our patient with Charcot foot, the pain, deformity, instability, and risks for future wounds necessitated surgical reconstruction. Regional anesthesia techniques are used to minimize risks in patients with complicated comorbidities. Extensive discussion of risks, benefits, and alternatives, including concerns about aortic valve replacement prior to surgery, should be discussed with the patient. Our patient elected peripheral nerve blockade and surgery under regional anesthese.

REFERENCES
CRNA BILLED-TO-STAFFED HOURS AS A MEASURE OF OPERATING ROOM EFFICIENCY ACROSS A LARGE MULTI-HOSPITAL HEALTH CARE SYSTEM

Andrius Giedraitis, MD, MBA, MS; Trent Emerick, MD; David Nelson, MD, MBA; Mark Hudson, MD, MBA
UPMC Department of Anesthesiology

INTRODUCTION
The current health care climate mandates efficient management of resource costs to assure the sustainability of hospital economics. One metric to assess efficiency of resource utilization in the operating room (OR) is the CRNA billed-to-staffed hours percentage, which represents the percentage of time CRNAs are engaged in billable activity. It may also be used as a proxy of overall OR efficiency. In a multi-hospital health care system that utilizes a standardized staffing model for CRNAs, this measure can serve as a comparative metric for the system and aid in the identification of best practice OR management models, as well as sites with opportunity for improvement.

METHODS
CRNA billed-to-staffed hour percentages were obtained for 13 hospitals within the UPMC system for fiscal year (FY) 2013, FY 2014, and FY 2015 YTD. Demand (number of CRNA staffed hours from FY 2014) was also obtained for each hospital. Sixty percent was used as the target CRNA billed-to-staffed hours mark from 7am to 3pm. Best practice hospitals were identified using CRNA billed to staffed hours greater than 60% in FY 2013. These best-practice approaches were then shared among other hospitals during quarterly system-wide surgical services meetings. A line graph (Figure 1) was created to show the change in CRNA billed-to-staffed hours from FY 2013 to FY 2015 YTD. Eighty-two dollars was used as the average CRNA cost per hour for calculation.

RESULTS
The target of 60% CRNA billed-to-staffed hours was exceeded by five of 13 hospitals by FY 2015 YTD; only two hospitals exceeded this threshold in FY 2013. No sub-threshold hospital increased this percentage beyond 60% between FY 2014 and FY 2015 YTD. The overall improvement between FY 2013 and FY 2015 YTD amounted to a total of $1,600,590.26 in cost savings. However, $1,116,128.41 in additional cost savings would have been achieved if each hospital increased their CRNA billed-to-staffed hours percentage to a minimum threshold of 60% (Table 1).

| TABLE 1: CRNA BILLED-TO-STAFFED HOURS PERCENTAGES AND COST SAVINGS ACROSS OUR HEALTH SYSTEM |
|-------------------------------|---------------|---------------|-----------------------------|-----------------------------|
| HOSPITAL | FY 2013 | FY 2015 | SAVINGS FROM FY13 to FY15 | POTENTIAL SAVED AT 60% |
| A | 61.4% | 65.6% | $175,250.79 | |
| B | 46.3% | 54.8% | $93,100.81 | $56,642.67 |
| C | 65.1% | 64.1% | $(39,092.22) | |
| D | 48.5% | 43.0% | $(66,488.91) | $203,133.80 |
| E | 55.8% | 57.6% | $83,949.12 | $116,657.56 |

Figure 1

Percent Billed Hours to Staffed Hours 2013-2015 YTD

<table>
<thead>
<tr>
<th>Hospital</th>
<th>FY 2013</th>
<th>FY 2015</th>
<th>Savings from FY13 to FY15</th>
<th>Potential saved at 60%</th>
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</table>
DISCUSSION
In our large, multi-hospital health care system, overall OR efficiency can be gauged by CRNA billed-to-staffed hours due to the Department of Anesthesiology’s consistent staffing methodology. Providing expectations for this metric and targeting sites and services with low utilization can be effective in improving overall resource efficiency. As a comparative metric, CRNA billed-to-staffed hours has allowed us to identify opportunities for progress and change OR processes, which have led to improved resource utilization. For example, by identifying locations and times when CRNAs are poorly utilized, changes in staffing have been implemented; offsite coverage has been consolidated, staffing patterns have changed, and allocation of ORs has been addressed. We have utilized this metric as a starting point to help identify inefficiencies in resource allocation, and it has demonstrated significant achievable savings. Furthermore, these savings are compounded with improved efficiency of hospital resources.

This abstract was presented at the American Society of Anesthesiologists Practice Management Conference, Dallas, TX, January 2015

WORKED HOURS PER 100 SURGICAL MINUTES AS A PERFORMANCE IMPROVEMENT METRIC ACROSS A LARGE MULTI-HOSPITAL HEALTH CARE SYSTEM

Trent Emerick, Andrius Giedraitis, David Nelson, Mark Hudson
Department of Anesthesiology, University of Pittsburgh/UPMC, Pittsburgh, PA

INTRODUCTION
Worked hours per 100 surgical minutes (WH/100SM) is an efficiency metric defined as total nursing and technician hours per 100 surgical minutes. This metric can be utilized to evaluate the efficiency of operating room (OR) staffing models and for OR performance improvement. WH/100SM metrics can be useful in a large hospital system to identify best-practice approaches and improve lagging performers in both inpatient hospitals and outpatient surgical centers.

METHODS
WH/100SM monthly data was retrospectively obtained for 15 hospitals across our multi-hospital system from September 2013 to August 2014. WH/100SM monthly data was also retrospectively obtained for five outpatient surgery centers within the hospital system. Mean, standard deviation, minimum values, and maximum values were obtained for each hospital or outpatient surgical center. Mean WH/100SM was calculated at each hospital site for the first three and the last three months of the study period. Net change in WH/100SM was then calculated for each hospital site by comparing the first three month WH/100SM mean and last three month WH/100SM mean. Line graphs were created to allow for an easy visual representation of the WH/100SM month-to-month variance (Figure 1 and Figure 2).

RESULTS
Figure 1 provides an overview of WH/100SM over the course of a 12 month period. The mean WH/100SM for inpatient hospitals was 8.51 (±2.39). The mean WH/100SM for outpatient surgical centers was 16.49 (±5.30). The
Largest month-to-month variation in WH/100SM for inpatient hospitals was at Hospital L with a range of 11.86 to 18.74. The largest month-to-month variation in WH/100SM for outpatient surgical centers was at Surgery Center 2 with a range of 21.47 to 27.26. Ten of the 15 inpatient hospitals and four of the five outpatient surgery centers improved over the course of the year when comparing beginning three month and ending three month WH/100SM means. The overall mean improvement in WH/100SM for inpatient hospitals and outpatient surgical centers was 0.34±0.84 and 1.04±1.54, respectively. The largest improvement in 3 month mean WH/100SM was Hospital L with a decrease of 2.57 WH/100SM.

**DISCUSSION**

WH/100SM is a useful measure of the efficiency of ancillary staff in both inpatient hospitals and ambulatory surgical centers. A best practice approach can be identified using both inpatient hospitals and outpatient surgical centers with the least WH/100SM. This best practice hospital approach to efficiently using ancillary staff (nurses and technicians) can lead to improvement in other poor performing hospitals with lagging metrics. Comparative analysis of WH/100SM at inpatient versus outpatient surgical centers shows that inpatient centers are more efficient using this metric. This is due to the economies of scale that larger hospital centers employ, whereas small outpatient surgical centers need many of the same surgical ancillary staff for fewer surgical minutes.
THE EFFECT OF AN ORIENTATION CHECKLIST ON RESIDENT COMFORT, SATISFACTION, AND KNOWLEDGE OF PATIENT SAFETY PROTOCOLS

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UPMC Department of Anesthesiology, Pittsburgh, Pennsylvania, United States

INTRODUCTION
Orientation of residents to new clinical rotation sites serves as a transition for trainees from various backgrounds into a complex residency learning environment and has the potential to set the stage for the individual’s success during that rotation. While emerging evidence shows that cognitive aids such as checklists may have applications in acute and emergency situations, with particular emphasis on surgical and anesthetic practice, there is a paucity of literature on their use in residency orientation programs, with none related specifically to anesthesiology.

OBJECTIVE
We aimed to show that implementation of a checklist during the orientation process would improve residents’ comfort, satisfaction, and knowledge of patient safety protocols.

METHODS
Eighteen post-graduate year (PGY)-2 anesthesiology residents were given an anonymous survey in September 2014 within one week of orientation at a new site. The survey addressed topics related to the primary outcomes of the study (resident comfort, resident satisfaction, and knowledge of patient safety protocols), as well as components of a checklist in order to evaluate orientation criteria at four different clinical sites. The results of this survey were used to create a checklist, which was then implemented during the orientation process for academic year 2015. The survey was then administered again to 15 new PGY-2 anesthesiology residents in September 2015. Survey results between September 2014 and September 2015 were then compared for statistical difference resulting from implementation of the created checklist using Chi Square test or Mann Whitney U test. A p-value of <0.05 was considered significant.

RESULTS
Compared to the pre-implementation resident survey (2014), the post-implementation resident survey (2015) found a statistically significant improvement in both resident satisfaction, from 77.8% to 100% (p=0.039), and ability to correctly identify defibrillator location, which improved from 16.7% to 40% (p=0.016). While there was improvement in residents’ ability to correctly identify the location of both the difficult airway cart (50% to 73.3%) and malignant hyperthermia cart (50% to 66.7%), both failed to reach statistical significance, with p-values of 0.071 and 0.197, respectively. Resident comfort, measured by knowledge of intraoperative duties, ability to locate places of interest, familiarity of controlled substance policies, and knowledge of who to contact regarding schedule changes, did not show post-implementation improvement.

CONCLUSION
The implementation of a checklist during new-site orientation can improve both resident satisfaction and the ability to correctly identify the location of intraoperative defibrillator. Further studies are needed in order to define best practices.
This abstract was presented as a poster at the 14th annual Safar Symposium and sixth annual Multi-Departmental Trainees’ Research Day on May 16-17, 2016 at the University of Pittsburgh.

**RACIAL AND ETHNIC DISPARITIES IN PAIN DURING CHILDBIRTH**

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1Department of Anesthesiology, University of Pittsburgh

**INTRODUCTION**
We aimed to determine how pain improvement under labor epidural analgesia may vary with race and ethnicity.

**HYPOTHESIS**
Racial and ethnic disparities exist in pain relief under labor epidural analgesia.

**METHODS**
This was an unplanned secondary analysis of an existing dataset comprised of a single institutional, retrospective evaluation of 920 women who delivered between February and April 2015. Pain improvement was defined as percent improvement in pain after initiation of labor epidural analgesia [1,2]. Due to the low numbers of American Indian or Alaskan Native, Hispanic, and Other Asian identifiers in our cohort, we categorized race and ethnicity into three groups: White, Black or African American, and Non-Hispanic Latino and Other (Table). Simple and multiple linear regression was used to assess the association between race and ethnicity and pain improvement after adjusting for age, gravidity, parity, body mass index (BMI), chronic pain, history of abuse, marital status, onset of labor, and use of labor induction or augmentation agents.

**Table. Cohort characteristics.**
Data are reported as mean (standard deviation) or frequency [percent].
PIP = Percent improvement in pain.

*P < 0.10, marginally significant term included in final model

<table>
<thead>
<tr>
<th></th>
<th>White</th>
<th>African American</th>
<th>Non-Hispanic Latinos and Others</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PIP</strong></td>
<td>60.2 (52.0)</td>
<td>44.9 (55.1)</td>
<td>21.3 (79.0)</td>
<td>0.02*</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>30.4 (5.7)</td>
<td>25.8 (5.3)</td>
<td>29.6 (4.0)</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>Gravidity</strong></td>
<td>2.0 (1.2)</td>
<td>2.3 (1.3)</td>
<td>1.5 (0.8)</td>
<td>0.19</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td>1.4 (0.9)</td>
<td>1.5 (1.1)</td>
<td>1.2 (0.6)</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Body Mass Index</strong></td>
<td>31.9 (7.0)</td>
<td>30.2 (6.6)</td>
<td>29.3 (5.4)</td>
<td>0.04*</td>
</tr>
<tr>
<td><strong>Chronic Pain</strong></td>
<td>4 [3.5]</td>
<td>0[0]</td>
<td>0[0]</td>
<td>0.36</td>
</tr>
<tr>
<td><strong>History of Abuse</strong></td>
<td>15 [13.0]</td>
<td>5[14.7]</td>
<td>0[0]</td>
<td>0.07*</td>
</tr>
<tr>
<td><strong>Onset of labor</strong></td>
<td>96 [68.1]</td>
<td>24 [61.5]</td>
<td>9 [60.0]</td>
<td>0.06*</td>
</tr>
<tr>
<td><strong>Spontaneous</strong></td>
<td>45 [31.9]</td>
<td>15 [38.5]</td>
<td>6 [40.0]</td>
<td></td>
</tr>
<tr>
<td><strong>Induced Labor</strong></td>
<td>60 [61.2]</td>
<td>16 [61.5]</td>
<td>2 [25.0]</td>
<td>0.85</td>
</tr>
<tr>
<td><strong>Augmentation Agent Used</strong></td>
<td>50 [35.0]</td>
<td>35 [87.5]</td>
<td>2 [13.3]</td>
<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td>88 [61.5]</td>
<td>4 [10.0]</td>
<td>13 [86.7]</td>
<td>0.43</td>
</tr>
<tr>
<td><strong>Single</strong></td>
<td>4 [2.8]</td>
<td>1 [2.5]</td>
<td>0 [0]</td>
<td></td>
</tr>
<tr>
<td><strong>Married</strong></td>
<td>1 [0.7]</td>
<td>0 [0]</td>
<td>0 [0]</td>
<td></td>
</tr>
</tbody>
</table>
RESULTS
There were 201 women who received labor epidural analgesia and had intra-partum pain data recorded. By simple linear regression, racial and ethnic groups differed significantly in their labor pain improvement; non-Hispanic Latino and other groups experienced less improvement in pain after labor epidural analgesia compared to Whites ($\beta=-38.9$, $F=4.13$, $P=0.018$). There were no significant interaction terms and no collinearity among variables. Simple linear regression was used to identify all marginally significant terms ($P < 0.1$), which ultimately included BMI, history of abuse, and onset of labor. After adjusting for these covariates, African Americans had significantly less improvement in pain under labor epidural analgesia compared to Whites ($\beta=-26.4$, $t=-2.78$, $P=0.006$).

CONCLUSIONS
Racial and ethnic disparities may exist in the improvement of pain under labor epidural analgesia.

SIGNIFICANCE
Non-Whites may be more likely to experience less analgesic benefit from labor epidural techniques. The veracity and potential reasons for this inequality deserves further scrutiny.

REFERENCES

This abstract was presented as a case report poster at the International Anesthesia Research Society Annual Meeting on May 23, 2016.

EXCHANGE OF A KING AIRWAY UNDER FIBEROPTIC DIRECT VISUALIZATION USING AN AINTREE CATHETER
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Department of Anesthesiology, UPMC

INTRODUCTION
The King LTS-D™ airway (King airway) is a disposable supraglottic airway with gastric access. It is inserted blindly into the esophagus and is commonly used by EMS personnel. Placement of the King airway can cause pharyngeal and tongue edema that can distort airway anatomy, and prolonged use of the King airway will result in progressively worsening edema. Proposed strategies for definitive airway management in patients presenting with a King airway include removal of the King airway and using direct or video laryngoscopy to place an endotracheal tube, removal of the King airway and using fiberoptic-guided tracheal intubation, catheter-guided airway exchange without visualization, and surgical tracheostomy.1,2 We present a safer alternative: placement of an Aintree catheter through the King airway under direct fiberoptic visualization, over which the King airway can be removed and an endotracheal tube can be placed again under direct fiberoptic visualization.

CASE REPORT
A 57-year-old female developed acute right-sided weakness and aphasia at home. EMS attempted rapid sequence intubation but was unsuccessful, and a King airway was placed. Upon admission to the emergency room, the patient was found to have signs and symptoms of an acute ischemic stroke. Before admission to the ICU, anesthesia was consulted for definitive airway management, and the patient was transferred to the operating room for airway exchange. An Aintree catheter was preloaded over a pediatric fiberoptic bronchoscope and the vocal cords were visualized with the bronchoscope through the laryngeal ventilation side port of the King airway.

Figure 1: An Aintree catheter was preloaded over a pediatric fiberoptic bronchoscope and the vocal cords were visualized with the bronchoscope through the laryngeal ventilation side port of the King airway.
fiberoptic bronchoscope. The vocal cords were visualized with the bronchoscope through the laryngeal ventilation side port of the King airway (Figure 1). The bronchoscope and catheter were advanced together through the cords into the trachea (Figure 2). The bronchoscope was then removed and the King airway was removed over the Aintree catheter after its balloon was deflated. Position of the Aintree catheter was rechecked with bronchoscopy, after which the patient was ventilated using jet ventilation via the Aintree catheter to maintain oxygen saturation. A 7.0 parker flex endotracheal tube was then advanced over the Aintree catheter into the trachea, visualizing tip placement using the bronchoscope. The Aintree catheter and bronchoscope were then removed, and the patient was ventilated using the endotracheal tube.

CONCLUSIONS
This technique has the advantage over other techniques discussed in the literature of maintaining the ability to provide positive pressure ventilation to the patient at all times during the exchange process. This is achieved by the ability to visualize placement of the exchange catheter in the trachea prior to removal of the King airway. We believe this is the safest method of exchanging a King airway to an endotracheal tube described thus far.

REFERENCES
2. Laryngoscope. 2014 May;124(5):1123-7

This abstract was presented as a poster at the 31st spring meeting of the Society for Education in Anesthesia, Baltimore, MD, June 3-5, 2016.

ADVERSE OUTCOMES ASSOCIATED WITH PERIPHERAL NERVE BLOCKS
Vladyslav Melnyk, MD; Nicole Verdecchia, MD; Steven Orebaugh, MD
Department of Anesthesiology, UPMC

BACKGROUND AND OBJECTIVE
Ultrasound (US) guidance for peripheral nerve blockade permits visualization of the needle, the surrounding structures, and the deposition of local anesthetic, which may favorably impact complications, particularly local anesthetic systemic toxicity (LAST) 1. In prior studies, we detailed our practice’s evolution towards the use of US for the great majority of nerve blocks, with a significant decline in LAST 2. In this study, we present an updated retrospective analysis of peripheral nerve block (PNB) complications at our institution over the last four years as we continue to progress towards US use for guidance of all PNBs. Our hypothesis is that with complete implementation of US-guided PNB, the rate of adverse outcomes remains significantly lower.

METHODS
This study was designated as exempt by the Institution Review Board. The 48-month period between January 1, 2012 and December 31, 2014 was analyzed. Patient’s billing data was reviewed to obtain a total number of PNBs performed over this period, as well as block site and technique. Concurrent quality improvement data from our prospective departmental database of all patients undergoing PNB was analyzed for records of anesthesia complications associated with PNBs.

The incidence of complications was compared between each technique and with historical data from our previous data 2. Incidence is expressed per 1,000 nerve blocks. Confidence intervals were calculated using binominal (Clopper-Pearson) “exact” method. Statistical analysis was performed using Chi-square test with Yates correction.
RESULTS
A total of 8,229 PNBs were performed over the query period, including paravertebral, sciatic, femoral, subclavian, axillary, saphenous, and distal arm blocks. The majority (94%) were performed with US guidance; by the end of the period, US-guided regional anesthesia (UGRA) was used for all blocks.

Five complications during this period were attributed to anesthetic care. Three sensory deficits following femoral nerve and interscalene block occurred with UGRA approaches. There was one case of LAST presenting as seizure, which occurred with interscalene block performed using landmark approach. In addition, there was one case of a mild local infection at the site of femoral nerve catheter. There were no recorded cases of pneumothorax, bleeding/hematoma, or unintended neuraxial blockade.

Statistical analysis did not demonstrate a significant difference in the incidence of suspected nerve injury between UGRA and non-ultrasound-assisted blocks (p=0.66) or in the incidence of LAST (p=0.07) for the four-year period. However, when combined with data from the 2009 and 2012 reports, the difference in incidence of LAST reached statistical significance (p<0.01) (Table 1).

Table 1: Comparison of utilization of peripheral nerve block techniques and incidence of complications

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</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Nerve Injury, n (95% CI /1000)</td>
<td>LAST, n (95% CI /1000)</td>
</tr>
<tr>
<td>US-guided</td>
<td>7725</td>
<td>3</td>
<td>0-1/1000</td>
</tr>
<tr>
<td>Non-US</td>
<td>504</td>
<td>0</td>
<td>0-0.5/1000</td>
</tr>
<tr>
<td>p</td>
<td>0.66</td>
<td>0.067</td>
<td>See Ref 2 for details</td>
</tr>
</tbody>
</table>

CONCLUSIONS
UGRA has become the predominant modality for PNBs at our institution and is now used as the primary guidance method for all of our PNBs. While infrequent neurologic complaints continue to occur, the rate of LAST has significantly decreased with the introduction of ultrasound guidance, a finding consistent with those from large databases from other institutions 3.

REFERENCES

This abstract was submitted as a “Medically Challenging Case” at the American Society of Anesthesiologists Annual Meeting, October 22-26, 2016, Chicago, IL.

EXTENSIVE BLEEDING DURING ORAL SURGERY IN A PATIENT WITH TYPE 2B VON WILLEBRAND’S DISEASE
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Ibtesam Hilmi, MB ChB, FRCA
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CASE DESCRIPTION
Type 2B Von Willebrand’s Disease (VWD) is among the rarest variants, comprising only 5% of all cases, and makes bleeding difficult to treat, as DDAVP (desmopressin) is contraindicated for these patients. This case involved a 37-year-old male with Type 2B VWD and thrombocytopenia (pre-operative platelets 135,000) who presented for a routine complete dental extraction secondary to extensive caries. Per Hematology, he received 7908 IU (80 IU/kg) Humate-P IV prior to induction with propofol and succinylcholine. One hour into the case, the surgeons reported extensive, difficult to control mucosal bleeding. The patient was then given 5 g Amicar, with moderate improvement in hemostasis. Total EBL was 270 mL. The patient was transferred to the inpatient floors, where he received Humate-P 80 IU/kg IV q8H (total of three doses), along with oral gauze packs soaked in 1 mg Amicar syrup q1H until bleeding stopped. The patient was discharged in stable condition the next day.
IMPLEMENTATION OF AN “INTRODUCTION TO REGIONAL ANESTHESIOLOGY” MINI-ELECTIVE FOR FIRST AND SECOND YEAR MEDICAL STUDENTS

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

BACKGROUND
Implementation of an “Introduction to Regional Anesthesiology” mini-elective for first and second year medical students offered an opportunity to engage students early in their medical training and facilitate their understanding of ultrasound and peripheral nerve blockade. The goals for the mini-elective were to improve the knowledge of upper extremity anatomy, learn the benefits of and indications/contraindications for peripheral nerve blockade, appreciate how regional anesthesia complements general anesthesia, understand how to optimize patient safety during peripheral nerve blockade, and learn the potential advantages of ultrasound guidance during nerve blockade.

NEEDS ASSESSMENT
Medical students desire the opportunity for clinical connections to their classroom instruction. Additionally, the utility of ultrasound for procedural guidance and/or diagnostics is expected to increase in the future. The implementation of a regional anesthesiology mini-elective early in medical training introduces students to the basics of ultrasound techniques, the indications/contraindications for peripheral nerve blockade, and the usage of regional anesthesia in the perioperative care of the patient. Utilizing 3-D anatomy dissections and cadaver models in conjunction with live-model ultrasound scanning further assists the learners with their comprehension of upper extremity anatomy.

CURRICULUM DESIGN
The mini-elective was open to first and second year medical students and was scheduled for 90-minute sessions for four consecutive weeks. Brief introductory presentations were given at the start of each session on one of four topics: “Introduction to Peripheral Nerve Blockade,” “Upper Extremity Anatomy for Peripheral Nerve Blockade,” “Safety in Peripheral Nerve Blockade,” and “Ultrasonography for Guidance in Peripheral Nerve Blockade.”

Following the presentations, students were divided into three groups and rotated through one of three stations each week for the first three weeks. These stations included ultrasound guidance of needle placement using gel blocks, 3-D anatomy dissection review of the brachial plexus, and brachial plexus exploration utilizing a dissected cadaver. During the fourth week, the groups rotated through three live-model, ultrasound-scanning stations of the interscalene, supraclavicular, and axillary blocks and were asked to identify surface anatomy and pertinent underlying structures.

CURRICULUM EVALUATION
The students completed a multiple choice and visual anatomy pre-test before the course started and then completed the same multiple choice and visual anatomy post-test after the last session. Following the course, the students completed a comprehensive post-course evaluation.
TEACHING MEDICAL STUDENTS ANATOMY FOR REGIONAL ANESTHESIA USING MULTIMODAL INSTRUCTION

Kaarin Michaelsen, MD, PhD and Steven Orebaugh, MD
Department of Anesthesiology, University of Pittsburgh/UPMC

INTRODUCTION
Increasingly, anatomy instruction incorporates multiple training methodologies beyond classic dissection, including imaging and digital media[1-3]. We proposed to test the effectiveness of using a multimedia approach to teach medical students anatomy of the neck and axilla relevant to brachial plexus nerve blockade during an elective course for first- and second-year medical students. Our primary hypothesis was that participation in this elective course would improve students’ knowledge of regional anatomy based on pre- and post-course test scores.

METHODS
The course met once weekly for 90 minutes for four sessions. Students took a pre-course test, then rotated each week through one of three stations during each class: viewing cadaveric pro-section of neck and axillary structures, using ultrasound to identify simulated “nerves” in a phantom task trainer followed by needle guidance for simulated “nerve block,” and employing a 3-D computer program to locate key anatomic structures. During the fourth session, all students identified designated neck and axillary structures using ultrasound on live models and then completed a post-course test identical to the initial one (Table 1: List of Structures Tested). Our primary outcome was the degree of improvement between pre- and post-course test scores. Our secondary outcome was student evaluation of the course instruction methods, in particular the use of ultrasound imaging.

RESULTS
Fourteen students participated in the course; all were first- or second-year medical students, with a M:F ratio of 1:8:1. For the primary outcome, post-course test scores increased from 6.21/12 (SD 1.85) to 9.14/12 (SD 1.99), p = 0.006, 95% CI -4.33 to -1.52 (two-tailed, paired t-test). For the secondary outcome, students generally supported the use of multi-media for learning anatomy in this course and had positive feelings about the use of ultrasound (Table 2: Post-Course Survey Results).

DISCUSSION
This study confirms our hypothesis that using multimedia anatomy instruction does improve medical students’ ability to identify structures in the neck and axilla. It also supports our secondary outcome that students feel that ultrasound is an effective tool for learning regional anatomy.

REFERENCES
This abstract was presented as a poster presentation at the ASA Practice Management Meeting, Atlanta, GA, Jan 23-25, 2015, as well as the Pennsylvania Annual Resident Research Conference, Hershey, PA, May 14, 2016.

AN ANALYSIS OF OPERATING ROOM COST PER SURGICAL MINUTE AS A MEASURE OF EFFICIENCY ACROSS A LARGE MULTI-HOSPITAL HEALTH CARE SYSTEM

David F Nelson MD, MBA; Trent Emerick MD; Andrius Giedraitis MD, MBA; Mark E Hudson MD, MBA
UPMC Department of Anesthesiology

INTRODUCTION

Current economic conditions across health care systems include reduced reimbursement rates and swings in patient volume based on both policy changes and patient insurance options. This has necessitated operating room (OR) management to reduce costs and maximize profits. One simple global metric to quantify OR cost is salary expense per minute of surgical time. This allows for expression of efficiency as labor utilization to perform the task of surgery, a metric that can be used to compare performance among OR units of different hospitals.

METHODS

For FY14 year-to-date, annualized total OR minutes, hourly base wages, premium hourly wages, salaried wages, and miscellaneous payments were tabulated for each hospital within our multi-hospital system. The cost of salaries per surgical minute was then calculated for each individual hospital and for the overall system. In addition, the cost per minute was determined for hourly base wages, premium hourly wages, and salaried wages as above. OR staffing mix as a percentage of total personnel was also calculated. Using these data, we identified “best practice” hospitals and their approaches to demonstrate improvement across the entire system.

RESULTS

Total salary pay-type composition ranged from 5% for “other payments” to 94% for hourly base salaries. Total salary cost per OR surgical minute for each of the core hospitals is shown in the figure below. A system-wide average was calculated at $2.81, representing the average per minute cost to OR staff across the entire healthcare system. Various other core hospital staffing costs are compared against this average and range from $2.23 per OR minute for Hospital “A” (a quaternary care center) to $5.50 per OR minute for Hospital “L” (a community hospital). In addition, OR staffing mix was also compared. For example, the multi-hospital system had an average staffing mix of 44% nursing, 38% “other tech,” 8% clinician, and 10% “other.”

DISCUSSION

Setting cost per minute goals as determined by benchmark institutions employs a quantitative, verifiable metric that can be used to track progress and directly link best practice approaches to the bottom line. However, while such a metric can be useful in making quantitative comparisons between OR units, several other variables should be considered when identifying areas of improvement. Consideration of OR staffing mix becomes particularly important when comparing efficiency across facilities. For example, higher performing ORs tend to minimize high base-salary employees compared to others. They also appear to have staffing mixes that favor technicians and aides as opposed to clinicians and nurses. Clearly, a better understanding of the variables that contribute to such metrics as OR cost per surgical minute, and using this knowledge to identify best practices, can be an effective means of improving efficiency within a hospital system.
This abstract was a poster presentation at the ASA Practice Management Meeting, San Diego, CA, Jan 29-31, 2016, as well as at the Pennsylvania Annual Resident Research Conference, Hershey, PA, May 14, 2016.

DOES A DEDICATED CHARGE ANESTHESIOLOGIST AFFECT OR PERFORMANCE METRICS IN A LARGE TERTIARY-CARE TEACHING HOSPITAL?
David F Nelson, MD, MBA; Trent Emerick, MD; Andrius Giedraitis, MD MBA, MSE; Tetsuro Sakai, MD, PhD; Mark Hudson, MD, MBA
Department of Anesthesiology, UPMC, Pittsburgh, PA

INTRODUCTION
The sustainability of healthcare economics is heavily reliant on appropriate allocation of resources and minimization of costs. This has led to increased scrutiny of operating room (OR) performance to identify inefficiencies and opportunities for cost savings. It has been established that core OR performance metrics are a useful way to measure and track such efficiencies and develop best practices. However, it is not clear whether tracking metrics and identifying best practices alone are sufficient for maintaining sustainable OR economics. Some institutions have invested in a dedicated charge anesthesiologist (DCA) who is responsible for daily OR operational management and resource allocation. Our study seeks to determine whether the implementation of a DCA is a useful endeavor that can affect OR performance.

METHODS
For FY15 January through June, data was retrospectively obtained for: core OR performance metrics such as CRNA utilization data (CRNA anesthesia billed hours divided by CRNA staffed hours), on-time start performance, and turnover data. This data was then compared among weekdays that a DCA worked to days in which he or she did not (“other” days). For each of the “other” days, charge assignments were shared among five non-DCAs.

RESULTS
The DCA worked 64 weekdays during the six-month period compared to 62 weekdays worked by all non-DCAs combined. When the DCA worked, on-time start performance increased by 4% from 65.4% to 69.4%, turnover time decreased by 0.6 minutes (44.3 min. to 43.7 min.), and gaps (number of occurrences per day where time between cases >75 min) decreased by 0.7 (10.5 to 9.8). Additionally, CRNA utilization performance decreased by 1% from 52.7% (SD 3.8%) to 51.7% (SD 3.7%) when the DCA worked. Student’s T test (two tailed, paired) was performed and did not find significant differences (P<0.05) among any of the above data.

DISCUSSION
Analytics have been used in other industries to compare individual performance across a variety of metrics. The Society for American Baseball Research coined the term “sabermetrics” to represent individual performance based on a composite of objective metrics such as base runs, late-inning performance, etc. Similarly, we seek a way to identify high-performing individuals and their best practices in their role as charge anesthesiologists based on composite performance data. While we have failed to demonstrate statistical significance among our selected OR performance metrics between the DCA and five other non-DCAs during the time period studied, we do appreciate a general trend toward more efficient overall OR performance since the dedicated charge program was introduced. We also appreciate improved staff satisfaction, better communication with surgical services, and organizational know-how when a DCA or one of a small number of non-DCAs works—perhaps due a change in culture and/or accountability established by the DCA. The question as to how OR performance metrics have changed since before institution of the DCA program merits further investigation.
ANESTHETIC CHOICE FOR SUSPECTED PLACENTA ACCRETA AND MATERNAL AND NEONATAL OUTCOMES

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INTRODUCTION
Equipoise may exist for the ideal type of anesthesia to be chosen for surgical management of suspected placenta accreta. This study aims to determine whether the type of anesthesia induced for cases of placenta accreta correlates with severe maternal hemorrhage and neonatal compromise.

DESIGN
In this IRB-approved, single-center, retrospective observational cohort study, subjects with prenatal ultrasonographic diagnosis of accreta who delivered between 2007 and 2014 were identified. Pathology reports were used to cross-reference diagnoses and to identify cases detected late in prenatal care. All cases had antenatal anesthesia consultation and multidisciplinary preoperative planning. Severe hemorrhage was defined as estimated blood loss (EBL) ≥2 liters (L) and any requirement for transfusion. Neonatal compromise was defined as a five-minute Apgar score of ≤6. Bivariate logistic regression analysis was performed to identify and adjust for factors that may have influenced anesthesia choice, risk for higher blood loss, need for transfusion, and lower Apgar scores. Fisher’s exact test was used for categorical variables and Wilcoxon rank sum test for continuous variables. P < 0.05 was considered significant.

RESULTS
Fifty-one cases were identified. Table 1 shows characteristics of women receiving neuraxial (NA) or general anesthesia (GA). The incidence of EBL ≥2L and transfusion were similar for both anesthesia groups (EBL <2L: GA = 26.1% v. NA = 73.9%; ≥2L: GA = 35.7%, NA = 64.3%, P=0.552. No transfusion: GA = 30.8%, NA = 69.2%; Transfusion: GA = 31.6%, NA = 68.4%, P>0.999). After adjusting for mode of delivery, anesthesia choice remained not significantly related to EBL or transfusion. GA was associated with lower one-minute, but not five-minute Apgar scores compared to NA (one-minute Apgar ≤6: GA = 70.0% v. NA = 30.0%; >6: GA = 20.8% v. NA 79.2%, P=0.015. five-minute Apgar ≤6: GA = 60.0% v. NA = 40.0%; >6: GA = 31.0% v. NA = 69.0%, P>0.319). Intraoperative conversion from NA to GA was not associated with increased EBL or transfusion (EBL <2L: GA conversion = 34.8% v. NA or GA = 65.2%; EBL ≥2L: GA conversion = 28.6% v. NA or GA = 71.4%, P=0.764. No transfusion: GA conversion = 23.1% v. NA or GA = 76.9%; transfusion required: GA conversion = 34.2% v. NA or GA = 65.8%, P=0.730).

CONCLUSIONS
Anesthetic choice for the surgical management of suspected placenta accreta does not appear to correlate with severe hemorrhage or neonatal compromise.
Table 1. Maternal, anesthetic, and obstetric features of women receiving neuraxial or general anesthesia

<table>
<thead>
<tr>
<th></th>
<th>Neuraxial anesthesia (n=35)</th>
<th>General anesthesia (n=16)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maternal Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Age</td>
<td>32 [7]</td>
<td>33.5 [10]</td>
<td>0.776</td>
</tr>
<tr>
<td>Morbid obesity (BMI ≥40)</td>
<td>7/32 (21.9)</td>
<td>2/14 (14.3)</td>
<td>0.701</td>
</tr>
<tr>
<td>BMI</td>
<td>32 [10.9]</td>
<td>28.5 [8.1]</td>
<td>0.064</td>
</tr>
<tr>
<td>Gravidity</td>
<td>4 [3]</td>
<td>4 [2.5]</td>
<td>0.398</td>
</tr>
<tr>
<td>Parity</td>
<td>2 [2]</td>
<td>2 [1.5]</td>
<td>0.584</td>
</tr>
<tr>
<td><strong>Anesthetic Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anesthesiologist</td>
<td>Presented separately</td>
<td></td>
<td>0.008*</td>
</tr>
<tr>
<td>Mallampati ≥3</td>
<td>2/35 (5.7)</td>
<td>1/16 (6.3)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Malignant hyperthermia history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prolonged labor</td>
<td>0/35 (0.0)</td>
<td>0/16 (0.0)</td>
<td>--</td>
</tr>
<tr>
<td>Tocylotytes used antenataly</td>
<td>6/35 (17.1)</td>
<td>3/16 (18.8)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Hextend intraoperatively</td>
<td>22/35 (62.9)</td>
<td>10/16 (62.5)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Baseline hemoglobin</td>
<td>11 [1.5]</td>
<td>10.9 [1.9]</td>
<td>0.423</td>
</tr>
<tr>
<td>Abrupton or preoperative bleeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placenta previa</td>
<td>27/35 (77.1)</td>
<td>11/16 (68.8)</td>
<td>0.730</td>
</tr>
<tr>
<td>Previous cesarean</td>
<td>33/35 (94.3)</td>
<td>16/16 (100.0)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Number of previous cesareans</td>
<td>2 [2]</td>
<td>2 [2]</td>
<td>0.520</td>
</tr>
<tr>
<td>Previous myomectomy</td>
<td>0/35 (0.0)</td>
<td>0/16 (0.0)</td>
<td>--</td>
</tr>
<tr>
<td>Previous D&amp;C/D&amp;E</td>
<td>8/35 (22.9)</td>
<td>4/16 (25.0)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Degree of placental invasion by pathology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1/35 (2.9)</td>
<td>2/16 (12.5)</td>
<td>0.228</td>
</tr>
<tr>
<td>Accreta</td>
<td>12/35 (34.3)</td>
<td>4/16 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Increta</td>
<td>15/35 (42.9)</td>
<td>4/16 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Percreta</td>
<td>7/35 (20.0)</td>
<td>6/16 (37.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Mode of delivery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled cesarean</td>
<td>27/35 (77.1)</td>
<td>5/16 (31.3)</td>
<td></td>
</tr>
<tr>
<td>Unscheduled cesarean</td>
<td>0/35 (0.0)</td>
<td>2/16 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Cesarean with take back</td>
<td>1/35 (2.9)</td>
<td>1/16 (6.3)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7/35 (20.0)</td>
<td>8/16 (50.0)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index; D&C, dilation and curettage; D&E, dilation and evacuation.
Data are presented as number (percentage %); median [interquartile range].
+Fisher’s exact test for categorical variables and Wilcoxon rank sum test for continuous variables.
IMPLEMENTING A RESIDENT CHARGE ROLE TO ADDRESS ACGME SURVEY RESULTS AND PROGRAM REQUIREMENTS

Alexander P. Preus, MD; E. Gail Shaffer, MD; David G. Metro, MD; Robert G. Krohner, DO
Department of Anesthesiology, UPMC, University of Pittsburgh

BACKGROUND
The Accreditation Council for Graduate Medical Education (ACGME) requires training in systems-based practice, as well as graded and progressive responsibility. Residents have been discontent with competing with other trainees to practice procedures, and additionally have felt they needed more supervisory and managerial experience.

OBJECTIVE
We aimed to address a perceived problem with competition for procedures from other trainees and facilitate the acquisition of complex skill sets associated with attending anesthesiologists, especially supervision and management of members of an anesthesia care team (ACT).

METHODS
An Obstetric (OB) Charge Resident role was created for experienced anesthesiology residents in a busy labor and delivery unit. The resident in charge is responsible for interfacing between obstetric staff and other anesthesia providers to provide high quality and efficient anesthetic care while facilitating the education of junior trainees (Figure 1). Participants were surveyed and we compared rotation evaluation data before and after implementation (Table 1).

<table>
<thead>
<tr>
<th>Duties of OB Charge Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Substaff junior residents and nurse anesthesia students with epidural and spinal placement</td>
</tr>
<tr>
<td>2. Follow all patients with labor epidurals, especially high risk patients</td>
</tr>
<tr>
<td>3. Assign residents and other providers to place epidurals, manage Caesarian sections, perform preoperative evaluations, evaluate anesthetic complications, and respond to airway emergencies and cardiac arrests</td>
</tr>
<tr>
<td>4. Handle unexpected scheduling issues</td>
</tr>
</tbody>
</table>

Table 1: Rotation evaluations obtained with a nine-point scale

<table>
<thead>
<tr>
<th>Evaluation Prompt</th>
<th>Advanced OB Anesthesiology</th>
<th>Basic OB Anesthesiology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-charge</td>
<td>Post-charge</td>
</tr>
<tr>
<td>For elective cases, quality of faculty teaching</td>
<td>7.72 ± 1.03</td>
<td>7.96 ± 0.89</td>
</tr>
<tr>
<td>For nighttime cases, quality of faculty teaching</td>
<td>7.8 ± 0.77</td>
<td>8.12 ± 0.91</td>
</tr>
<tr>
<td>Quality of scheduled teaching sessions</td>
<td>7.45 ± 1.13</td>
<td>8.02 ± 0.79</td>
</tr>
<tr>
<td>Relief from OR duties to go to relevant teaching sessions</td>
<td>7.93 ± 0.83</td>
<td>8.34 ± 0.75</td>
</tr>
<tr>
<td>Value of this rotation for my education</td>
<td>7.87 ± 1.06</td>
<td>8.51 ± 0.61</td>
</tr>
<tr>
<td>General support from the faculty</td>
<td>7.87 ± 1.06</td>
<td>8.45 ± 0.69</td>
</tr>
<tr>
<td>Overall quality of this rotation</td>
<td>7.72 ± 1.03</td>
<td>8.35 ± 0.75</td>
</tr>
<tr>
<td>Overall quality of faculty teaching for this hospital site</td>
<td>7.65 ± 1.05</td>
<td>8.01 ± 0.79</td>
</tr>
<tr>
<td>Overall quality of clinical experience</td>
<td>7.72 ± 1.03</td>
<td>8.4 ± 0.82</td>
</tr>
<tr>
<td>Overall quality of educational sessions for this hospital site</td>
<td>7.65 ± 1.05</td>
<td>7.95 ± 0.94</td>
</tr>
</tbody>
</table>
This case was an oral presentation at the 11th Annual Pennsylvania Anesthesiology Resident Research Conference on May 14th, 2016

INTRAVENOUS KETAMINE INFUSION FOR THE TREATMENT OF REFRACTORY LOWER EXTREMITY CHRONIC REGIONAL PAIN SYNDROME

Daniel Sandusky, MD; Andrew Clary, DO; Michael Mangione, MD
Department of Anesthesiology, UPMC and VA Pittsburgh Healthcare System

INTRODUCTION
Complex Regional Pain Syndrome (CRPS) is a rare but well-characterized disease that can often be resistant to multiple modalities of pain management therapy.1–2 Signs and symptoms can include allodynia, hyperalgesia, trophic changes, and sudomotor and vasomotor abnormalities.1 Increasing evidence and clinical data support the ideas of central sensitization and altered modulatory controls of nociceptive stimuli in the central nervous system as causative pathologies.2–3 Furthermore, use of the anesthetic ketamine as an infusion has been advocated as an effective therapy for chronic pain patients through its action as an N-methyl-D-aspartate receptor antagonist, which is thought to play a significant role in attenuating centralized sensitization and nociceptive modulation abnormalities.2–3

CASE PRESENTATION
A 21-year old male Veteran who had sustained a left ankle fracture with a past medical history of asthma, obesity, and hyperlipidemia underwent open reduction and internal fixation of the extremity, and subsequently developed hyperalgesia, allodynia, trophic changes, and vasomotor abnormalities consistent with CRPS. Upon presentation to the Pain Management Clinic, his primary care physician had trialed a variety of conservative therapies, including antidepressants, alternate neuromodulating agents, and high dose opioid therapy. These therapies did not lead to sufficient improvement in pain or functionality. Ultimately, a spinal cord stimulator was placed. While this provided modest improvement, it also caused a new severe thoraco-abdominal neuropathic pain over the area where the device was implanted. The patient also suffered from recurrent oral abscesses, necessitating complete dental extractions. Fearing the development of another CRPS-like presentation at the third surgical site, a multimodal approach to anesthesia and pain management was planned, including use of a low-dose ketamine infusion. Unexpectedly, the patient reported a significant reduction in his CRPS symptoms in his lower extremity following this ketamine-based anesthetic. Subsequent therapy with varying doses and durations of ketamine infusions (75-200mg/hr over 2–4 hours) continued to improve his pain significantly, allowing him to be more functional with decreased pain and lower opioid requirements for periods of weeks to several months.

DISCUSSION
Several studies have advocated the use of intravenous ketamine infusion for the treatment of patients diagnosed with CRPS with remarkable success.4–5 Moreover, patients have reported improved pain scores several weeks to months from the time of treatment, and long term success often correlated with increasing dose and duration of therapy at a relatively similar cost to other interventional therapies (i.e., sympathetic blocks or spinal cord stimulators).2–3 A variety of doses and durations of ketamine infusions have been trialed. In one study, patients were given a low-dose 0.35 mg/kg/hr regimen of intravenous ketamine over four hours for a period of 10 days in an outpatient...
setting with notable improvement of pain scores when compared to a placebo group. In another study, 18 CPRS outpatients were administered a higher 1 ± 0.5 mg/kg/hr dose over an average 43.8 min. every 30.8 days with reported improvements in visual analog scale pain scores from 8.5 to 0.8 and reported improvement in functionality post therapy. In our case, ketamine used as part of an anesthetic for an unrelated procedure resulted in marked improvement in his CRPS symptoms, and more importantly, in the functionality of his affected extremity. Therapy with intravenous ketamine infusion appears to be a durable and cost effective means of treating this difficult patient population.

REFERENCES
2) Bruehl, S. Complex Regional Pain Syndrome. BMJ 2015;350:h2730

INDEX PROFILE SYSTEM: A NOVEL APPROACH TO IDENTIFY PATIENTS AT RISK FOR TRIPLE LOW STATE AND POSTOPERATIVE MORTALITY

Michael P. Schnetz, MD, PhD; Melissa Giraldo Duque, MD; Steven L. Whitehurst, MD; Ata M. Kaynar, MD, MPH
1Department of Anesthesiology, University of Pittsburgh/UPMC 2Department of Neurobiology, Pittsburgh Center for Pain Research, University of Pittsburgh; 3Department of Critical Care Medicine, University of Pittsburgh/UPMC

BACKGROUND
Electronic medical record (EMR) systems are now commonly used to collect data throughout a patient’s surgical experience. These datasets represent a rich source of information that can be used to explore the clinical and physiologic factors influencing postoperative outcomes. Recent work suggests that an intraoperative “triple low state” (MAP <75 mm Hg, BIS index <45, and MAC of volatile anesthesia <0.7) is associated with increased 30-day mortality and hospital length of stay. However, only total duration of the triple low state has been examined; the topography of the triple low state, defined as the pattern of simultaneously measured MAP, BIS, and MAC values that give rise to the triple low state, remain unknown. To better understand the association between the triple low state and postoperative mortality, we created a novel index system that identifies patients at high risk for experiencing the triple low state and increased postoperative mortality.

METHODS
MAP, BIS, and MAC values were extracted from the anesthesia EMRs in 715 surgery cases performed at UPMC from 2012-2015. To ensure case heterogeneity, cases were selected from eight UPMC hospitals and at least 45 cases from each ASA physical
status class were included. MAP, BIS, and MAC values had been simultaneously monitored in approximately 60% of the cases (413). For each case, an index was calculated by summing the Z-score of each variable at time points where variables overlapped. A unique profile was created for each case by plotting index values over the intraoperative period. K-means cluster analysis organized cases into clusters based upon index profile similarity (Figure 1). Thirty-day and six-month all-cause mortality were evaluated across case clusters.

RESULTS
Cases clustered in three general patterns according to their index value over intraoperative time: consistently elevated index (clusters 1 and 3), consistently depressed index (clusters 4 and 5), and fluctuating index (cluster 2). Elevated and depressed index cases also segregated according to total monitoring time: (cluster 1 vs. 3 and cluster 4 vs. 5). Case clusters exhibited different rates of all cause mortality at both the 30-day and six-month end points (Table 1). In depressed index clusters (4 and 5), 20% and 25% of patients identified died at 30 days and six months, respectively. In elevated and fluctuating index clusters, less than 5% of identified patients died at 30 days and six months. Despite accounting for only 18% of all study cases, cluster 4 and 5 patients represented 65.2% and 57.5% of all deaths that occurred at 30 days and six months, respectively.

CONCLUSION
Index profiling with subsequent K-means cluster analysis offers a novel approach to identify patients at risk for postoperative death. Thirty-day and six-month postoperative mortality occurred most frequently in patients exhibiting a depressed index throughout their surgery.

ANALYSIS AND COMPARISON BETWEEN TERM VAGINAL DELIVERY AND TERM CESAREAN DELIVERY NEONATAL TEG ASSAYS WITH ESTABLISHMENT OF NORMATIVE DATA
Nicholas J. Schott, MD¹; Stephen Emery, MD²; Jonathan Waters, MD³
¹ Resident, Department of Anesthesiology, UPMC; ² Director, Center for Innovative Fetal Intervention, Division of Ultrasound, Magee-Womens Hospital of UPMC; ³ Professor of Anesthesiology and Bioengineering, Vice Chair for Clinical Research, Department of Anesthesiology; Chief of Anesthesiology, Magee-Womens Hospital of UPMC

INTRODUCTION
Thromboelastography (TEG) is utilized for point-of-care monitoring of coagulation function. Normal adult values, graphing curve patterns, and various abnormalities are well known and described. However, immediate newborn TEG information is poorly documented. Specifically, TEG changes characterized throughout the later weeks of gestation have not been documented, nor has the influence of mode of delivery on this coagulation function been measured.

OBJECTIVE
We documented normative term delivery TEG, as well as the influence of vaginal and scheduled Cesarean delivery methods, on these TEG tracings.

METHODS
This study was approved by the local IRB committee. Venous umbilical blood was obtained within ten minutes of stage 3 delivery of the fetal placenta. Citrated-kaolin sampling and analysis methods were conducted. Cesarean samples were collected for scheduled cases, as well as for cases that were converted to Cesarean delivery for failure of cervical progression of labor prior to active stage 2 pushing. TEG values with corresponding images were obtained for comparison. A total of 50 vaginal delivery and 50 Cesarean delivery samples were to be collected.

RESULTS
The total numbers of samples for neonate venous cord blood at the completion of this study were 49 vaginal deliveries and 34 Cesarean deliveries in each group. One vaginal neonatal sample with poor fetal well-being in the setting of low APGAR scores was excluded and not included in our analysis. A total of 16 Cesarean samples were excluded (six for fetal distress with low APGAR scores reported by nursing and 10 for inability to collect in the required time frame or inadequacy of sample volume to perform the assay). Vaginal term deliveries in which no
known previous abnormalities were documented resulted in neonatal, infant, and adult TEG study values: R: 5.4 ± 1.4 (mean ± SD) minutes, K: 1.6 ± 0.8 minutes; α-angle: 65.3 ± 8.8 degrees, MA: 65.9 ± 5.8 mm, and LY30: 1.3 ± 1.1 percent. Results of the Cesarean deliveries showed: R: 5.9 ± 1.8 (mean ± SD) minutes, K: 1.6 ± 0.5 minutes; α-angle: 62.3 ± 9.9 degrees, MA: 64.4 ± 3.6 mm, and LY30: 1.2 ± 1.1 percent. No statistical significance was found between the groups (p>0.01).

CONCLUSION
We found that observing TEG samples from term gestation overall mimicked adult values when delivery was normal. There appeared to be a tendency for a more pro-thrombotic TEG curve; however, parameters were neither statistically nor clinically significant. We speculate that this is favorable to the baby in order to eliminate the risk of neonate bleeding during immediate delivery. More likely, factors affecting neonatal TEG assays appear to be clinical state of mother and fetus without being inherent to delivery type or age of the neonate.

REFERENCES

DECREASED VENTILATOR AND MORTALITY IMPACT OF PARAVERTEBRAL NERVE CATHETERS ON OUTCOME OF TRAUMA PATIENTS WITH MULTIPLE RIB FRACTURES: A RETROSPECTIVE ANALYSIS

Schott NJ¹, Pearce-Smith B², Chelly JE³, Ibinson J⁴, Sperry J⁵, Alarcon L⁶
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BACKGROUND
Multiple rib fracture (MFR) is associated with significant morbidity and mortality. Treatment includes controlling pain and optimizing oxygenation and ventilation. Optimizing pain control and minimizing complications are paramount in management.

OBJECTIVE
We sought to compare outcomes of a high number of MRF patients treated with paravertebral nerve catheters (PVC) compared to standard patient controlled analgesia (PCA) medication.

METHODS
A retrospective review of trauma patients with MRF admitted between 2006 and 2013 was
performed. Data collected included patient age, injury severity score (ISS), days of mechanical ventilation, ICU length of stay (LOS), total hospital LOS, and in-hospital mortality. Epidural catheters were not included in analysis for hospital preference as well as safety and hemodynamic stability concerns.

RESULTS
A total of 4,640 patients sustained MRF after blunt chest trauma. Of these, 460 patients met criteria to receive PVC for treatment. All-cause mortality was lower in patients treated with PVC (2.0% vs 6.1%, p<0.01). Duration of mechanical ventilation was shorter for PVC patients (0.51 ± 2.15 d vs 2.00 ± 5.5 d [mean± SD], p<0.01). ICU LOS was shorter for PVC patients (2.71 ± 3.26 d vs 3.71 ± 7.35 d, p = 0.04). Hospital LOS did not differ between groups. After excluding patients with significant head, abdominal, or pelvis injury (Abbreviated Injury Scale ≥4), in-hospital mortality remained lower for PVC patients (1.6% vs 3.4 %, p<0.01). Duration of mechanical ventilation was shorter for PVC patients (0.46 ± 2.19 d vs 1.17 ± 3.78 d, p < 0.01). However, ISS, ICU, and hospital LOS did not differ between groups.

CONCLUSIONS
In this large retrospective review, the use of PVC in patients with MRF is associated with a decrease in duration of mechanical ventilation and in-hospital mortality compared to the use of PCA. These results suggest that PVC may be an effective and safe pain management modality in many patients with MRF.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Patients</th>
<th>In Hospital Mortality</th>
<th>Ventilator Days</th>
<th>ISS</th>
<th>ICU LOS Days</th>
<th>Total Hospital Days</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Non-PVC</td>
<td>4180</td>
<td>6.1%</td>
<td>2.00 ± 5.5</td>
<td>17.7± 10.4</td>
<td>3.71 ± 7.35</td>
<td>8.74 ± 9.96</td>
<td>54.1± 19.9</td>
</tr>
<tr>
<td>All PVC</td>
<td>460</td>
<td>2.0%</td>
<td>0.51 ± 2.15</td>
<td>15.5± 6.9</td>
<td>2.71 ± 3.26</td>
<td>7.24 ± 5.92</td>
<td>62.0± 17.5</td>
</tr>
<tr>
<td>P Value</td>
<td></td>
<td>&lt;0.01*</td>
<td>&lt;0.01*</td>
<td>0.08</td>
<td>0.04*</td>
<td>0.06</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>Non-PVC, AIS Head/Abdomen/Pelvis ≤4</td>
<td>3040</td>
<td>3.4%</td>
<td>1.17 ± 3.78</td>
<td>15.9± 7.3</td>
<td>2.63 ± 5.25</td>
<td>7.18 ± 8.10</td>
<td>54.2± 19.5</td>
</tr>
<tr>
<td>PVC, AIS Head/Abdomen/Pelvis ≤4</td>
<td>376</td>
<td>1.6%</td>
<td>0.46 ± 2.19</td>
<td>13.9± 3.2</td>
<td>2.51 ± 3.26</td>
<td>7.03 ± 5.05</td>
<td>61.8± 17.4</td>
</tr>
<tr>
<td>P Value</td>
<td></td>
<td>&lt;0.01*</td>
<td>&lt;0.01*</td>
<td>0.12</td>
<td>0.04*</td>
<td>0.04*</td>
<td>&lt;0.01*</td>
</tr>
</tbody>
</table>

Table 1: Resulting data from analysis between PVC group when compared to the non-PVC group after sustaining MRs. Groups divided by Abbreviated Injury Scale (AIS) by combined head, abdomen, and pelvic injury. Between the PVC and non-PVC groups, significant results are shown between “in hospital mortality,” “ICU length of stay (LOS),” “Total Hospital LOS,” age in years, and “Ventilator Days” (p<0.05 ). ” * ” delineates a statistically significant difference.

REFERENCES
INTRAOPERATIVE USE OF POINT OF CARE ULTRASONOGRAPHY (POCUS) FOR STAT CESAREAN DELIVERY WITH REFRACTORY HYPOXEMIA

Nicholas J. Schott, MD; Dana Leonelli, BSN; Susan McElroy, DO
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2Nurse, School of Nursing, University of Pittsburgh
3Associate Professor, Department of Anesthesiology, University of Pittsburgh

ABSTRACT
A 30-year-old female at 24 weeks gestation presented with headache, hypertension, and blurry vision. She was diagnosed with pre-eclampsia on chronic hypertension. An obstetrical emergency was called due to fetal heart rate decreasing to a nadir of 40bpm and the patient was taken for an emergent Cesarean delivery. Prior to induction of anesthesia, SpO2 was 92%. A rapid sequence induction was conducted with confirmed intubation; however, SpO2 decreased to 71% over time. The patient was ventilated manually and was given bronchodilators. However, oxygenation did not improve. A portable point-of-care ultrasound (POCUS) device was brought into the operating room. Windows obtained suggested that the patient had gross pulmonary edema resulting from beginning cardiac failure. Given the findings, 1:1 crystalloid replacement was undertaken rather than the traditional 3:1 replacement for crystalloid to blood loss ratio. Blood pressure was reduced with medications, including volatile agents. The patient's SpO2 slowly improved and recovered by the end of the surgical procedure. Re-imaging of the pleural views revealed improvement of interstitial pulmonary fluid. The patient remained intubated post-operatively. The patient was extubated on POD 2 and eventually discharged home. Perioperative POCUS was used to aid in a diagnosis of an emergent Cesarean delivery with ongoing hypoxia. Clinicians from multiple disciplines, including obstetrics, anesthesiology, and critical care, were able to visualize her problems and collaborate on a management and post-operative care plan.
THE EFFECT OF ANESTHETIC AGENTS ON MARKERS OF NEUROLOGIC INJURY IN JUVENILE RATS

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INTRODUCTION

Experimentally, common anesthetic agents induce neuronal apoptosis and long-term behavioral deficits in post-natal day seven rats (PND7, ~ human neonate), but not in PND17 rats (~ 3-5-year-old human infant). Multiple mechanisms were implied to mediate such deficits. Specifically, propofol was linked to tumor necrosis factor alpha (TNFα) signaling. We analyzed the effects of clinically relevant anesthetics to determine their effects of biomarkers of neurological injury and TNFα production. We hypothesized that PND17 rats subjected to different anesthetic protocols would not exhibit neurological damage.

METHODS

Male Sprague-Dawley PND17 rats were anesthetized, intubated, and mechanically ventilated. According to randomization, five groups (n=4/group) were studied: 1) naïve; 2) fentanyl (10 mcg/kg + 50 mcg/kg/h IV); 3) isoflurane (isoflurane 1%); 4) isoflurane + fentanyl (isoflurane 1%, fentanyl 10 mcg/kg + 50 mcg/kg/h IV); and 5) propofol (20 mg/kg/h IV). Anesthesia was maintained for 6 h. Hemodynamic parameters were assessed at baseline (BL) and at 1, 3, and 6 h. At 24 h, rats were sacrificed and plasma and brain tissue samples were obtained for analysis of neuron-specific enolase (NSE, marker of neuronal injury), soluble protein 100-b (S100b, marker of astroglial injury), and TNFα (pivotal pro-inflammatory cytokine) using ELISA. TNFα was evaluated separately for cortex, cerebellum, and brain homogenate. Hemodynamic parameters were assessed using repeated measures analysis of variance (ANOVA) with post-hoc Bonferroni correction. Biochemical parameters were assessed using one-way ANOVA. A p value of <0.05 was considered statistically significant.

RESULTS

Heart rate (Fig. 1A) and mean arterial pressure (Fig. 1B) significantly differed between groups. No differences were observed over time in individual groups. No differences in plasma NSE, plasma S100b, or brain S100b were detected. Brain tissue NSE levels were highest in naïves and lowest in the propofol group (p<0.05). (Fig. 2) TNFα was not detected in any brain region.

CONCLUSIONS

In this small-size exploratory pilot study, we report previously undescribed changes in brain tissue NSE after propofol anesthesia. This could suggest neuronal injury. Our preliminary findings are important since neurotoxic effects of anesthetics in rats at this developmental stage have never previously been reported. These effects do not seem to be mediated via TNFα signaling. Histological damage and neurobehavioral deficits need to be assessed in future experiments.
CHANGES IN BLOOD PRODUCT UTILIZATION IN A SEVEN HOSPITAL SYSTEM AFTER THE IMPLEMENTATION OF A PATIENT BLOOD MANAGEMENT PROGRAM: A NINE YEAR FOLLOW UP

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OBJECTIVES
To analyze changes in red cell (RBC), platelet (PLT), and plasma transfusion volumes nine years after the implementation of a multifaceted patient blood management (PBM) program across multiple hospitals.

METHODS
Between fiscal years 2007 and 2015, the annual transfusion volumes for seven hospitals in a regional health care system were analyzed by hospital, and between 2014 and 2015, by four service lines including the emergency department, intensive care unit (ICU), medical/surgical ward, and operating room at each hospital. The number of units of RBCs administered to transfused recipients on the wards and in ICUs was also enumerated.

RESULTS
For these seven hospitals combined, there was a 29.9% reduction in the number of RBCs transfused between 2007 and 2015, a 24.8% reduction in plasma units, and a 25.7% reduction in PLT units. The two largest hospitals saw some of the largest reductions in RBC transfusions (40.1%, 25.1%), and plasma transfusions (26.1%, 33.8%), and one of those hospitals had a 49.5% reduction in PLT transfusions. Smaller-sized hospitals also had reductions in transfusion volumes, while some volumes increased at hospitals when new or expanded clinical services were introduced. The number of RBC units per transfused recipient was generally between 1.5-2 units on the wards and slightly higher in the ICUs.

DISCUSSION
Although the overall volume of transfusions has generally decreased at each hospital site over time, the appropriateness of the administered transfusions cannot be evaluated by these data.

CONCLUSION
The system-wide implementation of a PBM program has reduced transfusion volumes.
This abstract was presented as a poster at ASRA in New Orleans on April 1st, 2016. It has been submitted to the ASA conference for a poster presentation.

THE PHYSICAL RELATIONSHIP OF THE SCIATIC NERVE AND ITS PARANEURAL SHEATH

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INTRODUCTION

The optimal location for local anesthetic injection during nerve blocks is within the paraneural sheath, but outside the epineurium of the nerve. The force required to puncture these tissues is unknown. Based on pilot data, we hypothesized that the puncture force required to enter the sciatic nerve would be greater than for the overlying paraneural sheath. Secondarily, we evaluated whether a “tangential” approach of needle to nerve would result in a lower chance of intraneural injection.

MATERIALS AND METHODS

Seven sciatic nerves in non-preserved human cadavers were harvested after approval from the University of Pittsburgh Committee for Oversight and Clinical Training Involving Decedents. Needle-force evaluations were conducted on nerve segments including: nerve alone (IN); nerve with overlying sheath (NPS), paraneural sheath alone (IPS). Specimens were mounted onto a 50g (IPS) or 500g (IN & NPS) load cell and secured with sutures onto the mounting stage of a customized micro indentation system calibrated to ASTM standards. A 21 g 50 mm block needle was driven towards the specimen using a stepper motor at a speed of 0.1 mm/sec. Needle-tip force and displacement were recorded. Maximal values on the force-time graph were recorded as the puncture force. Mean puncture force values were compared using ANOVA and pairwise analysis performed in Excel.

Prior to harvesting, two sciatic nerves were identified in situ using S-Nerve ultrasound (Sonosite Inc, Bothell, WA) after an echogenic block needle (B, Braun, Bethlehem, PA) was used to inject 0.1 ml of dilute black ink within the paraneural sheath with either a tangential or direct approach at 18 sites (Figure 1). The two nerves were examined grossly for evidence of dye in the nerve.

RESULTS

Mean puncture force was significantly different for IN, IPS, and NPS (P<0.001) with ANOVA analysis, Table 1. Pairwise analysis revealed that the mean puncture force for IPS (118.5±67 mN, n=16) was significantly lower (P<0.001) than forces for NPS (1540.7±645 mN, n=16) or IN (1143.6±421 mN, n=19). The difference was less significant (p=.045) between the forces required to penetrate the IN and the NPS.

During the injection experiments, 12 tangential and six perpendicular subparaneural injections were performed. None of the tangential injections resulted in dye deposition within the nerve substance. In contrast, the direct approach resulted in four (67%) intraneural injections.

DISCUSSION

The paraneural sheath offers significantly less resistance to puncture force than the sciatic nerve. However, it’s challenging to differentiate puncture of the sheath from intraneural needle-tip placement when the needle is applied directly over the nerve. This substantiates the suggestion that needle approach to a nerve with overlying fascial sheaths should be tangential.
IMPLEMENTATION OF A WEB-BASED LEARNING TUTORIAL INTO AN ANESTHESIOLOGY RESIDENCY’S CHRONIC PAIN ROTATION CURRICULUM

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INTRODUCTION

Trends toward incorporating “web-based learning” (WBL) into the medical education curricula are increasing. A significant number of studies have shown that simple WBL tools are at least as effective as conventional methods in teaching knowledge content (1). WBL has also been praised by learners and encouraged its implementation in additional curricula (2).

This institution’s anesthesiology residency chronic pain rotation curricula currently does not contain any WBL. A review of the current literature found no studies evaluating the potential knowledge-gaining benefits of implementing tutorial-based WBL into the curriculum of an outpatient clinic-based residency rotation. This type of rotation brings the unique challenge of achieving fundamental knowledge gains in the setting of busy clinic days dominated by clinical activity.

METHODS

Anesthesiology residents (n=12) on their required chronic pain rotation were randomly divided into either the study (n=6) or control (n=6) group. At the beginning of the rotation, both groups took a pre-test consisting of 30 Anesthesiology Continuing Education (ACE) questions pertinent to chronic pain. The residents in the study group were then given access to 19 online WBL tutorials focusing on chronic pain topics. On the last day of the rotation, both the control and study groups took a post-test consisting of the same 30 ACE questions. Both groups also filled out short surveys specific to the study and control groups.

The average pre-test scores of the study group were compared to those of the control group. The same was done for the groups’ average post-test scores and the groups’ average improvement in test score. Comparison was done with appropriate two-tailed t tests. Statistical significance was deemed for a p-value < 0.05. The study group was asked to fill out a brief seven question survey, utilizing Likert Scores and yes or no answers, that sought to assess their attitudes towards the WBL tutorial.

RESULTS

No statistical significant difference was found in the pre-test scores between the study and control groups (17.5 ± 1.6 vs. 18.2 ± 0.8, p = 0.4). In the post-test, the study group scores were superior to those of the control group (24.5 ± 2.7 vs. 20.5 ± 1.9, p = 0.01) (Figure 1). In terms of improvement post-test scores compared to pre-test scores, the study group was higher than the control group (7.0 ± 2.9 vs. 2.3 ± 1.6, p = 0.02).

All study group residents reported that the tutorials should be kept in the rotation’s curriculum. The residents indicated that the tutorials greatly increased both their knowledge (8.0 ± 1.6) and clinical skills (7.8 ± 1.0) in the rotation.

CONCLUSIONS

Our study found that the addition of WBL tutorials to medical resident curricula has the potential to increase resident knowledge gains. It also showed that residents believe that WBL tutorials have the potential to greatly enhance their knowledge base and clinical skills. Our results support much of the previous literature on WBL
This abstract was presented at the Society for Obstetric Anesthesia and Perinatology 48th Annual Meeting, Boston, MA, May 18-22, 2016.

ANESTHETIC MANAGEMENT OF LABOR AND INTRAPARTUM CESAREAN DELIVERY IN A PATIENT WITH CONVERSION DISORDER

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INTRODUCTION
Conversion disorder is a psychiatric disorder involving altered sensory and/or motor function that cannot be explained by organic mechanisms. Conversion events occur in four to 12 of 100,000 patients yearly, with the overwhelming majority occurring in young adult females during times of stress. Pregnant women with conversion disorder can pose a challenge for an obstetrical anesthesiologist. A concomitant episode of conversion disorder while undergoing a neuraxial anesthesia may present a confusing clinical picture, considering that neuraxial anesthesia, its complications, and conversion episodes may manifest with overlapping and dramatic motor and sensory elements.

CASE DESCRIPTION
Our patient had a history of conversion disorder, which manifested as loss of consciousness. She presented for induction of labor for pre-eclampsia. A labor epidural catheter was placed at the patient’s request after confirmation of normal hematological laboratory values. After an extended period of no cervical change, the decision was made to proceed with an intrapartum cesarean delivery. At that time, epidural analgesia was found to be ineffective. Forty-five minutes were allowed to elapse to permit local anesthetic resorption from the neuraxis, and then a spinal anesthetic was performed in the operating room. One minute after induction of the subarachnoid block, she complained of leg weakness and her eyes closed. Her lid response was absent and she was unresponsive to verbal or painful stimuli to her extremities. Her ventilation was infrequent, but vital signs were stable with no evidence of bradycardia or significant hypotension.

Spontaneous ventilation was maintained with supplemental oxygen given by facemask. A conversion episode was diagnosed and a high spinal block was ruled out based on the lack of apnea or hemodynamic perturbations. Given her lack of return in mental status, inability to assess the adequacy of spinal anesthesia, and apparent inability to cope with psychologically stressful situations, a decision was made to proceed with cesarean delivery under general anesthesia.

DISCUSSION
We highlight the challenges surrounding obstetric and anesthetic management of a parturient with conversion disorder. Stringent avoidance of general anesthesia in these cases may not always be warranted, and a balanced view of all anesthetic options is preferred.

REFERENCES
OCCULT SOFT PALATE OBSTRUCTION DURING BAG-MASK VENTILATION: 
SOFT PALATE “FLAP VALVE”

Yu V1, Ma Z1, Snyder J2, Orebaugh S3, Buffington C3
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2. Department of Critical Care Medicine, University of Pittsburgh
3. Department of Anesthesiology, University of Pittsburgh

INTRODUCTION
Expiratory obstruction due to the soft palate forming a one-way “flap valve” during mask ventilation is not familiar to most clinicians. Originally described by Dr. Peter Safar in his early resuscitation research (1), flap valve expiratory obstruction (FVEO) may cause air trapping, hypoventilation, high airway pressures, and cardiovascular compromise.

HYPOTHESIS
Bag-mask ventilation with tight mouth closure can produce a one-way valve with obstruction to exhalation in a non-preserved cadaver model simulation.

METHODS
Utilizing a non-preserved cadaver (73 year old female, 176 cm, 207 lbs.), we provided bag-mask ventilation. FVEO was produced by tightly closing the mouth during ventilation. We then inserted a bronchoscope into the nasal cavity through a port in the mask while continuing to provide positive pressure ventilation to illustrate the behavior of the soft plate during ongoing ventilation.

RESULTS
The soft palate was seen to “flutter” open with each positive pressure inspiration, then settle into the “closed” position against the posterior pharynx after completion of the inhalation phase. A thin layer of fluid could be seen at the interface of the soft palate and the posterior nasopharyngeal wall, helping to verify the potential for a seal. The development of FVEO resulted in breath-stacking with successive degrees of chest rise and a palpable decrease in pulmonary compliance. The obstruction was confirmed when removal of the mask and mouth opening revealed a rush of air and deflation of the chest.

CONCLUSION
FVEO occurs commonly in sedated, relaxed patients and in cardiac arrest due to the soft palate lying against the posterior pharyngeal wall (1, 2). Recognition of this condition is important to avoid hypoventilation, high inspiratory pressures, and cardiovascular compromise (3-5). The easiest means to confirm and treat FVEO is to allow exhalation via the mouth.

SIGNIFICANCE
Recognition and management of FVEO during mask ventilation can prevent serious complications during airway management.

REFERENCES
ANESTHETIC MANAGEMENT OF INCARCERATED UMBILICAL HERNIA REPAIR IN A PATIENT WITH CHILD C CIRRHOSIS UTILIZING SURGICAL TRANSVERSUS ABDOMINIS PLANE NERVE BLOCK
Shashank Saxena, David Yui, Catalin Ezaru
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INTRODUCTION
Transversus Abdominis Plane (TAP) nerve blocks can provide post-operative analgesia for anterior abdominal surgery. There is limited literature on their use as surgical blocks or as primary anesthetics. This case will demonstrate the use of bilateral surgical TAP blocks in a male with end-stage liver disease (ESLD) undergoing an emergent incarcerated umbilical hernia repair.

MATERIALS AND METHODS
A 58-year-old male (69 inches/145lb/BMI 21.4) with a history of cirrhosis Child-Pugh Class C was admitted for an emergent incarcerated umbilical hernia repair. Co-morbidities included hepatic encephalopathy, esophageal varices, type II diabetes, hypertension, and GERD. His vital signs in the pre-op holding area were normal except blood pressure (BP) of 80/51 mm Hg. We were concerned about the adverse hemodynamic effects of general anesthesia in this patient. Since we wanted to avoid hypotension and the use of vasoactive drugs, which can both worsen hepatic function, we elected to proceed with surgical bilateral TAP blocks. We performed bilateral TAP blocks using 20ml of 0.375% bupivacaine for each side. Propofol at 25mcg/kg/min, 100 mcg fentanyl, and 25mg of IV ketamine was used intraoperatively. He required no airway manipulation and remained very comfortable during the entire procedure.

RESULTS/CASE REPORT
Throughout the surgery, the patient’s vital signs remained stable with BP 84-98/53-69 mm Hg, without vasopressor support, 02 saturation 95-100% on 6 liters/minute 02 via face mask. The surgery time was 69 minutes. Patient was “extremely pleased” and required no postoperative pain medications for about 40 hours post procedure.

DISCUSSION
The incidence of umbilical hernia in cirrhotic patients is about 20%. The morbidity and mortality of abdominal hernia repair in cirrhotic patient is higher than similar surgery in non-cirrhotics, with a seven fold increase in mortality with emergency surgery2 in cirrhotics. Maniatis and Hunt reviewed the literature published between 1956 and 1995 and reported that while elective surgery was associated with a mortality rate of 2%, emergency surgery showed a mortality rate of 14%. The incidence of morbidity and mortality after umbilical hernia repair in emergencies increases in advanced stages of liver cirrhosis, with a study by Banu et al. showing a mortality of 22.7% with Child C Disease.

Jensen et al. demonstrated the use of a bilateral TAP block for revision of abdominal wall defects without the use of sedation. Our case presentation is to our knowledge the first time that a surgical TAP block has been used successfully in a patient with ESLD for incarcerated umbilical hernia repair. We avoided general anesthesia and provided good postoperative pain relief.

REFERENCES
RENAL OUTCOMES WITH INTRAOPERATIVE HYDROXYETHYL STARCH USED IN ELECTIVE HYSTERECTOMIES

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INTRODUCTION
Hydroxyethyl starch (HES), a synthetic colloid, is one of the most frequently used volume expanders and can assist in treating hypovolemia. However, low-molecular-weight HES has been shown to increase the risk of acute kidney injury (AKI) in large randomized trials, mostly in critically ill patients. Despite this, surgical patients are typically given smaller amounts of hetastarch in the operating room. Literature assessing the perioperative effects of HES on kidney function is limited. We performed this retrospective study to evaluate the association between intraoperative HES administration and postoperative kidney function after elective hysterectomies.

OBJECTIVE
To demonstrate that intraoperative hetastarch use in elective procedures does not increase the risk of AKI when compared to other colloids such as albumin and even crystalloids.

MATERIALS AND METHODS
We obtained data on adults who had hysterectomies from 2012-2013 at eight hospital sites in our health system. Specifically, these cases included laparoscopic total abdominal hysterectomies, total abdominal hysterectomies, laparoscopic supracervical hysterectomies, laparoscopic vaginal hysterectomies, and salpingo-oophorectomies. We excluded patients who had chronic kidney disease (CKD), received intraoperative blood transfusions, and who did not have appropriate pre- and post-operative data for the objective of this study. We recorded baseline characteristics, including ASA classification, BMI, hypertension, coronary artery disease, congestive heart failure, COPD, asthma, diabetes mellitus I/II, cerebrovascular accident, peripheral vascular disease, and CKD. Patients were divided into three groups based on volume expanders used intraoperatively: HES, 5% albumin, and crystalloids. We used the Acute Kidney Injury Network (AKIN) criteria to define AKI. Numbers of cases are described as percentages. A chi-square test was performed to compare the incidences of AKI among the HES, albumin, and crystalloid groups. A p value less of than 0.05 was considered statistically significant.

RESULTS
Of the 427 adult patients (ages ranging from 28 to 90 years old), 199 were excluded from the analysis (180 due to lack of perioperative data, four due to CKD, and 15 due to blood transfusion). A total of 228 patients were included in the final analysis. Of the 147 patients in the HES group, 22 patients (15%) developed AKI [16 (11%) in Stage 1, six (4%) in Stage 2]. Of the 36 patients in the albumin group, six patients (17%) developed AKI [three (8%) in Stage 1, two (6%) in Stage 2, and one (3%) in Stage 3]. Of 45 patients in the crystalloid group, 10 patients (22%) developed AKI [five (11%) in Stage 1, three (7%) in Stage 2, and two (4%) in Stage 3]. These results demonstrate no significant difference in AKI incidence between the groups (Table 1). There were no in-house mortalities.

DISCUSSION
Although HES use in the critically ill has been associated with AKI, there is no association between intraoperative HES use and renal function when compared to 5% albumin and crystalloids. Kancir et al. demonstrated that hydroxyethyl starch used during hip arthroplasty made no statistically significant difference on renal function. The study measured urinary excretion of neutrophil gelatinase-associated lipocalin (u-NGAL), plasma creatinine, and urine albumin as outcomes. However, unlike this study, they compared HES vs. isotonic saline and did not compare albumin. Interestingly, Kashy et al. showed that dose-dependent renal toxicity was associated with Hextend® in non-cardiac surgery patients. Our study demonstrates a similar AKI incidence among patients receiving HES, 5% albumin, and crystalloids post-operatively. Compared to 5% albumin solution, the use of HES could bring a significant cost savings, as 5% albumin is three times more expensive than HES.
Table 1. Postoperative AKI/Postop Complications

<table>
<thead>
<tr>
<th></th>
<th>Patients receiving Hetastarch (n = 147)</th>
<th>Patients receiving Albumin (n = 36)</th>
<th>Patients receiving Crystalloid (n = 45)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No AKI, n (%)</td>
<td>125 (85)</td>
<td>30 (83)</td>
<td>35 (78)</td>
<td>0.9738</td>
</tr>
<tr>
<td>AKI Stage 1, n (%)</td>
<td>16 (11)</td>
<td>3 (8)</td>
<td>5 (11)</td>
<td></td>
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<tr>
<td>AKI Stage 2, n (%)</td>
<td>6 (4)</td>
<td>2 (6)</td>
<td>3 (7)</td>
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<tr>
<td>AKI Stage 3, n (%)</td>
<td>0 (0)</td>
<td>1 (3)</td>
<td>2 (4)</td>
<td></td>
</tr>
<tr>
<td>In House Mortality, n (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Post-op ICU Stay, n (%)</td>
<td>2 (1)</td>
<td>1 (3)</td>
<td>2 (4)</td>
<td>0.3522</td>
</tr>
<tr>
<td>Post-op Mechanical Ventilation, n (%)</td>
<td>1 (1)</td>
<td>0</td>
<td>0</td>
<td>0.5534</td>
</tr>
</tbody>
</table>

Note: The data are presented as number of cases (%)

REFERENCES
The UPMC/University of Pittsburgh Department of Anesthesiology serves 17 hospitals:

**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.

**CHILDREN’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 has been named in *U.S. News & World Report*’s Honor Roll of America’s Best Children’s Hospitals for seven consecutive years.

**MAGEE-WOMEN’S HOSPITAL OF UPMC** is ranked among the top 12 hospitals in the nation for gynecological care and is 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 one of the largest in 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 brand new 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 that is recognized for a high level of specialized care in gastroenterology. This state-of-the-art digestive health and endoscopy center, located in Penn Hills, PA, is equipped to provide technologically advanced medical care.

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. Their satellite locations include the Womancare Center in Hermitage, diagnostic and imaging centers in New Wilmington and Mercer, and affiliated physician offices throughout Mercer and Lawrence counties in Pennsylvania and Trumbull and Ashtabula counties in Ohio.

UPMC PALERMO (ISMETT) serves as a major transplantation center for Southern Italy and other countries in the Mediterranean region.
UPMC Presbyterian/Montefiore

Shawn T. Beaman, MD
Interim Chief Anesthesiologist

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 49 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 FY16 at UPMC Presbyterian decreased slightly. Presbyterian faculty supervised a grand total of 40,414 anesthetics, a decrease of 498 cases (1.2%) from the previous fiscal year. Of these cases, 23,670 were performed in the operating rooms, a decrease of 992 cases (4.0%) compared to FY15. Procedures spanned the entire spectrum of surgical and special procedures, from combined thoracic and abdominal transplantation to anesthesia for electroconvulsive therapy. Reversing a trend seen in the prior year, transplant procedures increased to 370 during FY16, an increase of 32 (3.1%) compared to FY15. For yet another year the volume of cases managed outside of the operating rooms increased by 5.3% (from 16,330 in FY15 to 16,744 in FY16, a 2.5% increase). For the first time, the percentage of case volume done outside the operating room increased, eclipsing the 40% threshold, with a final value of slightly more than 41%. 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). The largest increases in case volume outside the OR were seen in the electrophysiology and cardiac catheterization suites (increasing more than 24% from the prior year) and ECT suite (increasing by almost 22% from the prior year). On the other hand, there were modest decreases in year-over-year case volume in the gastroenterology lab (6.4% decrease) and bronchoscopy suite (7.7% decrease). The most important new clinical initiative during FY16 was the Enhanced Recovery After Surgery program, which led
to significant decreases in hospital length of stay and patient costs and increases in patient satisfaction after its introduction on the Colorectal Surgery and Surgical Oncology services.

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 neuroanesthesia) 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, 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., neuroanesthesia, cardiac, hepatic transplantation, and ambulatory anesthesiology). Continuing medical education credits are awarded for these activities.

TRAUMA ANESTHESIOLOGY
SHAWN T. BEAMAN, MD
Director

Patient Care and Clinical 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 center cared for over 4,800 trauma patients during the 2015-2016 academic year. Despite being an urban center, approximately 50% of the trauma patients cared for were transferred from outlying hospitals, while the remainder were transported directly from the scene of the trauma. A total of 24% were transferred to the center via helicopter medical service. The vast majority (92%) of patients sustained blunt injuries, while the remainder sustained penetrating injuries. The top three mechanisms of injury of our trauma patients in 2015-2016 were fall, motor vehicle crash, and assault. The top three injuries were traumatic brain injury, orthopedic injury, and thoracic injury. The UPMC Presbyterian trauma program is somewhat unique in that the average age of trauma patients was 55 years old, as opposed to a 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 most critically injured trauma patients are designated as “Level 1” traumas. Seventeen percent (17%) of trauma patients cared for in 2015-2016 were Level 1 patients. Less acute, but still significantly injured patients receive a “Level 2” designation. Over half (51%) of patients met this criteria in 2015-2016. A total of 11% of trauma patients presenting to UPMC Presbyterian required immediate operative management and were transferred emergently from the trauma bay to the trauma operating room. The three most common procedures performed emergently were exploratory laparotomy, open repair of fractures, and craniotomy.

Outcomes Data
The UPMC Presbyterian Trauma program meticulously tracks patient outcomes and strives to constantly improve. In 2015-2016, trauma patients spent an average of 4.1 days in the ICU vs. a national average of 5.6 days. Ventilated trauma patients spent an average of 5.3 days on a ventilator vs. a national average of 6.1 days. Total hospital length of stay was
5.8 days vs. a national average of 6.1 days. Mortality was 3.6% vs. a national average of 4.7%. 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 Director of Trauma Anesthesiology 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 coagulation testing intraoperatively, and mass casualty coordination.

Education and Training
Educational efforts surrounding the care of the traumatized patient continued in 2015-2016 within the Department of Anesthesiology. Trauma topics were presented during anesthesiology faculty development sessions, combined faculty/resident/CRNA meetings, the anesthesiology resident lecture series, the anesthesiology resident problem-based learning educational series, and the anesthesiology resident simulation based Difficult Airway Course and Anesthesia Crisis Leadership Training.

NEUROANESTHESIOLOGY AND SUPPORTIVE CARE

Overview
The UPMC Presbyterian Neurosurgical Anesthesiology service provided anesthetic care for almost 5,000 neurosurgical procedures during FY16. Procedures included expanded endonasal approaches (EEAs) to skull base pathologies, craniotomies for tumor, retromastoid craniectomy for microvascular decompression of various cranial nerves, 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.

Patient Care & Clinical Activities
We are highly involved in 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 thrombolysis, 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, including EEAs for select aneurysms. 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.

BRIAN GIERL, MD
Director, Neuroanesthesiology & Supportive Care
UPMC Presbyterian

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, including EEAs for select aneurysms. 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 in order to optimize their care. The Epilepsy and Movement Disorders program is one of the busiest in the country and is participating in a number of 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
PATRICK J. FORTE, MD, Medical Director, Same Day Services, UPMC Presbyterian

Same Day Services at UPMC Presbyterian/Montefiore includes both Same Day Surgery (SDS) and the Preoperative Evaluation Center (PEC). In FY16, a total of 13,610 patients were processed in SDS, either as same day-admitted patients (6,698) or outpatient surgery patients (6,912); 4,105 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 will be screened for frailty at the surgeons’ offices and if they are deemed to be at risk for postoperative complications, they will be scheduled for an extended appointment in the PEC, which could include 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.
**CLINICAL DIVISIONS**

**UPMC PRESBYTERIAN/MONTEFIORE**

**TRANSPLANTATION ANESTHESIOLOGY**

**Patient Care and Clinical Activities**

Anesthesiologists in the UPMC Presbyterian/Montefiore Division of Transplantation Anesthesiology (TA) are responsible for the care of 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.

TA’s 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.

Anesthetic management of hepatic, intestinal, multivisceral, kidney, pancreatic, and CTA transplantation requires both highly sophisticated monitoring and tight control of physiologic variables. Anesthesiologists carry out this management with the assistance of trainees, CRNAs, and clinical technicians. For hemodynamic monitoring, the TA staff routinely determines 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 FY16, 282 solid organ transplants were performed at UPMC Presbyterian/Montefiore, a 15% increase from FY15.

**Education and Training**

Education in the TA service is comprised of a mandatory rotation (four weeks) for 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 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.” 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 FY16, they participated in numerous meetings and symposiums, such as the Annual International Congress of International Liver Transplantation Society and the International Anesthesia Research Society Annual Meeting.
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. CHP Main celebrated its five-year anniversary at its new site in FY14. 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 two Saturdays a month. CHP pediatric anesthesiologists and CRNAs are responsible for perianesthetic care. Dr. Laima Bendel serves as medical director of the satellite.

In June 2010, CHP anesthesiology became the first division in the UPMC system to implement the Cerner Electronic Anesthesia Record.

Patient Care and Clinical Activities
In FY16, the division provided anesthesiology services for a total of 28,328 procedures, a slight increase (207 cases) from the prior year (28,121). Of the total number of procedures, 7,598 were carried out at CHP North and 20,730 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. Other CHP acute pain faculty members include Drs. Denise Hall-Burton, R. Scott Lang, Antonio Cassara, Josh Eaton, and Franklyn P. Cladis. 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 blocks with and without catheters and thoracic epidurals for postoperative analgesia in older patients following thoracic and upper abdominal surgery. In infants, it is possible to provide similar high thoracic epidural analgesia by using a caudal approach to place the catheter. Regional blocks involving nerve stimulation and/or ultrasound guidance are also frequently performed in appropriate patients. 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 1,300 pediatric regional blocks are performed annually.

CHP not only has an acute pain service, but also a chronic pain service that includes Drs. Charles Yang and Fidan Genc as well as nurse practitioners Cathy Campese and Rachael Lauer. The CHP chronic pain program 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 clinic treats patients at the Lawrenceville campus, CHP North, and the new CHP campus in Bridgeville. Other specialty anesthesiology service divisions at CHP include transplantation, radiology, and cardiology, headed by Drs. James Cain, Brian Blasiole, and Patrick Callahan, respectively.

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 postgraduate 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
Anesthesiologists in the Division of Transplantation Anesthesiology (TA) at 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 FY16, both living donor and cadaveric donor transplants were performed. The CHP TA Faculty includes Drs. Brian Blasiole, James Cain, Franklyn Cladis, Antonio Cassara, Daniela Damian, Peter Davis, W. Scott Jones, Prema Krishnamurthy, R. Scott Lang, Gregory McHugh, David Rymer, and Mihaela Visoiu. The total number of pediatric transplants completed by CHP TA faculty in FY16 was 58, an 11.5% increase from FY15.
Anesthesiology for Radiology at Children’s Hospital of Pittsburgh (CHP) continues to grow and serve the children of Pittsburgh and beyond for radiologic imaging and procedures. Our department provides anesthesia and sedation for children on a daily basis in interventional radiology, MRI, CT, nuclear medicine, PET, and radiation oncology. Due to the unique restrictions and challenges that accompany safe administration of anesthesia for children undergoing MRI, a dedicated group of anesthesiologists that include Drs. Brian Blasiole, Patrick Callahan, James Cain, Daniela Damian, Scott Lang, Khoa Nguyen, Erica Sivak, Cristina Roosen, and Mihaela Visoiu specifically provides care in this area. Commonly under one anesthetic, this group of physicians coordinates other care for these medically complex children after MRI, including lumbar punctures, dental and ophthalmologic exams, and transthoracic echocardiograms. Our anesthesiologists also work closely with the Pediatric Sedation Service in Radiology (operated by the Division of Pediatric Emergency Medicine) as consultants in guiding the appropriate care for imaging, which can range from distraction techniques, anxiolysis, sedation, and general anesthesia.

A major change announced by Dr. Steven Docimo, Chief Medical Officer at CHP, is that the Pediatric Sedation Services at CHP will be overseen by the Department of Anesthesiology, effective July 2016. Dr. Brian Blasiole will serve as the medical director for Sedation Services and Off-site Anesthesia at CHP. The goal of this change in leadership and transition of the Sedation Service to fall under the direction of the Department of Anesthesiology is to provide pediatric patients with the entire continuum of sedation and anesthesia resources. In addition to continuing sedation in Radiology and Hematology-Oncology, Sedation Services and Off-site Anesthesia will expand its practice to acute care floors with the goal of providing moderate to deep sedation to children who need to proceed to the CHP operating rooms.
Overview
The Magee-Womens Hospital (MWH) anesthesiology clinical site comprises 21 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 FY16, the Obstetric Anesthesia section oversaw 9,395 deliveries, an approximate 7% decrease from FY15. Of these deliveries, 5,743 were vaginal births (a 20% decrease from FY15) and 3,652 (39% of all deliveries) were cesarean deliveries. Additional procedures performed on the unit include combined cesarean/abdominal hysterectomy, external cephalic version (ECV), percutaneous umbilical blood sampling (PUBS), manual placental extraction, urogenital laceration repair, and postpartum tubal ligation (PPTL). Fetal surgery continues to increase as the hospital focuses more resources on this activity. Of note for this year, a performance improvement project was initiated to improve our cesarean section on time starts. This has resulted in an improvement from an on time start of <20% to now approaching 70%.

Beyond the birthing suite, MWH provided anesthetic management for 15,415 cases in the Surgical Services Center in FY16, which is a 184 case decrease from FY15. The FY16 site total (including deliveries and off site cases) was 24,810 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 FY16, 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 School of Medicine and UPMC. The division provides both obstetrical anesthesiology and general gynecology anesthesiology rotations. In addition, anesthesiology 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 anesthesiology 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 and Ms. Cara Fleischman, 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 opted 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) accredited the program for a three year time period, the maximum cycle length granted for first time accreditation, effective July 1, 2012. In January 2016, the program was reaccredited until 2022 with no citations, with a potential site review in April of that year. 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.

Honors and Appointments
Dr. Tony Silipo received the annual Resident Teacher of the Year Award for the third year in a row. He was also elected as the Pennsylvania Society of Anesthesiologists representative to the American Society of Anesthesiologists. Dr. David Seng received the Stephen C. Finestone Clinical Instructor Award from the School of Nurse Anesthesia. Dr. Patricia Dalby continued to serve as chair of the membership committee for the Society for Education in Anesthesia (SEA) and as a delegate to the Pennsylvania Medical Society as a representative of the Allegheny County Medical Society. Dr. Grace Lim received a grant from the Society of Education in Anesthesia as well as from the Virginia Kaufman Foundation. Dr. Joe DeRenzo graduated from the Marshall W. Webster Physician Leadership program. Dr. Ryan Romeo received the University of Pittsburgh School Of Medicine Clerkship Preceptor of the Year Award for Outstanding Achievement in Educating Future Physicians. Chief Anesthesiologist Dr. Jonathan H. Waters is an Associate Editor for the journal Transfusion and is a contributing editor for Obstetric Anesthesia Digest. He was recently appointed as the Department’s Vice Chair for Clinical Research.
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 FY16, clinical anesthesiology services were performed for 20,767 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 anesthesia 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, Brent Cain, Rama Joshi, Michael Ingram, Mark Hudson, Mohamed Khanzada, Steven McHugh, Mahesh Sardesai, and Sudakar Yenem, provides 24/7 coverage for cardiac surgical cases. All are board-certified in transesophageal echocardiography.

Dr. Jonathan Waters, Interim Director of Acute Pain Management, and the acute pain team of Drs. Bruce Ben-David, 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. Lawrence Marr, 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 anesthesia 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 also 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 services at UPMC Shadyside are provided by Dr. Teeple (Director), Stephen M. McHugh, MD, Mahesh Sardesai, MD, and Sharad Khetarpal, MD. In FY16, 1,449 neuroanesthesiology cases were treated at the hospital. An excellent mix of neurosurgical and spinal orthopedic cases such as craniectomy, cranioplasty, craniotomy, cranial nerve blocks, and implantations of ventriculoperitoneal shunts, spinal cord and nerve stimulators, and pain pumps were carried out.

Residents are offered a neuroanesthesiology rotation at UPMC Shadyside. Although Shadyside handles less neuroanesthesiology cases than UPMC Presbyterian, the hospital provides a unique environment for residents to learn. UPMC Shadyside is a tertiary level teaching hospital and provides similar opportunities to practice the highest quality of neurosurgical and neuroanesthesiology practice. Our Neurosurgical ICU and neuroradiology and neurophysiological monitoring departments provide similar opportunities to practice the best neurosurgical and neuroanesthesiological care. One resident per month rotates through the UPMC Shadyside Neuroanesthesiology Service, allowing us the unique opportunity to pick the best and most appropriate cases for the resident.

The rotation is designed to provide both an excellent knowledge of the theory of neuroanesthesiology and actual practice. Newfield and Cottrell’s Handbook of Neuroanesthesia is the basic text. Outlines and homework provide structure for discussion. Four attending anesthesiologists provide the majority of the supervision and lecture content. Lectures are given during cases and after. Close attention is paid to technical aspects of the anesthesia practice. Continuous intravenous anesthesia is taught and frequently used for these cases. Knowledge content is further expanded by doing literature reviews as interesting cases occur.
Overview
Veterans Affairs Pittsburgh Healthcare System (VAPHS) Anesthesiology is staffed by 10 physician full-time equivalents, a mix of VA and University of Pittsburgh employees. Additionally, CRNAs provide care to veteran patients in a team care model. The department provides clinical care for veterans in a 10-room operating suite, a gastrointestinal (GI) lab, a cardiac electrophysiology (EP) suite, a preoperative evaluation clinic, and a pain clinic. FY16 saw the opening of a new vascular angiography suite, as well as a medical fluoroscopy suite. The staff is involved in a wide range of administrative, educational, research, and quality assurance activities at both the VAPHS and the University of Pittsburgh School of Medicine (UPSOM).

Patient Care and Clinical Activities
Clinical service volume for FY16 saw a considerable increase in the total case volume, with an OR utilization rate that ran near 90%. A total of 6,678 OR cases were completed, an 18% increase over the year prior, including more than 100 solid organ transplants. Off-site anesthesiology coverage continue to grow exponentially, with 3,285 GI Lab cases (a 28% increase), 529 EP Lab cases (a 7% increase), as well as coverage for interventional radiology, pulmonary, MRI, and other off-site cases (330 off site cases total).

Pain management services again saw a big increase in patient load for FY16. A total of 1,163 new consults (a 14% increase), 1,180 follow-up encounters (a 20% increase), and 757 interventional procedures (a 13% increase) were completed. Tele-health services continued with 175 E-consults (a 27% increase), as well as a Scan Echo clinic that allows providers to communicate virtually to coordinate clinical care. The Acute Pain Medicine/Regional Anesthesia team remained very active and an enhanced recovery after surgery (ERAS) program is in development. Dr. Mangione continued as Chair of the VAPHS Pain Committee and Co-chair of the Veterans Integrated Service Networks (VISN) 4 Pain Committee and Opioid Safety Initiative.

Education and Training
During the course of the year, 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 40 different residents rotating during the year. 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.

Drs. Oravitz, Ibinson, Ezaru, and Saxena were faculty members for the department’s CMEinfo course. Drs. Oravitz and Mangione contributed to the recently-published textbook Basic Clinical Anesthesia. Dr. Mangione was featured on the local KDKA evening news discussing pain management in returning OEF/OIF veterans. Dr. Ezaru was invited to lecture at the international 6th Romanian National Sleep Conference in Brasov Romania. VAPHS faculty members also served as lecturers and panelists at a variety of other local, regional, and national meetings/forums.

Research and Scholarly activity
In FY16, faculty members were active in terms of scholarly activity, authoring multiple peer-reviewed publications and several abstracts/poster presentations. The biggest event on this front occurred in September 2015 when Dr. Brian
Williams received funding approval for a $1.9 million US Department of Defense grant, “Four-drug Nerve Block versus Plain Local Anesthetic for Knee and Hip Arthroplasty Analgesia in Veterans.” Drs. Ibinson and Mangione are co-investigators on this grant.

**Administrative Activity**
In addition to the various administrative activities mentioned above, Dr. Oravitz continued to serve as Chair of the Moderate Sedation Committee of the VA Adverse Events and Procedure Review Committee.

**Honors and Awards**
Dr. Rakesh won another award from the University of Pittsburgh Department of Anesthesiology for Excellence in Clinical Teaching of Residents.

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**UPMC MERCY**

**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.

**Calin Gorun-Gorunescu, MD**
Interim Chief Anesthesiologist

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.

Richard J. Kuwik, MD, who had been serving as Interim Chief Anesthesiologist at UPMC Mercy since July of 2015, sadly passed away in January of 2016. The Pitt/UPMC Department of Anesthesiology established a professorship in his name and in honor of his work (please see the “Awards and Accolades” section for more information). We are actively recruiting for a new Chief/E.S. Siker Chair of Anesthesiology at Mercy.
Patient Care and Clinical Activities
In FY16, UPMC Mercy clinicians supervised 19,628 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.

Honors and Appointments
Andrew Herlich, DMD, MD, FAAP was invited to serve on the Pennsylvania Medical Society Opioid Advisory Task Force and began his year term as President of the Pennsylvania Society of Anesthesiologists for 2015-2016. Kristin M. Ondecko Ligda, MD was invited to serve on the Pennsylvania Patient Safety Authority’s Task Force on Wrong Site Blocks Expert Panel and was an invited faculty member for the 6th Annual Ultrasound-guided Regional Anesthesia Cadaver Course at Penn State College of Medicine in Hershey, Pennsylvania, April 30-May 1, 2016
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 once 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 peri-operative environment for the past six years at a time when the local population continues to decline. In FY16, anesthetics were provided for 20,070 cases. A total of 16,041 cases were completed at the main hospital and 4,029 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 FY16, 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 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

FY16 was UPMC East’s fourth 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.

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 8,310 cases in FY16, an over 8% 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 15%, going from 3,109 to 3,605 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 533 the previous fiscal year to 608 blocks in FY16.

MICHAEL L. KENTOR, MD
Chief Anesthesiologist

UPMC MERCY SOUTH SIDE OUTPATIENT CENTER

MICHAEL L. KENTOR, MD
Chief Anesthesiologist

STEVEN L. OREBAUGH, MD
Assistant Chief Anesthesiologist

Overview

FY16 was UPMC Mercy Southside Outpatient Center’s seventh 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. This year, our center received a new CRNA director, John Borza, who is clinically active and also has a doctorate in nursing. 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 5,730 during FY16 (an over 4.5% increase from FY15).
Overview
UPMC McKeesport is a 222-bed community hospital serving patients along the Monongahela Valley.

Currently, the division is staffed by three full-time anesthesiologists and a 0.7 FTE anesthesiologist shared with other UPMC sites for additional coverage as needed. Seven full-time CRNAs, three part-time CRNAs, and two casual CRNAs staff the division.

In FY16, UPMC McKeesport provided anesthesia for 3,906 cases. OR cases accounted for 2,705 of those procedures and 1,201 were off-site procedures. In addition, anesthesiologists performed 417 acute pain regional blocks for immediate post-operative pain control and provided blocks for chronic pain patients. Forty-eight consultations were conducted for chronic low back pain and 31 subsequent epidural steroid injections were performed.

Clinical Activities
Typical of a community hospital, the surgical procedures performed at UPMC McKeesport include major non-cardiac vascular surgery, thoracic surgery, lumbar laminectomies, spinal fusions, total joint replacements/orthopedic cases, abdominal surgery, gynecologic surgery, urologic, ENT, opthalmologic, plastic surgery, and minimally invasive chronic pain procedures. Anesthesiology services are also provided at non-OR sites for GI, cardiac catheterization, 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 McKeesport 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 McKeesport 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 McKeesport anesthesiologists and CRNAs are committed to the clinical teaching and training of student nurse anesthetists.
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 FY16 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 PASSAVANT

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 is a 399-bed campus that attracts patients from around the region and the 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.

DANIEL R. SULLIVAN, MD, JD, MBA
Chief Anesthesiologist

116 DEPARTMENT OF ANESTHESIOLOGY
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 104 credentialed CRNAs, translating to an approximate 14.5 FTE physician/40 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 FY16, UPMC Passavant anesthesiologists treated 25,994 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.

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.
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 FY16, 4,034 cases were performed. The total number of cases comprised 459 inpatient OR procedures, 2,261 outpatient OR procedures, 71 inpatient GI procedures, and 1,243 outpatient GI procedures. The obstetric case count total was 293 total deliveries (197 vaginal and 96 C-section). Ninety-nine labor epidurals were administered, accounting for a 34% 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. The pre-operative clinic’s second full year continued the last two years’ trend of decreasing case delays and cancellations.

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.
Overview
During FY16, 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, which would not have been possible without the input, hard work, and dedication of all the members of the ISMETT Department of Anesthesiology and Critical Care Medicine as well as the ICU, 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 started work to expand our facility. We added six more ICU beds for a total of 20 beds, and an additional operating room, a cardiac hybrid OR. These acquisitions are in addition to the 25 beds that we will gain with our connection via a bridge to Civico’s hospital building behind ours.

Thanks to the hybrid OR, we started a mini invasive interventional cardiology program, performing TAVI, Mitral clip atrial septal defect closures, and other procedures on a regular basis. The National Extracorporeal Membrane Oxygenation Network (ECMO Net) 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 team has been dedicated to managing 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 FY16, ISMETT’s Department of Anesthesiology and Critical Care Medicine treated a total of 2,319 cases. One hundred and ten (110) transplants were carried out, including 16 cadaveric kidney transplants, seven living donor kidney transplants, 52 cadaveric liver transplants, two living donor liver transplants, 14 lung transplants, 17 heart transplants, one combined kidney-liver transplant, and one combined kidney-pancreas transplant. Additionally, UPMC Palermo treated 845 ICU admissions, 585 cardiothoracic surgeries, 228 thoracic surgeries, 438 abdominal surgeries, and 113 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 anesthesia and critical care medicine at University of Palermo in the School of Anesthesiology. Many anesthesiologists lectured at national and international meetings. Dr. Arcadipane attended the annual meetings of the Italian Society of Anaesthesia and Intensive Care Medicine (SIAARTI) and CARACT (Congresso Nazionale di Aggiornamento in Rianimazione e Anestesia Cardio Toraco vascolare). He has also committed to lectures at many Italian congresses on ECMO issues over a three year period (2015-2018). Dr. Arcadipane was elected as coordinator of the SIAARTI Study Group for Cardiothoracic and Vascular Anesthesia.

Dr. Arcadipane traveled to Astana with Drs. A. Beratni and F. Milazzo for a one week master class in thoracic surgery.
In FY16, 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. Iwan Sofjan, Mary Lim, Bryant Bunting, Joseph Williams, Christopher Johnson, and Chris Howson), as well as Pamela Asaro Illuminata, Claudio Gargiulo, Giuseppe Accurso, Vincenzo Benenati, Giorggia Corpora, Cristina Geraci, Federica Rodriguez, Daniela Bono, Grazia Foresta, and Antonella Lo Scurdato from the University of Palermo; Drs. Alessia Bartolotta, Marilicia Mileto, Fortunato Barresi, Francesco Tripodi, and Dr. Raffaele Cuffaro from La Sapienza University Rome; Drs. Valentina Milazzo and Alda Mussoni from the University of Catania, and Drs. Siba Kallab and Sophie Tohmè from Beirut Lebanon.

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 became an American Heart Association-licensed International Training Center and conducted about 103 courses and trained more than 900 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 FY16, South Surgery Center provided anesthesiology services for 2,815 cases.
UPMC MONROEVILLE SURGERY CENTER

The UPMC Monroeville Surgery Center is now in its 24th 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 FY16, the center provided anesthesiology services for 5,568 cases. The surgery center is housed on the first and second floors of a four story building at 125 Daugherty Drive, Monroeville. There are four large operating rooms on the first floor and two GI rooms on the second floor.

A variety of surgical procedures as well as a large chronic pain service are provided on the first floor. Surgical specialties include ophthalmology, orthopedics, urology, and general surgery. Specialized areas within these groups include hand, glaucoma, and breast surgery. All GI procedures are performed on the second floor. We look forward to maintaining these services, as well as expanding into the areas of foot and ankle surgery, laser cataract surgery, and implantation of permanent contact lenses.

CYNTHIA WELLS, MD
Chief Anesthesiologist

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.

Patient Care and Clinical Activities
During FY16, clinical anesthesiology services provided care for 6,132 surgical cases at UPMC Horizon. Our caseload primarily includes outpatient adult surgical procedures, including orthopedic, urologic, gynecologic, ENT, bariatric, and general surgery. Regional anesthesia services are 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% receiving epidurals, were managed at Horizon in FY16.

Education and Training
The Department of Anesthesiology recently began providing education opportunities at Horizon. Biweekly meetings include morbidity and mortality conferences, educational sessions, and business discussions. We have the opportunity to teach medical students and surgery residents who rotate through the Horizon anesthesiology department. In addition, airway management training is provided for STAT MedEvac paramedics who spend time in our department.
Overview
The UPMC Pain Medicine Division, consisting of ten faculty members, is a multidisciplinary clinical, teaching, and research endeavor spread over seven clinic locations: UPMC St. Margaret, Centre Commons in East Liberty, Oakland campus, Monroeville, UPMC Passavant, UPMC Mercy, and Children’s Hospital of Pittsburgh of UPMC. 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 FY16, Department of Anesthesiology Pain Medicine physicians completed 46,231 visits. Interventional modalities are carried out at all seven 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.

Education and Training
The Division of Pain Medicine offers a one-year pain medicine fellowship that is fully accredited by the Accreditation Council for 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.
Overview

The mission of the 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.

AIPPS managed 36,218 cases and a total of 15,846 blocks in FY16.

Teaching Activities

Fourteen acute pain and regional anesthesiology fellows were trained in academic year 2016, rotating at UPMC Presbyterian, UPMC Montefiore, UPMC Shadyside, UPMC Mercy, UPMC Passavant, Children’s Hospital of Pittsburgh of UPMC, and the UPMC Harmar and UPMC South surgery centers (for more information, please see the Regional Anesthesiology Fellowship Section).

CRNAs

The Certified Registered Nurse Anesthetist (CRNA) professional staff met all patient care delivery needs in FY16 with 360 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 of 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, currently ranked #1 by U.S. News and World Report. All CRNAs participate in clinical instruction; 45 CRNAs graduated from the program in 2015. 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.
Cardiothoracic Anesthesiology

Patient Care and Clinical Activities
The Cardiothoracic Anesthesiology Division encompasses UPMC Presbyterian, UPMC Shadyside, UPMC Passavant, UPMC Mercy, and the VA Pittsburgh Healthcare System. This report includes data obtained from the SurgiNet Anesthesia electronic database for UPMC Presbyterian, UPMC Shadyside, UPMC Passavant, and UPMC Mercy for FY16. A total of 2,636 cardiac and 6,455 thoracic procedures were performed at these four sites in FY16. 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, minimally invasive/robotic valve and MAZE surgery, 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 implantation (TAVI), pulmonary resection (conventional and minimally invasive approach), pneumonectomy, minimally invasive 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. During FY16, 100 cardiothoracic transplants (25 heart transplants and 75 lung transplants) were performed, an almost 9% increase from FY15. UPMC Presbyterian was one of the leading centers in the nation in the number of lung transplants performed at a single center during FY16. This campus 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 II, Ventrassist, Levotronix, Heartware, Novocor, and Thoratec); 42 devices were implanted at UPMC Presbyterian in FY16.

Perioperative Echocardiography
The cardiothoracic anesthesiology faculty performs diagnostic perioperative transesophageal echocardiography (TEE) on all patients undergoing cardiac and transplant surgery. We enjoy substantial equipment resources and have established an excellent rapport with our echocardiology colleagues. Monthly Interdepartmental Echocardiography Conferences (IDECs) are held jointly between the Divisions of Cardiothoracic Anesthesiology, Cardiac Surgery, Cardiology, and the Department of 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 Department 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 FY16, 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 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.

Several faculty members achieved notoriety this past year. During the October 2015 American Society of Anesthesiologists (ASA) annual meeting in New Orleans, LA, Dr. Theresa Gelzinis moderated a problem-based learning discussion (PBLD). Dr. Joseph Quinlan served as Co-moderator for the Difficult Airway and Simulation Workshop and Dr. Theresa Gelzinis participated as a workshop instructor. Dr. Erin Sullivan participated as a Delegate in the ASA House of Delegates and serves as the Chair for the ASA Committee on Governmental Affairs. She is also a member of the Committee on Surgical Anesthesia and the Committee on Governance Effectiveness and Efficiency.

During the April 2016 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. Dr. Sullivan was an invited author for articles for the ASA Newsletter and the Pennsylvania Society of Anesthesiologists newsletter Sentinel.

The Third Annual UPMC Anesthesiology Symposium and Society for Advancement of Transplantation Anesthesiology Meeting was held on September 26-27, 2015 at the UPMC Herberman Conference Center. Drs. Stephen Esper and Kathirvel Subramaniam were the Course Directors. This two day conference and workshop offered a comprehensive review of anesthesia and perioperative care for patients undergoing solid organ transplantation using concise didactic lectures, research abstract presentations, case presentations and workshops. Faculty from the Division of Cardiothoracic Anesthesiology participated as speakers and workshop instructors.

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.

During the annual meeting of the SCA in San Diego, CA, the 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.

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 announced that the WAKE Score would become the official recovery (Phase I PACU) scoring system for all VA hospitals in the nation. Dr. Williams was named “Gold Status Fellow for the Promising Practices Consortium Diffusion of Excellence” program by VA Undersecretary of Health Dr. David Shulkin, who is an alumnus of the UPMC Internal Medicine Residency Program. Dr. Williams will be working with Dr. Shulkin’s appointees over the next two years in this VA nationwide transition.

In March 2016, Peter Pronovost, MD, PhD, an acknowledged thought leader in anesthesiology and critical care medicine (with landmark work including the prevention of central-line related infections), asked to partner with Dr. Williams to promulgate the WAKE Score nationwide in the private sector. It is anticipated that the University of Pittsburgh and Johns Hopkins University will serve as co-headquarters for this effort, and Pitt-based infrastructure (e.g., Dr. Yan Xu’s NIH-funded T32 program in our department) is being established at the time of this writing.

Our Department Chair Dr. Howard Gutstein and Executive Vice Chair Dr. Mark Hudson anticipate a significant re-routing of UPMC ambulatory anesthesia cases from our central critical care centers to patient-friendly facilities, and a coordinated team effort system-wide with respect to ambulatory anesthesia is forecasted.

Several important research advances in ambulatory anesthesiology (originating from the University of Pittsburgh School of Medicine Department of Anesthesiology) occurred during FY15-16. Most of these are related to the MMPNA concept described
In July 2015, in conjunction with the Department of Surgery and Drs. Jennifer Holder-Murray and Amer Zureikat and with the help of project managers Natalie Dick and Katie Meister, UPMC launched its pioneer 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 post-operative physiological function, reduce rates of complications, facilitate faster recovery through early ambulation and feeding (thus reducing length of stay), and improve patient/family satisfaction.

The success of ERAS has been demonstrated at UPMC hospitals by reducing length of stay by two to three days and reducing patient-controlled analgesia use from >95% to approximately 16% after complex abdominal surgery. 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.

In FY16, the March 14, 2016 edition of the Pittsburgh Tribune-Review featured the ERAS program in the article “UPMC doctors get patients fit to speed recovery from surgery.”

Following up on the success of the ERAS protocols has been the development of the Perioperative Evaluation and Enhancement of Recovery Services (PEERS) initiative. A team-based initiative led by the staff mentioned above and including project manager Mary Kay Wisniewski, 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. Patients are seen at the Center for Pre-Surgical Care at UPMC Shadyside Hospital and are recognized as the leaders of their teams.
FY16 was a productive year for basic research in the Department of Anesthesiology. We received a total of $5,257,138 in extramural grants, $4,440,815 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 100 NIH-funded investigators in anesthesiology, each bringing in from $419,599 to $1,140,273 in total NIH grant funding in 2016.

Department of Anesthesiology basic researchers authored 32 peer-reviewed publications in FY16, 25 of which were published in journals with impact factors (IF) above three. Please see the publications section of this report for a full list of publications.

Significant studies published during FY16 (IF > 5) include the following:


A mouse model that allowed for the conditional inactivation of the APE1 gene was created and used to demonstrate that deletion of APE1 resulted in impaired recovery of sensorimotor and cognitive defects following transient focal cerebral ischemia. APE1 inactivation also aggravated myelin loss and impaired neuronal communication in the same ischemia model. These studies provide evidence that endogenous APE1 protects against ischemic infarction in both gray and white matter and facilitates the functional recovery of the CNS after mild stroke.


Ethanol-induced changes in epigenetic processes have been hypothesized to mediate changes in the brain transcriptome following ethanol consumption. This study established that ethanol exposure induced numerous transient changes in epigenetic processes that varied across brain regions. These studies provide unique insight into the mechanisms by which the brain adapts to alcohol exposure.


Previous studies have revealed that TRPV1 and TRPA1 function downstream of many itch receptors, where they mediate inward current to trigger action potentials in primary afferents. Although other TRP channels, such as TRPV4, are expressed in primary afferents, whether or not they play an analogous role in itch was
previously unknown. Now, Akiyama et al. provide evidence that TRPV4 is a key mediator of serotonin-induced itch. This finding is important because it uncovers an unanticipated role for TRPV4 in itch, thereby identifying a novel therapeutic target.


The last few years have seen major advances in our understanding of spinal microcircuits that integrate somatosensory input, resulting in part from availability of mice that allow genetically defined neuronal populations to be marked or manipulated. However, a genetically defined population does not necessarily correspond to a functional population, and defining functional populations remains a major challenge. Here we begin to address this by focusing on a group of inhibitory interneurons in superficial dorsal horn. These have been variously identified as PrP-GFP,4,9 B5-I,6,7 or Dyn-cre2 neurons. However, it now appears that they represent largely overlapping populations stemming from a common lineage. Here, we summarize what is known about these neurons, and consider their roles in the inhibition of itch and pain.


How thermal, mechanical and chemical stimuli applied to the skin are transduced into signals transmitted by peripheral neurons to the CNS is an area of intense study. Several studies indicate that transduction mechanisms are intrinsic to cutaneous neurons and that epidermal keratinocytes only modulate this transduction. Using mice expressing channelrhodopsin (ChR2) in keratinocytes we show that blue light activation of the epidermis alone can produce action potentials (APs) in multiple types of cutaneous sensory neurons including SA1, A-HTMR, CM, CH, CMC, CMH, and CMHC fiber types. In loss of function studies, yellow light stimulation of keratinocytes that express halorhodopsin reduced AP generation in response to naturalistic stimuli. These findings support the idea that intrinsic sensory transduction mechanisms in epidermal keratinocytes can directly elicit AP firing in nociceptive as well as tactile sensory afferents and suggest a significantly expanded role for the epidermis in sensory processing.


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.


A functionally relevant propofol-binding site was identified in ELIC, a homologue of nicotinic acetylcholine receptors, by photolabeling, 19F NMR, and propofol modulation of ELIC and an ELIC-GABAAR chimera. The site in ELIC overlaps with sites in homologous channels, suggesting a common anesthetic inhibitory site.
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 37 in the nation selected to serve as a host site for the 2016 Foundation for Anesthesia Education and Research (FAER) Medical Student Anesthesia Research Fellowship program. Finally, 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 of Neurological Disorders and Stroke and one funded by the National Institute for General Medical Sciences (see the “Research Fellowships” section for more information).

**Basic Research**


The α7 nicotinic acetylcholine receptor (α7 nAChR) is highly expressed in the brain for maintaining various neuronal functions. A classic view of α7 nAChR is that it assembles into homo-pentamers in the mammalian brain. Emerging evidence, however, demonstrates the presence of heteromeric α7 nAChRs in heterologously expressed systems and naturally in brain neurons, where α7 subunits are co-assembled with β2 subunits to form a novel type of α7β2 nAChR that exhibits distinctive function and pharmacology from traditional homomeric α7 nAChRs.


Neurons communicate with each other dynamically, but how such communications lead to consciousness remains unclear. The authors present a theoretical model to understand the dynamic nature of sensory activity and information integration in a hierarchical network. The model offers mechanistic insights into the emergence of information integration from a stochastic process, laying the foundation to understand the origin of cognition. This research was the topic of several feature news articles in the scientific community.


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.
LAB MEMBERS
Howard B. Gutstein, MD (PI)
Roger Lopez-Bellido, PhD (post-doctoral research associate)
Stephanie Puig, PhD (post-doctoral research associate)

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 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
HOMANICS LAB
Biomedical Science Tower-3, Rm 6068

LAB MEMBERS
Gregg E. Homanics, PhD (PI)
Carolyn Ferguson (Lab Manager)

Graduate Students, Center for Neuroscience
Gregory Rompala
Nicholas Kunz

Undergraduate Assistants
Zachary Nobile
Michelle Slater

OVERVIEW
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 and for anti-inflammatory drugs. 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


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

U01 AA020889-04 (Homanics): Genetically-Engineered Rodents Core
09/01/2014 – 08/31/2015, NIH/NIAAA

R01 AA006399 (Harris): Alcohol Actions-Molecular Targets on Brain Proteins
04/01/2015 – 05/31/2016, Role: Co-I
University of Texas/NIH, (University of Pittsburgh subcontract)

R21 AA022753 (Martin & Boffelli): Transgenerational Epigenetic Effects Induced by Paternal Preconception Ethanol
07/01/2014 – 06/30/2015, Role: Co-I
RESEARCH

BASIC RESEARCH

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)

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

OVERVIEW
Dr. Tang’s lab focuses 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.

PUBLICATIONS


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, 04/01/16–03/31/17
LAB MEMBERS
Yan Xu, PhD (PI)

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

Tommy Tillman, PhD, Research Associate

Staff:
Nicole Brandon, MS
Sandy Hirsch, MBA
Brandon Scott Tommy Tillman, PhD, Research Associate

Undergraduate Researchers:
Kerryann Koper
Nathan Reinert

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 cerebral global ischemia, and (3) the molecular and cellular mechanisms underlying the actions of low-affinity neurological drugs. 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 molecular and cellular 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.
RESEARCH

BASIC RESEARCH

(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 Cerebral Global 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 proposed to develop a paradigm-shifting strategy 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 knockdown 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.

Molecular and Cellular 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 connectivity 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.
**PUBLICATIONS**


This article was featured in physics.ps.org, physicsworld.com, and insidescience.org:


**CURRENT FUNDING**

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

Principal Investigator, R01GM114851-01A1, NIH/NIGMS, Injury Mechanisms and Systemic Immune Responses after Cerebral Global Ischemia, 09/01/14-07/31/18

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), 08/01/13-07/31/18

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
Dr. Bircher’s research focuses on improving overall and neurological outcomes after resuscitation and critical care, as well as improving educational methodology. With Professor Yan Xu, he is conducting a detailed analysis of the Get With The Guidelines®-Resuscitation database. This American Heart Association program collects data on in-hospital resuscitation events from hospitals across the US. The data is used to provide participating hospitals with feedback on their resuscitation practices and patient outcomes, as well as to develop new evidence-based guidelines for in-hospital resuscitation. The focus of their analysis is the effect of delays in starting CPR and delays in Advanced Cardiac Life Support interventions on survival. A manuscript has been approved by the Executive Data Steering Committee of the database and is ready for submission.

Dr. Bircher is a consultant on the Use of Personal Protective Equipment (PPE) to Ensure Safety (UPPEES) Project. This study with John O’Donnell and JaHyun Kang of the School of Nursing compares the effectiveness of conventional (web-based training) and simulation-based training both for universal precautions and for Ebola PPE use. This study was funded by the Association for Professionals in Infection Control and Epidemiology. The project was published in abstract form and a manuscript has been accepted for publication in the American Journal of Infection Control. With Edwin Nemoto and the QUOVADIS (Quantitative Occlusive Vascular disease Study) investigators, they evaluated cerebrovascular reactivity and oxygen metabolism in subjects free of vascular disease but with one or more of the risk factors for metabolic syndrome (MetS, hypertension, diabetes, obesity, and dyslipidemia) using quantitative positron emission tomography for measurement of cerebral blood flow, oxygen consumption, oxygen extraction fraction, and acetazolamide cerebrovascular reactivity. The work was reported in: Uchino K, Lin R, Zaidi SF, Kuwabara H, Sashin D, Bircher N, Chang YF, Hammer MD, Reddy V, Jovin TG, Vora N, Jumaa M, Massaro L, Billigen J, Boada F, Yonas H, Nemoto EM: Increased Cerebral Oxygen Metabolism and Ischemic Stress in Subjects with Metabolic Syndrome-Associated Risk Factors: Preliminary Observations. Transl Stroke Res. 1:178-183, 2010. The full analysis of this study has been submitted to the journal Stroke.

PATRICIA L. DALBY, MD
Associate Professor

PROJECTS

Genetic Determinants of Ante Partum, Parturition, And Postpartum Pain And Labor Analgesia
Primary Investigator: Patricia Dalby, MD (formerly Inna Belfer, MD, PhD)
Co-investigator: Katherine Grace Lim, MD

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 was 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.

Although the study is now closed to patient recruitment, the data will continue to be analyzed for potential publication in the future.

Protein Shake and Progress of Labor Study
Summer MWH Research Internship Project for Jessica Shaffer and Samantha Braun
Primary Investigators: Pamela Flood MD; Ina Belfer, MD, PhD; and Jonathan Waters, MD
Co-investigators: Patricia Dalby, MD; Jodi Martin; Manuel C. Vallejo, MD

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).

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 Magee-Womens Hospital of UPMC. 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 abruption (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).

The results of this case series are consistent with findings from other series.
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 the initial experiments used a canine model (e.g. Circulation 2006, J Cereb Blood Flow Metab 2008), Dr. Drabek’s group developed a rodent model of EPR. A miniaturized CPB circuit enables to utilize molecular tools to define potential therapeutic targets and develop drugs that would augment the effect of hypothermic preservation.

We initially characterized the rodent model of EPR using rapid lethal hemorrhage followed by 20 minutes of CA (Crit Care Med 2007). 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 (Resuscitation 2008) and increased secondary injury cascades (Resuscitation 2008). The blood-brain barrier was not disrupted, even in insults that were associated with poor outcome (Resuscitation 2009; Neurosci Lett 2014). The delta-opioid agonist DADLE, linked to hibernation-induction agents with organ-preservation properties, failed to augment the hypothermic protection (Resuscitation 2008). 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 (Anesth Analg 2009). This finding shifted our focus to neuroinflammation. Further studies are needed to elucidate the role of microglia in this complex model. We pioneered a method of selective depletion of microglia using intrahippocampal injection of clodronate, a pro-drug that depletes macrophages when injected systemically (Resuscitation 2012). Our current results also suggest that there are significant regional differences in brain neuroinflammatory response to CA (Ther Hypothermia Temp Manag 2015).

Recently, we established a normovolemic ventricular fibrillation (VF) CA model (Crit Care Med 2013). We characterized the model and also explored cerebral blood flow after asphyxial CA vs. VFCA (Resuscitation 2014). We have also characterized early neuroinflammatory region-specific responses to various durations of VFCA (Resuscitation 2014). This research is being conducted in collaboration with the Pittsburgh NMR Center for Biomedical Research, Carnegie Mellon University.

We are 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. We are also developing a pediatric model of asphyxial CA rescued by extracorporeal cardiopulmonary resuscitation to mirror the clinical setting of extracorporeal membrane oxygenation.

Our 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.
It has recently been shown that small fluctuations in the functional magnetic resonance imaging (fMRI) signal are temporally correlated between communicating brain regions. This technique, termed functional connectivity magnetic resonance imaging (fcMRI), analyzes the co-variation of low frequency (< 0.1 Hz) oscillations in the MRI signal between brain areas. These occur in an organized and coherent manner across brain areas that are functionally related, likely reflecting spontaneous neuronal activity, and are present at rest. This simplifies the experimental design – subjects only need to lie quietly in the scanner while the images are collected to determine resting-state functional connectivity. As such, resting-state fcMRI methodologies can more readily be used to study ongoing and 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.

With funding from a Department of Anesthesiology seed grant, we have collected and analyzed data determining functional connectivity during both acute and chronic pain processing in healthy controls, finding preliminary evidence that we can differentiate a painful state from the non-painful resting state through fcMRI and setting the stage for future investigations into how alterations in the connectivity of these areas may predict, or even be partially responsible for, chronic pain. This project has already produced 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 journal devoted solely to cutting-edge developments in fcMRI. Two follow-up publications are under review, applications for funding to extend this project to clinical pain was recently awarded.

**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 are going to 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. Funding applications for this work are currently under review.

**PUBLICATIONS**


**CURRENT FUNDING**

Principal Investigator, University of Pittsburgh Department of Anesthesiology Seed Grant, Imaging Brain Phenotype and Genotype, 2013-2015

Co-investigator (5%), DoD 13232002, U.S. Dept. of Defense, Total Joint Replacement with Four-drug Nerve Block in Veterans (PI: Brian Williams) 2015-2020

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
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 2015-16 academic year, Dr. McIvor worked with a team of master’s degree candidates and their faculty at Carnegie Mellon University to develop a screen-based simulation. The goal is to produce a sophisticated first-person simulated clinical experience that can be run over the web or from a local hard drive.

He has authored a paper that has been accepted to Simulation in Healthcare that provides a taxonomy for deviations from standardized simulation encounter deliveries, and a second in review 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. This year he was made a member of the American Society of Anesthesiologists’ Simulation Education Network.

LI-MING ZHANG, MD
Associate Professor
Associate Medical Director, UPMC China, UPMC International Services

PROJECTS
WISP1 and TLR4 Signaling in Ventilator-induced Lung Injury (VILI)
National Institutes of Health (NIH) RO1, Principal Investigator

Collaborators:
Timothy R. Billiar, MD, George Vance Foster Endowed Professor and Chair, Department of Surgery

Bruce R. Pitt, PhD, Professor and Chair, Department of Environmental and Occupational Health

Our previous unbiased genome-wide association studies on a genetically diverse panel of 23 mouse strains found that WNT1-inducible signaling pathway protein 1 (WISP1) played an important role in a murine VILI model. 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 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 in intact mice. In particular, we have been collaborating 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. We also propose to examine the role of important damage-associated molecular pattern molecules, including HMGB1, in the above double hit (sepsis + MV) model.

Although both sepsis and mechanical ventilation signaling occur via TLR4, the molecular determinants
underlying the activation of TLR4 signaling in the latter sterile conditions 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.

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 the 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 the supportive measures of mechanical ventilation, and mechanical ventilation itself may cause iatrogenic ALI, few reports have combined these stimuli in a calibrated double hit ALI model. 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.

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 WISP1 by itself increased the release of TNF-α from RAW264.7 cells (with baseline expression of αvβ3) in an RGD-sensitive fashion, but primary cultures of PMø required activation of TLRs to induce de novo synthesis of αvβ3, enabling WISP1 to stimulate the 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, and 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, intra-tracheal 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 migration of amplified polymorphonuclear leukocytes 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 and mechanical ventilation and 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.
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. This year, we contracted clinical trials with six 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 FY16, the CTP was involved in 18 active studies, including two studies that had been recruiting subjects for over five years. CTP contracted ten new clinical trials and completed three ongoing clinical trials. Contracted grants totaled $1,697,801 (direct contracted revenue, $1,326,601; indirect contracted revenue, $3371,200) and $553,416 was collected. Over 50 faculty members were involved in clinical sponsored research at eight UPMC sites. CPT interacted with 14 different companies and one university (Avancen MOD Corporation, AcelRx Pharmaceuticals Inc., CARA Therapeutics Inc., Endo Pharmaceuticals Inc., Grifols Therapeutics Inc., Grünenthal:Janssen/Worldwide Clinical Trials, Haemonetics Corporation, Incline Therapeutics Inc., Mallinckrodt Pharmaceuticals, Medtronic Sofamor Danek USA Inc., The Medicine Company, Mylan Specialty L.P., Octapharma USA, and Purdue Pharma L.P., University of Pennsylvania).

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The University of Pittsburgh Clinical and Translational Science Institute (CTSI) is one of 60 medical research institutions funded by National Institutes of Health Clinical and Translational Science Awards (CTSAs). Since 2006, the CTSI has collaborated within the national CTSA consortium to improve the way biomedical research is conducted. CTSI provides a broad range of resources and training opportunities to support researchers across the full spectrum of translational research. The institute fosters collaboration that can influence knowledge, experiences, and perspectives and lead to revolutionary research. At the University of Pittsburgh, CTSI’s focus is to facilitate the translation of biomedical research advances into clinical and public health practice and policy. Since its inception, CTSI has impacted 4,049 unique studies in 218 University of Pittsburgh departments and divisions. Interactions with 2,225 individual investigators have resulted in 5,015 publications acknowledging CTSI, cutting edge technology, and new ideas to improve health in the community. CTSI support accounts for 25% of Pitt’s NIH portfolio. By bridging the gaps from the laboratory bench to the patient bedside to community-based practice, CTSI-supported research can accomplish its end goal of improving public health.

Integral to this effort is the training and education of a new generation of clinical and translational researchers. According to Steven E. Reis, MD, CTSI director and the University’s Associate Vice Chancellor for Clinical Research, Health Sciences, CTSI aims “to promote initiatives that ensure that patients and members of the general community have greater access to clinical trials and research studies, to encourage collaborations between stakeholders that can facilitate the adoption of new medical therapies in clinical practice, to foster the launch of novel technologies, and to promote the training of a new generation of clinical scientists.” To achieve these goals, CTSI marshalled existing resources and created an array of new resources to develop an infrastructure that advances and supports a wide range of institutional research.

Based on ongoing needs assessments, CTSI continuously develops new research and investigator support core resources that cultivate clinical and translational research. One example of CTSI’s educational programming is the Institute for Clinical Research Education (ICRE), which offers formal programs in clinical and translational science,
as well as courses for non-degree candidates. CTSI is committed to training and career development through the support of KL2 and TL1 training programs conducted by ICRE.

Examples of additional CTSI core programs that are highly utilized by investigators are described below. Researchers predominantly interact with these service-oriented cores for pre-implementation and implementation essentials of a research study and added sources of training, mentoring, and education. In addition to the service-oriented core programs, CTSI offers a variety of other programs that are useful for investigators but are not discussed in detail here (The full list of CTSI cores includes the Center for Clinical and Translational Informatics, Pilot and Collaborative Translational and Clinical Studies, Development of Novel Clinical and Translational Methodologies, Evaluation Core. Please visit http://www.ctsi.pitt.edu for more details.

The Responsible Conduct of Research (RCR) Center provides a variety of resources for researchers to enhance their knowledge and practice of research ethics. Through an innovative series of workshops, the RCR Center offers in person training in topics of interest for bench, clinical, and translational scientists. RCR instruction is delivered in a format that combines presentations by senior researchers and research ethics experts with case-based discussion of ethical dilemmas. To meet the needs of specific trainee groups, customized presentations are also available. CTSI RCR Center staff advise researchers in the design of individualized and departmental RCR training programs. Additional support is available through consultation with CTSI research facilitators and affiliated ethicists.

Biostatistics, Epidemiology, and Research Design (BERD) provides services to researchers at all stages of the research process including grant application development, study design, data analysis, and data management consultation for planning and conducting clinical research. Consultation with up to 10 hours of support per project is provided at no cost. All investigators are highly encouraged to take advantage of this service early and often during the development of their research projects.

The Community PARTners Core supports the development of sustained partnerships among academic researchers and members of the community to encourage translational research. Facilitation of relationships between community organizations and clinical and translational researchers by the Community PARTners enhances collaborative research, fosters public trust in clinical and translational research, and ultimately increases activities that promote health.

The UPMC/University of Pittsburgh CTSI Research Participant Registry is a component of CTSI, in partnership with UPMC. The goal of the registry is to aid investigators with recruitment and to promote a research-informed community of potential research participants. After signed informed consent, the registry uses a centralized IT-based system to collect relevant clinical information about participants for the purposes of matching participants with relevant clinical research studies. Potential participants are screened by registry staff and if eligible, their contact information is forwarded to the study team for further screening and enrollment. To date, the registry has 100,500 participants; 69,583 adults and 24,200 children are currently active. The registry is currently recruiting for 232 studies (172 adult and 60 pediatric).

The Regulatory Knowledge and Support Core (RKSC) promotes good clinical practice and facilitates regulatory compliance in clinical and translational research. RKSC works directly with researchers in collaboration with regulatory agencies to navigate all necessary regulatory pathways at any stage of their research. The CTSI Regulatory Knowledge and Support Core further assists the planning and conduct of clinical and translational research by providing Regulatory Compliance Facilitators who directly support investigators as they address compliance regulations (e.g., IRB, IND, IDE, HIPAA).

The Research Facilitator Program is an integral part of CTSI efforts to overcome barriers to research through the provision of a single point of contact to access an extensive array of University of Pittsburgh and CTSI programs. The CTSI Research Facilitator Program employs expert Research Facilitators (RFs) to meet the individual researchers’ needs of in all aspects of their studies. They work directly with investigators to reduce barriers to the research process, facilitate the use of available resources, and identify needs for the development of new resources.
Studies show that personalized service, education, support, and guidance for any aspect of research from hypothesis to publication. To date, RFs and RKSC facilitators have interacted with 813 scientists and clinician investigators to review and assist with 842 research projects, facilitate referrals to resources, and link them with potential collaborators. RFs have delivered educational programs to over 170 groups since 2007.

Individual meetings with investigators are the cornerstone of the facilitator program. RFs meet with individual researchers on an ongoing basis as they plan and conduct their research to help them overcome any barriers to the continued success of their projects. The RF team assembles all appropriate and available expertise to discuss grant submissions or research projects and provide advice regarding the appropriate research processes for protocols. They can address important issues such as recruitment, retention, regulatory compliance, ethics, budgets, staffing, education, or study design that investigators may encounter in the preparation and conduct of research. As advocates for investigators, RFs help them to advance the quality and speed of their research by facilitating collaborations and access to the vast resources available at the University of Pittsburgh. CTSI and the RF services make investigators more competitive in today's research environment.

The Department of Anesthesiology at the University of Pittsburgh School of Medicine has been a collaborator, advocate, and recipient of CTSI philosophies, services, and education. Seven educational sessions from 2009 to 2014 were offered to 288 anesthesia residents by CTSI RFs. One important series of educational offerings consisted of a problem-based learning discussion (PBLD) on research fundamentals. Under the direction of Tetsuro Sakai, MD, PhD, the RFs directed the resident groups through the research life cycle from an intuitive clinical question to publication using a simulated scenario to guide the residents and to foster problem solving skills. Adding the Research PBLD to the curriculum led to double the number of anesthesia resident research projects making use of CTSI consultation services. Increased awareness of the support and education offered by CTSI resulted in 64 publications from the Department of Anesthesiology that benefitted from CTSI services from October 2011 to date. During this period, 69 Department of Anesthesiology staff and faculty members took advantage of CTSI support and of these, 23 were anesthesia residents. There were over 166 research projects with requests for services.

The relationship between CTSI and the Department of Anesthesiology continues to provide support, referral, and bi-directional contributions to education and research. For CTSI, the future of research lies in continued connectivity with scientists and in the provision of research support and advocacy. Partnerships with departments are instrumental in creating the next generation of exciting and influential research to advance health and wellness. The CTSI is supported by the National Institutes of Health through grant number UL1TR000005.

Related Publications

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.

Former Fellows

Predoctoral Trainees
Nathan Glasgow
Training period: September 1, 2012 - August 31, 2014
Current position: Postdoctoral Fellow, University of Pittsburgh

Peer-reviewed Publications

• Clarke RJ, Glasgow NG, and Johnson JW. (2013). Mechanistic and structural determinants of NMDA receptor voltage-dependent gating and slow Mg2+ unblock. J Neurosci 33, 4140-4150.


RESEARCH FELLOWSHIPS

Aging Cell 14, 635-643.

Mark Doyal
Training period: September 1, 2012 - August 31, 2014
Current position: Medical student, University of Pittsburgh School of Medicine

Jean-Marc Guedon
Training period: September 1, 2013 - August 31, 2014
Current position: Researcher, Alliance for Cancer Gene Therapy

Peer-reviewed Publications

Eser Yilmaz
Training period: September 1, 2014 - August 31, 2015
Current position: Postdoctoral Fellow, Lab of Carla Ng, Department of Civil and Environmental Engineering, University of Pittsburgh

Peer-reviewed Publications

Postdoctoral Trainees

Kyle Baumbauer
Training period: June 1, 2013 – May 31, 2014
Current position: Assistant Professor, University of Connecticut

Peer-reviewed Publications:

Richard Miller
Training period: June 1, 2013 – May 31, 2014
Peer-reviewed Publications:


**Jami Salomon**
Training period: September 1, 2013 – August 31, 2014
Current position: Postdoctoral scholar, Neurobiology, University of Pittsburgh

Peer-reviewed Publications:


**Brianna Sheppard**
Training period: June 1, 2014 – March 31, 2015
Current position: Program Coordinator, Institute for Community and Rural Health, Robert C Byrd Health Sciences Center, West Virginia University, Morgantown WV

**FY16 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**

Pathological pain is a widespread condition that affects one in four Americans. Opioids have long been used for their analgesic effects in pain management; however, opioids such as morphine cause severe adverse effects. An alternative pain therapeutic with reduced adverse effects is to reduce the perception of pain by modulating the affective pain circuits within the brain. In doing so, such approaches would also permit pain patients to retain aspects of somatosensation that local anesthetics would otherwise remove. Affective components of pain are presumed to arise from the spino-parabrachial pathway via the lateral parabrachial nucleus (LPBN). Therefore, understanding LPBN pathways that convey pain and how pain is perceived within the brain is critical to developing safer and more effective therapies.

Our preliminary data suggest that different LPBN pathways mediate distinct aspects of the affective response to a painful stimulus. Using optogenetic approaches to study circuit function, we looked for changes in the following qualities of a painful response: aversion, heart rate, and descending modulation of pain. 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. Similar results were found in mice in which LPBN terminals were activated in the hypothalamus or periaqueductal gray, although the effect was less than that of stimulation within either central amygdala or bed nucleus stria terminalis. To assess for the effects of activating these pathways on heart rate, we used a mouse pulse oximeter to measure changes in heart rate during optogenetic stimulation. Only mice in which LPBN terminals were activated within the hypothalamus exhibited a decrease in heart rate. No other effects were observed when other downstream regions were photostimulated. Lastly, we used hot plate and tail immersion tests to determine whether the activation of these LPBN pathways affects descending modulation of pain. We found that the activation of LPBN – periaqueductal...
gray resulted in an increase in latency to tail flick during the tail immersion test. Furthermore, an increase in latency to flick or lick the hindpaw or jump was observed in the hot plate test. Together, these data suggest that the pathways that stem from 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. To increase the specificity of our study within the external lateral region of the PBN (PBNel), we used a genetic mouse model that expresses cre-recombinase in PBNel+ cells expressing the calcium binding protein calretinin (CR). Cre-dependent virus encoding channelrhodopsin-2 was stereotaxically delivered to the PBNel and implantable optical fibers were placed above either the central amygdala or bed nucleus stria terminalis. We are currently repeating the battery of behavioral assays to determine whether the CR+ PBNel cells mediate the effects we found in our preliminary study.

Future Research Directions:
Preliminary anatomical tracing data indicate that the CR+ PBNel neurons project to several downstream structures such as the central amygdala, bed nucleus stria terminalis, and to a minor extent, the insular cortex. Interestingly, no axonal terminals were found in the hypothalamus or periaqueductal gray, suggesting that specific subpopulations of PBNel neurons exhibit distinct anatomical pathways. We are currently using retrograde tracing approaches to determine whether the same CR+ PBNel neurons send collaterals to numerous downstream structures. Furthermore, we are working to determine which PBNel subpopulations project to the hypothalamus and/or periaqueductal gray. Determining this would potentially provide new insight into the anatomical organization of the LPBN. These approaches will be combined with neurochemical characterizations of the LPBN to elucidate the neurochemical organization of these projection neurons in the LPBN.

Publications

Marissa Kuzirian

Education/Training: BA, Neuroscience, Kenyon College, 2006
PhD, Neuroscience, Brandeis University, 2015

Mentor: Sarah Ross, PhD, Assistant Professor of Neurobiology

Research Overview
Chronic pain and/or itch affect one in four Americans. Unfortunately, these debilitating conditions lack effective treatments without serious side effects. This widespread problem highlights the need to understand how itch and pain are coded in the nervous system. One of the central, unanswered questions is the nature of spinal projection neurons. In other words, while it is known that spinal projection neurons play an essential role in conveying nociception (pain), pruritoception (itch), and thermoception (temperature) to the brain, the logic of these neurons is completely unknown. In particular, it is unclear how spinal projection neurons are organized by either function or molecular profiles. There may be distinct subclasses of projection neurons (labeled-line) or ensembles of projection neurons may work together to process itch, pain, and temperature sensations. The literature hints at the possibility of functional divisions in lamina I projection neurons, where a
population of nociceptive projection neurons in the dorsal horn express the neurokinin I receptor (NK1R), the target of substance P-expressing afferent nociceptors (Ding et al., 1996; Todd et al., 1998; Weisshaar and Winkelstein, 2014). Studies in monkeys and cats suggest the possible presence of temperature-selective projection neurons as well (Dostrovsky and Craig, 1996; Craig and Andrew, 2002). We hypothesize that distinct spinal projection neurons are selectively tuned for different types of somatosensory input—noxious, pruritogenic, warm, and cool. To answer these questions, I am using calcium imaging of populations of spinal projection neurons to visualize their responses to natural stimulation of the skin. I am also working to genetically target subsets of spinal projection neurons using Cre-alleles to test how acute inhibition of these populations affects somatosensation. The successful completion of these experiments will provide important insight into the logic of spinal projection neurons.

During this project, we have begun to investigate these questions by studying two different alleles, NK1R-CreER and KOR-Cre, which express Cre in lamina I of the spinal cord, where 80% of spinoparabrachial output neurons reside. The Ross Lab previously demonstrated that kappa opioid signaling is important in the spinal cord for itch, but not pain perception (Kardon, et al. 2014). However, the expression profile of kappa opioids and their receptors are not well characterized, limiting our understanding of their role in somatosensation. To address this gap in knowledge, we generated a kappa opioid receptor (KOR) Cre knock-in mouse to investigate the expression and function of KORs throughout the body (Cai et al., 2016). We found that 46% of projection neurons in lamina I express KOR-Cre. Additionally, we have created a NK1R-CreER mouse that demonstrates Cre-mediated recombination in lamina I (Huang*, Kuzirian*, et al., submitted). Using these mice, we will be able to test whether these subsets of neurons are important in pain, itch, or temperature sensation.

Future Research Directions
We hypothesize that the KOR-Cre and NK1R-CreER populations of projection neurons comprise a subset of projection neurons that encode inflammatory pain and itch. To test this, in the future, I will use c-fos staining to see if these neurons are activated after inflammatory pain (CFA), itch (chloroquine and serotonin), and thermal stimulation (Hargreaves). Additionally, I will utilize the Cre-mediated recombination in these cells to activate (ChR2-mediated optogenetic activation) or inhibit (DREADD hM4Di) KOR-Cre or NK1R-CreER projection neurons in animals during behavioral assays to determine their responsivity to inflammatory pain, itch, and thermal stimulation. I expect that inhibition of KOR-Cre+ projection neurons will lead to a reduction in the sensitivity of mice to pain and itch, but not temperature.

Publications


Grants awarded during fellowship
F32 National Research Service Award, National Institute of Neurological Disorders and Stroke, in submission, 6th percentile score.
Lindsey Snyder

**Education/Training:** Bachelor of Liberal Arts, Allegheny College, 2010
Translational Neuroscience Program, University of Pittsburgh, 2012

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

**Research Overview**
Peripherally selective kappa opioids are emerging as a novel treatment for pain and itch that have shown efficacy in several recent clinical trials. Yet, the subtypes of somatosensory neurons that express KOR remain unclear. Using a newly developed KOR-cre knockin allele, viral tracing, and single-cell PCR we reveal that that KOR is expressed in a specific subset of peptidergic afferents that are tuned for inflammatory pain and itch, but not heat or mechanical force. Consistent with this, peripherally restricted KOR agonists inhibit behavioral responses to chemical pain and itch, but not acute heat responses nor punctuate mechanical sensitivity. At a functional level, optogenetic experiments reveal that dynorphin inhibits glutamate release from the central terminals of KOR-expressing afferents, and genetically-labeled afferents show inhibited calcium influx in response to kappa agonists. These experiments provide key insight for the rationale use of peripherally selective KOR agonists for the modulation of inflammatory pain and itch.

**Future Research Directions:**
Unexpectedly, we also find that KOR is expressed in subsets of primary afferents that form lanceolate or circumferential endings around hair follicles, suggesting an unappreciated role for KOR signaling in the modulation of low-threshold mechanosensation. Future experiments will investigate the role of KOR-signaling in sensitivity to stimuli presented to the hairy skin, as well as investigate if KOR agonists can mitigate mechanical allodynia.

**Publications**


**Funded Grants**
Lindsey was awarded a F31NS092146-01A1, Ruth L. Kirschstein National Research Service Award (NRSA)
Margaret Wright, PhD

**Education/Training:** BS, Health Studies, Biology, Utica College of Syracuse University, 2010
PhD, Neuroscience, University of Pittsburgh, 2016

**Mentor:** Richard Koerber, PhD, Professor of Neurobiology

**Research Overview**

Somatosensory neurons are responsible for detecting and transmitting environmental stimuli from our periphery to the central nervous system. These afferents have a wide array of heterogeneity and can be categorized by a number of criteria including cell soma size, gene expression profiles, and functional responses to stimuli. My current project aims to characterize how MrgD-lineal afferents respond following injury. Specifically, transgenic MrgDCre;Ai32 mice have been generated that allow for selective activation of these afferents upon presentation of blue light, as the Ai32 locus contains a channelrhodopsin-YFP reporter that simultaneously permits their histological identification and optogenetic activation. MrgD-lineal afferents were previously believed to be nociceptors, in that their activation results in an aversive response. However, our lab has preliminarily demonstrated that optogenetic activation of this subset of C-fibers does not result in aversive behavior in a naïve state. We have found though that this is altered in the context of nerve injury. We subjected MrgDCre;Ai32 mice that received spinal nerve ligation injuries to a place preference test, with orange (non-activating) and blue (activating) LED-lit floors on either side of a testing chamber. These injured mice spent less time on the blue-lit side of the chamber after injury, indicating that activation of the MrgD-lineal afferents became aversive. I am currently developing an ex vivo dorsal root ganglia-sural nerve-glabrous skin preparation that will permit electrophysiological testing of the cutaneous afferents innervating the bottom of the foot. Intracellular recordings will determine how the signaling properties of these afferents may change during and after nerve injury.

**Future Research Directions:**

In addition to characterization of the functional recovery of MrgD-lineal afferents post-injury, the changes in their gene expression profiles, and peripheral and central innervation patterns will be examined. The finding that this subpopulation of C-fibers is non-nociceptive in naïve conditions will reframe the way that sensory neurobiologists categorize afferents based on their cell size and conduction velocity. Moreover, the gene expression and innervation changes contributing to the sensitization of these afferents will enhance our understanding of how they function during injury recovery.

**Publications**


RESEARCH FELLOWSHIPS

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.

Former Fellows

Danette Jordan, MD, MPH
T32 Fellowship Period: June 2008-May 2009
Current Position: Family Medicine Physician

Thomas Chalifoux, MD
T32 Fellowship Period: March 2008-Feb 2009; March 2010-June 2011
Current Position: Assistant Professor, Anesthesiology, University of Pittsburgh

Dan Willenbring, PhD
T32 Fellowship Period: March 2009-Feb 2012

Peer-reviewed Publications

**James Ibinson, MD, PhD**
T32 Fellowship Period: June 2010-Dec 2011
Current Position: Assistant Professor, Anesthesiology, University of Pittsburgh

Peer-reviewed Publications


**Gerhardt Konig, MD**
T32 Fellowship Period: June 2010-June 2012
Current Position: Clinical Instructor, Anesthesiology

Peer-reviewed Publications

RESEARCH FELLOWSHIPS

Lindsay M. Stollings, MD
T32 Fellowship Period: June 2011-June 2013
Current Position: Anesthesiology Resident, UPMC
Peer-reviewed Publications

Monica Kinde, PhD
T32 Fellowship Period: June 2011-June 2014
Current Position: Assistant Professor, Biochemistry, Kansas City University of Medicine and Biosciences
Peer-reviewed Publications

Jonathan Beckel, PhD
T32 Fellowship Period: June 2013-June 2015
Current Position: Research Instructor, Pharmacology, University of Pittsburgh
Awarded NIH K01 (K01DK106115) Role of Pannexins in Urinary Bladder Pathology, 08/01/2015-07/31/2018
Peer-reviewed Publications
- Coffey EE, Beckel JM, Laties AM, Mitchell CH. (2014) Lysosomal alkalization and dysfunction in fibroblasts with the Alzheimer’s disease-linked presenilin-1 A246E mutation can be reversed with cAMP. Neuroscience, 263:111 -124
**FY16 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. In particular, 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.

**Nasal nitric oxide**

We have seen an increased use of inhaled nitric oxide in single ventricle children with low levels of nNO after CPB. Preliminary data may also indicate that low nNO is associated with impaired cardiac function and increased risk of needing a heart transplant at a younger age for single ventricle CHD patients.

**Ciliary Dysfunction**

For the first time ever, we are implementing nebulized technetium mucociliary clearance scans in CHD patients undergoing CPB procedures. We are also using spirometry to correlate pulmonary compliance with ciliary function, as early preliminary data indicate lower compliance with ciliary dysfunction.

**NIRS-AKI**

We are evaluating the correlation between renal NIRS and postoperative AKI as diagnosed using Kidney Disease: Improving Global Outcomes criteria, and serum (NGAL, cystatin C) and urinary (NephroCheck [TIMP-2, IGFBP-7]) biomarkers.

**Future Research Directions:**

The use of non-invasive, bedside testing (nNO, NIRS) can lead to earlier identification of patients at risk for increased perioperative morbidity, which can lead to earlier intervention, and over time, even prevention, to lead to improved outcomes in CHD patients undergoing CPB procedures.
RESEARCH FELLOWSHIPS

K. Grace Lim, MD

Education/Training: Bachelor of Liberal Arts, University of Missouri, 2008
MD, University of Missouri, 2008
Clinical Base Year Internship, Northwestern University, 2009
Anesthesiology Residency, Northwestern University, 2012
Obstetric Anesthesiology Fellowship, Northwestern University, 2013
Master of Science in Clinical Research (MSc) Candidate, University of Pittsburgh, 2016

Mentors: Michael S. Gold, PhD, Professor of Neurobiology, Pittsburgh Center for Pain Research
Ajay D. Wasan, MD, MSc, Professor of Anesthesiology and Psychiatry, Pittsburgh Center for Pain Research

Research Overview and Current Findings
To date, our research has generated preliminary data in support of our global hypothesis: that pain associated with childbirth impacts risk for perinatal depression, and that enhanced control of this pain results in a significant risk reduction for postpartum depression (PPD). We conducted a retrospective medical record review of 2,491 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. A total of 201 patients received labor epidural analgesia, had intrapartum pain data available, and had the primary outcome of interest. We found a weak but significant relationship between percent improvement in pain (PIP) and EPDS (Spearman’s $\rho = -0.18$, $P = 0.012$). By simple linear regression, women with higher improvements in pain were 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 ($\beta = -0.022$, $t = -2.70$, $P = 0.008$). Improvement in pain during labor under epidural analgesia is a significant predictor in the development of PPD symptoms. Labor pain, alongside other established risk factors, is important to the subsequent detection of PPD symptoms.

In a critical next step toward establishing the veracity of this relationship between labor pain and depression, we are currently conducting a prospective observational pilot study among first-time pregnant mothers at two sites: Magee-Womens Hospital of UPMC and The Midwife Center for Birth and Womens Health. In this investigation, we aim to determine the extent to which the emotional components of labor pain correlate with psychological and psychosocial outcomes while accounting for covariates, including existing depression symptoms, anxiety, resiliency, pain catastrophizing, perceived social support, and pain sensitivity. We are characterizing the emotional valence of labor pain using an electronic pain diary, assessed with a bedside tablet, and assessed at high density (hourly). We 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. Genetic markers will be assessed for their
relationship to labor pain and PPD symptoms. A feasible study design to assess the role of labor pain improvement in PPD risk reduction will be generated. As a result, we will be able to identify the influence of labor pain on PPD risk, thereby allowing investigators to efficiently target novel pain management strategies. After completing these projects, I will have the preliminary data needed to support an application to fund a trial that is powered to compare the effectiveness of two epidural analgesia initiation techniques in mitigating risk for PPD in women at risk. My 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.

Publications


Funded Grants
PI, Labor Pain and Maternal, Infant, and Parent-Infant Psychological and Psychosocial Health (Ajay Wasan, MD, MSc Co-PI; Ann McCarthy, CNM, MSN, Collaborator; Janet Catov, PhD, MS, Collaborator). UPMC Department of Anesthesiology, 7/1/2015 - 6/30/2016

PI, Labor Pain and Maternal, Infant, and Parent-Infant Psychological and Psychosocial Health (Ajay Wasan, MD, MSc Co-PI; Ann McCarthy, CNM, MSN, Collaborator; Janet Catov, PhD, MS, Collaborator). University of Pittsburgh Physicians (UPP) Foundation, 7/1/2015 - 6/30/2016

PI, Reducing the Impact of Pain on Perinatal Depression (Ajay Wasan, MD, MSc Co-PI; Patricia L. Dalby, MD, Collaborator). University of Pittsburgh Virginia Kaufman Endowment Fund and CTSI Pain Research Challenge, 7/1/2016 – 6/30/2017

PI, Residents as Teachers: Effect of a Patient Education Strategy on Resident Self-Efficacy and Maternal Outcomes (The EDUCATE Study) (Tetsuro Sakai, MD PhD, Co-Investigator). Society for Education in Anesthesia (SEAd) Grant, 7/1/2016 – 6/30/2017
RESEARCH

RESEARCH FELLOWSHIPS

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

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

**Research Overview**
Tissue and/or nerve injury can cause neurogenic inflammation, locally and centrally releasing cytokines from nerve endings that induce vasodilation and activation of immune cells. These changes in the central nervous system are known to be associated with the development of chronic pain; however, changes in the peripheral nervous system are not well delineated. 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 glial cell-derived neurotrophic factor (GDNF) family is a group of growth factors known to impact neuronal development and maintenance of nerve health. Of particular interest is neurturin, a member that is known to be involved in the development of the autonomic nervous system and a subset of sensory neurons. Recently, neurturin has also been shown to modulate the immune system by decreasing the secretion of inflammatory cytokines. Our lab has developed a transgenic mouse line that overexpresses neurturin. The use of this mouse model will improve the understanding of neurturin effects on the nervous and immune systems, in both health and different models of tissue injury. The goal of this research is to demonstrate the value of neurturin in modulating neurogenic inflammation and therefore improve both acute and chronic pain.

**Current Project: Neurturin Increases Antigen-presenting Cell Recruitment to the Skin and Dorsal Root Ganglia and Provides Resistance to Infectious Challenge**

Pain is triggered by release of inflammatory molecules that sensitize primary afferents. It is typically accompanied by changes in immune cell infiltration at the site of injury, in sensory ganglia, and in the spinal cord dorsal horn. Changes in neurotrophic growth factors, which are known to increase sensory neuron activity, also occur in response to injury or infection. We found that the growth factor neurturin (Nrtn) may also regulate immune cell infiltration. In mice that overexpress Nrtn in the skin, a significant increase in antigen-presenting cells (APCs) that express major histocompatibility complex II (MHC II+) localize to the dorsal root ganglia (DRG) and skin when compared to wild type (WT) mice. We therefore investigated whether the Nrtn-induced increase in MHCII+ cells altered the response to an inflammatory challenge elicited by *C. albicans* (CA) infection.

The dorsal skin of Nrtn-OE and WT mice was depilated and infected with CA. At three days, post infection sections of the dorsal skin and thoracic DRG were isolated. Colony forming assays (CFUs), used to assess the clearance of CA from infected skin, showed significantly fewer colonies in Nrtn-OE skin, indicating faster CA clearance. Immunohistofluorescence demonstrated a significantly greater number of MHC II+ cells in both the skin and DRG of NrtnOE mice. In the skin, this increase was in both the epidermis and deeper dermal layers, suggesting transit of these cells through the skin. In the DRG, labeled cells appeared preferentially adjacent to neuronal cell bodies.

Neurturin expression in the skin increased the number of MHC II+ APCs in the skin and sensory ganglia. The increase in Nrtn and APCs led to faster clearance of *C. albicans*. 
Future Research Directions
Neurotrophic factors play an important role in neural development and health and our current studies demonstrate that they impact the immune system/response to inflammatory challenge. Therefore, they may be ideal candidates for modulation of neural-immune communication. Future studies will elucidate the mechanisms by which Nrtn affects the immune system and how these changes impact pain behaviors and primary afferent signaling. Other neurotrophic factors will also be studied to determine their potential roles in neurogenic inflammation. Finally, studies will be evaluated to identify potential sex differences to neurotrophic factor interventions. The goal of this research is to identify potential targets that will treat acute pain and prevent chronic pain development at the site of injury via modulation of neural-immune communication.

Publications

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 did my anesthesiology residency (2012-2015) here at UPMC, culminating in a very rewarding experience as Chief Resident (2014-2015). I also did 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, including two manuscripts in review which examine functional connectivity data as a marker for the experience of pain.

At the time of writing this report, I am completing the first year of my postdoctoral fellowship, and have completed considerable development work on a novel project examining the effect that pain may have on memory during sedation with anesthetic agents. Specifically, we are exploring how long term auditory memory for words is modulated by pairing with brief painful electrical stimulation. Subjects’ performance is being compared between states of light sedation with midazolam and dexmedetomidine and a saline control condition. Intersubject variability characterizes the results to date, which will hopefully be clarified by additional data. In the near future, we plan to use fMRI to identify the neural mechanisms by which pain may influence memory during sedation. Our long-term goal is to use this human subject model for memory under anesthesia to understand the risk factors for unintended awareness with recall during anesthetic care.

I am fortunate to work with several mentors in my postdoctoral work who have contributed to my experimental design and my development into a successful 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 is an invaluable asset, working hands-on with me to acquire data and monitor subjects during sedation.
RESEARCH

RESEARCH FELLOWSHIPS

I am grateful for seed grant funding (2015-2016) from the Department of Anesthesiology, which has made my project 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.

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 FY16.

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 2016, we were one of 37 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.

FAER MSARF Fellow (2015)
Max Samimi (Howard University College of Medicine)
Modification of Shear Induced Hemolysis by Anesthetic Agents

FAER MSARF Fellows (2016)
- Anh Nguyen (Lake Erie College of Osteopathic Medicine)
  Immune Changes in the ICU Following Sepsis: an Experimental Model of Sepsis in Drosophila Melanogaster

- Elizabeth Snajdar (Ohio University Heritage College of Osteopathic Medicine)
  Hemoadsorption Removes Plasma Cytokines after Experimental Cardiac Arrest in Rats
SAFAR SYMPOSIUM & MULTI-DEPARTMENTAL TRAINEES’ RESEARCH DAY

The 14th annual Safar Symposium and sixth annual Multi-Departmental Trainees’ Research Day was held on May 16-17, 2016. This yearly event honors the late Dr. Peter Safar (founding Chair of the Department of Anesthesiology and Critical Care Medicine) and his wife Eva for their contributions to the scientific community and highlights current research in areas spanning Dr. Safar’s interests.

The two-day event kicked off with patient safety and simulation sessions at the Peter M. Winter Institute for Simulation Education and Research (WISER). After opening remarks from John M. O’Donnell, CRNA, MSN, DrPh (Univ. Pittsburgh, Dept. of Nurse Anesthesia), presentations began, followed by a tour of WISER. The symposium continued on the next day at the University Club with presentations on the theme “Biomarkers in Resuscitation and Neurocritical Care.”

The Multi-Departmental Trainees’ Research Day took place in the afternoon. The event is a collaboration between the Departments of Anesthesiology, Critical Care Medicine, Emergency Medicine, and Physical Medicine & Rehabilitation. In 2016, the Department of Neurological Surgery joined this multi-departmental event for the first time.

Fifty five posters were presented, as well as five oral presentations from trainees in each of the five collaborating departments. Trainees in the Department of Anesthesiology presented 40% of the abstracts. Phillip Adams, DO, a T32 post-doctoral scholar working with mentor Cecilia W. Lo, PhD, was the oral presenter from the Department of Anesthesiology. His presentation “Increased Use of Inhaled Nitric Oxide in Single Ventricle Patients with Low Nasal Nitric Oxide Undergoing Congenital Heart Surgery” won the 2nd place oral presentation award.

Michael Chiang, a T32 pre-doctoral trainee working with mentor Sarah Ross, PhD, won the 1st place Department of Anesthesiology Poster Award for “Dissociating Affective Components of Cerebral Pain Pathways.” Grace Lim, MD, a T32 postdoctoral scholar working with mentors Michael Gold, PhD and Ajay D. Wasan, MD, MSc, and Stephanie Puig, PhD, a post-doctoral associate working in the lab of Howard B. Gutstein, MD, tied for the 2nd place Department of Anesthesiology poster award for “Intrapartum Pain Improvement is a Predictor for Post-partum Depression: Labor Pain Matters” and “Inhibition of the Sonic Hedgehog Pathway Prevents Morphine Tolerance,” respectively.
The Department of Anesthesiology, in conjunction with the Society for Advancement of Transplant Anesthesia (SATA) and the University of Pittsburgh Center for Continuing Medical Education, held the third annual UPMC Anesthesia Symposium and Inaugural Meeting of SATA at the Herberman Conference Center, UPMC Shadyside on September 26-27, 2015. National experts presented current standards and recent advances in the field of anesthesiology for organ transplantation.

The Course Directors were Raymond M Planinski MD; Kathirvel Subramaniam, MD MPH; and Stephen A. Esper, MD, MBA, anesthesiologists from UPMC Presbyterian and Montefiore hospitals. Professor Ernesto Pretto, MD MPH, Professor of Anesthesiology and Head of Transplantation at University of Miami, represented SATA as President. Professor Peter Slinger from the University of Toronto delivered the keynote lecture, “Lung Protection Strategies.” Professor Kenichi Tanaka, Director of Cardiac Anesthesiology at University of Maryland, moderated the coagulation monitoring section, which was well-received by the audience.

The symposium featured a wide array of national speakers including Drs. Andrew Murray and Sher-Lu, Pai from Mayo Clinic, Bala Subramaniam from Harvard University, Brandi A. Bottiger from Duke University, Andre DeWolf from Northwestern University, Srikantha Rao from Penn State University, and Julie Huffmyer from the University of Virginia. Dr. Coridalia Wald-Chen from University of Miami and Dr. Kim Sang from Mount Sinai Medical Center, New York, NY won fellow travel awards for their abstract presentations. Various department faculty delivered lectures, moderated panel sessions, and participated in workshops. Department faculty members Drs. Mark E. Hudson, John C. Caldwell, Jose Marquez, Tetsuro Sakai, Erin A. Sullivan, Cynthia M. Wells, Ibtesam Hilmi, Todd Oravitz, John Hache, Charles Boucek, Wendy Haft, and Michael Boisen participated in the event.

One hundred and twenty individuals attended the conference, including anesthesiologists and faculty members from other parts of the country, as well as certified registered nurse anesthetists, nurse practitioners, registered nurses, and trainees including fellows, perfusionists, medical students, and student nurse anesthetists. The 2015 conference was a huge success. The response to this educational event was robust and we look forward to the 4th UPMC Anesthesiology Symposium to be held at a future date.
INCREASED USE OF INHALED NITRIC OXIDE IN SINGLE VENTRICLE PATIENTS WITH LOW NASAL NITRIC OXIDE UNDERGOING CONGENITAL HEART SURGERY

Adams PS\textsuperscript{1}, Zahid M\textsuperscript{2}, Khalifa O\textsuperscript{2}, Lo CW\textsuperscript{2}

\textsuperscript{1}Department of Anesthesiology, Division of Pediatric Anesthesiology, University of Pittsburgh School of Medicine
\textsuperscript{2}Department of Developmental Biology, University of Pittsburgh School of Medicine

INTRODUCTION

Cardiopulmonary bypass impairs endogenous production of nitric oxide (NO), leading to increased pulmonary vascular resistance (PVR) and associated increased stress on an already vulnerable ventricle\textsuperscript{1}. Supplemental inhaled NO (iNO) decreases PVR and has improved post-bypass mortality\textsuperscript{1}. We hypothesized that nasal NO (nNO), which can be sampled in a quick, easy, non-invasive bedside test, may be a biomarker for endogenous NO homeostasis; thus, patients with low nNO undergoing cardiac surgery may be predicted to have increased perioperative iNO use.

METHODS

With institutional review board approval, 132 congenital heart disease patients undergoing cardiac surgery consented to participate in the study. Nasal NO was obtained using an Eco Physics CLD 88sp NO analyzer. Patients were categorized as having normal or low nNO based on established cutoff values\textsuperscript{2,3}. Charts were reviewed for perioperative iNO administration. All health care providers were blinded to the study.

RESULTS

Sixty-four patients had low nNO (48.5%). Of these, 35 patients (54.7%) received perioperative iNO compared to 21/68 (30.9%) patients with normal nNO (p=0.006, OR 2.7 [1.3-5.5]) (Table 1). There were significantly more single ventricle physiology (SV) patients in the low nNO group (29/64 vs. 16/68, p=0.008). Subgroup analysis showed the incidence of receiving perioperative iNO was significantly higher in SV patients with low nNO than in SV patients with normal nNO (21/29 [72.4%] vs. 5/16 [31.2%], p=0.007, OR 5.8 [1.5-21.9]). There was no significant difference in iNO use between SV and two-ventricle (2V) patients with normal nNO (5/16 vs. 16/52, p=1), but there was a difference in the low nNO groups (21/29 vs. 14/35, p=0.01).

CONCLUSIONS

SV patients with low nNO undergoing cardiac surgeries are more likely to receive perioperative supplemental iNO. Patients with normal nNO and 2V patients with low nNO are less likely to receive perioperative iNO. These findings suggest that nNO sampling obtained at the bedside can help identify patients who can benefit from supplemental iNO for their cardiac procedure. Mitigating delays in treatment with iNO may help improve postsurgical outcomes by preventing severe hemodynamic derangements due to NO deficiency.

Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Did not receive iNO</th>
<th>Received iNO</th>
<th>p</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>All pts, low nNO (%)</td>
<td>29 (45)</td>
<td>35 (55)</td>
<td>0.006</td>
<td>2.7</td>
</tr>
<tr>
<td>All pts, normal nNO (%)</td>
<td>47 (69)</td>
<td>21 (31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SV, low nNO (%)</td>
<td>8 (28)</td>
<td>21 (72)</td>
<td>0.007</td>
<td>5.8</td>
</tr>
<tr>
<td>SV, normal nNO (%)</td>
<td>11 (69)</td>
<td>5 (31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal nNO, SV (%)</td>
<td>11 (69)</td>
<td>5 (31)</td>
<td>1</td>
<td>1 (0.3-3.4)</td>
</tr>
<tr>
<td>Normal nNO, 2V (%)</td>
<td>36 (69)</td>
<td>16 (31)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table showing increased odds of receiving iNO perioperatively for patients with low nNO.

Key: pts - patients, iNO - inhaled nitric oxide, nNO - nasal nitric oxide, SV - single ventricle physiology, 2V - two-ventricle physiology

References:

INTEGRATED CLINICAL SUBSPECIALTY AND RESEARCH TRAINING IN ANESTHESIOLOGY:
ACADEMIC ANESTHESIOLOGY SCHOLAR TRACKS

Department of Anesthesiology, University of Pittsburgh School of Medicine

BACKGROUND
Academic Anesthesiology Scholar Tracks (ASTs) will provide anesthesiology trainees with a core foundation of anesthesia knowledge and fundamental clinical skills, subspecialized clinical training in a specific field of anesthesiology, and an integrated, streamlined progression of focused research and academic development to generate top leaders in anesthesiology practice and innovation.

NEEDS ASSESSMENT
Successful academic anesthesiologists will need to possess skills to be master clinicians as well as skills in innovation, scholarship, and investigation. In an effort to effectively advance the science and practice of anesthesiology, we will need to facilitate trainees’ transitions into productive clinician scientists. The process of progressing through residency, subspecialty fellowship, and postdoctoral research training can be disjointed and cumbersome for trainees. ASTs provide a route for those envisioning academic careers seeking both clinical and research fellowships by offering an integrated training pathway.

CURRICULUM DESIGN
The AST program will be introduced to anesthesiology trainees during the PGY-1 year. Those interested will complete the application process early in fall of the PGY-3 year after exposure to the various anesthesiology subspecialties. The AST trainee(s) will be selected in late fall of the PGY-3 year.

Being awarded the AST appointment provides acceptance and progressive transition from residency to clinical fellowship, with potential subsequent appointment as a T32 postdoctoral scholar. Acquiring these positions all at once during the PGY-3 year will facilitate earlier commencement of academic projects and eliminate the distractions of multiple application processes.

CURRICULUM EVALUATION

CONCLUSION
ASTs will allow residents to focus on their clinical and academic interests as well as board preparation. Furthermore, AST programs will attract top candidates and usher in future academic anesthesiologists and physician leaders.

SUPPORT
This project was supported in part by a grant from the National Institutes of Health (T32GM075770).
This abstract was presented as a poster at the 14th annual Safar Symposium and sixth annual Multi-Departmental Trainees’ Research Day on May 16-17, 2016 and won the first place Best Poster Award in the Department of Anesthesiology.

DISSOCIATING AFFECTIVE COMPONENTS OF CENTRAL PAIN PATHWAYS
Chiang MC¹⁻³; Ross, SE¹⁻³

¹Department of Anesthesiology, ²Medical Scientist Training Program, ³Department of Neurobiology, University of Pittsburgh

INTRODUCTION
Pathological pain is a widespread condition that affects one in four Americans. Opioids have long been used for their analgesic effects in pain management; however, opioids such as morphine cause severe adverse effects. An alternative pain therapeutic with reduced adverse effects is to reduce the perception of pain by modulating the affective pain circuits within the brain. Affective components of pain are presumed to arise from the spino-parabrachial pathway via the lateral parabrachial nucleus (LPBN). Therefore, understanding LPBN pathways that convey pain and how pain is perceived within the brain is critical to developing safer and more effective therapies.

HYPOTHESIS
The LPBN conveys pain aversion through its neural pathway to the central amygdala (CeA) and dorsolateral bed nucleus stria terminals (BNSTdl), whereas its functional connection to the periaqueductal gray (PAG) and dorsomedial ventromedial hypothalamus (VMHdl) are involved in descending modulation of pain and autonomic response to painful stimuli, respectively.

METHODS
Brains from mice were extracted, fixed, sectioned at 40um, and immunostained for neurochemical markers. For behavioral experiments, mice were injected with AAV virus encoding channelrhodopsin-2 into the LPBN and optical fibers were implanted into the CeA. Mice were subsequently tested for aversion using real-time place preference assay in two chambered place preference assay via optogenetic activation of the LPBN-CeA pathway.

RESULTS
Injection of virus expressing a fluorescent reporter into the LPBN reveals neural connectivity between numerous brain regions including CeA, BNSTdl, PAG, VMHdl, and insular cortex. Immunohistochemistry has revealed that many LPBN neurons express the neurochemical marker calretinin, and 30% of calretinin+ LPBN neurons express the immediate early gene cFOS following injection of formalin into either hindpaw or forepaw of mice. A subset of calretinin+ LPBN neurons co-localize with other neurochemical markers such as nNOS. Furthermore, calretinin+ LPBN neurons do not co-localize with inhibitory neurochemical markers. Mice in which LPBN terminals into the CeA were optogenetically stimulated exhibited robust aversion in real-time place preference assay.

CONCLUSIONS
These data suggest that the LPBN comprises heterogeneous and neuro-chemically defined populations that respond to painful stimuli. Furthermore, our data indicate that optogenetic activation of the neural pathway between LPBN and CeA results in aversion.

SIGNIFICANCE
The research in this project seeks to understand which neural pathways within the brain transmit specific components of a painful response. Understanding this can potentially identify which neural pathways convey nociceptive information that should be targeted with therapeutic agents, thus reducing adverse effects resulting from analgesics that act on receptors broadly expressed throughout the brain.

RESEARCH/GRANT SUPPORT
R01 AR063772, T32 NS073548-04
This abstract was presented as a poster at Mammalian Circuits Underlying Somatosensation, HHMI Janelia Research Campus, Loudon County, VA, November 15-18, 2015.

MODULATION OF MULTIPLE MODALITIES OF SOMATOSENSORY INFORMATION BY PERIPHERAL KAPPA OPIOID RECEPTORS
Departments of Neurobiology, Anesthesiology, and Pharmacology & Chemical Biology, University of Pittsburgh, Pittsburgh, PA

Recently, several companies have developed peripherally selective kappa opioid receptor (KOR) agonists as a putative treatment for pain and itch. Yet, the subtypes of somatosensory neurons that express KOR remain unknown, and therefore the role of KOR in modulating somatosensory transmission is not fully understood. We have identified and characterized the subtypes of peripheral somatosensory neurons that express KOR using a newly developed KOR-cre knockin allele. We find that that KOR is expressed by two main groups of peripheral neurons: a population of unmyelinated neurons that form free nerve endings in the epidermis involved in detecting pain and itch, and a population of neurons that forms specialized endings surrounding hair follicles involved in detecting low-threshold mechanosensation. We also demonstrated that a KOR agonist decreases calcium influx in these neurons. Finally, we found that a peripherally restricted KOR agonist inhibits itch. These experiments provide key insight for the rationale use of peripherally selective KOR agonists for the treatment of pain and itch.

This research was supported in part by NIH grants R01 AR063772 and R21 AR064445, the Rita Allen Foundation and the Whitehall foundation grants to S.E.R, and the NIH grants T32 NS73548-3 and F31NS092146-01A1 to L.M.S. The authors have no conflicts of interest to disclose.

INHIBITION OF THE SONIC HEDGEHOG PATHWAY PREVENTS MORPHINE TOLERANCE
Puig S, Cui Y, **Gutstein HB**
1Department of Anesthesiology, University of Pittsburgh School of Medicine, Pittsburgh, PA, 2Department of Anesthesiology, University of Texas MD Anderson Cancer Center, Houston, TX

INTRODUCTION
For centuries, opioids have been the gold standard for treating severe pain. However, with repeated dosing, the analgesic effect of opioids decreases. The mechanisms underlying opioid tolerance remain poorly understood. We recently made the groundbreaking discovery that Cyclopamine, an inhibitor of the Sonic Hedgehog (SHh) signaling pathway, can block the development of morphine tolerance centrally and in the periphery. Cyclopamine is known to have off-target effects, and the expression of SHh signaling effectors in the pain-processing structures has never been analyzed. Therefore, this study aims at confirming the expression of SHh effectors in the pain processing structures and their involvement in the development of morphine tolerance.

HYPOTHESIS
We hypothesized that the specific inhibition of SHh and its downstream effectors could block the development of tolerance. We also hypothesized that smoothened, a receptor of the SHh signaling pathway, is expressed in the pain processing structures where the mu-opioid receptor is expressed.

METHODS
Male Sprague-Dawley rats were injected intrathecally with morphine in combination with a specific inhibitor of the SHh signaling pathway components (Robotnikinin: SHh inhibitor, Vismodegib: Smoothened inhibitor, or GANT58:...
Gli inhibitor). The development of tolerance was assessed by measuring the thermal paw withdrawal latency for five consecutive days. Using immunohistofluorescence coupled to confocal microscopy imaging, we also defined the specific types of cells expressing the smoothened receptor in the dorsal root ganglia (DRG) and the substantia gelatinosa (SG) in basal conditions.

RESULTS
We found that inhibiting SHh, smoothened, or Gli individually completely eliminated morphine tolerance. We also discovered that smoothened is expressed in the pain-processing structures that are known to express the mu-opioid receptor.

CONCLUSIONS
In this study, we confirmed that the SHh signaling pathway is an important component in the development of morphine tolerance to analgesia. We hope that the advances generated by this study could impact not only our understanding of the molecular and cellular mechanisms underlying opioid tolerance, but also the treatment of chronic pain.

RESEARCH/GRANT SUPPORT
NIH - NIDA 7R01DA036680-03 (PI: Howard Gutstein)

This abstract was presented as a poster at the annual Society of Biological Psychiatry meeting, May 12-14, 2016 in Atlanta, GA.

A SCHIZOPHRENIA-ASSOCIATED MISSENSE MUTATION INCREASES KALIRIN-9 PROTEIN LEVELS IN PRIMARY NEURONAL CULTURE


BACKGROUND
Kalirin (KAL) is a Rho GEF that is highly involved in the regulation of the actin cytoskeleton within dendritic spines. Several isoforms of the protein arise from differential splicing of KAL’s 66 exons. We previously showed that protein levels of the KAL-9 isoform are increased in the auditory cortex of subjects with schizophrenia, and KAL-9 overexpression induces reduced dendritic length in primary neuronal culture. A missense mutation (P2255T, PTKAL9) located within the Kal-9 sequence has been shown to be associated with schizophrenia. We hypothesized that this mutation may exert effects by altering KAL9 expression levels.

METHODS
We transfected rat embryonic cortical neurons to test the effects of wildtype and PTKAL9 overexpression on KAL9 abundance. Cells were transfected at DIV14 with either GFP-only vector, GFP/wildtype myc-KAL9, or GFP/myc-PTKAL9 and fixed at DIV28. They were labeled for myc. Overexpression of KAL was quantified based on myc label intensity. The overexpression model was also generated in HeLa cells, which were transiently co-transfected with GFP and wildtype or PTKAL9. They were lysed at 24h, 48h, and 72h and KAL expression was quantified with western blot using an antibody directed against the spectrin repeat domains of KAL. To evaluate effects without the confounding variable of overexpression, CRISPR/Cas9 genome editing was used to knockin the PTKAL9 mutation into the endogenous KAL locus in C57BL/6J mice.

RESULTS
There was significantly higher expression of PTKAL9 compared to wildtype in cultured cortical neurons (p≤0.01), with no difference in transfection efficiency between conditions (as assessed by GFP intensity). Increased PTKAL9 expression was also seen in HeLa cells at 48h and 72h (p≤0.01 and p<0.05, respectively). There was no difference
in transfection efficiency between wildtype and mutant conditions at either time point. CRISPR/Cas9 was used to successfully generate numerous F0 mice with the PTKAL9 mutation. KAL9 levels were studied in PTKAL9 mutant mice.

CONCLUSIONS
Overexpression of the PTKAL9 mutation appears to have a higher relative abundance than the wildtype KAL9 under the same conditions. Previous studies have demonstrated decreased dendritic tree complexity with overexpression of KAL9. It remains unknown if the PTKAL9 mutation exerts its disease-associated effects through alteration of expression levels and/or if there are other mechanisms (e.g., altered RhoA activation) associated with the mutation. Further studies are required to determine the mechanism underlying this increased expression of PTKAL9, as well as to determine the phenotype associated with the mutation. Understanding which signaling pathways may be altered by this mutation may provide potential sites for therapeutic intervention to alleviate the disease burden of schizophrenia.

This symposium was presented at the annual Research Society on Alcoholism meeting, June 25-29, 2016 in New Orleans, LA.

GINS OF THE FATHERS: CAN ALCOHOL USE DISORDERS BE EPIGENETICALLY INHERITED?
Organizers: Gregg Homanics (Chair) and Matthew Reilly (Discussant)

RATIONALE AND CONTENT
Transmission of DNA variants from parent to offspring (i.e., Mendelian inheritance) has been the generally accepted explanation for the familial nature of alcoholism. However, despite decades of intense effort, only a few DNA variants have been identified and they only explain a small fraction of alcoholism heritability. The search for the “missing heritability” has reinvigorated interest in the once discounted theory that traits acquired during an individual’s lifetime can be transmitted across generations. This symposium will challenge the dogmatic Mendelian view of inheritance by focusing on investigations of transgenerational epigenetic inheritance (a.k.a., soft inheritance). Speakers will address the provocative hypothesis that alcohol exposure produces enduring epigenetic effects that can be passed through the germline, influence the epigenetic program of descendants, and ultimately impact alcohol drinking and behavioral responses to alcohol.

SARKAR D: TRANSGENERATIONAL EPIGENETIC INHERITANCE: EVIDENCE FROM FETAL ALCOHOL EXPOSURE
It is now recognized that maternal conception alcohol use affects behaviors and health outcomes in offspring, possible by epigenetic modifications of genes that regulate cellular functions. Epigenetic marks carried over from the parents are known to undergo molecular programming events that happen early in embryonic development by a wave of DNA demethylation, which leaves the embryo with a fresh genomic composition. However, the proopiomelanocortin (Pomc) gene that controls the stress axis and neuroendocrine-immune functions and is imprinted by fetal alcohol exposure has been shown to be hypermethylated through three generations, a phenomenon of transgenerational epigenetic inheritance. We have obtained preliminary evidence that a gene, like sex-determining region Y (Sry), in the euchromatic region of the Y chromosome undergoes heritable epigenetic modifications, leading to expression changes in its product, SRY, which in turn modify the expression of Pomc. These data identify a possible cellular mechanism of transgenerational transmission of fetal alcohol-induced alteration in the stress response.
ROMPALA GR: PATERNAL ALCOHOL OR STRESS IMPARTS ALCOHOL PHENOTYPES TO MALE OFFSPRING
Several recent studies demonstrate that paternal experience can drive inheritance of complex behavioral phenotypes in rodents and possibly humans. Using mice, we tested the hypothesis that paternal preconception ethanol exposure impacts ethanol drinking and ethanol-induced behaviors in offspring. Paternal ethanol exposure reduced ethanol drinking behavior and increased ethanol sensitivity selectively in male F1 offspring. Some of these effects were also observed in F2 male offspring. In addition, paternal chronic variable stress induced similar effects on ethanol drinking behavior in F1 male offspring. Further examination of the parallel effects of paternal ethanol and stress may facilitate the discovery of novel epigenetic mechanisms that influence the ethanol phenotype of offspring.

WEINER J: INFLUENCE OF PATERNAL ETHANOL EXPOSURE AND EARLY LIFE STRESS ON BEHAVIORAL RISK FACTORS OF ALCOHOL ADDICTION VULNERABILITY
Ongoing studies in our lab, using outbred Long Evans rats, have demonstrated that chronic adolescent stress can engender long lasting increases in a wide range of behaviors that may be associated with increased vulnerability to alcohol use disorders. For example, relative to animals that were group housed throughout adolescence, rats that were socially isolated during this period exhibit increased measures of anxiety-like behavior, increased sensitivity to the acute anxiolytic effects of ethanol, and enduring increases in ethanol intake and preference. In these studies, we are beginning to examine whether paternal ethanol exposure and early life stress may interact to influence alcohol addiction vulnerability. Our initial findings reveal that paternal ethanol exposure increases acute sensitivity to ethanol-mediated anxiolysis in offspring and that this effect may be exacerbated, in a sex-dependent manner, by adolescent social isolation. Ongoing studies are examining how these putative epigenetic and environmental factors influence ethanol drinking behavior.

MARTIN D: INDUCTION OF HERITABLE EPIGENETIC CHANGES BY PATERNAL PRECONCEPTION ALCOHOL EXPOSURE
We designed a study to test for inheritance of epigenetic variants induced by paternal preconception alcohol exposure. To control for confounding effects of cell lineage, we studied a single homogeneous cell type and used RNA levels as the functional readout of epigenetic variation. Male C57BL/6J mice were mated immediately after chronic intermittent alcohol vapor exposure. We isolated a highly homogeneous subpopulation of monocytes from peripheral blood of F1 offspring of exposed and control sires and used RNA-Seq to characterize gene expression variants in these cells. Selected F1 mice were bred to obtain an F2 population, in which monocyte gene expression variants were analyzed in the same way. The induction of excess or recurrent variants in F1 mice and their transmission into the F2 generation will indicate that paternal alcohol exposure induces heritable epigenetic changes.
PATERNAL ALCOHOL IMPARTS STRESS HYPORESPONSIVITY TO MALE OFFSPRING
Rompala GR, Finegersh A, Homanics GE
Departments of Anesthesiology and Pharmacology & Chemical Biology, University of Pittsburgh, Pittsburgh, PA

Alcohol use disorder (AUD) is associated with dysfunction of the hypothalamic-pituitary-adrenal (HPA) axis, the endocrine system critical for mounting an appropriate physiological response to stress. Adult men with a family history of alcohol abuse exhibit reduced HPA axis responsivity. Numerous studies have demonstrated that ancestral perturbations, including exposure to stress or ethanol (EtOH), can impact subsequent generations via epigenetic mechanisms. In the present study, we tested the hypothesis that chronic paternal preconception EtOH exposure alters acute stress responsivity and stress-evoked EtOH drinking behaviors in offspring. Adult male mice were exposed to five weeks of intermittent vapor EtOH or control conditions and then mated with EtOH-naïve females to produce EtOH-sired (E-sired) and control-sired (C-sired) offspring. Paternal EtOH blunted corticosterone (CORT) responses to acute restraint stress selectively in male offspring. To assess stress-evoked EtOH drinking, adult E-sired and C-sired male offspring were exposed to chronic variable stress (CVS) (comprised of three days each of social defeat, forced swim, predator odor, and restraint stress exposures) over four weeks. Throughout the CVS period, mice were assessed for two-bottle choice EtOH (8% w/vol) drinking in the home cage. While we did not detect an effect of stress on EtOH consumption, C-sired males exhibited increased total fluid intake from baseline during CVS (polydipsia). In contrast, E-sired males were resistant to this stress-induced phenotype. Following CVS and 72 hours after cessation of EtOH availability in the home cage, mice were sacrificed for brain tissue collection and analysis of stress-responsive gene expression [i.e., corticotropin-releasing factor (CRF), glucocorticoid receptor (GR), and arginine vasopressin (AVP)] in the paraventricular nucleus (PVN) using rt-qPCR. CRF mRNA expression in the PVN was significantly reduced for E-sired vs C-sired males with no difference in AVP or GR expression. In addition, using bisulfite-treated DNA from the PVN and melt curve analysis, we detected significantly increased DNA methylation of the CRF promoter in E-sired vs C-sired male offspring. Levels of DNA methylation showed a significant inverse correlation with CRF gene expression. All together, we present endocrine, behavioral, molecular, and epigenetic findings suggesting that E-sired males are hyporesponsive to stress.

PATERNAL ALCOHOL OR STRESS IMPARTS ALCOHOL PHENOTYPES TO MALE OFFSPRING
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While the familial nature of alcoholism has been extensively studied, the high heritability (~60%) has yet to be fully accounted for by transmission of genetic variants. In consideration of alternative mechanisms of inheritance that may help elucidate this “missing heritability,” we posit that paternal experience can drive inheritance of complex behavioral phenotypes like alcoholism. Using mice, we tested the hypothesis that paternal preconception ethanol exposure impacts ethanol drinking and ethanol-induced behaviors in offspring. Male mice underwent six weeks of ethanol vapor exposure (five days/week, 8 hours/day), achieving blood ethanol concentrations averaging 170 mg/dl. Following chronic ethanol exposure, males were bred with ethanol naïve females to produce F1 offspring. Adult offspring were examined for ethanol drinking preference in a two bottle choice paradigm and for sensitivity to the acute anxiolytic effects of ethanol in the elevated plus maze test. Paternal ethanol exposure reduced ethanol consumption and preference and increased ethanol sensitivity selectively in male offspring (F1 females were unaffected). In addition, ethanol-sired male offspring were hyporesponsive to acute stress exposure. In order to determine if these male-specific phenotypes were transgenerational, we bred F1 males to produce F2 ethanol- and control-sired male offspring. Testing of F2 males indicated that the increased ethanol sensitivity and stress hyporesponsivity phenotypes were transgenerational. Lastly, we tested the hypothesis that paternal preconception stress similarly effects ethanol phenotypes in the next generation. Adult male mice were exposed to six weeks of chronic variable stress before breeding two weeks later with a stress naïve female to produce the F1 generation. We found that similar to paternal ethanol, paternal stress attenuated ethanol drinking behavior selectively in male offspring in unlimited access two bottle choice and limited access drinking in the dark paradigms. Ongoing studies are examining the possible role of sperm RNA in transmission of ethanol phenotypes via the male germline. Further examination of the parallel effects of paternal ethanol and stress may facilitate the discovery of novel epigenetic mechanisms that influence the ethanol phenotype of offspring.
This abstract was presented as a poster and a platform presentation at the Gordon Research Conference, February 7-12, 2016 in Galveston, TX.

PATERNAL CHRONIC VARIABLE STRESS SUPPRESSES ETHANOL DRINKING BEHAVIOR SELECTIVELY IN MALE OFFSPRING
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BACKGROUND
We have previously shown that chronic paternal vapor ethanol (EtOH) decreased EtOH drinking behavior, increased sensitivity to an anxiolytic injection of EtOH, and blunted HPA axis responsivity selectively in male offspring. Interestingly, paternal chronic variable stress (CVS) has been shown to act similar to paternal EtOH exposure by blunting HPA axis responsivity in the next generation. Since EtOH is a physiological stressor, it is possible that paternal EtOH exposure and paternal CVS have similar intergenerational epigenetic effects and induce similar EtOH phenotypes in offspring.

HYPOTHESIS
Paternal CVS impacts EtOH-related behaviors in the next generation.

METHODS
To test this hypothesis, we exposed adult C57BL/6J males to six weeks of CVS. This entailed daily exposure to one of seven stressors (i.e., restraint, novel object, predator odor, wet cage, constant light, white noise, and multiple cage changes) on a randomized schedule. Following CVS, and after two weeks of paired housing with an adult female (to mitigate the effects of acute stress and to clear spermatozoa from the epididymis that matured prior to CVS), CVS- and control (C-) males were bred with stress naïve Strain 129/SvJ females to produce hybrid (129/SvJ x C57BL/6J) male and female offspring to be tested for EtOH drinking and EtOH sensitivity. For EtOH drinking tasks, adult offspring were tested for two bottle choice (EtOH or H2O) drinking at EtOH concentrations of 3, 6, 9, 12, and 15% (w/vol) and for binge-like EtOH consumption (20% w/vol) in a limited access drinking in the dark paradigm. Sensitivity to an anxiolytic injection of EtOH was tested in the elevated plus maze, with mice receiving an acute injection of EtOH (1.0 g/kg, i.p.) 10 min before testing. HPA axis responsivity was tested by collecting tail blood at time points 0, 15, 30, and 90 min from the onset of a 15 min restraint stress and analyzed for plasma corticosterone using an ELISA assay.

RESULTS
In the two bottle choice EtOH drinking task, CVS-sired male offspring exhibited reduced EtOH preference at concentrations of 3, 6, and 9% and reduced EtOH consumption at concentrations of 9 and 12% vs. C-sired males. Moreover, when CVS-sired male offspring were tested for binge-like EtOH consumption in the drinking in the dark task, there was similarly a significant reduction in EtOH consumption vs. C-sired male offspring. In contrast, CVS-sired female offspring showed no difference in EtOH drinking behaviors vs. C-sired females in either EtOH drinking paradigm. We did not find a difference in EtOH sensitivity or HPA axis responsivity to acute stress for CVS-sired males or females vs. C-sired groups.

CONCLUSION
These results suggest that paternal EtOH and paternal CVS may act through overlapping epigenetic mechanisms to paradoxically attenuate intergenerational EtOH drinking behavior. Ongoing studies are exploring possible mechanisms of intergenerational epigenetic transmission such as small noncoding RNAs in sperm.
PATERNAL PRECONCEPTION ETHANOL EXPOSURE ENHANCES THE EFFECT OF ADOLESCENT SOCIAL ISOLATION ON ETHANOL DRINKING IN FEMALE RATS

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We established a rodent adolescent social isolation (SI) model that engenders long-lasting increases in behaviors linked with alcohol addiction vulnerability, including increases in anxiety measures and ethanol drinking. Notably, although early life stress increases addiction vulnerability in men and women, the addiction-related changes observed following SI in rats are only observed in males. Recent evidence suggests that paternal preconception exposure (PE) to ethanol can lead to behavioral alterations in the offspring, possibly via epigenetic mechanisms. Here, we asked whether PE might influence the impact of adolescent SI on ethanol drinking, particularly in female rats. Adult male Long Evans rats were exposed to a six week intermittent ethanol vapor procedure (12 hr on/12 hr off, BECs 150-200 mg%) or constant air and then bred with ethanol-naïve females. Offspring were weaned at postnatal day 21, group housed for a week, and then randomly divided into SI or group housed (GH) cohorts as described (ACER 37S1:E394-403, 2013). Between PD72-90, acute effects of ethanol (0.75 g/kg) were assessed on the plus-maze and open field. All subjects were then single housed and ethanol drinking was assessed using the intermittent two-bottle choice procedure. PE did not affect locomotor activity. However, male PE offspring were more sensitive to the acute anxiolytic effects of ethanol and SI engendered this phenotype in both male and female rats. As in our prior studies, control SI male rats exhibited an enduring increase in ethanol intake, relative to control GH males, while female SI rats did exhibit an enduring increase in ethanol intake that lasted at least five weeks, but PE actually delayed the SI-associated increase in drinking in SI males. Collectively, these data confirm our ongoing studies demonstrating the utility of adolescent SI as a model of addiction vulnerability. Importantly, these studies reveal significant sex-dependent interactions between chronic adolescent stress and paternal ethanol exposure. PE appears to dampen the influence of SI on ethanol intake in males but actually exacerbates this interaction in females. These findings may now provide us with a rodent model that can be used to examine the neural substrates linking early life adversity and addiction vulnerability in women.
This abstract was presented as a poster at the annual Research Society on Alcoholism meeting, June 25-29, 2016 in New Orleans, LA.

ROLE OF BK CHANNELS IN THE ACUTE BEHAVIORAL EFFECTS OF ETHANOL IN MICE

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Large conductance, voltage- and calcium-activated potassium (BK) channels are critical modulators of neuronal excitability and neurotransmitter release. Their activity can be altered by ethanol through direct interaction of ethanol with residue K361 in the cytosolic tail of the BK channel pore-forming α subunit. Ethanol-induced potentiation of BK currents is hypothesized to mediate some of the cellular and behavioral effects of this drug in vivo and possibly contribute to ethanol drinking. We used pharmacological and genetic approaches to test this hypothesis. Paxilline, a BK channel blocker, did not alter limited-access two-bottle choice drinking when administered at doses below its tremorgenic threshold (22-550 microg/kg, i.p.). BMS-204352, a BK channel opener, did not alter ethanol intake either when administered at a dose previously shown to reverse the behavioral abnormalities caused by Fmr1 inactivation (2 mg/kg, i.p.). To further examine the role of ethanol interaction with BK channels, we generated knock-in mice expressing a point mutant BK α subunit (K361N) that renders BK channels insensitive to ethanol without otherwise impacting their function. Knockin, heterozygous, and wildtype littermates were tested in assays of acute ethanol intoxication. In contrast with the phenotype of genetically engineered worms carrying a similar mutation, the knockin mice displayed unaltered sensitivity to ethanol-induced ataxia, sedation, and hypothermia. Altogether, it appears that ethanol’s action on BK channels does not contribute to the acute motivational and intoxicating effects of ethanol in mammals. Our previous findings in BK auxiliary subunit-deficient mice suggest that BK channels instead play a role in the behavioral adaptations elicited by chronic exposure to ethanol.

VOLTAGE-GATED SODIUM CHANNEL SCN4B CONTRIBUTES TO BEHAVIORAL EFFECTS OF ETHANOL

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Sodium channel beta4 subunit (Scn4b) is an auxiliary subunit with a role in regulation of neuronal activity and pathogenesis of Huntington’s disease. Several different gene expression studies nominated this gene as a top candidate for regulation of alcohol consumption in humans and mice. We asked if genetic deletion of the Scn4b subunit in mice would alter the behavioral effects of ethanol. Gene targeting in mouse ES cells was used to create mice with a Scn4b null allele. Scn4b null mice showed no differences in consumption and preference for alcohol in a two-bottle choice test as compared with wild-type littermates, and also no differences in acoustic startle response, severity of ethanol-induced acute withdrawal, or metabolism of ethanol. However, mutant mice demonstrated longer duration of the loss of righting reflex (LORR) induced by ethanol (3.6 g/kg), gaba oxadol (55 mg/kg), pentobarbital (50 mg/kg), or ketamine 175 mg/kg). No sex-dependent differences in the effects of all drugs were found. These results indicate that regulation of voltage-gated sodium channels by SCN4B may be important for several behavior effects of ethanol as well as other sedative drugs, most notably, hypnotic action. Overall, the revealed behavioral phenotype is in agreement with the major function of this channel – regulation of neuronal excitability.
VALIDATION OF INSULA CONNECTIVITY CHANGES DURING PAIN

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INTRODUCTION
Pain is a complex, multidimensional sensory and emotional experience. As such, attempts to objectively measure pain have been met with limited success. Functional connectivity MRI (fcMRI) offers a promising new avenue toward a neuroimaging-based method for differentiating between pain and non-pain states. The insula is a key region for pain processing, with changes in both activity and functional connectivity shown for acute and chronic pain states.

PURPOSE
Prior work has demonstrated that functional connectivity between the posterior insula (pIns) and posterior cingulate cortex (PCC) is uniquely altered by pain perception. Further, using a carefully selected pIns-PCC connectivity threshold value, we were able to differentiate pain scans from non-pain scans with 92% accuracy. The current study sought to validate our previous findings with the use of an independent sample, also including innocuous touch as a non-painful control condition.

METHODS
We present interim results from 3T BOLD functional imaging data from five healthy adults in each of four conditions: rest, innocuous touch, light pain, and moderate pain. Innocuous touch consisted of a researcher continuously moving a gauze pad around the left volar forearm of each subject. Velocity, direction, and pressure were varied randomly to ensure the salience of this stimulus. Pain was induced with topical application of capsaicin to the same region of the left volar forearm. This remained in place for 30 minutes. The light pain condition occurred at the beginning of this 30-minute period; the moderate pain condition occurred at the end. Functional connectivity maps were generated using the CONN toolbox for SPM. ROC curves were generated to assess the capacity of pIns to PCC connectivity to identify the presence of pain. Our previously determined pIns-PCC connectivity threshold was assessed for overall accuracy of classification, sensitivity, and specificity.

RESULTS
Group average functional connectivity maps revealed altered pIns to PCC connectivity in response to pain, consistent with our previous findings (Figure 1). The area under the ROC curve for pIns-PCC connectivity in predicting the presence of pain was 0.71 (95% CI = 0.46-0.95; Figure 2). Using our previously determined connectivity threshold value, we were able to differentiate non-pain scans (i.e., rest, innocuous touch) from pain scans (i.e., light pain, moderate pain) with 70% overall accuracy (sensitivity = 0.9, specificity = 0.5).

CONCLUSIONS
These preliminary results support our prior findings that pIns-PCC functional connectivity is altered by pain perception and suggests that a pIns-PCC connectivity threshold is sensitive to pain state, although improvements are needed to increase the specificity. This supports a potential role for pIns-PCC connectivity in a neuroimaging-based method for differentiating between pain and non-pain states.

REFERENCES
2. PLoS ONE 6(9): e24124.
COST-EFFECTIVENESS ANALYSIS OF INTRAOPERATIVE CELL SALVAGE FOR CESAREAN DELIVERY

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BACKGROUND
Cell salvage for obstetric hemorrhage is effective in attenuating allogeneic blood product consumption, but uncertainty exists around optimal cost-effective strategies to implement cell salvage in obstetrics. Our objective was to determine the cost-effectiveness of cell salvage strategies in cesarean delivery using a societal perspective and lifetime horizon.

METHODS
We used a Markov decision analysis model to compare the cost-effectiveness of three primary strategies: use of cell salvage for every cesarean delivery; cell salvage use for high-risk cases alone; and no cell salvage. We assumed a societal perspective and a lifetime horizon for the base case of a 26-year-old nulliparous woman presenting for cesarean delivery. For each strategy, the model integrated: 1) probabilities of hemorrhage, hysterectomy, transfusion reactions, emergency procedures, and cell salvage utilization; 2) utilities for quality of life (0=dead, 1=perfect health); and 3) costs at the societal level. One- and two-way sensitivity analyses, as well as Monte Carlo probabilistic sensitivity analysis were performed. A threshold of $100,000 per quality-adjusted life-year (QALY) gained was utilized as a cost-effectiveness criterion.

RESULTS
Cell salvage use for cases at high risk for hemorrhage (IOCS-HR) was cost-effective, with an incremental cost-effectiveness ratio (ICER) of $34,881 per QALY gained. Routine cell salvage use for all cesarean deliveries was not cost-effective, costing $415,488 per QALY gained. In one-way sensitivity analyses, IOCS-HR exceeds the $100,000 per QALY threshold when the health state utility associated with receiving any transfusion was ≥0.902 (base case 0.8). Results were not sensitive to individual variation of other model parameters. The probabilistic sensitivity analysis showed that at the $100,000 per QALY gained threshold, there is >85% likelihood that IOCS-HR is favorable.

CONCLUSIONS
The use of cell salvage for cases at high risk for hemorrhage is economically reasonable; routine cell salvage use for all cesarean deliveries is not. Elucidating the utility of the health state associated with allogeneic transfusion in obstetric patients will be useful in further assessing the robustness of these findings.

REFERENCES
INTRAPARTUM PAIN IMPROVEMENT IS A PREDICTOR FOR POSTPARTUM DEPRESSION: 
THE IMPORTANCE OF LABOR PAIN
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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
A total of 2,491 medical records were reviewed. 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 was found between PIP and EPDS (Spearman’s σ = -0.18, 
P = 0.012). By simple linear regression, women with higher improvements in pain were associated with lower 
EPDS scores (β = -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 (β = -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 for 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
LOW-FIDELITY HAPTIC SIMULATION VERSUS “MENTAL IMAGERY” TRAINING FOR EPIDURAL ANESTHESIA TECHNICAL ACHIEVEMENT IN NOVICE ANESTHESIOLOGY RESIDENTS: A RANDOMIZED COMPARATIVE STUDY

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INTRODUCTION
Epidural anesthesia (EA) is rated among the most difficult technical skills for anesthesia trainees to acquire. Many teaching methods for EA exist, ranging from traditional “see one, do one, teach one” approaches on a human patient, to low fidelity (LF) haptic or high fidelity (HF) haptic simulation. Previous work indicates that there is no difference in skill acquisition when novice learners engage in HF versus LF simulation for EA.1 However, no study to date has compared the effect of LF haptic simulation versus “mental imagery” training (or “non-haptic” simulation) for EA. We hypothesized that LF haptic simulation EA training would more effectively facilitate novice trainees’ achievement of technical skills compared to “mental imagery” training in which no physical practice is attempted.

METHODS
In this IRB-approved, single center, randomized comparative study, 20 PGY-2 anesthesiology residents were tested at the beginning of the training year. After a didactic lecture on EA, they were randomized to two groups. Group 1 received 60 minutes of LF simulation training for EA using a banana.2,3 Group 2 got 60 minutes of “mental imagery” training: they were oriented to the parts of the epidural kit, EA was described in stepwise detail, and a spine model was referenced, but no physical practice was undertaken. Each resident then individually performed EA on a partial-human task trainer on three consecutive occasions under the direct observation of skilled evaluators, who were blinded to group assignment and who assessed technical achievement using a modified validated skills checklist.4 Scores (0 –21) and duration (minutes) to task completion were recorded. A mixed model analysis was performed to determine differences in scores and duration between groups and over time. Post hoc comparisons were made using Type III Tests of Fixed Effects with Bonferroni correction. The asterisk (*) denotes a P<0.05 for the third attempt compared to the first attempt among both groups.

Results

Table 1. Comparison of the baseline characteristics of the two groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group LF n = 10</th>
<th>Group MI n = 10</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>28.7 ± 2.0</td>
<td>28.9 ± 4.4</td>
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<td>Sex</td>
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<td>3 (33.3%)</td>
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<tr>
<td>Prior spinal anesthesia experience</td>
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<td>2 (22.2%)</td>
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</tr>
<tr>
<td>M.D., Ph.D.</td>
<td>1 (10.0%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: LF, low fidelity; MI, mental imagery.
Note: Data are reported as mean ± SD or frequency (percentage).
RESULTS
Baseline characteristics were similar between the groups (Table 1). There was no statistically significant difference in scores between the two groups ($P=0.58$) (Figure 1A). Both groups showed a similar time effect for score, in that scores increased over time ($P=0.0015$). Time to complete the procedure decreased similarly for both groups after the first attempt ($P=0.032$) (Figure 1B).

CONCLUSION
Our results suggest that utilization of LF haptic simulation is not superior to “mental imagery” training for technical performance of EA. Education on EA with structured didactics and “mental imagery” training may adequately prepare novice learners prior to an attempt on human subjects.

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This abstract was presented as a poster at the 41st Annual American Society of Regional Anesthesiology and Acute Pain Medicine Meeting, March 31-April 2, 2016 in New Orleans, LA.

CONTINUOUS BILATERAL SCIATIC NERVE BLOCKS IN A PATIENT WITH BILATERAL LOWER EXTREMIT Y BURNS REQUIRING EARLY AMBULATION

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INTRODUCTION
Regional anesthesia has been suggested to be beneficial for the management of acute and perioperative pain associated with burns. Bilateral lower extremity burns present the regional anesthesiologist with a choice of approach: neuraxial or bilateral peripheral nerve blocks. It is recommended that patients with lower extremity burns ambulate as soon as possible after skin graft. As with knee replacements, peripheral nerve blocks may provide better pain management with fewer side effects and permit early ambulation for burn victims. In addition, each nerve block infusion can be adjusted independently. Here, we report the use of bilateral continuous sciatic nerve blocks for a patient with bilateral lower extremity burns.

CASE DESCRIPTION
The patient was a 27-year-old female who sustained thermal partial-thickness burns to the bilateral posterior thighs and circumferential calves, totaling 15% total body surface area. Her past medical history was significant for untreated anxiety and depression. The Acute Pain Service was consulted four days post injury. Multimodal pain management was instituted, which included placement (on day five post injury) of bilateral continuous sciatic nerve blocks via the gluteal approach using ultrasound. The infusion solution for the blocks was started at 0.03 (v/v)% bupivacaine at 5 mL/hour, but was decreased to 3 mL/hour on the left due to decreased movement in the great toe. The patient was also prescribed ketamine, acetaminophen, extended-release morphine, oxycodone, ketorolac, gabapentin, and lorazepam.

The spray skin graft was performed six days post injury; however, the nerve blocks were not used as part of the intraoperative anesthetic; they were restarted postoperatively. On the first day post graft, the concentration of both infusions was increased to 0.06 (v/v)% bupivacaine due to increased pain. She also received a left lateral femoral cutaneous nerve block for pain at the donor site. The patient reported improved pain relief and sleep with these additional interventions.

The sciatic nerve block catheters were maintained for four days, three of which were post graft. She started ambulating with a walker one day post graft with minimal assistance, ambulating 20 ft. On the subsequent day, the physical therapist reported that the patient was able to ambulate 30ft. Her tolerance of physical therapy improved daily. During the infusion of the nerve blocks, her average hourly opioid consumption was at its maximum 24 hours
before the skin grafting (8.8 mg/hr morphine equivalents). The patient was discharged 12 days post injury, six days post graft to self-care at home. Two weeks post discharge, the patient’s burns had healed and she had no residual pain.

**DISCUSSION**

Regional anesthesia has been demonstrated to be beneficial for the management of acute pain and is suggested to be beneficial for treatment of pain associated with burns. In some patients, regional anesthesia has been demonstrated to decrease opioid consumption. The use of bilateral peripheral nerve blocks was advantageous in this patient because it allowed for early ambulation and independent adjustments of settings on each block. In addition, the patient experienced minimal side effects from opioids.

**REFERENCES**


This abstract was submitted to the Society for Neuroscience 46th Annual Meeting, San Diego, CA, November 12-16, 2016.

**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.
NOVEL MODULATORS OF GLYCINE RECEPTORS
Marta M. Wells1,2; Andrew Maxwell3; Yan Xu1,3,4; Pei Tang1,2,4
1Department of Anesthesiology, University of Pittsburgh School of Medicine; 2Department of Computational and Systems Biology, University of Pittsburgh; 3Department of Structural Biology, University of Pittsburgh; 4Department of Pharmacology and Chemical Biology, University of Pittsburgh; 5Department of Molecular and Cell Biology, University of Connecticut

Inhibitory glycine receptors (GlyRs), pentameric ligand-gated ion channels found primarily in the spinal cord, are important targets for neuroactive drugs. Δ9-tetrahydrocannabinol (THC) potentiates GlyRs by interacting with residue S296 in GlyR-α1 and S307 in GlyR-α3 subunits, directly contributing to cannabis-induced analgesia. Other local anesthetics, as well as certain antiemetic agents, have been shown to similarly enhance GlyR function at low concentrations, but additionally inhibit glycinergic responses at high drug concentrations. We previously effectively employed a combination of virtual screening on an ensemble of GlyR-α1 structures with in vitro functional validation to identify novel GlyR-α1 positive allosteric modulators effective at low concentrations. Here, using an ensemble of GlyR-α3 structures that were obtained from homology models of GlyR-α1 NMR and crystal structures and subsequent molecular dynamics simulations, we screened over 2 million drug-like compounds from the ZINC database. Screened compounds were pre-filtered by physiochemical features selected for their ability to penetrate the blood-brain barrier and exhibit central nervous system activity, and specifically targeted to the cannabinoid binding site near residue S307 of GlyR-α3. Drugs were ranked based on their predicted binding affinities across the ensemble of GlyR-α3 structures. Leading compounds were selected for experimental validation in Xenopus laevis oocytes expressing GlyR-α3, and several were found to exhibit dose-dependent inhibitory effects at micromolar concentrations. This study provides evidence that the cannabinoid-binding site may be shared in GlyRs for both positive and negative allosteric modulators and demonstrates the complexity of the molecular mechanisms of allosteric modulation in GlyRs.

This research was supported by NIH grants and T32EB009403 and R01GM049202.
the Remember-Know-New procedure. “Remember” indicated recall of specific (episodic) details. “Know” indicated familiarity with no specific association recalled. “New” indicated no recognition. Subjects received the other drug during a subsequent visit (with different words). As in a similar study, d’ (d-prime) was calculated for each condition; d’ reflects the proportion of words correctly identified with the false-alarm rate incorporated.

RESULTS
The group average memory results (d’ values) are displayed graphically in Fig. 1. Driven by large differences in “Remember” responses, d’ was significantly lower with both Dex and Mdz, compared to saline. Under Mdz, pain significantly reduced “Remember” responses (p = 0.006). Fig. 2 demonstrates the inter-subject variability that characterizes our results, using the non-significant “remember” responses under Dex as an example. Subjects varied greatly in their sedated memory performance (notably Subj 2). Further, the effect of pain on memory varied between improvement (Subj 7), worsening (Subj 1), and no difference (Subj 5).

CONCLUSIONS
We have developed an experimental framework for determining how pain influences auditory memory at baseline and under sedation with two distinct anesthetic agents. Preliminary findings suggest great heterogeneity for memory performance as a function of both pain pairing and sedative given.

REFERENCES

This abstract was presented at the Society for Obstetric Anesthesia and Perinatology 48th Annual Meeting, Boston, MA, May 18-22, 2016.

SUBDURAL HEMATOMA ASSOCIATED WITH LABOR EPIDURAL ANALGESIA AND POST-DURAL PUNCTURE HEADACHE: A CASE SERIES
Jamie Zorn, Yuanxu Dong, Grace Lim, Joseph S. Derenzo, Jonathan H. Waters
Department of Anesthesiology, Magee-Womens Hospital of UPMC, Pittsburgh, PA

BACKGROUND
Subdural hematoma (SDH) after labor epidural analgesia is rare, with a quoted incidence of 1:250,000 to 1:500,000.1 The proposed mechanism of SDH following labor epidural is low cerebrospinal pressure following unintentional dural puncture that leads to traction and tear of thin-walled meningeal blood vessels.2,3 We report a series of 11 obstetrical patients with SDHs that were associated with the use of labor epidural analgesia at a single, high volume tertiary teaching hospital.

DESCRIPTION
All patients developed headaches consistent with post dural puncture headache (PDPH) prior to the diagnosis of SDH. Five patients (50%) had a recognized unintentional dural puncture, one patient (10%) had a combined spinal and epidural with a 24 gauge pencil-point needle, and five patients (40%) had no recognized dural puncture. SDH was diagnosed in 10 patients (91%) with radiologic studies an average of 5.4 days (range 1-8 days) after performance of labor epidural analgesia. Three patients were found to have small amount of intraventricular air at time of diagnosis. All patients without severe symptoms had a second hospital stay ranging from two to four days (average 2.8 days) for observation of the SDH. One patient experienced loss of consciousness and required neurosurgical intervention. Over the time period, 42,969 labor epidurals were placed and 437 inadvertent dural...
punctures were observed. Thus, the observed institutional rate of labor neuraxial anesthesia-associated SDH was 0.026% (approximately 1:5000). The observed rate of SDH was 1.3% (approximately 1:100) if a recognized dural puncture occurred during labor epidural catheter placement.

CONCLUSIONS
We conclude that SDH as a result of dural puncture during placement of labor epidural is rare, but potentially more common than historically thought. SDH after unintentional dural puncture is likely underdiagnosed and may be appropriately managed expectantly without surgical intervention if no other serious associated neurological signs are present. In fact, SDH associated with PDPH appears to be a frequently clinically incidental finding, the detection of which has the potential to increase healthcare utilization and cost.

REFERENCES

USE OF CELL SALVAGE FOR POSTPARTUM HEMORRHAGE AFTER VAGINAL DELIVERY

Jamie M. Zorn, MD; Eleni Kotsis, DO; Grace Lim, MD; Patricia L. Dalby, MD; Catherine Ralph, MBBS, FRCA; Jonathan H. Waters, MD

1. Department of Anesthesiology, University of Pittsburgh School of Medicine
2. Royal Cornwall Hospital, Truro, Cornwall, UK

INTRODUCTION
Cell salvage is effective in reducing allogeneic blood product requirements during hemorrhage. While its utility has been described for cesarean delivery-related hemorrhage, its use in vaginal delivery is controversial. In this preliminary report, we evaluated cases for adverse events related to the use of cell salvage for maternal hemorrhage during vaginal delivery.

METHODS
We reviewed a database that tracks all cases in which standby cell salvage is set up, and in which reinfusion of salvaged shed blood is performed during maternal hemorrhage at our institution. Cases of maternal hemorrhage during vaginal delivery over the period 2010 – 2015 that were associated with the institution of cell salvage setup were included for review. This group was then categorized based on the successful transfusion of salvaged blood from the vaginal field: one group received reinfusion of salvaged shed blood that was acquired from the vaginal delivery field, and in a second group cell salvage equipment was set up, but inadequate blood was collected to process and reinfuse. Blood was processed by one of two machines, either the COBE BRAT (Arvada, CO) or a Sorin Electa (Mirandola, Italy). Each event was reviewed independently by two reviewers, and data were abstracted for demographic characteristics, estimated blood loss, cell salvage volume returned, reason for blood recovery, hospital length of stay, and the occurrence of wound infection, sepsis, thromboembolic events, or suspected amniotic fluid embolism. Inconsistencies were resolved by consensus.

Descriptive statistics were presented as mean and standard deviation for continuous data, or frequency and percentages for categorical data. Evaluations of the normality of data distribution were made using histograms. Demographic features were compared using Fisher's Exact test, the Student t-test for normally distributed data, or the Wilcoxon Rank Sum test for data other than normally distributed. Comparisons were made between groups for length of stay, wound infection, sepsis, thromboembolic events, and amniotic fluid embolism (Table 1). All
statistical analyses were two-sided, and $\alpha = 0.05$ was used by convention to reject the null hypothesis. Analyses were performed using StataSE 12.1, StataCorp LP, 1985, College Station, TX.

RESULTS
Patient data is summarized in Table 2. There were no instances of postpartum sepsis, wound infection, thromboembolism, or increased hospital stay associated with the use of cell salvage. One case of suspected amniotic fluid embolism occurred, however severe symptoms began prior to the infusion of salvaged blood.

CONCLUSIONS
Reinfusion of salvaged blood after vaginal delivery is feasible. This report provides preliminary clinical information on outcomes associated with reinfusion of salvaged blood from vaginal delivery. Larger scale clinical evaluations of the use of cell salvage in vaginal delivery are warranted to determine the safety and efficacy of this intervention.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Salvaged blood transfused (n = 9)</th>
<th>No salvaged blood transfused (n=16)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay (days)</td>
<td>3.44 (0.9)</td>
<td>4.51 (3.96)</td>
<td>0.44</td>
</tr>
<tr>
<td>Wound infection</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>-</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>-</td>
</tr>
<tr>
<td>Thromboembolic events</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>-</td>
</tr>
<tr>
<td>Suspected amniotic fluid embolism</td>
<td>0 (0)</td>
<td>1 (6.25)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Data are presented as mean (standard deviation) or frequency (percentage)

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Salvaged blood transfused (n = 9)</th>
<th>No salvaged blood transfused (n=16)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>28.8 (9.4)</td>
<td>32.8 (4.7)</td>
<td>0.17</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>31.9 (7.2)</td>
<td>32.1 (4.9)</td>
<td>0.93</td>
</tr>
<tr>
<td>Gravidity</td>
<td>2.11 (1.5)</td>
<td>3 (3.0)</td>
<td>0.42</td>
</tr>
<tr>
<td>Parity</td>
<td>1 (1.3)</td>
<td>2 (3.0)</td>
<td>0.35</td>
</tr>
<tr>
<td>Estimated Gestational Age (weeks)</td>
<td>35.4 (5.1)</td>
<td>36 (3.8)</td>
<td>0.74</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td>White</td>
<td>4 (44.4)</td>
<td>10 (62.5)</td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
<td>4 (44.4)</td>
<td>2 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1 (11.1)</td>
<td>4 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Group B Streptococcus status</td>
<td></td>
<td></td>
<td>0.66</td>
</tr>
<tr>
<td>Positive</td>
<td>3 (33.3)</td>
<td>8 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>3 (33.3)</td>
<td>4 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (33.3)</td>
<td>4 (25.0)</td>
<td></td>
</tr>
<tr>
<td>Reason for Cell Salvage setup</td>
<td></td>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>Atony</td>
<td>5 (55.6)</td>
<td>6 (37.5)</td>
<td></td>
</tr>
<tr>
<td>Lacerations</td>
<td>1 (11.1)</td>
<td>2 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Abruptio/DIC</td>
<td>1 (11.1)</td>
<td>5 (31.25)</td>
<td></td>
</tr>
<tr>
<td>Retained placenta</td>
<td>1 (11.1)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Other*</td>
<td>1 (11.1)</td>
<td>3 (18.75)</td>
<td></td>
</tr>
<tr>
<td>Antibiotics received during vaginal delivery</td>
<td>7 (78.8)</td>
<td>9 (56.3)</td>
<td>0.40</td>
</tr>
<tr>
<td>Estimated Blood Loss (mL)</td>
<td>1577.4 (870.1)</td>
<td>1591.6 (1284.6)</td>
<td>0.98</td>
</tr>
<tr>
<td>Shed blood volume retrieved (mL)</td>
<td>358.6 (148.7)</td>
<td>122 (333.6)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*Other reasons for cell salvage setup include Jehovah’s Witness status or other bloodless medicine request, history of or current uterine inversion, or history of postpartum hemorrhage
INVASION OF CYTOTOXIC T CELLS AND MONOCYTES INTO BRAIN PARENCHYMA AFTER DISRUPTION OF BLOOD BRAIN BARRIER
Can Zhang¹, Nicole R. Brandon,¹ Huanyu Dou,² Yan Xu¹
¹Department of Anesthesiology, University of Pittsburgh School of Medicine
²Department of Biomedical Sciences, Texas Tech University

INTRODUCTION
Although a direct link has long been suspected between brain and systemic immune responses in various central nervous system disorders, which immune cells play an important role in this process is still unclear. Questions remain as to whether the blood brain barrier is transiently disrupted after cardiac arrest and resuscitation.

HYPOTHESIS
A transient disruption of the blood brain barrier accompanies possible invasions of immune cells into the brain parenchyma.

METHODS
Adult male mice were subjected to 5-min cardiac arrest, induced by an intravenous bolus injection of a short acting β-blocker (esmolol) followed by apnea. Resuscitation was achieved through a retrograde arterial infusion of oxygenated blood containing epinephrine. We measured various immune cell markers in the brain, blood, bone marrow, spleen, and liver using flow cytometry. Selected mice were assigned to receive magnetic resonance imaging scan in the days preceding cardiac arrest (Day –1), several hours after cardiac arrest (Day 0), and up to nine days after resuscitation in order to assess the integrity of blood brain barrier.

RESULTS
A large degree of neuronal injuries in the CA1 hippocampal region was associated with an increase in monocytes (CD11b+CD45+) and cytotoxic T cell (CD8+CD4–) in the brain. Region-averaged pixel variances from T1-weighted difference images revealed blood-brain barrier disruption on Day 0 and Day 1 after cardiac arrest and resuscitation.

CONCLUSIONS
Peripheral cytotoxic immune cells were found in the brain parenchyma after cardiac arrest and resuscitation. While a causal relationship has yet to be established, strong experimental evidence from MRI scans suggests a transient disruption of the BBB, underlying a possible pathway for blood-borne immune cells to invade the brain and cause injuries secondary to the primary ischemic insult. Immune cells may contribute to the pathology of neuronal injuries.

This work was supported in part by NIH grant R01GM114851.
This abstract was presented as a poster at the 57th Experimental Nuclear Magnetic Resonance Conference, Pittsburgh, PA, April 10-15, 2016 and at the 14th annual Safar Symposium, Pittsburgh, PA, May 17, 2016.

**PIXEL VARIANCE MAPS FROM T₁-WEIGHTED DIFFERENCE IMAGES FOR BLOOD BRAIN BARRIER INTEGRITY ASSESSMENT AFTER CARDIAC ARREST AND RESUSCITATION IN MICE**

Nicole R. Brandon;¹ Can Zhang;¹
Kerryann E. Koper;¹ Huanyu Dou;² Yan Xu¹
¹ Dept. of Anesthesiology, Univ. of Pittsburgh School of Medicine
² Dept. of Biomedical Sciences, Texas Tech University Health Sciences Center

**INTRODUCTION**

Whether or not the blood brain barrier (BBB) is transiently disrupted after cardiac arrest (CA) and resuscitation is not well established. Several MRI-based approaches, including dynamic contrast enhancement (DCE), have been developed to assess BBB integrity under clinical and experimental conditions (Heye et al., Neuroimage Clin 2014; 6: 262-74). When the BBB is disrupted, a blood-pool contrast agent, normally impermeable across BBB, can gain access to brain parenchyma, resulting in disseminated accumulation of the contrast agent in brain microenvironments. Even when the pharmacokinetics of contrast clearance from the blood is not precisely known, the heterogeneity of contrast accumulation in the brain provides a measure of the degree of BBB disruption. Here we present a robust procedure to determine BBB integrity on the basis of pixel variance maps in a clinically relevant model of CA and resuscitation in mice. The method is straightforward and can be easily implemented in a clinical setting.

**METHODS**

Male CD-1 mice, ~35 g, were subjected to 5-min CA induced by an intravenous bolus injection of a short acting β-blocker (esmolol) followed by apnea. Resuscitation was achieved through a retrograde arterial infusion of oxygenated blood containing epinephrine, sodium bicarbonate, and heparin. Animals were randomly assigned to receive MRI scans in the days preceding CA (Day –1), several hours after CA (Day 0), and then once per day for 9 days. Image sets were distributed among different mice so that no single one contributed to all 11 possible scans. For T₁ contrast, 0.3 mmol/kg Gd-DTPA was given through the tail vein ~9 min before the first T₁-weighted image. Additional mice without CA were scanned to serve as controls. Images from a mouse without CA and contrast agent were used as the negative control. All MRI scans were performed on a 600-MHz Bruker imaging spectrometer. T₁-weighted images were acquired using MSME with a TE = 12 ms, TR = 500 ms, and NA = 4. T₂-weighted images were acquired using RARE with TE = 12 ms, TR = 2 s, RARE factor = 8, and NA = 4. Trans-axial sections of T₁- and T₂-weighted images were co-registered for anatomical reference, with a FOV = 20 mm x 20 mm and a digital resolution of 256x128 (zero filled to 256). The slice thickness was 1mm with an inter-slice space of 0.2 mm for nine slices. Mice were kept at 36-37ºC during the scans.

**RESULTS AND DISCUSSION**

Representative T₂- and T₁-weighted images of the mouse brains before and 0-2 days after CA and resuscitation are shown in the first and second rows in Figure 1, respectively. Sequential T₁-weighted images were acquired ~9 and ~46 min after the intravenous injection of Gd-DTPA, which has a half-life time of ~17 min in the blood. The T₁-weighted difference images, as shown in the third row in Figure 1, were calculated from the two co-registered T₁-weighted image sets. These difference images, even when processed using the DCE method, failed to show obvious regional contrast. However, when the pixel-by-pixel variances of the difference images were quantified, a clear trend emerged (Figure 2): the BBB was compromised on the day of CA and one day after reperfusion and recovered after two days. Co-registration of the variance maps with the corresponding high-resolution T₂-weighted images permitted quantification by anatomical regions of interest.

This work was supported by NIH grant R01GM114851.
SYSTEMIC IMMUNE RESPONSES TO CARDIAC ARREST IN MICE
Brandon NR; Thomas T; Dou HY; Xu Y
1Department of Anesthesiology, University of Pittsburgh School of Medicine;
2Center of Excellence for Infectious Diseases, Department of Biomedical Sciences, Texas Tech University, Health Sciences Center; 3Department of Pharmacology & Chemical Biology, University of Pittsburgh School of Medicine; 4Department of Structural Biology, University of Pittsburgh School of Medicine

Systemic immune responses to cardiac arrest and resuscitation have both neuroprotective and neurodegenerative effects. Here we examined the time-dependent immune processes in mice to understand possible pathways for future therapeutic interventions. We hypothesized that cardiac arrest activates specific components of the immune system in a time-dependent manner with measurable quantities, which correlate with the degree of neuronal damage and consequently with functional and behavioral outcomes. Six-minute cardiac arrest was induced in adult male BALB/c mice (Jackson Labs) by intravenous injection of a short acting β-blocker (esmolol) along with asphyxia and reversed by a retrograde arterial infusion of oxygenated blood containing a resuscitation mixture of epinephrine, sodium bicarbonate, and heparin. Sham-operated mice each had one of their femoral arteries and veins tied off but did not receive drugs other than anesthesia and analgesia. Surgically naïve mice were also used as controls. Bone marrow, blood, spleen, liver, and brain were collected on post-surgical days 1, 3, and 5 for flow cytometry and/or histology analyses. In the spleen, CD11b+ cells were continuously increased on days 1, 3, and 5 after resuscitation. The ratio of CD4+ to CD3+ T-cells was decreased from 68% of control to 61.25% and 60.25% on days 3 and 5 after resuscitation, respectively. The sham operation slightly increased the ratio of CD4+ to CD3+ T-cells to 71%. In bone marrow, cardiac arrest mice exhibited decreases in CD11c+ cells and increases in CD11b+ cells compared to the naïve and sham controls. The CD4+ and CD3+ T-cells were clearly increased on post-arrest day 3, but returned to control levels on post-arrest day 5. In both the liver and spleen, cardiac arrest resulted in a depletion of CD3+FoxP3+ and CD8+FoxP3+ T-cells and a significant increase in CD11b+/Ly6C+ inflammatory monocytes/macrophages and CD11b+/Ly6G+ immune suppressor cells on post-arrest days 3 and 5 compared to the controls. In addition, the cardiac arrest mice showed decreased CD11b+Ly6C+F4/80+ tissue macrophages in the liver and spleen on post-arrest days 3 and 5. We conclude that specific immune responses to cardiac arrest and resuscitation can be identified to better understand the timing and pathways, allowing us to design new therapeutic strategies to selectively enhance or suppress portions of the immune system as needed.

This work was supported by NIH grant R01GM114851.
INTERSTITIAL CYSTITIS (IC) is a disease of the urinary bladder that causes increased urgency to void and pelvic pain. It is commonly thought that increased bladder sensations in IC are due to sensitization of bladder afferent nerves by inflammatory mediators. Current therapies aimed at known targets in the inflammatory or nociceptive pathways have, to date, been ineffective at reducing the symptoms in IC patients. To find potential new treatments for IC, we expressed a non-native chloride channel (EG3RF) in bladder afferent neurons. This family of channels can be activated by either inflammatory conditions or by an exogenous pharmaceutical compound, but has no activity under normal physiological conditions. We hypothesized that successful transfection of the EG3RF chloride channel into rat bladder afferent nerves would diminish bladder hyperexcitability in the cyclophosphamide model of bladder inflammation. To transfect bladder afferent nerves, an expression plasmid containing the sequence for EG3RF was encapsulated in liposomes and instilled into the urinary bladder of Sprague Dawley rats using a transurethral catheter. Bladder activity was measured one to two weeks later using metabolic cages or bladder cystometry. Bladder inflammation was induced by intraperitoneal (i.p.) injection of cyclophosphamide (CYP, 150 mg/kg) 1 hour prior to measurement of bladder activity. Successful expression of the EG3RF channel up to two weeks following transfections was confirmed in the bladder smooth muscle, urothelium, and dorsal root ganglia (T11–12, L1–L2, and L6-S1 levels) using RT-PCR, Western blot, and immunofluorescence analyses. Metabolic cage and cystometry experiments indicated no differences in voiding function between the control and non-inflamed EG3RF-transfected animals. However, EG3RF-transfected rats were resistant to the excitatory effects of cyclophosphamide treatment. Treatment with cysteamine, which has been shown to activate EG3RF, decreased CYP-induced bladder activity in both metabolic cage and cystometry experiments (31 mg/kg i.p. or intravenously (i.v.), respectively) in EG3RF-transfected rats, but was ineffective in control rats. Intravesical instillation of cysteamine (5 mM) during cystometry in EG3RF-transfected rats excited bladder reflexes, while i.v. administration (31 mg/kg) decreased peak micturition pressure. These data suggest that expression of a non-native chloride channel in bladder afferent nerves may be an effective treatment for painful bladder disorders such as IC. Further development of the technique may lead to significant advances in efficacy over existing treatments.

This research was supported by NIH grants R37GM049202 (Xu); T32 GM075770 (Xu); K01 DK106115 (Beckel); and R01 DK091253 (de Groat).


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Jacques E. Chelly, MD, PhD, MBA edited the section on regional anesthesia in the October 2015 issue of Current Opinion in Anesthesiology. Dr. Chelly’s section featured seven articles, four of which were written by authors in our department.

The article “Percolation Model of Sensory Transmission and Loss of Consciousness Under General Anesthesia” by the research team of Yan Xu, PhD and Pei Tang, PhD was published in the September issue of the journal Physical Review Letters (2015; 115(10): 108103). The research attracted a bevy of media attention; it was featured on the news websites physics.aps.org, physicsworld.com, gizmodo.com, motherboard.vice.com, and insidescience.org, as well as the fall 2015 issue of Pitt Med.

Brian A. Williams, MD, MBA was awarded a $2 million grant from the U.S. Department of Defense for his proposal “Four-drug Nerve Block versus Plain Local Anesthetic for Knee and Hip Arthroplasty Analgesia in Veterans.”

Kathirvel Subramaniam, MD, MPH received funding from Mylan Specialty to conduct an investigator-initiated clinical trial on remifentanil and the glycemic/stress response to cardiac surgery.

A fiction book by Steven L. Orebaugh, MD, A Night in the Life, based on his real life experiences working in the ER at South Side Hospital (now UPMC Mercy South Side), was published.

James G. Cain, MD, MBA, FAAP was inducted into the Port Jervis High School Alumni Hall of Fame. A plaque with Dr. Cain’s photograph and biography was placed on permanent display at the school.

An article by Ibtesam A. Hilmi, MB, CHB, FRCA; Daniela Damian, MD; and Ted Sakai, MD, PhD, “Acute kidney injury after orthotopic liver transplantation using living donor versus deceased donor grafts: A propensity score–matched analysis” (Liver Transplantation. 2015;21(9):1179-85) was featured in the Hepatology News section of the website Healio.com.

Department members delivered 48 presentations at the American Society of Anesthesiologists (ASA) Annual Meeting, October 24-28, 2015 in San Diego, CA. Additionally, 15 faculty members and three residents served on ASA and ASA-related committees. Many from our department also participated in related pre-ASA meetings such as the Society of Pediatric Anesthesia Annual Meeting and the Society for Education in Anesthesia Fall Meeting.

Kristin Ondecko Ligda, MD received a scholarship from the Pennsylvania Medical Society to attend their 2015-2016 Year Round Leadership Academy as a part of their outreach program for early career physicians.

Zachary Cohen, MD was chosen as President-Elect for the Pennsylvania Society of Anesthesiologists Resident Component for 2015-2016.

Dr. Kristin Ondecko Ligda
Carolyn Garver, CRNP/C received the 2015 Richard L. Simmons, MD Speak up for Patient Safety Award from UPMC at the Dr. Loren Roth UPMC Quality and Patient Safety Symposium.

William Simmons, MD was featured in an article in Mayo Clinic’s Alumni Magazine.

Marc Wicker, MSN, CRNA received a UPMC Award for Commitment and Excellence in Service (ACES) at the 2015 ACES Awards Banquet. ACES honors the most outstanding employees within UPMC; winners are nominated by their peers and reflect the highest standards of excellence.

Gale A. Jackman, BSN, CRNA and Marc Wicker, MSN, CRNA received Cameos of Caring Awards at the Cameos of Caring Awards Gala on November 7, 2015. This awards program honors exceptional bedside nurses who work at acute care hospitals.

Ashley Galadyna, BSN, MSN and Jeffrey M. Varga, MD were commended by UPMC safety officials on November 9, 2015 for reporting an operating room incident to prevent a “wrong site” surgery on a patient. On November 12, Dale E. Heron, CRNA was also recognized for helping to prevent a wrong site craniotomy.

These members of our anesthesia team were praised for their diligence and attention to detail to keep patients safe.

Tetsuro Sakai, MD, PhD was invited for a visiting professorship with the Department of Anesthesiology at Rutgers New Jersey Medical School.

Yan Xu, PhD was invited to serve as a visiting professor with the University of Virginia Department of Anesthesiology in Charlottesville, VA.

Tetsuro Sakai, MD, PhD was appointed Committee Chair Designee of Society for Education in Anesthesia (SEA) Research in Education Committee.

Chuck Giordano, MSN, CRNA and David Seng, DO were presented the Mary DePaolis Lutzo Anesthetist of the Year Award and the Stephen Finestone Anesthesiologist of the Year Award, respectively, at the University of Pittsburgh Department of Nurse Anesthesia Fall Class of 2015 Graduation Ceremony.

Staff from various sites planned community service projects over the holiday season. Children’s Hospital of Pittsburgh of UPMC (CHP) Anesthesiology held a holiday gift card drive to benefit Jeremiah’s Place, a crisis nursery located in East Liberty. They raised over $600 in gift cards to help support the pediatric community outside of CHP.

UPMC Presbyterian CRNAs organized a holiday cookie collection. They delivered cookies to the University Place Family House and Fisher House at the VA Pittsburgh Health Care System Oakland hospital. They also brought cookies to the UPMC Presbyterian family waiting rooms on 4F/G and 6F/G, as well as in those in the transplant and surgical ICUs and Same Day Surgery.

Our UPMC Pain Medicine Fellowship Program was awarded a national “2016 Pain Medicine Fellowship Excellence Award” from the American Academy of Pain Medicine (AAPM). The award was one of only four given by the AAPM.
Jaymin Patel, MD received an AAPM 2016 Pain Medicine Fellowship Scholarship. The award included a one-day registration and up to $1,000 for related costs to attend the 2016 AAMP Meeting, registration to the “Essentials for Treating the Patient in Pain™ Program,” and a free year of AAPM membership.

Scott Brancolini, MD, MPH was appointed to the Board of Directors of the Association of Pain Program Directors.

William Simmons, MD received the Western Pennsylvania Executive Humanitarian Award from Achieving Greatness, Inc. (AGI) at AGI’s Pittsburgh City League Hall of Fame awards banquet. The event honors many champions of local humanitarian efforts.

K. Grace Lim, MD was invited for a visiting professorship with the University of Maryland Department of Anesthesiology.

Richard Hubbard, MD shared his very personal experiences as an anesthesiology resident in his essay “Overnight,” which was published in the Fall 2015 issue of Medical Literary Messenger.

Ajay D. Wasan, MD, MSc participated in a discussion about prescription opioids in the NPR segment Draft of CDC’s New Prescribing Guidelines Stirs Debate.

Our practice management research team, led by Mark E. Hudson, MD, MBA, won the first place poster prize at the ASA Practice Management Conference (San Diego, California, January 29-31, 2016):

Trent D. Emerick, MD; David F. Nelson, MD, MBA; Andrius Giedraitis, MD, MBA; Mark E. Hudson, MD, MBA: Perceived Work Hours versus Actual Work Hours in a Large Multi-Specialty Hospital. 2016 marked the fifth consecutive year that our practice management research team won awards at this annual conference.

The second edition of the book Manual of Simulation in Healthcare (Editor Richard H. Riley, MBBS, FANZCA, Oxford University Press) was published. Dr. Riley is currently an anesthesiologist at University of Western Australia/Royal Perth Hospital and an alumnus of our residency program (1984) and our Schertz Research Fellowship (1985). Department members Thomas Dongill and Joseph S. Goode Jr., MSN, CRNA authored chapters in the book.

K. Grace Lim, MD was accepted into the 2016 University of Pittsburgh Schools of the Health Sciences Leadership Academy for Early Career Faculty. The year-long professional development program is designed to cultivate a generation of transformative academic leaders through shared leadership training.
Philip Carullo, MD was awarded two grants for the development of a medical device that would prevent aspirated products from entering the lungs during intubation. Upon completing the First Gear Program run through the University of Pittsburgh Innovation Institute, Dr. Carullo received a $3,000 grant for his project. He was also awarded a one-year $20,000 pilot grant from the University of Pittsburgh Center of Medical Innovation for production of a functional prototype (see page 86 for more information about this work).

Andrea Ibarra, MD was accepted into the course “Health Disparities: A Translational Research Approach.” The course was limited to only 15 participants. As a selected applicant, Dr. Ibarra also received a $1,000 registration fee award.

David G. Metro, MD, Erin A. Sullivan, MD, and Jonathan H. Waters, MD were elected into the Association of University Anesthesiologists (AUA).

Our CRNAs celebrated National Nurse Anesthetists Week (January 24-30, 2016) by giving back to the community, launching several charity initiatives:

**UPMC St. Margaret CRNAs** donated their time and money to the Wounded Warrior Patrol Family Outing at Seven Springs Ski Resort on February 21-25, 2016. The event provides soldiers and their families a chance for rest, relaxation, and fun in the snow.

**CRNAs at Children’s Hospital of Pittsburgh of UPMC** provided breakfast, afternoon snacks, and baked goods for patients and their families at multiple sites throughout the hospital. They were able to extend this service to the families of the Surgical Family Lounge at the CHP main hospital, the Surgical Family Lounge at the CHP North Surgery Center, and the Pediatric, Cardiac, and Neonatal Intensive Care Units.

**CRNAs at Magee-Womens Hospital of UPMC** volunteered their time, donations, and supplies to help the Jubilee Kitchen. Since 1979, the Jubilee Kitchen has fed impoverished and challenged Pittburghers meals with dignity and respect to all that come. The volunteers helped with food preparation, food service, and clean up.

**UPMC Shadyside CRNAs** volunteered their time and cooking skills to the residents of the Shadyside Family House with a fiesta-themed dinner. The families were quite gracious and asked many questions about who they were and what exactly they do every day. The event provided a much appreciated service to the local community and was an excellent way to educate the public about CRNA practice.

**CRNAs at UPMC Presbyterian** served their seventh “Souper Bowl” dinner. The group prepared and served food to nearly 80-85 patients and their family members at Shadyside Family House. They also donated some gift cards with surplus money from their CRNA winter party.

The article “If my doctor had ignored my intuition about my pregnancy, I’d be dead,” published on the online news website Quartz, told a story about the life-saving work of K. Grace Lim, MD.

A project by PI Brian A. Williams, MD, MBA, “Design the Anesthetic to Meet the WAKE Score” was declared by VA Central Office as a “Gold Status Promising Practice,” the highest achievement conferred to the top 10 of 250 total submissions for the VA’s Promising Practice National Consortium. As part of this honor, the project will be implemented at other VA medical centers, facilities, and regions. Dr. Williams was invited to participate in the “Diffusion of Excellence” implementation phase of the project as a Best Practice Fellow.
Howard B. Gutstein, MD announced the establishment of a professorship named in honor of the late Richard J. Kuwik, MD, Chief of Anesthesiology at UPMC Mercy and 28-year physician and faculty member in our department. Mark E. Hudson, MD, MBA was named the inaugural holder of the Richard J. Kuwik Professorship of Anesthesiology.

Dr. Kuwik earned his BA and MD at Canisius College and State University of New York at Buffalo, respectively. He completed a surgical internship, anesthesiology residency, and fellowship at Mary Hitchcock Memorial Hospital in Hanover, NH (now Dartmouth-Hitchcock Medical Center). He remained on the faculty there until Dr. Rick Siker, then Chair at Mercy, enticed him and his wife Sandy to come to Pittsburgh.

A letter from the Department of Anesthesiology at Dartmouth-Hitchcock Medical Center regarding the Professorship said that when Dr. Kuwik was a young physician there, he was an “outstanding academic clinician” who was “technically expert, compassionate to patients and their families, and a tireless and effective teacher in the operating room, classroom, and in the intensive care unit. He always provided help to whomever asked, whether faculty, house staff, nurse, or medical student. He was the one physician you wanted to care for you if you were ill. Clearly these characteristics persisted and grew throughout his career.”

Sadly, Dr. Kuwik passed away on January 30, 2016. His tremendous impact on many physicians, nurses, and patients over his long career became evident when we announced the establishment of the Kuwik Professorship on our Facebook page. The post received an outpouring of comments of praise and thanks for Dr. Kuwick’s mentorship and care, far more so than any other announcement we have ever posted. Many responses called him a “hero” and one of the best physicians they have ever worked with and thanked him for saving their lives.

Dr. Hudson and future holders of the Professorship “shall emulate the dedication to the Department of Anesthesiology and UPMC exhibited by Dr. Kuwik during his 28 years of service to the Department, his colleagues, and his patients.”

Dr. Kuwik will be very sadly missed by all in the department, the many people he taught throughout his career, and the patients he cared for.
Our finance team members Beverly Savage and Michael Zoffel received certifications from the Research Administrators Certification Council and became CRAs (Certified Research Administrators).

The article “UPMC doctors get patients fit to speed recovery from surgery,” published in the March 14, 2016 edition of the Pittsburgh Tribune-Review, featured UPMC’s Enhanced Recovery After Surgery (ERAS) program, led by Stephen A. Esper, MD, MBA and colorectal surgeon Dr. Jennifer Holder-Murray (see page 122).

Spring 2016

Gregg E. Homanics, PhD received the Medical Student Research Mentoring Merit Award from the University of Pittsburgh School of Medicine at their 2016 Scholars Day.

Andrew Herlich, DMD, MD, FAAP was invited to serve on the Pennsylvania Medical Society Opioid Advisory Task Force. The task force works with Pennsylvania Legislature to combat the state’s prescription drug abuse crisis and develop responsible prescribing guidelines for the treatment of chronic pain.

Gregg E. Homanics, PhD was interviewed about his research on paternal alcohol exposure in an article on how fathers’ pre-pregnancy behavior affects their offspring posted on the Today Show’s website.

Erin A. Sullivan, MD was appointed to the Society of Cardiovascular Anesthesiologists Sub-Committee on Economics and Governmental Affairs for a two year term.

Shushma Aggarwal, MD; Cheryl D. Bernstein, MD; Jacques Chelly, MD, PhD; ZongFu Chen, 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 all named in Pittsburgh Magazine’s 2016 “Best Doctors” list.

Brian A. Williams, MD, MBA received the VA Pittsburgh Healthcare System’s Excellence in Research Award on May 16, 2016 during the VA Research Week kickoff at VA Pittsburgh’s University Drive campus.

Our residents swept the first place awards in ALL categories at the 11th Annual Pennsylvania Anesthesiology Resident Research Conference (PARRC) on Saturday, May 14, 2016 at Penn State Milton S. Hershey Medical Center. (see page 25)

A half hour PBS/ WQED Public Cable TV special called “Journey to Medicine” was filmed in Pittsburgh and focused on the Gateway Medical Society (GMS) mentorship program. Dr. William Simmons, Immediate Past President and Chairman of the Board of GMS, was featured on the show discussing the Journey to Medicine mentorship program. The special was initially only shown in Western PA. However, it won a journalism award for PBS and then was shown nationally several times.

Peter Yeh, MD was chosen as President-elect of the Society for Obstetric Anesthesia and Perinatology Resident Affairs Committee.
Michael P. Mangione, MD was nominated for the 2016 Golden Apple Award. The award is given each year by the University of Pittsburgh School of Medicine graduating class to a faculty member who has contributed the most to their experience transitioning from medical students to physicians.

James W. Ibinson MD; K. Grace Lim, MD; Ajay D. Wasan, MD, MSc; and Andrea Gillman, PhD were department principal investigators (PIs) or Co-PIs on research projects that won University of Pittsburgh CTSI Pain Research Challenge awards.

William Simmons, MD was one of three mentors in GMS’s Journey to Medicine Academic Mentorship Program selected to receive the Jefferson Award for Volunteerism, the highest award for volunteerism in the nation, in June 2016 in Washington, DC.

K. Grace Lim, MD was awarded a $10,000 Society for Education in Anesthesia (SEAd) Grant for her project, “Residents as Teachers: Effect of a Patient Education Strategy on Resident Self-Efficacy and Maternal Outcomes (The EDUCATE Study)” at the Spring 2016 SEA Meeting.

Phillip S. Adams, DO won the 3rd place abstract award at the Spring 2016 SEA Meeting for his oral presentation, “Integrated Clinical Subspecialty and Research Training In Anesthesiology: Academic Anesthesiology Scholar Tracks (AST)” (authors: Phillip S. Adams, DO; Tetsuro Sakai, MD, PhD; James Ibinson, MD/PHD; Keith M. Vogt, MD, PhD; Sandra C. Hirsch, MBA; Yan Xu, PhD; David G. Metro, MD).

The spring 2016 issue of Pennsylvania Physician Magazine featured an article about Kristin M. Ondecko Ligda, MD, who started a Facebook group for Physician Anesthesiologist Moms in February of 2015.

Bruce Ben-David, MD; Andrew Herlich, DMD, MD, FAAP; Steven L. Orebaugh, MD; and Joseph J. Quinlan, MD were elected into the AUA.

Student nurse anesthetists and CRNAs from UPMC Presbyterian participated in the Tunch and Wolf Walk for the Homeless on June 11, 2016 in Pittsburgh. Proceeds from the walk benefit the Light of Life Rescue Mission, a charity that provides homes for the homeless and food for the hungry, and helps people suffering from addiction and abuse.

Erin A. Sullivan, MD was appointed as a Senior Examiner for the American Board of Anesthesiology Part 2 exam for a four-year term beginning in 2017.

The department hosted a celebration in their honor of retiring physicians Shushma Aggarwal, MD; Barbara Brandom, MD; Charles Buffington, MD; Rajani Chuensumran, MD; Evelyn Gonzalez-Abola, MD; Thomas Lace, MD; Richard McHugh, MD; and Bharati Parikh, MD on June 27, 2016 at the University Club.
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<th>Category</th>
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<tr>
<td>Total Anesthesiology Cases</td>
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<tr>
<td>Non-Pain Cases</td>
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<td>Chronic &amp; Acute Pain Visits</td>
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<td>Obstetric Deliveries</td>
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