



# The Journal of Education in Perioperative Medicine

LETTER TO THE EDITOR

## Anesthesiologists Wake Up! It Is Time for Research and Innovative Medical Entrepreneurism

*ALBERT H. KWON, MD  
DIRK VARELMANN, MD  
SERGEY KARAMNOV, MD  
ALEXANDER H. SLOCUM JR, MD, PHD*

*LEENA K. PRADHAN-NABZDYK, PHD,  
MBA  
JEFF L. XU, MD  
WILLIAM J. MAUERMANN, MD*

*DANIEL R. BROWN, MD, PHD  
CARLOS B. MANTILLA, MD, PHD  
CHRISTOPH G. S. NABZDYK, MD, DR  
MED*

### **ANESTHESIOLOGISTS AND ACADEMIC PRODUCTIVITY: IS THERE A PROBLEM?**

Anesthesiologists have broad expertise in disease, physiology, pharmacology, and medical technology. Anesthesiologists are trained to think efficiently and work collaboratively. Moreover, the anesthesiologist's clinical work, although important, can be transferred to other colleagues (eg, taking over somebody else's case in the operating room). Similarly, anesthesiologists typically do not have a practice that requires repeated, long-term patient clinic follow-up. This should afford flexibility regarding research time. Anesthesiologists thus should be well situated to be leaders in academic medical research and innovation. How come they are not? Anesthesiology residency spots are competitive and applicants are smart, thus it cannot be a lack of talent.<sup>1</sup> Are we not attracting or producing future academic clinicians?

Although anesthesiologists significantly contributed to medical progress, there are signs that they lag behind with regard to academic output.<sup>2,3</sup> In 2006, Schwinn and Balser<sup>4</sup> studied the problem of low academic output in the field of anesthesiology and saw the need for a wake-up call. They reported a comparably low National Institutes of Health funding level for academic anesthesiologists and a

small number of T-32 and K-type training grants. These realities have hardly changed since. One problem the authors then noted was the lack of interest of anesthesiology residents in pursuing fellowship training. In 2006, more than 99% of anesthesiologists did not pursue fellowship training.<sup>4</sup> The authors<sup>4</sup> "painfully" reported that medical students considered "anesthesiology to be weak in its commitment to research training because of its lack of commitment to subspecialty fellowship training with compulsory research years." By now, approximately half of all anesthesiology residents pursue fellowship training.<sup>5</sup> However, this did not appear to improve the academic output when compared with other subspecialties.<sup>6</sup> In contrast to medical fellowships, all anesthesiology fellowships still are only 1 year and do not have a significant, mandatory research component that would allow trainees to learn the necessary skills or time to obtain sufficient data to become competitive academic clinicians upon graduation. In a recent analysis,<sup>6</sup> anesthesiologists were the least productive physician group across medical subspecialties and at every academic level according to their h-index. Even fellowship-trained cardiothoracic anesthesiologists fared only modestly better.<sup>6</sup> Surely, h-index can be affected by the research field/subject and thus may not reflect the quality of the individual manuscript. However, over a 2-year span, 6143 US academic anesthesiologists

published 8521 articles, with a median publication rate of zero.<sup>3</sup> Although the number of new American Board of Anesthesiology diplomates with at least 1 publication rose between 2006 and 2016, more than 70% of newly board-certified anesthesiologists have not co-authored a single article.<sup>7</sup> This low academic output holds true even when anesthesiologists are compared with clinicians in specialties with whom they work side by side, for example critical care medicine.<sup>8</sup> Even without protected time, graduates from medical subspecialty fellowships have a competitive edge over anesthesiologists.

Offering incentive pay for increased work (clinical, educational, or research) has shown to boost clinical productivity but not academic or educational output.<sup>9</sup> Even after 2 years of mentorship and protected time (20%), faculty members' academic output did not significantly improve.<sup>2</sup> It is not practical to think that academic productivity can be "purchased."<sup>2,9</sup> It is critical to establish good research habits during training to be competitive for research development grants. Extending the training programs in anesthesiology may decrease the number of applicants, but it is important to create a platform that fosters research careers. In time, anesthesiology may attract applicants who would otherwise choose another medical specialty for its established track record of launching academic careers.

*continued on next page*

*continued from previous page*

Research training as part of the anesthesiology education and affording protected time to staff and trainees are complex and costly subjects even under normal circumstances. Change will not come overnight. How can the field of anesthesiology provide “quick and easy academic wins” for anesthesiology trainees to encourage further, continuous research efforts? How could one allocate research support during economic contraction and uncertainties as during the current coronavirus disease 2019 (COVID-19) pandemic?

### **COVID-19 AND VENTILATORS: AN UNCONVENTIONAL EXAMPLE OF HOW RESEARCH COULD BE STIMULATED AMONG ANESTHESIOLOGISTS**

In the midst of the crisis in New York City and the associated ventilator shortage, A.H.K. and C.G.S.N. (both full-time clinical anesthesiologists), as members of a team of engineers and business partners, helped build what was later termed the MIT Emergency Ventilator (MIT E-Vent). Moreover, this group effort revealed to them how research and innovation can happen efficiently when hierarchies are removed, nontraditional partnerships are welcome, and small boluses of research time are granted on a short notice. This may serve as a complementary example of how research activities could be stimulated in addition to traditional, longitudinal research. Moreover, such short-term projects could serve as an introduction to research for anesthesiologists who may not have had much exposure or the confidence to conduct larger projects. This could be a source of research experience and motivation.

As this piece was originally written, New York City was the epicenter of the US COVID-19 pandemic. Among the many challenges New York City faces was that of a lack of ventilators. In March 2020, A.H.K. was asked by his friend and former MIT undergraduate classmate A.H.S. Jr, to join the MIT E-Vent initiative. MIT E-Vent is a volunteer group of engineers, physicians,

and industry partners. A.H.S. Jr, who is currently a senior resident in an integrated plastic surgery program, had experience in device prototyping and regulatory affairs pertaining to medical devices.<sup>10</sup> The goal was simple: build a rapidly scalable, open source mechanical ventilator to help with the COVID-19 pandemic and beyond (<https://e-vent.mit.edu/>). Following a formal design process, the MIT E-Vent team identified the minimum clinical functional requirements necessary to provide simple ventilation. At this point A.H.K. and C.G.S.N. joined the team. A.H.K.'s hospital appointment at the time was purely clinical. Graciously, the leadership of his department granted A.H.K. short-term protected research time to pursue this effort. C.G.S.N. was also granted instant support by the leadership of his department, as well as the Division of Engineering at Mayo Clinic.

Over the following month, the MIT E-Vent team not only built its own prototype in Boston, but also helped create the “Spiro Wave,” based on the MIT E-Vent, together with industry partners 10×Beta, Boyce Technologies, and NewLab in New York City. The Food and Drug Administration granted an emergency use authorization for Spiro Wave on April 17, 2020, and the device helped supplement New York City’s strategic reserve of ventilators. During that same time, A.H.K., A.H.S. Jr, D.V., and C.G.S.N. coauthored a research article<sup>11</sup> about the MIT E-Vent prototype. The MIT E-Vent project was a successful cross-institutional collaboration in which hierarchies were removed and nontraditional partners from industry were included. A.H.K., A.H.S. Jr, and C.G.S.N., and the other various team members of academia and industry are in ongoing discussions about future research projects based on the existing work.

The authors do not have all the answers to the problem of low academic productivity among anesthesiologists. The authors strongly believe that anesthesiologists can reclaim lost research territory as long as our field can learn from other specialties such as medicine and its American Board of Internal Medicine research track and fellowship system.<sup>12</sup> Adjustments to residency and fellowship structures to strengthen formal research education and

thus boost academic output are needed, but not in sight. In the meantime, this COVID-19–related project might serve as an unconventional example of how anesthesiologists can work efficiently in teams of diverse backgrounds, and quickly deliver a solution to a medical problem while also meeting peer review research standards in their academic output. Aside from traditional longitudinal academic research, the authors believe that nontraditional collaborative research, including with business partners as well as flexible short-term research time allocation, on a project-need basis can foster academic and entrepreneurial efforts.

### **References**

1. Kwon AH, Marshall ZJ, Nabzdyk CS. Why anesthesiologists could and should become the next leaders in innovative medical entrepreneurship. *Anesth Analg*. 2017;124(3):998-1004.
2. Hindman BJ, Dexter F, Todd MM. Research, education, and nonclinical service productivity of new junior anesthesia faculty during a 2-year faculty development program. *Anesth Analg*. 2013;117(1):194-204.
3. Hurley RW, Zhao K, Tighe PJ, et al. Examination of publications from academic anesthesiology faculty in the United States. *Anesth Analg*. 2014;118(1):192-9.
4. Schwinn DA, Balsler JR. Anesthesiology physician scientists in academic medicine: a wake-up call. *Anesthesiology*. 2006;104(1):170-8.
5. Warner NS, Warner MA, Eldridge JS, et al. Factors influencing immediate post-residency career decisions for graduating anesthesiology residents. *J Educ Perioper Med*. 2018;20(1):E616.
6. Zaorsky NG, O'Brien E, Mardini J, et al. Publication productivity and academic rank in medicine: a systematic review and meta-analysis. *Acad Med*. 2020;95(8):1274-82.
7. Ford DK, Richman A, Mayes LM, Pagel PS, Bartels K. Progressive increase in scholarly productivity of new American Board of Anesthesiology diplomates from 2006 to 2016: a bibliometric analysis. *Anesth Analg*. 2019;128(4):796-801.
8. Kiefer JJ, Cartron A, Galvagno S, Mazzeffi MA. Contemporary academic contributions from anesthesiologists in adult critical care medicine. *Anesth Analg*. 2019;129(2):428-33.
9. Reich DL, Galati M, Krol M, Bodian CA, Kahn RA. A mission-based productivity compensation model for an academic anesthesiology department. *Anesth Analg*. 2008;107(6):1981-8.
10. Slocum AH, Spiegel JE. Technical communication: design and in vitro testing of a pressure-sensing syringe for endotracheal tube cuffs. *Anesth Analg*. 2012;114(5):967-71.

*continued on next page*

*continued from previous page*

11. Kwon AH, Slocum AH Jr, Varelmann D, Nabzdyk CGS, Team MEV. Rapidly scalable mechanical ventilator for the COVID-19 pandemic. *Intensive Care Med.* 2020;46(8):1642-4.
12. Kwon AH, Nabzdyk CS. Other specialties might have a GPS. *Anesth Analg.* 2017;125(6):2164-5.

The following authors are in the Department of Anesthesiology, Westchester Medical Center/New York Medical College, Valhalla, NY: **Albert H. Kwon** is an Assistant Professor of Anesthesiology and **Jeff L. Xu** is an Associate Professor of Anesthesiology, Program Director, Regional Anesthesiology & Acute Pain Medicine Fellowship, and Chief, Division of Regional Anesthesia & Acute Pain Management. The following authors are in the Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA: **Dirk Varelmann** is an Assistant Professor of Anesthesiology and **Sergey Karamnov** is an Instructor of Anesthesiology. **Alexander H. Slocum, Jr.** is a Plastic Surgery Resident (PGY4), Department of Plastic and Reconstructive Surgery, Medical College of Wisconsin, Wauwatosa, WI. **Leena K. Pradhan-Nabzdyk** is an Assistant Professor of Surgery, Frank W. LoGerfo, MD Division of Vascular and Endovascular Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, and CEO of Canomiks, Inc. The following authors are in the Department of Anesthesiology

and Perioperative Medicine, Mayo Clinic, Rochester, MN: **William J. Mauermann** is an Associate Professor of Anesthesiology, and Chair, Division of Cardiovascular and Thoracic Anesthesia; **Daniel R. Brown** is a Professor of Anesthesiology, and Chair, Division of Critical Care; **Carlos B. Mantilla** is a Professor of Anesthesiology, and Chairman, Department of Anesthesiology and Perioperative Medicine; and **Christoph G. S. Nabzdyk** is an Assistant Professor of Anesthesiology.

**Corresponding author:** Christoph G. S. Nabzdyk, MD, Dr med, Mayo College of Medicine and Science, Mayo Clinic, 220 First Street, Rochester, MN 55905. Telephone: (507) 422-1214, Fax: (507) 255-6463

**Email address:** Christoph G. S. Nabzdyk: Nabzdyk.Christoph@mayo.edu

**Disclosure:** This work in part is supported by National Institutes of Health (NIH) 5 T35 HL110843 and NIH 5T32 HL007734 to L.K.P.-N.