

of 100% oxygen during induction and emergence is standard practice for the vast majority of anesthesiologists, our study reflects the impact of high intraoperative inspired oxygen in actual practice.

The use of 100% oxygen for induction and emergence also likely had minimal effect on our results because the degree of atelectasis induced by administration of 100% oxygen for only a few minutes is relatively minor. As noted in our article, Edmark *et al.*<sup>2</sup> (which is reference number 3 in Dr. Nemergut's letter) found 1–20% atelectasis in subjects preoxygenated with 100% oxygen whereas Benoit *et al.*<sup>3</sup> found approximately 8% in subjects administered 100% oxygen for 10 min before emergence. Of note, in the preoxygenation study, volunteers in the 100% group were apneic for approximately twice as long (7 min *vs.* 3.5 min) before the measurement of atelectasis, which may have exaggerated the effect of 100% oxygen.

Dr. Nemergut notes that the degree of atelectasis cannot be quantified with oxygen titration, and we agree. Oxygen supplementation in our study was used as a safety measure to prevent hypoxemia, because supplemental oxygen can overcome the combined effects of atelectasis and hypoventilation. Although at sea level it is likely we could have safely obtained room air arterial oxygen saturation by pulse oximetry measurements in most subjects,<sup>4</sup> this is not the case at our hospital, which is at an altitude of approximately 4,700 feet (1,433 m). Barometric pressure averages 635 mmHg (85 kPa). During room air breathing at this pressure, even mild hypoventilation (arterial partial pressure of carbon dioxide ~ 45 mmHg), likely present in all patients in the Post-Anesthesia Care Unit, makes hypoxemia likely: alveolar partial pressure of oxygen =  $0.21(635-647) - 45/0.8 = 67$  mmHg.

Therefore, the requirement for supplemental oxygen in our subjects does not suggest greater than normal hypoventilation or unusual anesthetic management. As noted in our article, oxygen requirement was minimal in all but a handful of subjects, in whom more severe hypoventilation and worse preexisting lung function were common, but there was no relationship with intraoperative inspired oxygen concentration. Although supplemental oxygen interferes with detection of hypoventilation (but not hypoxemia) by pulse oximetry,<sup>4</sup> hypoventilation can be detected by other monitors, and low dose (<30%) supplemental oxygen provides a safety margin for postoperative patients<sup>5,6</sup> in whom atelectasis and hypoventilation are common and difficult to avoid completely.

In conclusion, despite some limitations, our published randomized controlled trial adds to the evidence supporting a lack of harm from brief exposures to inspired oxygen concentrations greater than 90%.

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## References

1. Mackintosh N, Gertsch MC, Hopf HW, Pace NL, White J, Morris R, Morrissey C, Wilding V, Herway S: High intraoperative inspired oxygen does not increase postoperative supplemental oxygen requirements. *ANESTHESIOLOGY* 2012; 117:271–9
2. Edmark L, Kostova-Aherdan K, Enlund M, Hedenstierna G: Optimal oxygen concentration during induction of general anesthesia. *ANESTHESIOLOGY* 2003; 98:28–33
3. Benoit Z, Wicky S, Fischer JF, Frascarolo P, Chapuis C, Spahn DR, Magnusson L: The effect of increased FIO<sub>2</sub> before tracheal extubation on postoperative atelectasis. *Anesth Analg* 2002; 95:1777–81
4. Fu ES, Downs JB, Schweiger JW, Miguel RV, Smith RA: Supplemental oxygen impairs detection of hypoventilation by pulse oximetry. *Chest* 2004; 126:1552–8
5. Stone JG, Cozine KA, Wald A: Nocturnal oxygenation during patient-controlled analgesia. *Anesth Analg* 1999; 89:104–10
6. Govinda R, Kasuya Y, Bala E, Mahboobi R, Devarajan J, Sessler DI, Akca O: Early postoperative subcutaneous tissue oxygen predicts surgical site infection. *Anesth Analg* 2010; 111:946–52

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## Resident Research and Graduate Medical Education Funding

### To the Editor:

I sincerely enjoyed the recent article by de Oliveira *et al.*, which analyzed various factors associated with successfully matching to a residency in anesthesiology.<sup>1</sup> I also enjoyed the accompanying Editorial, written by four academic leaders in our specialty.<sup>2</sup> I strongly agree with the editorialists' sentiment that the future of anesthesiology must be built upon scholarly investigation into the basic and clinical sciences.

As the editorialists do not specifically articulate it, it is important to remind the readers of the complex process by which Graduate Medical Education is funded in the United States and how this process may affect research during residency training. The Center for Medicare & Medicaid Services (CMS) makes two types of Graduate Medical Education payments to support residency programs and teaching hospitals. Direct Graduate Medical Education payments compensate teaching institutions for costs directly related to resident education (*e.g.*, resident salaries). Indirect Medical Education payments are intended to compensate teaching hospitals for higher inpatient costs and are calculated as a percentage add-on to basic Medicare per case diagnosis-related group payments. In 2011, CMS Direct Graduate Medical Education and Indirect Medical Education payments totaled approximately \$3 billion and \$6.5 billion, respectively.

To the surprise of many, CMS does not automatically continue to fund a resident if he/she decides to participate in research during the course of residency training. In

August 2001, CMS indicated that it would exclude residents in the Indirect Medical Education count “to the extent that the residents are not involved in furnishing patient care but are instead engaged exclusively in research.” Further, CMS policy allows a resident to be counted for Direct Graduate Medical Education *only if the resident is engaged in research that occurs in the hospital* (but not in the nonhospital setting). The points were explicitly stated in section 5505 of the 2010 Patient Protection and Affordable Care Act (Public Law 111–148, Section 5505).

Thus, as residency positions are explicitly funded by CMS for clinical training, the lack of association between applicants’ prior scholarly production and a successful residency match, as observed by the authors, is not surprising. Residencies are not funded or intended for research. Similarly, one would not expect clinical experience to count as much as research productivity for positions explicitly funded for research (*e.g.*, research fellowships).

As pressure for reform of Graduate Medical Education financing mounts, both departments and teaching hospitals may find it increasingly difficult to provide residents with protected time for research.<sup>3,4</sup> Several departments have developed programs designed to support residents interested in an academic career. As implied in the Editorial, many of these programs specifically have National Institutes of Health (Bethesda, MD) Funding (often as part of a T32 research training grant). Unfortunately, the vast majority of residency training programs do not have these opportunities available. As the future of anesthesiology is dependent upon our ability to recruit and train not only talented clinicians but also tomorrow’s independent investigators, I hope that more departments work to expand the number of funded research positions.

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## References

1. de Oliveira GS Jr, Akikwala T, Kendall MC, Fitzgerald PC, Sullivan JT, Zell C, McCarthy RJ: Factors affecting admission to anesthesiology residency in the United States: Choosing the future of our specialty. *ANESTHESIOLOGY* 2012; 117:243–51
2. Fleisher LA, Evers AS, Wiener-Kronish J, Ulatowski JA: What are we looking for? The question of resident selection. *ANESTHESIOLOGY* 2012; 117:230–1
3. Iglehart JK: The uncertain future of Medicare and graduate medical education. *N Engl J Med* 2011; 365:1340–5
4. Iglehart JK: Financing graduate medical education—mounting pressure for reform. *N Engl J Med* 2012; 366:1562–3

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## Ensuring Future Academic Anesthesiologists: A Matter of Recruiting “The Best” Residents?

*To the Editor:*

In their Editorial View regarding the selection among applicants for U.S. anesthesia residencies, Fleisher *et al.*<sup>1</sup> raise the question “are we recruiting the wrong applicants if we desire the training of more physician scientists for the future?” They briefly acknowledge that all programs want foremost to train applicants who will become competent clinicians, demonstrate professionalism, and reflect well on the specialty. Beyond that, however, they focus on a concern that we are *failing to recruit* candidates destined to become academic anesthesiologists. They conclude, “If there is a flaw in the recruitment of research-oriented residents, it lies in our ability to attract the best applicants, not in our selection process.” Recent troubles in medical academia, however, could suggest an alternative view: that the failure to produce academically oriented anesthesiologists, has less to do with the aptitude and character of selected applicants, and more to do with unsavory aspects of the current culture within U.S. academic medicine.

A contemporary survey of established medical faculty found 21% considering leaving academics.<sup>2</sup> Relevant predictors of such intent were “feeling unconnected to colleagues, moral distress, perception of the culture being at times unethical, and feelings of being adversely changed by the culture.” Could it be that our residents, perceiving an ethically challenged environment, choose not to pursue creative impulses toward research or teaching, which might have flourished under a different model?

Arguably, recent changes in the goals and reward system of U.S. academic medicine have degraded its culture, and thus its appeal to idealistic potential future scholars. Among these changes are (1) the corporatization of U.S. academic medical centers, (2) the marketization of academic and clinical performance recognition, and (3) the increasing privatization of funding for clinical research. Accordingly, the mission of U.S. academic hospitals has shifted from providing care for all comers, to a morally questionable health-care-for-profit motivated endeavor.<sup>3</sup> Similarly, academic physicians, previously motivated by a culture placing highest value on clinical skill, masterful teaching, and scientific curiosity, are now accustomed to an intradepartmentally competitive “relative value units” system whereby each grant award, publication, patent, or clinical effort is driven by financial remuneration and increments of professional status.<sup>4</sup> Finally, a plurality of clinical research, historically funded publicly or by intramural sources, is now funded more often by industry, and thus is tainted by perceived, and often real, conflicts of interest.<sup>5</sup>