

2024

Beyond the Airway, Volume 1, Issue 1, May 2024

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Recommended Citation

(2024) "Beyond the Airway, Volume 1, Issue 1, May 2024," *Beyond the Airway*. Vol. 1, Article 1.
Available at: https://jdc.jefferson.edu/beyond_the_airway/vol1/iss1/1

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BEYOND THE AIRWAY

Jefferson Anesthesia Society
Volume 1 | Issue 1 | May 2024



Jefferson Anesthesia Society

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Foreword from the Editors-In-Chief Bhavana Thota and Sydney Baker

It is with great enthusiasm that we present the inaugural edition of *Beyond the Airway*, Jefferson Anesthesia Society's student-run, non-peer reviewed journal for Sidney Kimmel Medical College students. Recognizing a growing interest in the field of Anesthesiology and opportunities for early exposure to the field during medical school preclinical years, we launched this journal to inspire students to engage with anesthesia in innovative ways. The goal of this journal is to offer students a unique platform to discover emerging topics within anesthesia and gather insight from Thomas Jefferson University anesthesia faculty and residents.

This publication represents the collective effort and dedication of students who are enthusiastic about the specialty of Anesthesiology. Throughout the journal, you will find an array of topics covered including: interviews with resident and attending physicians, articles on medical education, and recent trends within the specialty. We extend our heartfelt thanks to each contributor for their hard work and commitment. We express our deep gratitude to the Jefferson Anesthesia Department for their support throughout this journey. Last but not least, we want to recognize Dr. Eric Schwenk, our faculty editor, who dedicated his time, effort, and expertise to providing feedback and guidance on how to create a successful publication.

Thank you all for joining us in our endeavor to create the first edition of this journal, and we look forward to many more to come.



A Message from **Dr. Eric S. Schwenk, MD FASA**

Professor
Acute Pain Management Service Director
Orthopedic Anesthesia Director

It is my distinct pleasure to introduce the first-ever edition of *Beyond the Airway*. The articles in this newsletter were written by SKMC medical students who are interested in anesthesiology as a career. The topics were chosen by them and my contribution was primarily offering some advice and lightly editing the articles for clarity. I mention these details up front because this effort was driven by the students and any credit for it should go to them. Anesthesiology as a specialty has been increasing in popularity in recent years and at Jefferson there were 32 applicants in 2023, up from 16 in 2020! I recall being the president of the Jefferson Anesthesia Society as a student here in 2007-08 and we had a small fraction of the interest and enthusiasm that the current students have. I also recall listening to a speaker who was a private practice anesthesiologist who stated that anesthesiology is a specialty that involves 99% controlled relaxation and 1% sheer terror. Although I think that ratio may have shifted over time as the patients in my practice at Thomas Jefferson University Hospital have gotten sicker and more complicated, the truth of her warning stuck with me. There are unquestionably stressful moments in the life of an anesthesiologist but they are greatly outnumbered by the number of rewarding clinical encounters, gratified patients, and perioperative triumphs. The students involved in this newsletter as well as many other SKMC students who have rotated with our department have challenged me to explain my decisions in the operating room as well as on acute pain rounds. They have asked probing questions about medications, hemodynamics, nerve blocks, and airway management. While I have answered many of them, I have simply responded, “You know, that’s a great question. I don’t know the answer to that” to many others. As far as we have come in our specialty, numerous questions remain unanswered.

Teaching and interacting with medical students are highlights of my academic career. I have always said if you can explain a topic satisfactorily to medical students you can explain it to anyone because they are sharp. In addition to scientific topics, in this edition you will get to know our outgoing chief residents a bit more through interviews and you will get the perspective of two trainees who have just gone through it all and will be part of the workforce next year. A newsletter like this one is a reminder that students have talents beyond test-taking and I look forward to many more years of interesting contributions.

Dr. Rishi Kothari

Written by Shady Mina, Class of 2027

Dr. Rishi Kothari is an Associate Clinical Professor and Director of Quality and Patient Safety in the Department of Anesthesiology. He was born in Connecticut and completed his undergraduate education at the University of Connecticut, where he received a B.S. in Computer Science. Dr. Kothari completed both medical school and residency at the Icahn School Medicine at Mount Sinai prior to pursuing a fellowship in liver transplantation anesthesiology at the University of California San Francisco. In this interview, Dr. Kothari discusses his path to anesthesiology and the ways in which his educational background has shaped his research and unique interests in the field.



How did you decide to pursue anesthesiology?

I initially thought that I wanted to be a neurologist before college because of a friend's brother who had an epileptic disorder. I spent many years with their family empathizing with his condition. I found the anatomy of the brain fascinating in medical school, but ultimately my neurology rotation ruled out neurology for me. From the moment I stepped foot into the operating room during my surgery rotation, I loved the environment, but had never thought about being a surgeon. My anesthesia rotation was right after my surgery rotation, and it had all the parts of medical school that I liked and all the parts about surgery that I liked.

For instance, it is an acute care environment; I get to work with my hands and be the primary care provider for patients that are ill. I get to utilize the physiology I learned in medical school for my patient cases, and it is absolutely thrilling. In anesthesiology, you physically operate behind the curtain, and as a result, if you do your job well, no one will ever know. For me, that is not a bad thing. It allows me to operate independently. The stereotype the anesthesiologist is the reserved person who shies away from social contact. That could not be further from the truth. Patients undergoing surgery are often in a very vulnerable state and you have ten minutes to convince this person that they should trust you with their life. If you are not a people person, that would be challenging. This establishment of trust is so special and is certainly an aspect of anesthesiology that keeps me coming back to it.

Why did you become involved with abdominal solid organ transplantation research?

Liver transplantation is quite niche. One of the nice things about subspecializing is that you get to have more communication and stronger relationships with a smaller community of people, and the community for liver transplantation seemed very welcoming. I had a great mentor at UCSF who was instrumental in getting my research career started. Your area of clinical specialty is easily the choice to do research in because you can use your clinical

experience to guide the research. There is no replacement for that even if you have good collaborators. Abdominal solid organ transplantation research is a rapidly advancing field, as we have only been doing organ transplants for about 40 years. We are now at an inflection point in research as the number of articles is growing exponentially from year to year, and the amount of data to do research with is growing even more quickly.

Can you speak on your work in clinical informatics?

I have been interested in computers and technology from a very young age, and when I obtained my computer science degree from the University of Connecticut, my goal was to integrate my interests in both technology and medicine. While in medical school, I also spent a summer at Harvard-MIT working with a deidentified database of 40,000 ICU patients. Ultimately, ending up in anesthesiology has been great for me and made sense because there is all of this automatically generated and high-quality data sitting there waiting to be used. In 2012, electronic medical record systems were being widely deployed, so I saw the early stages of Epic and loved it. Ultimately, when I got to UCSF for fellowship, I thought there was the opportunity for someone with a technical background to do good work. However, a programmer without a perspective of the subject matter they are working with is limited in their abilities. Clinical informatics took these two roles and rolled them up. As a physician-scientist, I am not only able to extract and examine the data, but I am familiar with the nature of the data before it makes it to any statistical analysis due to my clinical background. The clinical background makes you very valuable to a group of people who are looking to improve clinical care and speeds up the process of working with clinical data by an order of magnitude.

How has the field of anesthesiology changed since you started practicing?

First is the acknowledgment that throughout a surgical encounter, there is a serious risk of harm. The risk of harm is not just from the surgery itself, but from the stress that the body undergoes during

surgery and anesthesia, and the process of recovery. That awareness has led to an expanded list of things that an anesthesiologist must be mindful of. Whether it is surgical site infection, perioperative glucose control, transfusion management, hemodynamic management, DVT prophylaxis, postoperative delirium, or postoperative cognitive decline, there is an acknowledgment that a surgery is not just a surgery, it is a full body experience. We as anesthesiologists have embedded steps in our practice to attempt to mitigate these negative outcomes, as we are always thinking many steps ahead during surgery.

Second is the development of best-practice protocols and guidelines that are focused on taking care of patients who are undergoing a certain type of surgery or have an underlying illness. These guidelines, such as enhanced recovery after surgery protocols, have been developed for a variety of surgical specialties. For instance, you can use a framework for pain management for certain cases, beginning from a common starting point and adding or subtracting as you see fit. As we get better at sharing information and realizing that we do not have to reinvent the wheel for every patient, we can tailor standardized protocols and make them more individualized for each patient.

Other changes include anesthesiologists being called to perioperative positions to help assess patients before surgery. Anesthesiologists also understand what postoperative care looks like, so we are being invited to take a role in postoperative care and provide our input on patients' care after surgery.

What is your favorite memory from your time teaching and practicing at Jefferson?

I had a liver transplant case overnight. It was an incredibly tough case. If I recall correctly, the patient lost more blood than the total volume of blood in the body. We transfused back all of it and then some. With those cases, there is a narrow margin of error. You have to be hypervigilant of everything that is going in. It is a draining and taxing environment for everybody. The surgeons and nurses are hyper-focused on what they are doing. They do not have time to think about my responsibility and vice versa. We are aware of what each other is doing and constantly communicating, but there has to be an incredible amount of trust. It was a long night, and when we got done with the case, the surgeon came over to the anesthesia team and said, "Thank you guys, I did not think the patient was going to make it there for a while." I knew that it was a tough case, and I was satisfied with the outcome because the patient was doing great. But to hear the surgeon clearly recognize our essential role in making ensuring a good patient outcome felt great. That is the pat on the back that we rarely get.

Another stand out memory was a patient undergoing major liver resection. He was doing well, and all of a sudden, he coded. Within 60 seconds, the blood pressure went from 120/60 to 0, and chest compressions and an medications were not effective. He just... died. There was not a significantly elevated risk for this patient preoperatively. I have not had a death like that. Most of the deaths are patients who are very sick. Everyone in the operating room

was in absolute shock. We all supported one another. That day was just a reminder of the fact that sometimes things are far out of our control and that as much as loss hurts, you have to keep in mind that in order to do good. You are not going to make the right decision every single time, but if for every one wrong decision, you are making a 100 or more right, then you have to accept it for the greater good. Medicine is truly unique. It helps you gain and keep a perspective that not a lot of people might have.

What is your favorite hobby and what do you like to do at leisure?

I cook a lot. The kitchen is the one place where I do not have the fear of failure. I am an experimental cook who does not write things down, so even if I make a good recipe, I do not have a way to recall it. I like to play golf, shoot pool, and play video games. I play a lot of Rocket League, which is pretty much soccer with cars. It helps with the hand-eye coordination!

Anesthesia Considerations for Patients on Semaglutide

Written by Matthew Kraft, Class of 2026

Over the past two decades, the numbers of Americans diagnosed with diabetes mellitus has more than doubled and is expected to increase exponentially in the 21st century as the prevalence of obesity continues to grow.¹ Given these concerning trends and the heightened cardiovascular risks associated with diabetes and obesity, the need to improve prevention and management of these conditions has become a priority. While non-pharmacologic treatments such as lifestyle and dietary changes have yielded a modest improvement in metabolic function and weight loss, they have also demonstrated limited success in the long term.²

Over the past few years, the use of semaglutide (brand names Ozempic, Rybelsus, and Wegovy) have expanded considerably, with an estimated 8.2 million prescriptions written in the US alone in 2021.³ Approved by the FDA in 2017, semaglutide is a class of GLP-1-receptor agonists that increases insulin secretion and suppresses glucagon secretion, resulting in reduced blood sugar without serious side effects.⁴ Initially intended only for patients with type 2 diabetes mellitus, it has since become widely used for weight loss due to its ability to delay gastric emptying, reduce hunger, and thus decrease food intake.⁵

Despite its positive benefits on weight loss, concerns have been raised over semaglutide’s role in increasing the risk of pulmonary aspiration in the perioperative period. Instances have been reported where patients taking semaglutide have shown food in their stomach during endoscopies, experienced pre-operative vomiting despite fasting, and even had food regurgitated while under anesthesia during surgery.⁶ In response to these concerning anecdotes, Michael W. Champeau, MD., FAAP, FASA, the President of the American Society of Anesthesiologists (ASA), released a statement on the subject:

“While there is currently a lack of scientific data on how GLP-1 receptor agonists affects patients having surgery and interact with anesthesia, we’ve received anecdotal reports that the delay in stomach emptying could be associated with an increased risk of regurgitation and aspiration of food into the airways and lungs during general anesthesia and deep sedation. These complications can be serious, so we are providing guidance on when GLP-1 agonists should be stopped in advance of an elective procedure.”

This guidance Dr. Champeau described was a set of recommendations issued by the ASA in July 2023 of the preoperative management of patients on semaglutide and other GLP-1-receptor agonists.

Typically, the ASA completes a comprehensive review of research and literature of a topic before releasing official guidance. However, Champeau explained that there were a limited number of

studies published, and “wanted to just get some guidance out there because so many people had been concerned about the issue”.⁵

	Patients Requiring Urgent or Emergent Procedures	Patient Scheduled for Elective Procedures
Day(s) Prior to the Procedure	Proceed and treat the patient as ‘full stomach’ and manage accordingly.	For patients on daily dosing, consider holding GLP-1-receptor agonists on the day of the procedure/surgery. For patients on weekly dosing, consider holding GLP-1-receptor agonists a week prior to the procedure/surgery. This suggestion is irrespective of the indication (type 2 diabetes mellitus or weight loss), dose, or the type of procedure/surgery. If GLP-1-receptor agonists prescribed for diabetes management are held for longer than the dosing schedule, consider consulting an endocrinologist for bridging the antidiabetic therapy to avoid hyperglycemia.
Day of the Procedure	Proceed and treat the patient as ‘full stomach’ and manage accordingly.	If GI symptoms such as severe nausea/vomiting/retching, abdominal bloating, or abdominal pain are present, consider delaying elective procedure, and discuss the concerns of potential risk of regurgitation and pulmonary aspiration of gastric contents with the proceduralist/surgeon and the patient. If the patient has no GI symptoms, and the GL-1-receptor agonists have been held as advised, proceed as usual. If the patient has no GI symptoms, but the GLP-1-receptor agonists were not held as advised, proceed with ‘full stomach’ precautions or consider evaluating gastric volume by ultrasound, if possible and if proficient with the technique. If the stomach is empty, proceed as usual. If the stomach is full or if gastric ultrasound inconclusive or not possible, consider delaying the procedure or treat the patient as ‘full stomach’ and manage accordingly. Discuss the concerns of potential risk of regurgitation and pulmonary aspiration of gastric contents with the proceduralist/surgeon and the patient. There is no evidence to suggest the optimal duration of fasting for patients on GLP-1-receptor agonists. Therefore, until we have adequate evidence, we suggest following the current ASA fasting guidelines.

Table 1: ASA Consensus-Based Guidance on Preoperative Management of Patients on GLP-1-Receptor Agonists.¹¹

Concern for potential aspiration in patients taking semaglutide and receiving anesthesia is justified, considering the morbidity and mortality associated with aspiration. Aspiration only occurs in an estimated 1 in 10,000 patients undergoing anesthesia, but patients experiencing it can face a number of life-threatening complications, including pneumonia, airway obstruction, and even death.⁷ In fact, the 2021 ASA Closed Claims analysis found that 57% of anesthesia-related aspiration incidents resulted in death, and that aspiration is responsible for over 50% of all airway-related deaths under anesthesia.⁷

While the ASA's decision to release recommendations in lieu of strong evidence was justified by many as necessary in addressing widespread concerns, their recommendations have also sparked debate in the medical community. In particular, a group of five gastroenterological societies declared that there is not enough evidence to recommend patients to hold semaglutide and other GLP-1-receptor agonists before sedation.⁸ Other experts have argued that "recommendations by the ASA to withhold GLP-1 receptor agonists a day or week (depending on how often you take the drug) are aimed at maintaining perioperative glycemic control" and "do not address the concerns about delayed gastric emptying and the potential for increased regurgitation and aspiration."⁹

Moreover, Jones et al. pointed out that clearance of GLP-1-receptor agonists from the body can take over 3 weeks, and even then, there is not any direct evidence that clearing these drugs from the body will allow them to digest food at a normal rate.¹⁰ This divergence of opinions among experts underscores the complexity of this issue, and highlights the need for additional research.

Currently, several studies have assessed how GLP-1-receptor agonists like semaglutide affect residual gastric volume (RGV). A study by Silveira et al. reported RGV in 24.2% of patients taking GLP-1-receptor agonists compared to 5.1% of patients in the control group, while Stark et al. found 6.8% of GLP-1-receptor agonist patients with RGV and only 1.7% of control group with RGV.⁷ These results are preliminary and provide a starting point for additional studies on the topic.

Ultimately, the concerns related to perioperative semaglutide and other GLP-1-receptor agonists will likely continue to be a focal point as diabetes and obesity rates continue to increase and the drugs continue to be touted as weight-loss panaceas. While the ASA's recommendations are a good initial step in alerting anesthesiologists and other to the potential risks, it is clear that more research is needed to ensure effective medical decision-making and maximize patient safety.

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Dr. Jeffrey Mojica

Written by Grace Eddy, Class of 2026

Dr. Jeffrey J. Mojica, DO, serves as a Clinical Assistant Professor in the Department of Anesthesiology and Perioperative Medicine. Dr. Mojica's academic journey began at Rowan University School of Osteopathic Medicine, where he obtained his medical degree. He then completed residency and a regional anesthesia and acute pain medicine fellowship at Thomas Jefferson University Hospital. He also completed a pain medicine fellowship at the University of Texas Health Science Center at San Antonio. In this interview, Dr. Mojica discusses his research and clinical interests, which focus on innovative approaches to managing acute and chronic pain, enhancing recovery post surgery, and advancing interventional pain therapies, neuromodulation, and regional anesthesia.



What made you decide to pursue a pain fellowship?

I chose anesthesiology because of the pharmacology, physiology, and ability to do different procedures – for example, being able to manipulate blood pressure, heart rate, and other physiologic variables in real time and analyze those metrics using different procedures and technologies. Being able to manipulate physiology in real time is what drew a lot of us to this field in the first place. Pain is one of the fastest growing areas of anesthesia. There are a lot of cool procedures and there are a lot of things you can do to treat pain. Spinal cord stimulation, peripheral nerve stimulators, and other advancements that are evolving in this field are fascinating. It's becoming more of an interventional and surgical type of fellowship rather than the medically managed field it used to be.

What is the most fun or fulfilling part of your job?

The thing I like about my job is that it's a hybrid. I do a mix of operating room anesthesia and chronic pain. This means that in a given week, I do clinic one day, pain procedures another day, round on the acute pain service another day, and do general anesthesia on another.

What advice would you give to medical students interested in anesthesiology?

Right now, anesthesia is a weird and unknown specialty, but it's becoming super, super popular and more competitive. I would say get involved, whether that's through Jefferson Anesthesia Society, finding an anesthesia mentor, or doing research. Get involved as much as possible because I am seeing really amazing anesthesia residency applicants.

Neuromodulation is an area of growing interest in pain management. Could you speak a little on what that is and what has been going on in that field recently?

Neuromodulation is the use of targeted electrical stimuli to modulate the activity of the nervous system. Neuromodulators, like spinal cord or peripheral nerve stimulators, are like fancy epidurals or nerve blocks that are implanted in patients' backs or other areas of the body so that we can stop pain signals from reaching the brain. The use of these devices in pain medicine has opened the door for pain doctors to act like semi-surgeons.

Can you tell us about any recent projects you've been working on?

One of the hot topics in anesthesia right now is GLP agonists such as Ozempic and their perioperative implications. I recently hosted a webinar through The American Society of Regional Anesthesia and Pain Medicine to talk about the importance of holding GLP agonists before surgery, since they may increase the risk of aspiration and other perioperative anesthetic related complications.

How do you approach managing acute pain in surgical patients while considering the potential for developing chronic pain post-operatively?

Surgery triggers an inflammatory state and it's important to manage the pain that comes with that. Perioperative opioids can lead to chronic postoperative opioid use and the way we avoid this is through multimodal anesthesia. Using peripheral nerve blocks, epidurals, Tylenol, Ibuprofen, or Gabapentin initially, and then using opioids as a next step when other things aren't sufficient.

How do you integrate multimodal analgesia approaches into your practice to effectively manage pain while minimizing opioid use and its associated complications?

I did a fellowship in regional anesthesia, so I definitely do a lot of peripheral nerve blocks. Additionally, Jefferson tends to use a lot of ketamine in practice. In fact, consensus guidelines for the use of ketamine for acute pain management were authored by Dr. Schwenk and Dr. Viscusi, who are part of our department.

What advancements in regional anesthesia techniques have you found particularly promising for optimizing perioperative pain management?

The biggest advancements in this field over the past decade have been improvements in our ultrasound technology. Our ultrasound machines have gotten significantly better. For example, nerve blocks used to be done with a nerve stimulator and anatomical landmarks but now can be done just with ultrasound.

What do you envision for the future of anesthesia, particularly concerning pain management, and what role do you see yourself playing in shaping these advancements?

As anesthesiologists, we have long been branded as perioperative medicine experts, but this influence has started to expand beyond the confines of the operating room and what we call the “perioperative surgical home.” This includes pain medicine doctors as well as the many anesthesiologists who are now going into critical care medicine. Personally, I hope to develop a transitional pain clinic to help take care of postoperative pain patients better. This would look like seeing patients before surgery to optimize their pain management from the beginning as well as before they leave the hospital and even afterwards.

The National Resident Matching Program (NRMP) Match: Is Anesthesiology Becoming More Competitive?

Written by Justin Do, Class of 2027

Anesthesiology has seen an increase in application numbers over the past five years, jumping from 2,936 applicants in 2019 to 3,647 applicants in 2024 with 54% of anesthesiology program directors reporting a 10-25% increase in applications in 2022.^{1,2,3} This increased interest has been reflected by a 100% fill rate of the 1,695 categorical and 305 advanced anesthesiology positions in the 2024 match. Even among U.S. MD students, who have traditionally had the best match rates into their specialties of interest, the anesthesiology match rate has been decreasing; of 1,691 MD applicants, only 1,401 of them matched into a categorical or advanced position, reflecting a match rate of 82.85%. As a reference, historically competitive specialties such as dermatology have reported MD match rates of 66% in recent years⁴, and specialties such as diagnostic radiology, physical medicine and rehabilitation, and neurology report similar match rates to anesthesiology⁵. In response to this increased demand, the number of categorical anesthesiology programs available in the match have increased annually by approximately 4% per year, from 1,370 in 2020 to 1,695 in 2024.¹

Increased interest in anesthesiology may be driven by a number of factors, which may include a declining interest and number of applications in emergency medicine⁶ as well as perceived favorable work-life balance.⁷ The shift work, relative flexibility in type of schedules, generous compensation, and practical application of pharmacology and physiology have all been noted as being attractive to current anesthesiology residents.⁸ Longstanding workforce predictions have suggested a deficit of 2-12% in anesthesia providers⁹, with more recent analyses placing the deficit at 5-8% depending on the geographic region.¹⁰ Combined with an aging population that will demand further surgical services, demand for anesthesiologists is expected to remain high.¹¹ Furthermore, the increase in interest among medical students happens to coincide with a predicted surplus in emergency medicine physicians¹², which may suggest shifting specialty interests among US medical students.

Rising Competitiveness Among Jefferson Students

Evidence of anesthesiology's increased competitiveness is present among Jefferson's students. From 2021 to 2023, USMLE Step 1 scores of successfully matched anesthesiology applicants from Jefferson rose significantly from an average of 237.9 (60th percentile) to 244.2 (72nd percentile) ($t=2.12, p=0.04$) as well as number of 3rd year rotations with an "Honors" grade from an average of 3.47 to 4.89 ($t=2.29, p=0.029$). In addition, the proportion of students

from each class rank changed, with 26.3% of successful Jefferson applicants being from the top third of the class in 2023 compared to just 6.67% from 2021. Step 2 scores, research experiences, and number of letters of recommendations did not change significantly between the two years, but this may be explained by Step 1 still being scored during this time period, decreasing the perceived importance of Step 2 CK. However, the number of research experiences greatly rose from 5.3 in 2023 to 13.9 in 2024.

	2019 $n_a=1622$	2020 $n_a=1666$	2021 $n_a=1653$	2022 $n_a=1830$	2023 $n_a=1797$	2024 $n_a=13$
	-	-	$n_j=15$	-	$n_j=19$	-
Jeff: Step 1	-	-	237.9	-	244.2	-
Jeff: Step 2	-	-	253.3	-	257.9	254.2
AMCAS: Step 1	230.6	231.9	232.7	-	-	-
AMCAS: Step 2	241.3	242.6	243.3	-	-	-
Jeff: Research	-	-	6.03	-	5.3	13.9
AMCAS: Research	4.3	4.8	5.3	5.7	6.4	-
Jeff: Volunteer	-	-	5.4	-	9.2	3.5
AMCAS: Volunteer	6.1	6.4	6.6	7.6	7.5	-
Jeff: Work	-	-	3.1	-	4.3	2.9
AMCAS: Work	3.3	3.2	3.4	3.6	3.8	-

Table 1: Characteristics of Successful Anesthesiology Applicants from 2019-2023.

n_a = sample size for AMCAS group, n_j = sample size for Jefferson. Bold indicates significant ($p<0.05$) differences within a row, empty cells indicate missing or non-reported information. AMCAS data from Report on Residents (<https://www.aamc.org/data-reports/students-residents/report/report-residents>). AMCAS stopped reporting average board scores in 2022, Step 1 was converted to pass/fail by the 2024 application season.

Uncertain Selection Criteria

As competition for the limited number of anesthesia positions increases, program directors are seeking new ways to stratify applicants. Previous program director surveys across specialties have identified several important criteria that are utilized in applicant selection; however, the relative importance of each criterion varies by specialty.²

Step 1 & Step 2 CK Scores

The USMLE Step 1 score was one of the most important cited criteria for stratifying applicants for interview invitations, with 100% of program directors using it as a factor in the application review process and rating its relative importance as 4.3/5. After all, board scores are an easily filterable metric that have been shown to be a predictor of first-time surgical^{13,14} and internal medicine¹⁵ board pass rates. Since the 2020 survey noting Step 1 to be a critical component of the application review process, Step 1 has become pass/fail. Current literature suggests that Step 2 CK has replaced Step 1 as primary screening criteria.¹⁶ Thus, Step 2 CK will likely be a major selection criterion in the coming years, with average scores of successfully matched candidates potentially increasing if demand for anesthesiology residency spots continues to increase.

Research Output

Compared to other specialties with a similar degree of competitiveness, anesthesiology does not place the same emphasis on scholarly work. In the 2020 program director survey, only 36% of anesthesiology program directors used interest in research as a criterion, compared to 44% in neurology, a similarly competitive specialty. Accordingly, research output measured by average number of abstracts, presentations, and publications of accepted applicants in anesthesiology (6.6) lags behind neurology (7.8) and diagnostic radiology (8.0). While there has been renewed interest by applicants to contribute to scholarly work, a retrospective analysis of a residency program's applicants did not find a significant relationship between scholarly productivity and rank of matched program.¹⁸ It remains unclear whether research will become an important selection criterion for anesthesiology.

Preference Signaling

The introduction of preference signaling in recent years has significant implications for selection criteria for interview invites. With preference signaling, applicants can now “signal” specific programs to show their interest, with different specialties allowing a different number of signals.¹⁹ In both the 2023 and 2024 match, anesthesiology employed a two-tier system, with five “gold” signals and 10 “silver” signals for a total of 15 program signals. By employing a relatively large number of signals, preference signaling acts as an unofficial cap to applications. Programs often interview only applicants that signaled their program and still comfortably fill their slots come match day, leading to a preference signal being one of the most important prognostic factors to an applicant gaining an interview at a specific program.

Limitations

This article has several limitations. Unfortunately, residency match data come from disparate sources with varying methodology. While the National Resident Matching Program (NRMP), as the facilitators of the match, provide the gold-standard data, the NRMP's decision to publish detailed match data biennially via Charting Outcomes reports (which include applicant's test scores, characteristics, and controls for back up applications into different

specialties) limits any analysis of potential selection criteria. The same limitations are present regarding the biennial program director surveys. For instance, no survey of program director's criteria for stratifying applicants has been released after the introduction of preference signaling. Other professional organizations such as the Association of American Medical Colleges (AAMC) should be commended for publishing supplemental information via their annual Report on Residents, but the removal of the reporting of board scores and the relative dearth of data limits analysis of the information. And while the decision to end reporting of average board scores may be ultimately fueled by a desire to remove an overreliance on board scores, decreased transparency only hurts applicants and program directors.

Jefferson's match data were limited by the self-reported nature of the data; while the survey sent to all successfully matched applicants in 2021 had a 93.75% response rate, the 2023 survey had only a 67.86% response rate, which may have affected the results. More importantly, the manner in which the data were collected does not account for inconsistencies in the way students fill out the ERAS application. Were the five listed publications first-author papers published in high-impact journals like Anesthesiology, or were they middle-author publications in low-impact journals in unrelated fields? There is more nuance to the quantitative data collected than this article was unable to further explore.

Future Work

The limitations of this article underscore the need for further work on this subject, namely the need for more qualitative research to understand the factors driving the competitiveness of anesthesiology and the factors now being used as selection criteria by programs.

Increased interest in the specialty presents an opportunity for anesthesiology program directors to shape the profession and medical education as a whole. As students have proven time and time again, they will rise to the expectations set forth by residency selection. It is up to current leaders in anesthesiology to define what important qualities will be selected for in the next generation of anesthesiologists.

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Dr. Katherine Dillon Dr. Matteo Petrera

Written by Haani Jafri, Class of 2025

Drs. Katherine (Katie) Dillon and Matteo Petrera are current chief residents in the Department of Anesthesiology and Perioperative Medicine at Thomas Jefferson University Hospital. Dr. Dillon is from Yardley, PA and attended the University of Delaware for her undergraduate schooling, where she studied computer programming. She completed medical school at Philadelphia College of Osteopathic Medicine. Dr. Petrera is from Salisbury, Maryland and attended Villanova University for his undergraduate schooling, where he was both music director and general manager of Villanova's radio station. He completed medical school at Sidney Kimmel Medical College. In this interview, Dr. Dillon and Dr. Petrera discuss their passion for anesthesiology, key aspects of their time in residency, and insightful tips into the residency application process for aspiring anesthesiologists.



What made you choose to pursue Anesthesiology and when did you make that decision?

Dr. Dillon: Having a background studying computer programming in college, I came into medical school thinking anesthesia would be a good combination of technology and health care. I ended up doing research at Jefferson to study the pharmacokinetics and pharmacodynamics of subcutaneous insulin pump delivery in pigs. That really confirmed my interest in the field. Also, pigs have much larger airways than humans do!

Dr. Petrera: I decided on anesthesia halfway through third year. I was originally interested in orthopedic surgery and even did an elective rotation, but ultimately it wasn't for me. On clerkships, I remember being in a gynecology/oncology case and just standing in the corner. The anesthesiologist for the case called me over and taught me about intubation and lines. Nothing really clicked until then and I committed to anesthesia when I set up my fourth-year rotations. I absolutely loved the rotations I did in anesthesia as a fourth-year student.

How did you decide on which residency programs to apply to and how did you approach building a rank list?

Dr. Dillon: As far as deciding where to apply, Philadelphia is home for me. I've lived here for a long time and my family is here as well. Geographic location was the most important thing in my decision. When it came to building a rank list, I found that a lot of the places I interviewed at seemed to offer very similar things. So, I ranked my list based on where I felt most at home with the people at the program.

Dr. Petrera: I wanted to continue to stay in Philadelphia, so I chose Jefferson for residency. I prioritized everything by location. Once interview season was done, I thought back to where I interviewed

well. As anesthesia gets more competitive, something to keep in mind is assessing what your chances of matching at a certain program are. I looked into data on the typical applicants certain programs tend to take, data such as average scores and regional preferences. My rank list was based entirely on staying in Philly. I ranked all the programs I interviewed at, including some places in New York.

What about Jefferson made you want to come here for residency?

Dr. Dillon: Meeting the residents during interview day was the biggest pull for me. I found that a lot of the co-residents were friends with each other and there was a great spread of diverse people. That feeling has held true for me during residency - I have great relationships with my co-residents at Jefferson. I just went on a trip to Mexico with some of the first-year residents!

Dr. Petrera: In Philadelphia, I was looking at Cooper, Jefferson, and the University of Pennsylvania. University of Pennsylvania has a stronger focus on academics and, at the time, I did not feel it was the best fit. Jefferson's program was fifteen people, which felt like a good size. I also liked Jefferson's teaching model and the way call is structured. If I'm on call, I'm doing educational cases or teaching junior residents.

What were some of the highest and lowest points of residency for you?

Dr. Dillon: A major highlight is that I now feel comfortable doing almost any anesthetic case. There are quite a few medically complex patients at Jefferson and we really get a lot of exposure to it all. Also, Jefferson's network is very large, so many practices and hospitals have Jefferson alumni.

Dr. Petrera: There are different high and low points of each year of residency, but intern year is definitely tough. It varies from institution to institution, but at Jefferson intern year is a mix of medicine, surgery, ICU, and some consult services. At the start of CA-1, we had a bootcamp where we were in the OR in the morning and had

lectures in the afternoon. Bootcamp was amazing and, after the day was over, we would hang out as a residency cohort. CA-2 was the steepest learning curve with all the subspecialties. There were longer hours, but I felt I learned a lot. CA-3 year can be designed around individual interests.



Are you planning to do a fellowship? Why or why not, and if so, in what field?

Dr. Dillon: I am going straight into the workforce with a private practice group outside of Philadelphia. The same way you find out whether or not you want to do certain specialties in medical school applies to anesthesiology subspecialties. Cardiac anesthesiology is interesting, but I hope to never be in those rooms again. I feel like I have enough experience on regional anesthesia from residency. Pediatric anesthesiology is not for me, and neither was ICU. I just weeded out specialties I didn't like.

Dr. Petrera: I am also going straight into the workforce, but at Jefferson. I can never leave, as much as I said I wouldn't be a Jefferson lifer! I interviewed around with private groups, but private practice seemed like I would be doing more routine cases. I didn't want to jump into too much of a routine right away. I know Jefferson, so it'll be an easy transition. I was considering cardiac anesthesiology fellowship, but I didn't want to be too limited in the cases I would be put on. I enjoy the variety of cases.

Has the field of anesthesiology changed since you started residency, and how do you see the field changing throughout the course of your career?

Dr. Dillon: There's some ebb and flow between people wanting to

go for further fellowship and going straight into practice following residency. Currently most people are deciding to go straight into practice. Once you're an attending it's hard to retreat back into fellowship, but it's doable. There's also a lot of talk about CRNAs and their role in the OR. I am happy to have CRNAs, because they help out a lot and there's a lot of demand for anesthesia staff these days.

Dr. Petrera: A lot more technology is being integrated, and it's become more compact. There are video scopes now and ultrasound and ultrasound diagnosis has become massive. A lot hasn't changed though. Ventilators work the same and, while there are new drugs coming out, a lot of what we do is tried and true. People also talk about the wireless OR and artificial intelligence, but I don't think that's going to happen in my lifetime. Non-OR anesthesia is expanding, like in MRI suites, imaging, or surgical center/ambulatory care centers. Physicians will need to learn to adapt to smaller settings with less resources.

What do you see your future career looking like?

Dr. Dillon: I would love to stay with the same private practice group. The way private practice is structured, you stay with the same group for a certain number of years and then you become a partner. I picked my group, because I really liked the people, and they focus on the kind of cases I like to do, which are neurosurgery cases. The chief from two years ago and two residents from last year also currently work there.

Dr. Petrera: I don't see myself leaving Philly. I don't see myself staying in an academic environment forever. It really depends on how these first few years of being an attending go. I don't know. I could see myself going to a community hospital. It really depends on how things go these next few years.

What advice do you have for medical students interested in the field of anesthesiology?

Dr. Dillon: One of the biggest things I felt was that I did too many rotations as a fourth year. Pick your top place and do a rotation there. I did a rotation in Boston and thought it would be in my top ten programs, and it ended up being in my bottom five. So, try to go to your top spot and see if you can envision yourself being there.

Dr. Petrera: When you're in medical school, do the third-year anesthesia rotation. You get a good taste of anesthesia and it'll give you an idea of whether you want to pursue it or not. Set up fourth year rotations early. I didn't do any away rotations, but keep in mind that it is changing now. Do the scary cases in residency; residency is the time you want to be scared. Even as a CA-3, I've reached out to be in some of the bigger, scarier cases. Never forget that residency is about learning more than anything and set yourself up to be a good attending.

History of Ketamine in Anesthesia

Written by Bryce Dooley, Class of 2027

The desire to understand and minimize or even eliminate pain has long been a part of medical history. Ketamine, a drug with diverse molecular targets and neurophysiologic properties, was initially discovered by two Parke Davis scientists who stumbled upon a new organic chemical reaction and has a long and unique history in anesthesia.¹ In recent years ketamine has also been used for a variety of refractory psychiatric conditions, especially treatment-resistant depression.²

The history of ketamine began in the 1950s, when two chemists discovered a compound named phencyclidine. Lower doses provided analgesia and dissociation from events characterized by a catatonic state, but anesthetic doses could lead to what was referred to as “stormy recoveries.” These recoveries included convulsions, delusions, and potential seizures.³ Given these effects, phencyclidine’s practicality in the operating rooms remained limited.

Shortly after, in 1962, chemists synthesized a close chemical derivative of phencyclidine. While it still provided the analgesia and anesthetic state seen with phencyclidine, this new compound preserved cardiovascular and respiratory function, was shorter acting, and appeared to have few negative effects when tested in mice. First deemed CI-581, ketamine emerged on the pharmaceutical scene in 1964.

First tested on prisoner volunteers in the early 1960s, ketamine was administered at subanesthetic doses to demonstrate complete analgesia. The anesthetic state was characterized by increased muscle tone, maintained reflexes, and open eyes. In fact, closing the eyes appeared to be the first sign of an individual starting to regain consciousness. Unlike barbiturate anesthetics causing burst suppression and inhalational agents causing delta activity, ketamine showed a unique EEG profile on volunteers. In the anesthetic state, theta waves replaced basal alpha waves, which did not return for thirty minutes once consciousness returned and analgesia persisted. Volunteers afterwards reported intense hallucinations, experiencing events such as being surrounded by family or floating in outer space.⁵

The goal of searching for a non-barbiturate anesthetic with strong analgesic properties had succeeded. With a clinical profile unlike any other known anesthetic, ketamine was termed a “dissociative anesthetic.” Once approved by the FDA in 1970, ketamine successfully anesthetized patients, from pediatrics to geriatrics, for a variety of procedures in many different clinical settings over the next several decades.^{6,7,8}

During the 1970s, ketamine also became widely used in veterinary medicine as a sedative and an induction agent in a variety of species.^{9,10} Ketamine currently remains approved for veterinary anesthetic use in dogs, horses, and cats.

The warfare of the late twentieth century enlisted ketamine as the field sedative of choice for wounded soldiers. Injured individuals

could be safely sedated in the field before arriving to the military hospital. From the Vietnam War to the Gulf War, ketamine proved a valuable agent for its efficacy and safety profile, with its main drawback being the risk of distressing hallucinations when given IV as a sole agent.¹¹

By the 1990s, propofol, developed by a Scottish veterinarian and FDA approved in 1989, became the predominant injectable anesthetic of choice for anesthesiologists due to its rapid onset of action, muscle relaxation, minimal cardiovascular depressive effects, and short duration of action.¹² Though ketamine lost its role as a common induction agent, it became used in novel ways going into the 21st century.

Most notably, ketamine emerged as an important agent for trauma patients. In a similar manner to how it was used in the military, ketamine’s use expanded into pre-hospital transport during the early stabilization and resuscitation phase, particularly in areas with few resources. In comparison to opioids, ketamine’s sedation and analgesia was associated with improved hemodynamic stability in trauma patients.^{13,14} Ketamine’s short duration of action readily provided procedural sedation for emergency room patients, and its cardiovascular and respiratory stability were favorable for long-term sedation for critically ill patients, especially those requiring mechanical ventilation.¹⁵ Additionally, ketamine’s unique ability to stimulate the sympathetic nervous system and cause bronchodilation was especially useful in patients experiencing significant bronchospasm resistant to traditional treatments.¹⁶ In one study of septic patients requiring general anesthesia for surgery, ketamine was associated with better hemodynamic stability than etomidate.¹⁷

In the 1990s through the early 2000s the opioid epidemic surged in the United States. From 2000 to 2017, the United States saw deaths from prescription opioids rise from 3400 per year to over 17,000 per year.¹⁸ As addiction concerns and the recognition of opioid-induced hyperalgesia became hot topics in anesthesiology, the polarizing move towards “opioid-free” anesthesia and pain management took hold, and ketamine emerged as a potentially beneficial alternative to opioids. Use of ketamine at subanesthetic doses for perioperative analgesia was found to augment patient outcomes without negative side effects, and when timed correctly, was found to decrease the incidence of opioid-induced hyperalgesia.^{19,20} This has placed ketamine at the forefront of acute and chronic pain management in the past several years, especially in the setting of neuropathic pain.^{21,22,23} It has been recommended for both acute and chronic pain by a national consensus group as an effective, opioid-sparing analgesic.^{24,25}

In the past fifteen years, ketamine’s unique pharmacology has taken it beyond the operating room and emergency department and into some non-traditional areas of medical practice. Ketamine has most recently been investigated as a treatment for those suffering from psychiatric conditions. Specifically in patients with chronic PTSD, ketamine has produced greater response rates than

traditionally used medications like midazolam.²⁶ Additionally, ketamine's unique ability to combat treatment-resistant depression has been shown in multiple studies.^{27,28,29}

Most recently, ketamine's favorable properties were leveraged during the COVID-19 pandemic. For patients suffering from COVID-induced acute respiratory distress syndrome and requiring mechanical ventilation, co-infusions of ketamine allowed decreased infusions of other sedatives and potentially improved cardiovascular stability.³⁰ In a study involving Jefferson researchers, ketamine was associated with improved sedation as well as reductions in several inflammatory markers in mechanically ventilated COVID-19 patients.³¹ When addressing some of the long-term effects of "long COVID," such as depression and anhedonia, ketamine again has shown promise as a treatment option. Like in major depressive disorder, an underlying pathology of long COVID symptoms is neuroinflammation leading to gliosis.³² Ketamine's unique anti-inflammatory properties, along with neuromodulation, are the basis of its ability to successfully treat this particular subset of patients.^{33,34} Given these known capabilities of ketamine, research into its use for both major depressive disorder and chronic pain is increasing.

Many anesthesiologists routinely use ketamine, and it has proven to be a versatile drug for both anesthesia and analgesia. Jefferson's acute pain management service routinely successfully uses ketamine infusions for challenging patients with complex regional pain syndrome, refractory chronic migraine, opioid use disorder, and many other conditions. With more than a 50-year history of providing benefits to nearly every aspect of anesthesia-associated patient care, ketamine continues to contribute to patient care in ever-evolving ways.

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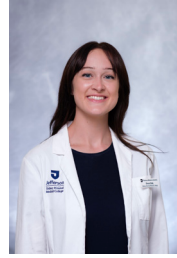
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