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Original Research

Critical Appraisal of Anesthesiology Educational Research for 2019

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Introduction

This is the third iteration of an annual project to review the anesthesiology education literature published over the year and highlight the top research articles that are notable for their rigorous design, innovation, and/or their relevance to those who work in anesthesiology education.[1,2] The concept for this series is based on another critical appraisal of education literature conducted in the field of emergency medicine.[3]

Through this investigation, we hope to shine a light on the type of research done in anesthesiology education and report trends in the literature. Through an analysis of trends in topics, study design, and other elements of the research, we can, as a specialty, work toward making changes and pushing the field forward. Our authors, comprising anesthesiologists, experts in medical education, and a medical librarian, implemented a study to identify the articles published in 2019 on education in anesthesiology, rate them, and create a list of articles that represent the best of what we read.

Materials and Methods

Article Identification

These methods replicate those of the first 2 critical appraisals in this series that reviewed the literature from 2017 and 2018.[1,2] Much of the description of the study methodology has been added here verbatim, with this year's modifications to allow readers to easily evaluate the methods.

To identify all articles in anesthesiology education, a medical librarian (MM) searched 3 Ovid MEDLINE databases (MEDLINE, In-Process and Other Non-Indexed Citations, Epub Ahead of Print), Embase.com, ERIC (via FirstSearch), PsycINFO (via EBSCOhost), and PubMed. These databases were selected to cast a suitable net over the health sciences, education, and psychology literature. Each search consisted of a set of anesthesiology and education terms. Appropriate controlled terms were used in MEDLINE, Embase, PubMed, and ERIC, and supplemented with a search of article title and abstract keywords. The PsycINFO search relied entirely on article title and abstract. A secondary approach to capture relevant studies involved searches of PubMed that targeted (1) education papers published in anesthesiology journals, and (2) anesthesiology-related papers published in medical education journals. All searches were initially run on March 6, 2020, to allow time for studies published in 2019 to be indexed. Animal and non-English studies were excluded from the search results, and all searches were limited to publication year 2019 with 2020 publications pre-printed in 2019 excluded. The Ovid MEDLINE search is available in Table 1. All reproducible searches are included in Appendix A. Endnote X20 (Clarivate Analytics) was used to remove duplicates.

In addition, on August 5, 2020, we conducted a manual review of the highest impact factor journals in both the fields of anesthesiology and medical education, as identified in Journal Citation Reports (Clarivate Analytics) and accessed through PubMed, to ensure that our searches did not exclude relevant articles. For medical education, the list included *Academic Medicine*, *Medical Education*, *Advances in Health Sciences Education*, *Medical Teacher*, and *Simulation in Healthcare*. For anesthesiology, the list included *Anesthesiology*, *Anesthesia & Analgesia*, and *British Journal of Anaesthesia*. In this manual search, we also included the *Journal of Education in Perioperative Medicine* due to its focus on medical education in anesthesiology.

Inclusion and Exclusion Criteria

We followed the same inclusion and exclusion criteria used by Heitz et al.[3] in the critical appraisal of research in education in emergency medicine and in previous years' critical appraisals of research in anesthesiology education.[1–3] We included all levels of learners (students, residents/fellows, and practicing clinicians) and articles applicable to physicians, nurses, and other providers in the field of anesthesiology. Studies were defined as hypothesis-testing investigations, evaluations of education interventions, or explorations of educational problems.[3] Publications were excluded if they were (1) not studies (editorials, commentaries), (2) short reports that lacked enough information to be evaluated, (3) not relevant to anesthesiology learners, (4) single-site

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survey studies, or (5) studies that examined outcomes limited to an expected learning effect without a comparison group.[3]

Data Collection

To create the list of articles to be included in the critical appraisal, one author (LZ) reviewed all abstracts and applied the inclusion and exclusion criteria. Abstracts unrelated to education or anesthesiology were excluded without further review. This included abstracts focused on clinical topics such as patient education and clinical research. All other abstracts were also divided into 2 separate lists. Two additional authors, (AG, FC), were each assigned 1 list and independently applied the inclusion and exclusion criteria to their assigned abstracts. If the initial reviewer (LZ) and the second reviewer (AG or FC) agreed that the article should be excluded, the article was excluded. Differences of opinion were reconciled by a third reviewer (AG or FC) who was not initially assigned the abstract. The list of articles and abstracts was maintained in a Microsoft Excel 2016 database.

Scoring

The quantitative and qualitative scoring rubrics developed by Heitz et al.[3] were used to score each article with the addition of a question that asked about the reviewers' overall impressions of the articles. Because all reviewers who participated in the 2017 and 2018 reviews also participated in this review, we did not conduct an additional training, but communicated common questions and reminded reviewers of the process over email and individual calls as necessary. In addition, 3 authors (AG, FC, LZ) were each assigned a list of articles to document funding, setting, study topic, study purpose, and learner group. The categories and the options under each category were selected based on the initial study by Heitz et al.,[3] a review of the top-cited articles in anesthesiology education, and data collected from previous years' critical appraisal articles.[1–4] These additional questions and the questions for coding can be found in Appendix B. Two authors (AG, LZ), who have expertise in qualitative research methods, scored all qualitative articles. Each item was discussed, and the 2 authors (AG, LZ) agreed on scoring. Tables 2 and 3 show the scoring rubrics used for the quantitative and qualitative articles respectively. Both rubrics allowed for scores ranging from 1 to 25, with a highest possible score set to 25 to make the scores comparable despite the difference in study type. In addition, a final question asked reviewers to rate each article on a scale from 1 to 10. This is an open scale that was meant to capture the reviewers' overall impression of the article based on their professional opinion. The averages of the 3 scores for each article based on the scoring rubric and the overall impression question were calculated to develop the highlighted list.

Unlike previous years, the top articles are determined based on the full scoring rubric and the reviewers' overall impression score. This allows for a balance in articles that have rigorous research and the articles that our authors, all experts in anesthesiology education, find compelling.

For the quantitative articles that met inclusion criteria, each article was randomly assigned to 3 of the 7 author raters. Each author independently scored on average 33 to 34 articles. Qualtrics (2019) was used to capture all scoring data, which then was exported into Excel 2016 for analysis. Mean scores were calculated through Excel 2016 and the articles with the top mean scores were selected. Interrater reliability was assessed with intraclass correlation coefficient (ICC) using a 1-way random-effect model in SPSS 26.0. Because this study did not involve human subjects, institutional review board approval was not sought.

Results

The initial search criteria identified a total of 1047 unique citations. Sixty-two quantitative and 8 qualitative articles met the inclusion criteria. For the manual review, 1327 unique citations were identified, but no additional articles met the inclusion criteria. See Appendix C for the full list of articles. Interrater reliability was assessed with ICC in terms of consistency using a 1-way random-effect model in SPSS 26.0. ICC found an average measure of ICC(1) = 0.82 (95% confidence interval: 0.73–0.89) for all quantitative study articles (n = 62) scored. Table 4 summarizes the characteristics of these 70 papers. Table 5 summarizes the scores of the quantitative and qualitative articles.

To facilitate easy access to the top-rated articles, an annotated bibliography of the top 6 quantitative papers based on the scoring rubric, the top 6 quantitative papers based on the reviewers' impression score, and the top 2 qualitative papers are listed as follows.

Top 6 Quantitative Papers Based on Scoring Rubric

Ambardekar AP, Black S, Singh D, et al. The impact of simulation-based medical education on resident management of emergencies in pediatric anesthesiology. Pediatric Anesthesia. 2019;29(7):753–759.[5]

Description. The objective of this study was to evaluate the impact of a simulation curriculum on anesthesiology resident performance during the management of crises in the pediatric operating room (OR). The randomized, crossover prospective study design is notable, and the study implies that simulation, regardless of its timing during the rotation, can impact residents' performance during these emergency situations.

Significance. Even though this study used a rigorous design to evaluate the effectiveness of the intervention, the conclusions of its impact do not conclusively point to the simulation training as the reason for the improvements. The improvements could have been the result of learning on the rotation and/or the assessment itself. There was insufficient information provided by the authors about the other training received to appropriately evaluate the study.

Ambardekar AP, Rosero EB, Bhoja R, et al. A randomized controlled trial comparing learners' decision-making, anxiety, and task load during a simulated airway crisis using two difficult airway aids. Simulation in Healthcare. 2019;14(2):96–103.[6]

Description. The objective of this study was to investigate a simplified approach for difficult airway scenarios. Results demonstrated that although learners had similar levels of anxiety and cognitive load using both the American Society of Anesthesiologists difficult airway algorithm and simplified Vortex model, performance

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scores were higher using the simplified approach.

Significance. Simplified approaches to emergency management hold the keys to improved clinical performances in early trainees. Further research could investigate at what point and in what context more complex algorithms are helpful.

Katz D, Blasius K, Isaak R, et al. Exposure to incivility hinders clinical performance in a simulated operative crisis. BMJ Quality & Safety. 2019;28(9):750–757.[7]

Description. This study demonstrated that incivility influenced anesthesiology resident performance during a standardized simulation scenario, but did not influence self-assessed performance. This is a multicenter, prospective, randomized control trial from 3 academic medical centers that exposed residents to normal or "rude" environments to evaluate technical and nontechnical performance.

Significance. Incivility can play a major role in OR environment stress. The fact that self-assessment scores did not show the same lapse in performance demonstrates the difficulty in providers' recognition of the detrimental impact of incivility.

Juve AKM, Kirsch JR. Does participation in written guided reflective practice exercises affect readiness for self-directed learning in a sample of US anesthesiology residents? The Journal of Education in Perioperative Medicine: JEPM. 2019;21(2):E622.[8]

Description. This study showed that an 8-week reflective practice did not influence the readiness for self-directed learning measured by Guglielmino's Self-Directed Learning Readiness Scale/Learning Preference Assessment in a sample of anesthesiology residents from 3 US residency programs.

Significance. Although this study did not demonstrate a statistically significant difference in performance on self-directed learning measures, the findings are not conclusive because there are multiple issues that come with conducting a study like this. Although written reflective practice can theoretically improve performance in self-directed learners, residents may feel burdened with this practice given already long clinical hours and may not have much room to benefit from the practice given the high pretest scoring at baseline.

Musits AN, Phrampus PE, Lutz JW, et al. Physician versus non-physician instruction: evaluating an expert curriculum-competent facilitator model for simulation-based central venous catheter training. Simulation in Healthcare. 2019;14(4):228–234.[9]

Description. In this paper, nonphysician competent facilitators instructing central venous catheter placement were studied in a noninferior approach compared with instruction from attending physicians. No difference was found in performance or course satisfaction when comparing the 2 types of instructors.

Significance. Attending physicians are limited and oftentimes expensive resources both from a time and fiscal standpoint. In addition, the reality of clinical training involves the informal teaching of residents by nurses and other nonphysicians particularly early in their medical education. Although the need for physicians to teach physicians is fundamental to the apprenticeship model of medical education, a culture promoting a philosophical approach in which physicians can learn exclusively from other physicians may exclude other excellent teachers from the process.

Nixon HC, Stariha J, Farrer J, et al. Resident competency and proficiency in combined spinal–epidural catheter placement is improved using a computer-enhanced visual learning program: a randomized controlled trial. Anesthesia & Analgesia. 2019;128(5):999–1004.[10]

Description. This study evaluated a web-based tool (computer-enhanced visual learning [CEVL]) to enhance trainee proficiency in combined spinal–epidural catheter placement in obstetric patients. This 2-center, randomized controlled trial showed that anesthesiology residents who used the web-based tool had significantly shorter mean procedure times and higher overall checklist performance on their first attempts.

Significance. Web-based learning interventions play an essential role in the development of competent trainees. Because of the pandemic and social-distancing guidelines, as well as optimizing remote-based learning, this learning tool helps to demonstrate the value that web-based learning can play in the training of residents.

Top 6 Quantitative Papers Based on Reviewers' Impression

Burnett G, Goldberg A, DeMaria S Jr, Levine A, Katz D. Knowledge retention after simulated crisis: importance of independent practice and simulated mortality. British Journal of Anaesthesia. 2019;123(1):81–87.[11]

Description. The objective of this study was to compare the effect of independent practice versus potential simulated mortality to determine which is more important to knowledge retention at 6 months. Results found that the group that had both independent practice and the possibility of mortality had the highest total treatment score, fastest time to treatment, and lowest mortality rate compared with all groups in managing a different case 6 months later.

Significance. Independence and potential mortality in simulation have a greater impact on performance in follow-up simulations when combined than either factor alone. This further adds to the literature on the positive impact of allowing the possibility of mortality in simulation and confirms the need for learners to make independent decisions to optimize learning.

Sun H, Warner DO, Macario A, et al. Repeated cross-sectional surveys of burnout, distress, and depression among anesthesiology residents and first-year graduates. Anesthesiology. 2019;131(3):668–677.[12]

Description. This repeated cross-sectional survey study showed that 50% of anesthesiologists who entered training from 2013 to 2016 experienced burnout, one-third experienced distress, and 1 in 8 screened positive for depression. Third-year clinical anesthesiology residents had a higher prevalence of burnout and distress.

Significance. This manuscript confirms a higher prevalence of burnout, distress, and depression for anesthesiology trainees than the general population and higher prevalence than trainees in other specialties. This study is part of an ongoing project called the American Board of

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Anesthesiology Survey Project, which was established in 2013 and gathers data among anesthesiologists in training and first year of practice. Although the response rate was fewer than 40%, the ability to survey anesthesiologists in training throughout their education from a variety of programs across the nation allows for continuous data collection of these important metrics, which is an essential first step to implementing changes. We cannot change what we do not measure, and we will only know if changes are effective through the analysis of these types of data.

Rebel A, DiLorenzo A, Nguyen D, et al. Should objective structured clinical examinations assist the clinical competency committee in assigning anesthesiology milestones competency? Anesthesia & Analgesia. 2019;129(1):226–234.[13]

Description. This study looked at the difference in assessment scores of resident performance as measured through Objective Structured Clinical Examinations (OSCEs) versus Clinical Competency Committee (CCC) milestones. The authors found that although both assessment methods showed resident growth, the CCC milestones were higher than the OSCE scores and that the CCC milestone scores correlated more closely with the resident's year of training.

Significance. With the addition of the OSCEs as part of board certification, more data about the validity of this method of assessment have become available. As programs implement OSCE practice sessions for residents to prepare for their certifying examinations, it is a natural progression to think about how we can use this method for a more robust assessment of performance while residents are in training. This study demonstrates the potential bias that can exist with current assessment methods used by CCCs and notes the possible benefit of diversifying methods by adding OSCE assessments.

Haydar B, Baker K, Schwartz AJ, Ambardekar AP. Academic anesthesiologists perceive significant internal barriers to intraoperative teaching in a cross-sectional survey. The Journal of Education in Perioperative Medicine: JEPM. 2019;21(1):E628.[14]

Description. This study sought to establish the most significant external and internal barriers to intraoperative teaching among faculty at 4 tertiary academic medical centers. Although the study confirmed production pressures as a significant external barrier to intraoperative teaching, which was expected, internal barriers, like self-efficacy, also affected teaching and were surprisingly common. In addition, the study showed that faculty with primarily clinical appointments felt that the environment was less supportive of teaching, which may be due to more exposure to production pressures of daily practice.

Significance. Although this study surveyed only 4 departments, there are some general findings that can help inform policies meant to promote teaching. For example, because faculty who have more clinical responsibilities were less likely to feel that the environment was supportive of teaching, departments may want to consider a different balance of clinical and nonclinical responsibilities in their efforts to promote teaching. In addition, the perceived significant internal barriers to intraoperative teaching demonstrate that improving self-efficacy in teaching and providing feedback are integral to promoting trainee teaching.

Rochlen LR, Malloy KM, Chang H, et al. Pilot one-hour multidisciplinary team training simulation intervention in the operating room improves team nontechnical skills. The Journal of Education in Perioperative Medicine: JEPM. 2019;21(2):E624.[15]

Description. This study measured the effectiveness of a short, in situ, simulated team training to improve nontechnical skills. Improvements in nontechnical skills were measured through surveys and observations of teams during a clinical day in the OR while taking care of patients. Participants found the intervention helpful and felt that the team performed better after the intervention. In addition, observations of the teams after the training in the OR during a normal day of cases showed improvements in nontechnical skills specifically associated with leadership and management when compared with teams that did not receive the training.

Significance. This study demonstrates that even short simulation trainings with the OR team can improve communication and teamwork measured through a validated observation tool. By holding the team training during time normally set aside for Grand Rounds, participation in the training was not an additional burden to the team members and all team members, including surgery, anesthesiology, and nursing, were able to participate in the training before they started cases for the day. Also notable is the use of direct observation in the OR to assess the impact on the care delivered to actual patients. Although we know the importance of team trainings, this pilot project provides an example of how to overcome the most common barriers to implementing such training, which is coordination of time and resources for all team members to be able to attend.

Wolpaw JT, Scher L, Smith S, et al. (2019). Assessing the impact of powerful experiences during anesthesia residency training. The Journal of Education in Perioperative Medicine: JEPM. 2019;21(3):E628.[16]

Description. In this study, the authors surveyed anesthesiology residents from 1 program to measure the frequency and type of formative events that affect resident well-being. The most impactful events included leaving work earlier than expected, a patient expresses gratitude, identifying a faculty role model, and having a patient die.

Significance. The study details commonly experienced formative events that have the greatest impact on resident well-being. Understanding these formative events can help program leadership to offer additional support during negative events. In addition, autonomy, positive feedback, time away from work, and positive relationships were valued among medical trainees and could provide opportunities for program leadership to focus on improvements in these areas.

Top Qualitative Article Based on Scoring Sheet

Wainwright E, Looseley A, Mouton R, et al., SWeAT Study Investigator Group. Stress, burnout, depression and work satisfaction among UK anaesthetic trainees: a qualitative analysis of in-depth participant interviews in the Satisfaction and Wellbeing in Anaesthetic Training study. Anaesthesia. 2019;74(10):1240–1251.[17]

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Description. This qualitative study was a follow-up to a quantitative well-being survey of UK anesthesiology trainees. "Factors enabling work satisfaction were patient contact; the privilege of enabling good patient outcomes; and strong support at home and work. Stressors were demanding non-clinical work-loads; exhaustion from multiple commitments; a 'love/hate' relationship, as trainees value clinical work but find the training burden immense; feeling 'on edge', even unsafe at work; and the changing way society sees doctors."

Significance. This is an exploration into the supportive aspects that can help protect residents from burnout, depression, stress, and low work satisfaction, and the manifestations of burnout risks. Although the study focuses on issues in the UK system, there are commonalities in programs in similar systems.

Top Qualitative Article Based on Reviewers' Impression

Brazil V, Purdy E, Alexander C, Matulich J. Improving the relational aspects of trauma care through translational simulation. Advances in Simulation. 2019;4(1):1–10.[18]

Description. This qualitative study aims to understand how trauma simulation is perceived by trauma care providers to influence their relationships with others and to identify those aspects of the simulation experience contributing to relational outcomes. By using Relational Coordination (RC) theory as a framework, the authors were able to establish that simulation affects the relationships and culture of groups working within a health care organization.

Significance. This study is an excellent example of qualitative research that can be used by researchers hoping to use qualitative methods or simulation educators who want to focus on improving culture. Deeply embedded in theory, the study uses RC as a framework to further explore the impact of simulation on the culture of teams. The framework can be used by educators to focus simulation experience and debriefs on how to provide care that is based on shared knowledge, shared goals, and mutual respect in the context of communication that is timely, accurate, frequent, and problem-solving based.

Discussion

As the third installment of this series, this paper adds to our annual assessment of anesthesiology education literature. The top 12 articles include multiple research designs, cover a variety of topics, and can be used to explore the different types of educational research being conducted in the field over the year.

Originally, our goal was to objectively highlight well-designed studies in the field of anesthesiology education during the year reviewed. We wanted to emphasize the use of evidence-based practice in medical education and highlight articles with the strongest designs. In addition, we felt that by focusing on rigorous design, we could expose developing researchers to the types of designs available and promote quality research in the areas of anesthesiology education. Last, we hoped that by focusing on more objective measures of quality we could decrease the bias innate in the critical appraisal process. However, after reviewing the list of articles from this object list, we realized that we could use our expert assessment to highlight more compelling articles by using the overall impression score for half of the highlighted articles and the scoring rubric for the other half. So, in addition to the goal of highlighting rigorous study design, we have expanded our goal to highlight articles that our anesthesiology education experts found particularly interesting and could influence the practice of educators working in the field.

When the top-scored articles based on the scoring rubric are compared with the articles highlighted based on the reviewers' overall impressions, interesting trends emerged. None of the articles met the criteria for inclusion in both lists. Therefore, the articles that were rated as the most rigorous were not the most interesting to our reviewers. It is possible that this bias may be due to the preference for studies that use random assignment of participants within our tool.

As noted in the past 2 years' reviews, 23% (23 of 101) of all articles used random assignment to groups.[1] This year, a similar trend existed with 24% (17 of 70) of manuscripts using randomization and, not surprisingly, 58% (7 of 12) of the highlighted articles included randomized design, which included all the articles that were in the top because of the scoring rubric. Although previously we saw this as a measure of the quality of the research conducted for anesthesiology education, the tool grants additional points for using this design, a perspective congruent with the perception of randomized controlled trials as the "gold standard" of clinical research. The use of randomization is an important way to reduce certain biases from confounding variables; however, it cannot control for other elements that can influence the outcomes considering the complexity of environments, interventions, and subjects.[19] The studies that developed this tool were focused on evaluating medical education research,[3] and because of the connection to medicine, it is only natural that the bias toward associating rigor with randomization would carry over into the evaluation of educational studies.

Although this is understandable, it does create problems. As Dr. Sullivan[19] wrote in her editorial, *Getting Off the "Gold Standard": Randomized Controlled Trials and Education Research*, randomization is generally not the appropriate methodology for medical education research. However, because so much of the research done in medical education is conducted by physicians or other providers who have been taught the scientific method through a clinical lens, studies are sometimes contorted to fit the randomized controlled trial design without considering the other sources of bias or the complexity of the context or the intervention.

In addition, although there were 2 studies in the top 6 articles of the scoring rubric group that focused on procedural skills, articles in the list based on the overall impression score focused more on nontechnical skills, wellness, and emotional elements of practice. Although we are always looking for ways to improve the teaching of procedural skills and these types of studies can more easily translate to randomized controlled trials, these studies generally had lower overall impression scores.

There is an emphasis on residency

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education in the anesthesiology education literature, with less of a focus on continuing education, education for all members of the anesthesiology team, including nurses, and medical students. As anesthesiology is not a core required rotation for many medical students,[20] it is understandable why there would be a gap in studies about this topic. However, with issues of recruiting medical students into the specialty, especially recruiting underrepresented minorities, this might be an area in which further investigation is needed.[20,21]

We also wanted to note the lack of studies that included information about underrepresented minorities in medicine or health care disparities. Although we do not expect all articles to focus on these topics, we did notice that there were opportunities to include diversity, equity, or inclusion in certain study designs. For example, the study that looked at rates of depression, burnout, and distress in trainees also could have looked at race, ethnicity, and gender as confounding variables.[12] This is a major concern for academic medicine. As early as 2012, there have been calls for medical education research to fully account for how the intersectionality of social identities affects the success of underrepresented minority groups.[22] In addition, in February 2018, the Accreditation Council for Graduate Medical Education recognized that increasing the diversity of trainees through recruitment efforts is only 1 part of the solution to achieving a more diverse workforce. Efforts need to be made to "assess current data…as it pertains to experiences of diverse trainees to establish whether there are particular risks to learning and well-being."[23] Although all of academic medicine needs to be actively working to improve the diversity, equity, and inclusion of medical education, anesthesiology residency and fellowship programs have more work to do, as they have not shown the same gains in the recruitment and retention of underrepresented minorities as undergraduate medical education or other specialties.[21] A recent review of best practices to improve recruitment and retention of underrepresented minorities in medicine particularly focused on the perioperative setting highlighting case studies to demonstrate positive retention strategies because of a lack of research focused on this issue.[24] With more journals calling for inclusion in medical research in general, we must consider similar concerns in medical education research.[25] An important first step would be the inclusion of gender, race, and ethnicity whenever applicable in our studies as well. [22,23]

This study is not without limitations. As we have discussed previously, the rating tool favors certain study designs, which does introduce some bias. In addition, as a critical appraisal, there is inherent bias present in the use of expert reviewers. The interrater reliability of our assessments using the rating tool was high, demonstrating relative agreement among our individual appraisals of each paper. We included a medical librarian (MM) on our team to ensure rigor in search strategies; however, it is possible that the search strategy may have excluded articles published that fit our inclusion criteria.

We hope that the critical appraisal continues to be a useful tool for those working in anesthesiology education. In the future, we plan to compile the results of this research over time to analyze trends and themes to help researchers better understand our field and the types of studies we produce and hopefully inspire interventions to improve the quality of that research.

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Abstract

Background: This study reviews and appraises the articles published about anesthesiology education in 2019. Through this critical appraisal, those interested in anesthesiology education are able to quickly review literature published during this year and explore innovative ways to improve education for all those involved in the practice of anesthesiology.

Methods: Three Ovid MEDLINE databases, Embase.com, ERIC, and PsycINFO were searched followed by a manual review of articles published in the highest impact factor journals in both the fields of anesthesiology and medical education. Abstracts were double-screened and quantitative articles were subsequently scored by 3 randomly assigned raters. Qualitative studies were scored by 2 raters. Two different rubrics were used for scoring quantitative and qualitative studies; both allowed for scores ranging from 1 to 25. In addition, reviewers rated each article on its overall quality to create an additional list of top articles based solely on the opinion of the reviewers.

Results: A total of 2374 unique citations were identified through the search criteria and the manual review. Of those, 70 articles met the inclusion criteria (62 quantitative and 8 qualitative). The top 12 quantitative papers and the top 2 qualitative papers with the highest scores were reported and summarized.

Conclusions: This critical appraisal continues to be a useful tool for those working in anesthesiology education by highlighting the best research articles published over the year. Highlighting trends in medical education research in anesthesiology can help those in the field to think critically about the direction of this type of research.

Keywords: Medical education, bibliometric, anesthesiology

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Tables

***Table 1**. Database Search Used in Ovid MEDLINE*

1	(exp anesthesiology/ or exp anesthetists/ or (anesthe* or anaesthe*).tw.) and (exp education/ or education.sh. or (academic* or class or classes or course* or curricul* or educat* or fellow or fellows or fellowship or instruct* or intern or interns or internship or learn or learner or learning or lesson* or resident or residents or residenc* or school* or student* or teach* or train* or workshop*).ti.) and english.la.
2	limit 1 to yr="2019"

***Table 2.** Quantitative Scoring Rubric*

Domain	Item	Item score	Max score 25
Introduction *(select all that apply)*			3
	Appropriate description of background literature	1	
	Clearly frame the problem	1	
	Clear objective/hypothesis	1	
Measurement			2
1. Methodology *(select one)*			
	Has no pretest or post-test	1	
	Has a post-test only (If has a pretest do NOT select)	1	
	Has a pretest and a post-test	2	
2. Groups *(select all that apply)*			2
	Both experimental and control group	1	
	Random assignment to groups	1	
Data collection			2
1. Institutions *(select one) Number of institutions refers to origin of study participants (not study authors)*			2
	1 institution	0	
	2 institutions	1	
	3 or more institutions	2	
2. Response rate *(select one)* *-Response rate is the proportion of those eligible who completed follow-up assessment.* *-Use "N/A" only if a response rate truly does not apply (eg, data obtained from a medical record or professional organization database).*			2
	<50% or not reported:	0	
	50%–74%	1	
	≥75%	2	
	N/A	0	

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Data analysis			
1. Appropriateness *(select one) Considered "0" if there is statistical error or if authors failed to analyze data*			1
	Data analysis inappropriate for study design/type of data	0	
	Data analysis appropriate for study design and type of data	1	
2. Sophistication *(select all that apply)* (*Any test of statistical inference is considered "beyond descriptive.")*			2
	Descriptive analysis only	0	
	Beyond descriptive analysis	1	
	Includes power analysis	1	
Discussion *(select all that apply)*			3
	Data support conclusion	1	
	Conclusion clearly addresses hypothesis/objective	1	
	Conclusions placed in context of literature	1	
Limitations *(select one)*			2
	Limitations not identified accurately	0	
	Some limitations identified	1	
	Limitations well addressed	2	
Innovation of project *(select one)*			2
	Previously described methods	0	
	New use for known assessment/intervention	1	
	New assessment/intervention methodology	2	
Relevance of project *(select one)*			2
	Impractical to most programs	0	
	Relevant to some	1	
	Relevant to many programs	2	
Clarity of writing *(select one)*			2
	Unsatisfactory	0	
	Fair	1	
	Excellent	2	
Total			25
Overall, how would you rate this article? This should take into consideration your overall feelings about the article. If you were to recommend that people read something good from this year, would you recommend this article? Is it relevant, well-done, innovative?			1–10

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Tables *continued*

Table 3. Qualitative Scoring Rubric

Domain	Item	Item Score	Max Score
Introduction *(select all that apply)*			3
	Appropriate description of background literature	1	
	Clearly frame the problem	1	
	Clear objective/hypothesis	1	
Measurement			3
1. Methodology *(select all that apply)*			
	Appropriate for study question	1	
2. Sampling of participants *(select all that apply)*			
	Appropriate study population	1	
	Enrolled full range of cases/settings beyond convenience	1	
Data Collection			3
1. Institutions *(select one) Number of institutions refers to origin of study participants (not study authors)*			
	1 institution	0	
	2 institutions	1	
	3 or more institutions	2	
2. Sample size determination *(select one)*			
	Appropriate sample size determination	1	
Data analysis *(select all that apply)*			5
	Clear, reproducible "audit trail" documenting systematic procedure for analysis	1	
	Data saturation through a systematic iterative process of analysis	1	
	Addressed contradictory responses	1	
	Incorporated validation strategies (eg, member checking, triangulation)	1	
	Addressed reflexivity (impact of researcher's background, position, biases on study)	1	
Discussion *(select all that apply)*			3
	Data support conclusion	1	
	Conclusion clearly addresses hypothesis/objective	1	
	Conclusions placed in context of literature	1	
Limitations *(select one)*			2
	Limitations not identified accurately	0	
	Some limitations identified	1	
	Limitations well addressed	2	

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Tables *continued*

Innovation of project *(select one)*			2
	Previously described methods	0	
	New use for known assessment/intervention	1	
	New assessment/intervention methodology	2	
Relevance of project *(select one)*			2
	Impractical to most programs	0	
	Relevant to some	1	
	Relevant to many programs	2	
Clarity of writing *(select one)*			2
	Unsatisfactory	0	
	Fair	1	
	Excellent	2	
Total			25
Overall, how would you rate this article? This should take into consideration your overall feelings about the article. If you were to recommend that people read something good from this year, would you recommend this article? Is it relevant, well-done, innovative?			1–10

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Tables *continued*

Table 4. *Trends for all reviewed manuscripts in Anesthesiology Education for 2019*

Variable	All Publications (n = 70)		Highlighted (n = 14)	
	%	n	%	n
External funding	36	25	21	3
Main setting *(Manuscripts could cover more than 1 group)*				
Data from nonclinical settings *(Surveys, assessment of nonclinical environments)*	51	36	36	5
Simulation	41	29	64	9
Clinical setting	7	5	0	0
Classroom setting	4	3	7	1
Purpose of the study				
Assessment of learner	34	24	21	3
Teaching methods	34	24	50	7
Program/intervention evaluation	16	11	7	1
Assessment of environment	10	7	14	2
Professionalism	1	1	7	1
Emotional impact of practice	1	1	0	0
Curriculum development	1	1	0	0
Study design				
Observational	67	47	50	7
Experimental	29	20	50	7
Validation	4	3	0	0
Learner group* *(Manuscripts could cover more than 1 group)*				
Residents	74	52	86	12
Practicing anesthesiologists	17	12	14	2
Medical students	11	8	7	1
Nurses	10	7	7	1
Topic being studied				
Learning procedure	21	15	21	3
Assessment/evaluation of learner	17	12	7	1
Curriculum development/evaluation	13	9	7	1
Wellness	11	8	21	3
Nontechnical skills	10	7	14	2
Clinical practice	6	4	7	1
Assessment of environment	4	3	7	1
Feedback	4	3	0	0
Crisis resource management	3	2	7	1
Recruitment	3	2	0	0
Professionalism	1	1	7	1
Assessment of teaching	1	1	7	1
Supervision	1	1	0	0
Equity and inclusion	1	1	0	0

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Tables *continued*

Table 5. *Score for Quantitative Articles for Scoring Sheet and Reviewers' Impression*

	Score Type	All Articles *Average Score (Range)*	Top Articles *Average Score (Range)*
Quantitative	***Scoring Sheet***	17.78 of 25 (12.67–23.00) *n = 62*	21.89 of 25 (21.33–23.00) *n = 6*
	Reviewers' Impression	6.25 of 10 (3–8) *n = 62*	8.44 of 10 (8.33–8.67) *n = 6*
Qualitative	***Scoring Sheet***	16.33 of 25 (10.5–21.5) *n = 8*	21.5 of 25 *n = 1**
	Reviewers' Impression	6.44 of 10 (4–10) *n = 8*	10 of 10 *n = 1**

*Only 2 qualitative articles received scores high enough to qualify for inclusion in the top list based on the scoring sheet and reviewers' impression scores.

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Appendices

Appendix A. Database Searches to Identify Best Articles in Anesthesiology Education

Database searches to identify best articles in anesthesiology education

Ovid Medline; Ovid Medline In-Process and Other Non-Indexed Citations; Ovid Medline Epub Ahead of Print; Daily and Versions (572 results on March 6, 2020)

1. (exp anesthesiology/ or exp anesthetists/ or (anesthe* or anaesthe*).tw.) and (exp education/ or education.sh. or (academic* or class or classes or course* or curricul* or educat* or fellow or fellows or fellowship or instruct* or intern or interns or internship or learn or learner or learning or lesson* or resident or residents or residenc* or school* or simulation or student* or teach* or train* or workshop*).ti.) and english.la.

2. limit 1 to yr="2019"

Elsevier Embase (543 results on March 6, 2020)

(('anesthesiology'/exp OR 'anesthetists'/exp) AND 'education'/exp OR ((anesthesia*:ti OR anesthesio*:ti OR anaesthesio*:ti) AND (academic*:ti OR class:ti OR classes:ti OR course*:ti OR curricul*:ti OR educat*:ti OR fellow:ti OR fellows:ti OR fellowship:ti OR instruct*:ti OR intern:ti OR interns:ti OR internship:ti OR learn:ti OR learner:ti OR learning:ti OR lesson*:ti OR resident:ti OR residents:ti OR residenc*:ti OR school*:ti OR simulation*:ti OR student*:ti OR teach*:ti OR train*:ti OR workshop*:ti)) OR (((anesthesia* OR anesthesio* OR anaesthesio*) NEAR/5 (academic* OR course* OR curricul* OR educat* OR fellow OR fellows OR fellowship OR instruct* OR intern OR interns OR internship OR learn OR learner OR learning OR lesson* OR resident OR residents OR residenc* OR school* OR student* OR teach* OR train* OR workshop*)):ab)) AND [english]/lim AND [2019–2019]/py NOT ('conference abstract':it OR 'conference paper':it OR 'conference review':it)

FirstSearch ERIC (4 results on March 6, 2020)

(ti: anesthe* OR ti: anaesthe*) or (ab: anesthe* OR ab: anaesthe*) or de: anesthesiology and yr: 2019–2019

EBSCOhost PsycINFO (15 results on March 6, 2020)

1. TI (anesthe* OR anaesthe*) OR AB (anesthe* OR anaesthe*)

2. TI (academic* OR class OR classes OR course* OR curricul* OR educat* OR fellow OR fellows OR fellowship OR instruct* OR intern OR interns OR internship OR learn OR learner OR learning OR lesson* OR resident OR residents OR residenc* OR school* OR student* OR teach* OR train* OR workshop*)

3. 1 AND 2 limited to 2019

PubMed - Anesthesia in medical education journals (13 results on March 6, 2020)

(anesthesiology[mh] OR anesthetists[mh] OR anesthesia[tiab] OR anaesthesia[tiab] OR anesthesiology[tiab] OR anaesthesiology[tiab]) AND ("Acad Med"[Journal] OR "Med Educ"[Journal] OR "Adv Health Sci Educ Theory Pract"[Journal] OR "Med Teach"[Journal] OR "Simul Healthc"[Journal]) AND 2019[dp]

PubMed - Education in anesthesiology journals (117 results on March 6, 2020)

(education[mh] OR education[sh] OR academic[ti] OR class[ti] OR classes[ti] OR course[ti] OR courses[ti] OR curricula[ti] OR curriculum[ti] OR educate[ti] OR educated[ti] OR educating[ti] OR education[ti] OR educator[ti] OR educators[ti] OR instructing[ti] OR instruction[ti] OR instructor[ti] OR instructors[ti] OR learn[ti] OR learned[ti] OR learning[ti] OR lesson[ti] OR lessons[ti] OR residencies[ti] OR residency[ti] OR school[ti] OR schools[ti] OR student[ti] OR students[ti] OR teach[ti] OR teacher[ti] OR teachers[ti] OR teaching[ti] OR train[ti] OR trained[ti] OR training[ti] OR trainer[ti] OR trainers[ti] OR workshop[ti] OR workshops[ti]) AND ("Anesthesiology"[Journal] OR "anesthesia and analgesia"[journal] OR "british journal of anaesthesia"[journal] OR "J Educ Perioper Med"[journal]) AND 2019[dp]

PubMed - Journal Table of Contents Handsearch (1574 results on August 5, 2020)

("Anesthesiology"[Journal] OR "anesthesia and analgesia"[journal] OR "british journal of anaesthesia"[journal] OR "J Educ Perioper Med"[journal] OR "Acad Med"[Journal] OR "Med Educ"[Journal] OR "Adv Health Sci Educ Theory Pract"[Journal] OR "Med Teach"[Journal] OR "Simul Healthc"[Journal]) AND 2019[dp] AND hasabstract[text] NOT (editorial[pt] OR letter[pt]) NOT pubstatusaheadofprint

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Appendices *continued*

Appendix B. Additional Questions

Questions to Code Articles Reviewed	
Funding	None (or internally funded by department)
	Yes, please specify
Target Audience: (Select all that apply)	Residents
	Medical students
	Practicing anesthesiologists
	Nurse
	Other
Nonphysician/Nonprovider author:*	Yes, first, second, or last
	Yes, but not first, second, or last
	No
	Unclear
Primary setting:	Simulation
	Real-life
	Other
Purpose:	Teaching methods
	Learner evaluation of programs
	Learner assessment
	Intervention description
	Environment assessment
	Other
Topic:	Case management/general practice
	Learning procedures
	Crisis resource management
	Anesthesiology nontechnical skills
	Professionalism
	Resident selection
	Interprofessionalism
	Other
Competency:*	Patient care
	Medical knowledge
	Practice-based learning and improvement
	Interpersonal and communication skills
	Professionalism
	Systems-based practice
	N/A

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Appendices *continued*

Theme topic: (Open-ended question)	
*We did not report on Nonphysician Author and Competency categories because the data collected were not useful. For Nonphysician Author category, 43% of the articles reviewed did not include the degrees of the authors. For the Competency category, many of the articles were not about competencies. For example, articles about the clinical competency committee work or patient dignity were not about a specific competency and therefor the coding was not useful.	
Additional Questions Piloted to Enhance Scoring Tool *(Not used for scoring in this review)*	
Sampling:	The sampling was not rigorous (small and/or convenience sample) = 0
	The sampling was rigorous (larger and/or purposeful sample) = 1
Study Design	
Appropriateness	The study design was inappropriate to answer the research question = 0
	The study design was appropriate to answer the research question = 1
Rigorous	The study design lacked rigor = 0
	The study design was somewhat rigorous = 1
	The study design was very rigorous = 2

Appendix C. Full List of Articles Included in the Critical Appraisal

Article No.	First Author	Title	Journal	Type
1	Adame, E.	Training the Anesthesiologist Trainer: Enhancing the Quality of Feedback During Human Patient Simulations	*Health Communication*	Quantitative
2	Adams, D.	Financial Incentive, in Place of Nonclinical Time, Increases Faculty Involvement and Improves Resident Didactic Evaluation Scores in an Anesthesiology Residency Training Program	*The Journal of Education in Perioperative Medicine*	Quantitative
3	Ambardekar, A.	A Randomized Controlled Trial Comparing Learners' Decision-making, Anxiety, and Task Load During a Simulated Airway Crisis Using Two Difficult Airway Aids	*Simulation in Healthcare: The Journal of The Society for Medical Simulation*	Quantitative
4	Ambardekar, A.	The Impact of Simulation-Based Medical Education on Resident Management of Emergencies in Pediatric Anesthesiology	*Paediatric Anaesthesia*	Quantitative
5	Argalious, M.	Simulation Versus Problem Based Learning for Cerebrospinal Drainage Catheter Insertion and Management: A Randomized Trial in a Large Academic Anesthesiology Residency Program	*Journal of Cardiothoracic & Vascular Anesthesia*	Quantitative
6	Arkin, N.	What's in a Word? Qualitative and Quantitative Analysis of Leadership Language in Anesthesiology Resident Feedback	*Journal of Graduate Medical Education*	Quantitative

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7	Berger, C.	Combination of Problem-Based Learning With High-Fidelity Simulation in CPR Training Improves Short and Long-Term CPR Skills: A Randomised Single Blinded Trial	*BioMed Central - Medical Education*	Quantitative
8	Berwick, R.	A Mixed-Methods Pilot Study to Evaluate a Collaborative Anaesthetic and Surgical Training Package for Emergency Surgical Cricothyroidotomy	*Anaesthesia & Intensive Care*	Quantitative
9	Bissing, M.	Status of Women in Academic Anesthesiology: A 10-Year Update	*Anesthesia & Analgesia*	Quantitative
10	Brazil, V.	Improving the Relational Aspects of Trauma Care Through Translational Simulation	*BioMed Central - Advances in Simulation*	Quantitative
11	Burmann, S.	Knowledge and Self-Efficacy Assessment of Residents and Fellows Following Palliative Care Unit Rotation: A Pilot Study	*American Journal of Hospice & Palliative Medicine*	Quantitative
12	Burnett, G.	Knowledge Retention after Simulated Crisis: Importance of Independent Practice and Simulated Mortality	*British Journal of Anaesthesia*	Quantitative
13	Burnett, G.	Survey of Regional Anesthesiology Fellowship Directors in the USA on the Use of Simulation in Regional Anesthesiology Training	*Regional Anesthesia & Pain Medicine*	Quantitative
14	Castanelli, D.	A Balancing Act: The Supervisor of Training Role in Anaesthesia Education	*Anaesthesia & Intensive Care*	Qualitative
15	Castanelli, D.	The Reliability of a Portfolio of Workplace-Based Assessments in Anesthesia Training	*Canadian Journal of Anaesthesia*	Quantitative
16	Chen, F.	Experience Is the Teacher of All Things: Prior Participation in Anesthesiology OSCEs Enhances Communication of Treatment Options With Simulated High-Risk Patients	*The Journal of Education in Perioperative Medicine*	Quantitative
17	Chuan, A.	Research Priorities in Regional Anaesthesia Education and Training: An International Delphi Consensus Survey	*British Medical Journal - Open*	Quantitative
18	Clavier, T.	Use of the Smartphone App whatsapp as an E-Learning Method for Medical Residents: Multicenter Controlled Randomized Trial	*JMIR MHealth and UHealth*	Quantitative
19	Daly Guris, R.	Training Novice Anaesthesiology Trainees to Speak Up for Patient Safety	*British Journal of Anaesthesia*	Quantitative
20	Desvergez, A.	An Observational Study Using Eye Tracking to Assess Resident and Senior Anesthetists' Situation Awareness and Visual Perception in Postpartum Hemorrhage High Fidelity Simulation	*PLoS One*	Quantitative
21	Dohlman, L.	The Impact of an International Elective on Anesthesiology Residents as Assessed by a Longitudinal Study	*Journal of Medical Education & Curricular Development*	Quantitative

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22	Eismann, H.	Changes of Collective Orientation through a Medical Student's Anaesthesia Simulation Course - Simulation-Based Training Study with Non-Technical Skills Debriefing Versus Medical Debriefing	*BioMed Central - Medical Education*	Quantitative
23	Erlinger, R.	High-Fidelity Mannequin Simulation versus Virtual Simulation for Recognition of Critical Events by Student Registered Nurse Anesthetists	*American Association of Nurse Anesthetists Journal*	Quantitative
24	Everett, T.	Simulation-Based Assessment in Anesthesia: An International Multicentre Validation Study	*Canadian Journal of Anaesthesia*	Quantitative
25	Fahy, B.	Evaluating an Interdisciplinary EEG Initiative on In-Training Examination EEG-Related Item Scores for Anesthesiology Residents	*Journal of Clinical Neurophysiology*	Quantitative
26	Ffremch-O'Carroll, R.	Grief Reactions and Coping Strategies of Trainee Doctors Working in Paediatric Intensive Care	*British Journal of Anaesthesia*	Quantitative
27	Gill, G.	Evaluation of Knowledge Acquisition with a Practice Management Course for Anesthesiology Residents: A Pilot Study	*The Journal of Education in Perioperative Medicine*	Quantitative
28	Goy, R.	Exploring the Challenges of Task-Centred Training in Obstetric Anaesthesia in the Operating Theatre Environment	*International Journal of Obstetric Anesthesia*	Qualitative
29	Hanley, M.	Faculty Perspectives on the Transition to Competency-Based Medical Education in Anesthesia	*Canadian Journal of Anaesthesia*	Qualitative
30	Haydar, B.	Academic Anesthesiologists Perceive Significant Internal Barriers to Intraoperative Teaching in a Cross-Sectional Survey	*The Journal of Education in Perioperative Medicine*	Quantitative
31	Heim, M.	Rational Application of Antibiotics—The Influence of Anaesthetists' Gender on Self-Confidence and Knowledge	*Acta Anaesthesiologica Scandinavica*	Quantitative
32	Hoffman, C.	Operating Room First Case Start Times: A Metric to Assess Systems-Based Practice Milestones?	*BioMed Central - Medical Education*	Quantitative
33	Katayama, A.	A High-Fidelity Simulator for Needle Cricothyroidotomy Training is not Associated with Increased Proficiency Compared with Conventional Simulators: A Randomized Controlled Study	*Medicine*	Quantitative
34	Katz, D.	Exposure to Incivility Hinders Clinical Performance in a Simulated Operative Crisis	*British Medical Journal - Quality and Safety*	Quantitative
35	Kim, T.	Efficacy and Cost Comparison of Case-based Learning to Simulation-based Learning for Teaching Malignant Hyperthermia Concepts to Anesthesiology Residents	*The Journal of Education in Perioperative Medicine*	Quantitative
36	Latif, U.	Assessing the Efficacy of an Online Preoperative Evaluation Course for PGY-1 Anesthesiology Residents	*The Journal of Education in Perioperative Medicine*	Quantitative

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Appendices *continued*

37	Leithead, J.	Examining Interprofessional Learning Perceptions Among Students in a Simulation-Based Operating Room Team Training Experience	*Journal of Interprofessional Care*	Quantitative
38	Lin, Y.	Transfusion Camp: A Prospective Evaluation of a Transfusion Education Program for Multispecialty Postgraduate Trainees	*Transfusion*	Quantitative
39	Lockman, J.	Professionalism in Pediatric Anesthesiology: Affirmation of a Definition Based on Results of a Nationally Administered Survey of Pediatric Anesthesiologists	*Paediatric Anaesthesia*	Quantitative
40	Wainwright, E.	Stress, Burnout, Depression and Work Satisfaction Among UK Anaesthetic Trainees: A Qualitative Analysis of In-Depth Participant Interviews in the Satisfaction and Wellbeing in Anaesthetic Training Study	*Anaesthesia*	Qualitative
41	Looseley, A.	Stress, Burnout, Depression and Work Satisfaction among UK Anaesthetic Trainees: A Quantitative Analysis of the Satisfaction and Wellbeing in Anaesthetic Training Study	*Anaesthesia*	Quantitative
42	Mandell, D.	A Porcine Model for Learning Ultrasound Anatomy of the Larynx and Ultrasound-Guided Cricothyrotomy	*Simulation in Healthcare: The Journal of The Society for Medical Simulation*	Quantitative
43	McKinley, S.	"Yes, I'm the Doctor": One Department's Approach to Assessing and Addressing Gender-Based Discrimination in the Modern Medical Training Era	*Academic Medicine*	Quantitative
44	Mcleod, G.	Validity and Reliability of Metrics for Translation of Regional Anaesthesia Performance From Cadavers to Patients	*British Journal of Anaesthesia*	Quantitative
45	Mendelsohn, D.	Impact of work hours and sleep on well-being and burnout for physicians-in-training: the Resident Activity Tracker Evaluation Study	*Medical Education*	Quantitative
46	Miller, A.	Does Participation in Written Guided Reflective Practice Exercises Affect Readiness for Self-Directed Learning in a Sample of US Anesthesiology Residents?	*The Journal of Education in Perioperative Medicine*	Quantitative
47	Moll-Khosrawi, P.	Anaesthesiology Students' Non-Technical Skills: Development and Evaluation of a Behavioural Marker System for Students (AS-NTS)	*BioMed Central - Medical Education*	Quantitative
48	Moran, K.	Do You Really Mean It? Assessing the Strength, Frequency, and Reliability of Applicant Commitment Statements During the Anesthesiology Residency Match	*Anesthesia & Analgesia*	Quantitative

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49	Musits, A.	Physician Versus Nonphysician Instruction: Evaluating an Expert Curriculum-Competent Facilitator Model for Simulation-Based Central Venous Catheter Training	*Simulation in Healthcare: The Journal of The Society for Medical Simulation*	Quantitative
50	Nixon, H.	Resident Competency and Proficiency in Combined Spinal-Epidural Catheter Placement Is Improved Using a Computer-Enhanced Visual Learning Program: A Randomized Controlled Trial	*Anesthesia & Analgesia*	Quantitative
51	Noll, E.	Trainability of Cricoid Pressure Force Application: A Simulation-Based Study	*Anesthesia & Analgesia*	Quantitative
52	O'Brian, M.	Nurse Anesthetists' Evaluations of Anesthesiologists' Operating Room Performance Are Sensitive to Anesthesiologists' Years of Postgraduate Practice	*Journal of Clinical Anesthesia*	Quantitative
53	Ostrokwki, A.	Development of a Training Program in Peripherally Inserted Central Catheter Placement for Certified Registered Nurse Anesthetists Using an N-of-1 Method	*American Association of Nurse Anesthetists Journal*	Quantitative
54	Perez, E.	Evaluation of Anesthesiology Residents' Supervision Skills: A Tool to Assess Transition Towards Independent Practice	*Cureus*	Quantitative
55	Poole, J.	Impact of Education on Professional Involvement for Student Registered Nurse Anesthetists' Political Activism: Does Education Play a Role?	*American Association of Nurse Anesthetists Journal*	Quantitative
56	Raksamani, K.	How Postgraduate Trainees From Different Health Professions Experience the Learning Climate Within an Operating Theater: A Mixed-Methods Study	*BioMed Central - Medical Education*	Quantitative
57	Raymond, B.	The Impact of Converting From an 'Educator-Driven' to a 'Learner-Initiated' Feedback Model	*The Journal of Education in Perioperative Medicine*	Quantitative
58	Rebel, A.	Should Objective Structured Clinical Examinations Assist the Clinical Competency Committee in Assigning Anesthesiology Milestones Competency?	*Anesthesia & Analgesia*	Quantitative
59	Renew, J.	The Impact of Social Media on Anesthesia Resident Recruitment	*The Journal of Education in Perioperative Medicine*	Quantitative
60	Rochlen, L.	Pilot One-Hour Multidisciplinary Team Training Simulation Intervention in the Operating Room Improves Team Nontechnical Skills	*The Journal of Education in Perioperative Medicine*	Quantitative
61	Saddawi-Konefka, D.	Establishing Psychological Safety to Obtain Feedback for Training Programs: A Novel Cross-Specialty Focus Group Exchange	*Journal of Graduate Medical Education*	Qualitative
62	Sun, H.	Repeated Cross-sectional Surveys of Burnout, Distress, and Depression among Anesthesiology Residents and First-year Graduates	*Anesthesiology*	Quantitative

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63	Villemure, C.	Examining Perceptions From In Situ Simulation-Based Training on Interprofessional Collaboration During Crisis Event Management in Post-anesthesia Care	*Journal of Interprofessional Care*	Quantitative
64	Weatherall, M.	Learner and Educator Experiences and Priorities in Paediatric Airway Education: A Qualitative Study	*Anaesthesia & Intensive Care*	Qualitative
65	Weber, U.	Resident Performance in Basic Perioperative Transesophageal Echocardiography: Comparing 3 Teaching Methods in a Randomized Controlled Trial	*Medicine*	Quantitative
66	Wei Wen Loh, L.	Exploring the Impact of Overnight Call Stress on Anaesthesiology Senior Residents' Perceived Ability to Learn and Teach in an Asian Healthcare System: A Qualitative Study	*Trends in Anaesthesia and Intensive Care*	Qualitative
67	Wolpaw, J.	Assessing the Impact of Powerful Experiences During Anesthesia Residency Training	*The Journal of Education in Perioperative Medicine*	Quantitative
68	Wolpaw, J.	Quality Control for Residency Applicant Scores	*The Journal of Education in Perioperative Medicine*	Quantitative
69	Zhou, Y.	Association Between Participation and Performance in MOCA Minute and Actions Against the Medical Licenses of Anesthesiologists	*Anesthesia and Analgesia*	Quantitative
70	Zhou, Y.	The American Board of Anesthesiology's Staged Examination System and Performance on the Written Certification Examination After Residency	*Anesthesia & Analgesia*	Quantitative