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ORIGINAL RESEARCH

An Analysis of the Top-cited Articles in Anesthesiology Education Literature

LARA ZISBLATT, EDD, MA
NORAH N. NAUGHTON, MD, MBA
MELISSA BYRNE, DO, MPH
NICOLE DOBIJA, MD

LESLIE COKER FOWLER, MEd
MARK MACEACHERN, MLIS
SHERON McLEAN, MD
BRENDAN W. MUNZER, MD

LAURYN R. ROCHLEN, MD
SALLY A. SANTEN, MD, PHD
EMILY PEOPLES, MD

INTRODUCTION

Like the field of medicine itself, there is a move in medical education to base educational practices on the best available evidence.¹ While groups like the Best Evidence Medical Education (BEME) Collaboration are working toward making best evidence available through systematic reviews, the types of research that education researchers find useful in a particular field may or may not be reflected in these systematic reviews.¹ Identifying articles most often cited in a particular field of medical education may provide important insights on which publications have been useful for education researchers and what studies have had the most impact on ongoing publications.

In *Emergency Medicine*, a review of the top-cited articles in the education literature was conducted in 2016.² The authors hoped the publication would serve as a resource for educators and researchers to identify trends that may be used to guide further research and publishing efforts in the field.² Munzer et al performed their research in response to an overall evaluation of top-cited articles in medical education by Azer in 2015.³ This article attempts to extend this model of analysis to the field of anesthesiology.

This study was designed to identify and analyze the content of the top 40 most frequently cited articles in anesthesiology education, both in anesthesiology journals and nonanesthesiology journals, to identify which articles have been most useful for researchers in ongoing research and publication.

MATERIALS AND METHODS

Search Strategy

The Web of Science (Clarivate Analytics) database was searched in March 2017 to capture the top-cited articles in anesthesiology education published in anesthesiology and nonanesthesiology journals. The identification of articles, which was based on a modified version of the search methods used in Munzer et al, consisted of 2 independent searches.² To identify articles in anesthesiology journals, the first step was to identify peer-reviewed anesthesiology-focused journals. Twenty-eight journals were identified in Journal Citation Reports (Clarivate Analytics) and approved by the authors. Next, this set of 28 peer-reviewed anesthesiology-focused journals was searched with a set of education-related terms to create the list of articles for anesthesiology journals. To identify articles in nonanesthesiology journals, the second search combined anesthesiology terminology with the same set of education terms, and excluded articles published in the previously identified 28 anesthesiology journals. Results in both searches were sorted from most to least frequently cited. Non-English studies were excluded. No date restrictions were included. See Appendix 1 for the complete, reproducible searches.

After sorting the results, 2 authors (LZ and EP) independently reviewed the abstracts of each article retrieved through the searches and assessed whether or not it met the inclusion criteria. They each reviewed

abstracts until both identified 60 articles, 30 from the anesthesiology journal search and 30 from the nonanesthesiology search. An article was included if it was (1) related to anesthesiology or included anesthesiologists as research subjects and (2) was related to the education of current or future anesthesiologists. Education topics were defined to include assessment and evaluation of learners, description and evaluation of educational activities, teaching methods, and educational design. Education topics were chosen based on similar prior research.^{2,3} Articles were excluded if they did not directly relate to methods of education or were about nursing education or other subjects focused on allied health professionals. Articles were included if both authors found the article to meet the inclusion criteria. Any disagreements were discussed, and a third author reviewed the article to decide if it should be included. Though the goal was to identify the top 20 articles in anesthesiology and nonanesthesiology journals, the 2 authors originally identified 30 articles each, in anticipation that some articles deemed to meet the inclusion criteria by one author would be determined not to meet the inclusion criteria by the other author and the third author reviewer.

Article Review

Authors were split into pairs. Each author pair was assigned to review the full text of 10 articles, 5 from the anesthesiology journal list and 5 from the nonanesthesiology

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journal list. Each author was asked to independently review and catalog the following information: (1) article name, (2) first author, (3) source journal, (4) year of publication, (5) number of citations, (6) funding source (if applicable), (7) journal impact factor, (8) journal discipline, (9) article type(s), (10) educational content, (11) subjects, (12) research method (if applicable), and (13) topic of article/additional notes. Each pair discussed the collected information for each article. If they were unable to reach consensus in any category, a third author reviewed the full text of the article and rendered a decision.

All authors met either in person or through conference call to discuss the findings, themes, and categories. Figure 1 shows the methodology for article selection and review.

Statistical Analysis

Pearson correlation coefficients were calculated using SAS v. 9.4 (SAS Institute, Cary, NC) to determine if the age of the article or impact factor of the journal were correlated to the number of citations.

This manuscript adheres to the applicable PRISMA guidelines. Since there were no human subjects, the authors did not need IRB approval.

RESULTS

The 20 articles from anesthesiology journals⁴⁻²³ and 20 from non-anesthesiology journals²⁴⁻⁴³ are included in Tables 1 and 2, respectively. There was a total of 2923 citations of articles in anesthesiology journals and 924 citations of articles in nonanesthesiology journals. The average impact factor for the anesthesiology journals was 4.649, and the average for non-anesthesiology journals was 3.092.

The top-cited articles were published in 7 anesthesiology journals (Table 3). *Anesthesiology* had the most articles from the top-cited list with 10. For nonanesthesiology journals, 12 journals were represented. *Medical Education* and *Academic Medicine* had the most articles, each with 4.

The article that received the most citations in anesthesiology journals was “Anaesthetists’ Non-Technical Skills (ANTS): evaluation of a behavioural marker system” by Fletcher

et al, published in the *British Journal of Anaesthesia* in 2003 and was cited 347 times.⁴ The article cited the most in nonanesthesiology journals was “Anesthesia crisis resource-management training - teaching anesthesiologists to handle critical incidents” by Howard et al, published in *Aviation Space and Environmental Medicine* in 1992 and cited 290 times.²⁴

Of all the articles included in both lists, 32 out of 40 articles (80%) were research studies. Only 1 article of 20 (5%) from the anesthesiology list was classified as a description of a curriculum with associated data, while for the articles in the nonanesthesiology list, 1 of 20 (5%) was a guideline; 2 of 20 (10%) were review articles; and 3 of 20 articles (15%) were descriptions of curriculum with associated data. One of 40 articles did not fit into our preset categories and was categorized as a descriptive article as it explained the use of a flight simulator for anesthesiology training.³⁰ For funding sources, 16 of the 40 articles (40%), 8 from both lists, disclosed foundation or government external support. Two disclosed internal support from departments.

The characteristics of the articles from both anesthesiology and nonanesthesiology lists are shown in Table 4. Looking solely at the 20 articles from the anesthesiology journals, half focused on learning procedures, such as direct laryngoscopy, regional anesthesiology procedures, and placing invasive lines. Fourteen of 20 (70%) included simulation, and 17 of 20 (85%) articles included residents as subjects. Most articles focused on teaching methods, with 13 of the 20 (65%) articles focusing on how to teach learners.

Similarly, for articles from nonanesthesiology journals, 11 of 20 (55%) focused on teaching methods. Fourteen of 20 (70%) included residents, and 11 of 20 (55%) included simulation. There was a greater variety of topics in the nonanesthesiology journal group with a total of 8 general topics covered. Forty-five percent (9 of 20) focused on case management or general practice.

Based on the Pearson correlation coefficient (r) for both anesthesiology and nonanesthesiology journals, neither year of publication nor journal impact factor are correlated with the number of citations that an article received. For nonanesthesiology journals, the correlation between number

of citations and year of publication was $r = -0.24$, $P = .294$ and the correlation between number of citations and journal impact factor was $r = -0.24$, $P = .302$. For anesthesiology journals, the correlation between number of citations and year of publication was $r = -0.26$, $P = .266$ and the correlation between number of citations and journal impact factor was $r = 0.18$, $P = .442$.

DISCUSSION

The purpose of this study is to identify and examine the characteristics of the most cited articles in anesthesiology education. This work serves as a resource for education researchers to access and review the most cited articles, examine characteristics of these articles, recognize trends, and better understand which journals have published highly cited work in anesthesiology education.

The review uncovered some trends in the top-cited anesthesiology education publications. Content that focused on learning clinical skills or medical procedures either through simulation or direct patient care comprise a large portion of articles from both lists. This may be because these studies are easier to design and execute, but it also may reflect the prioritizing of patient safety with regard to learning medical procedures.

The most frequently cited educational methodology was simulation; in particular, the first use of a simulator in anesthesiology, while published in 1987, was one of the most widely cited articles. The articles that were research studies showed simulation being used to study a variety of different topics, like training in nontechnical skills, crisis resource management, learning procedures, and general case management. Researchers may rely on simulation to assess teaching methods and learners because of the ability to control the complex nature of the perioperative environment.

Another identifiable trend was the lack of systematic reviews or other article types that synthesize the existing evidence in the literature. This might indicate that articles like systematic reviews, education guidelines, or general articles about learning theory might not receive as much attention. These types of articles are critical because they synthesize the existing evidence and are able

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to guide evidence-based practice and future research.⁴⁴ Thirty-one of 40 (78%) most-cited articles included residents as the subjects. This demonstrates a clear focus on graduate medical education, which may highlight an opportunity for researchers in undergraduate and continuing medical education. Changes in medical school curricula across the nation including earlier exposure to clinical specialties may provide greater opportunity to see how earlier exposure to the practice of anesthesiology complements basic medical training.⁴⁵ In addition, with the increased emphasis on Maintenance of Certification, investigating how to help physicians in lifelong learning is another opportunity for research.⁴⁶ Articles in the anesthesiology journals were cited more than the articles in the nonanesthesiology journals. This is in contrast to the findings in Munzer et al who showed that articles from nonemergency medicine journals received more citations.² This may be because the journal, *Academic Emergency Medicine*, focuses on education in emergency medicine. Without an indexed journal dedicated to anesthesiology education prior to the *Journal of Education in Perioperative Medicine*, it is possible that researchers may have had to look for journals outside of anesthesiology to publish their work.

Limitations

There are limitations to this study. First, the reason or in what capacity these works were cited is unknown since the original articles in which these works were cited were not reviewed. Frequency of citations might not be the best method for determining influence. Furthermore, some articles might lead to wide dissemination and implementation into practice, but may not lend themselves to further study and therefore would be less likely to be cited in future work.

Also, 1 database was used for the searches. The Web of Science is currently the only database that allows sorting by number of citations and the citation numbers are considered accurate. In addition, only articles written in English were included, which further limited the scope. If other databases were used and other languages included, there might have been other articles or the rank order might have changed.

Even though there were at least 2 authors who reviewed all articles in the original search results, there was subjectivity to the creation and application of our inclusion criteria. This may have resulted in some articles being excluded although others might consider them educational in scope.

Lastly, 1 article with a guideline for teaching transesophageal echocardiography was printed in both anesthesiology and nonanesthesiology journals.²⁷ Only the article in the nonanesthesiology journal, *Journal of The American Society of Echocardiography*, was included because the article did not have enough citations to be included in the anesthesiology top-cited list. In addition, only the number of citations the article received in the nonanesthesiology journal was used for sorting purposes. Since this article and any other article printed in 2 separate journals could be cited from either journal, that could influence the ordering and inclusion of publications in this study.

Conclusion

This study identifies and examines the characteristics of the most widely cited articles in anesthesiology education both in anesthesiology journals and nonanesthesiology journals. Common themes included procedural learning, interventional research study designs, simulation, and studies involving residents as subjects. This article may be a resource to anesthesiology education researchers to identify what articles are widely cited by other researchers.

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Lara Zisblatt is an Education Specialist at the University of Michigan in Ann Arbor, MI; **Norah N. Naughton** is a Clinical Associate Professor at the University of Michigan in Ann Arbor, MI; **Melissa Byrne** is a Clinical Instructor at the University of Michigan in Ann Arbor, MI; **Nicole Dobija** is a Clinical Assistant Professor at the University of Michigan in Ann Arbor, MI; **Leslie Coker Fowler** is a Director of Education Development at Vanderbilt University in Nashville, TN; **Mark MacEachern** is an Informationist at the University of Michigan in Ann Arbor, MI; **Sheron McLean** is a Clinical Assistant Professor at the University of Michigan in Ann Arbor, MI; **Brendan W. Munzer** is a Medical Education Fellow at the University of Michigan in Ann Arbor, MI; **Lauryn R. Rochlen** is a Clinical Associate Professor at the University of Michigan in Ann Arbor, MI; **Sally A. Santen** is a Senior Associate Dean at Virginia Commonwealth University in Richmond, VA; **Emily Peoples** is a Clinical Assistant Professor at the University of Michigan in Ann Arbor, MI.

Corresponding author: Lara Zisblatt, Department of Anesthesiology, University of Michigan Health System, 1500 E Medical Center Drive, SPC 5218, Ann Arbor, MI 48109-5218. Telephone (734) 998-6319, Fax: (734) 936-7416

Email address: Lara Zisblatt: lzisblat@med.umich.edu

This work should be attributed to Department of Anesthesiology, University of Michigan Health System

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Abstract

Background: In the same way that impact factor is calculated for journals, the number of citations an article receives can indicate its influence or value to a particular field. This study was designed to identify the most frequently cited articles in anesthesiology education to yield insight into which articles have been most useful for researchers in ongoing research and publication.

Methods: The Web of Science database was searched to capture the top-cited articles in anesthesiology education both in anesthesiology and nonanesthesiology journals. Results were sorted by the most frequently cited. The top 40 cited articles were identified. Articles were included if they (1) related to anesthesiology or included anesthesiologists as subjects and (2) were related to the education of current or future anesthesiologists. The full text was analyzed, and themes were identified.

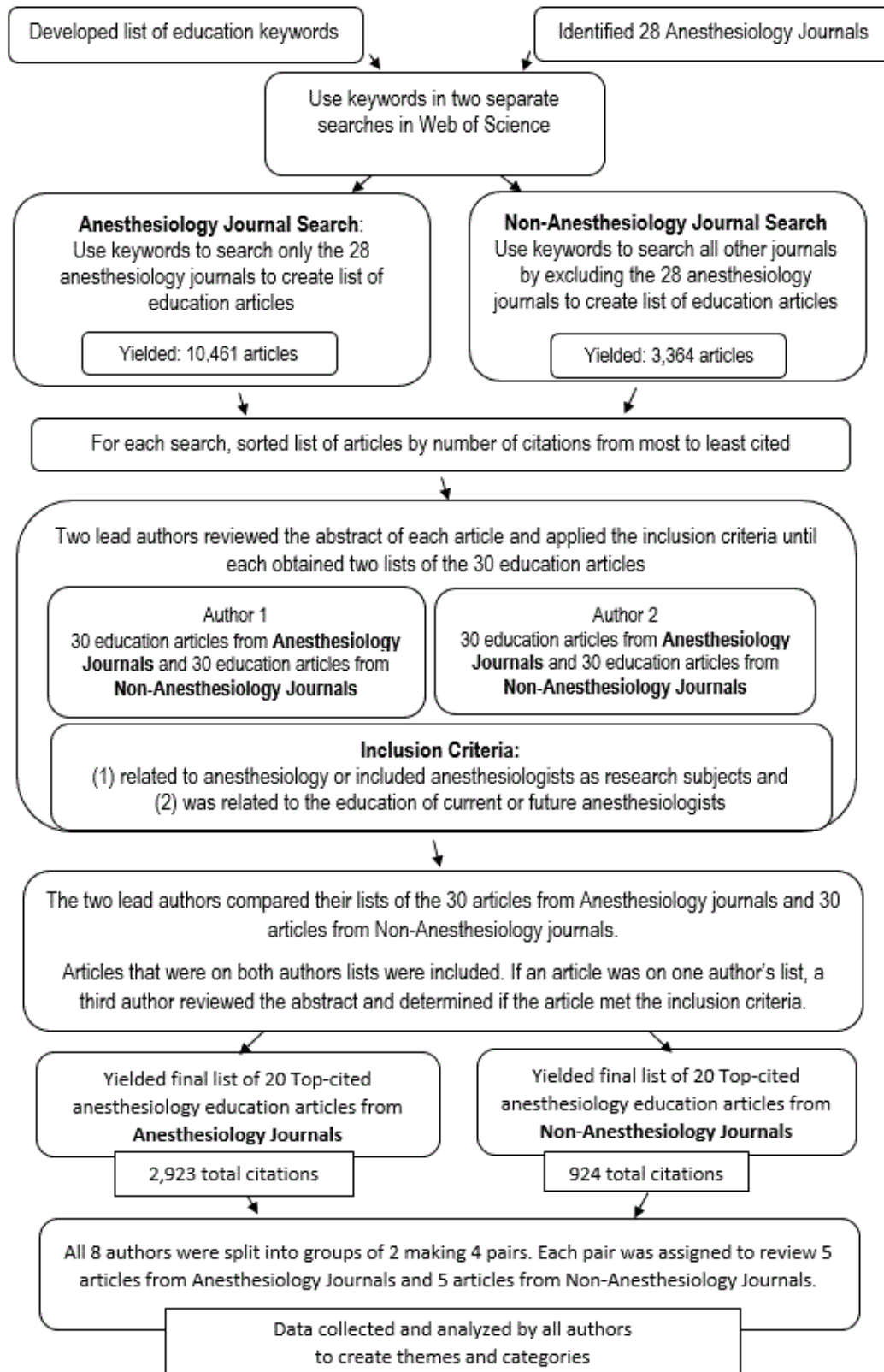
Results: There was a total of 2923 citations of articles in anesthesiology journals and 924 citations of articles in nonanesthesiology journals. Thirty-two of 40 articles (80%) were research studies. Twenty-four of 40 (60%) were about teaching methods. Twenty-five of 40 (63%) focused on simulation, and 31 of 40 (78%) had residents as the subjects. Twenty-eight of 40 (70%) articles were about either case management (15) or learning procedures (13).

Conclusions: This study identifies the most widely cited articles in anesthesiology education. Common themes included procedural learning, interventional research study designs, simulation, and studies involving residents as subjects. This article may be a resource to anesthesiology education researchers to identify what articles are widely cited by other researchers.

Key Words: Bibliometrics, medical education or graduate medical education, anesthesiology, publishing, biomedical research

Figures

Figure 1. Methodology for article selection and review.



Tables

Table 1. Most Cited Education Articles from Anesthesiology Journals

Rank	First Author, Year	Title	Journal; Impact Factor	Category/ Topics	Funding	Number of Citations
1	Fletcher, G; 2003	Anaesthetists' non-technical skills (ANTS): Evaluation of a behavioural marker system ⁴	<i>British Journal of Anaesthesia</i> ; 5.616	Research/ ANTS; Case Management	External - Scottish Council for Postgraduate Medical and Dental Education (now part of NHS Education for Scotland)	347
2	Gaba, DM; 1998	Assessment of clinical performance during simulated crises using both technical and behavioral ratings ⁵	<i>Anesthesiology</i> ; 5.555	Research/ Crisis Resource Management	PI receives royalties on sale of patient simulators; Dr Gaba's lab received payments from Eagle Simulation, Inc	258
3	Gaba, DM; 1988	A Comprehensive Anesthesia Simulation Environment - Recreating The Operating-Room For Research And Training ⁶	<i>Anesthesiology</i> ; 5.555	Research/ Case Management	Supportd by a grant from the Anesthesia Patient Safety foundation and in part by Veterans Administration. Mr. DeAnda was supported by a grant from the Pfeiffer Foundation	215
4	Konrad, C; 1998	Learning manual skills in anesthesiology: Is there a recommended number of cases for anesthetic procedures? ⁷	<i>Anesthesia and Analgesia</i> ; 3.827	Research/ Learning Procedures	None	191
5	Chopra, V; 1994	Does training on an anesthesia simulator lead to improvement in performance ⁸	<i>British Journal of Anaesthesia</i> ; 5.616	Research/ Case Management	None	178
6	Mulcaster, JT; 2003	Laryngoscopic intubation - Learning and performance ⁹	<i>Anesthesiology</i> ; 5.555	Research/ Learning Procedures	Internal/External - Dept of Anesthesia, Faculty of Medicine, Dalhousie University, Halifax, Nova Scotia, Canada; the Medical Research Council of Canada; and the Dept of Health of Nova Scotia, Canada	178
7	Sites, BD.; 2007	Characterizing novice behavior associated with learning ultrasound-guided peripheral regional anesthesia ¹⁰	<i>Regional Anesthesia and Pain Medicine</i> ; 3.459	Research/ Learning Procedures	Foundation for Anesthesia, Education, and Research (FAER)	143
8	Kopacz, DJ; 1996	The regional anesthesia "learning curve" - What is the minimum number of epidural and spinal blocks to reach consistency? ¹¹	<i>Regional Anesthesia</i> ; 2.412	Research/ Learning Procedures	None	139
9	Holzman, RS; 1995	Anesthesia crisis resource management: Real-life simulation training in operating room crises ¹²	<i>Journal of Clinical Anesthesia</i> ; 1.284	Curriculum – Yes Data/ Crisis Resource Management	None	135
10	Savoldelli, GL.; 2006	Value of debriefing during simulated crisis management - Oral versus video-assisted oral feedback ¹³	<i>Anesthesiology</i> ; 5.555	Research/ Crisis Resource Management	Dean's Excellence Fund (Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada); Geneva University Hospitals; the faculty of medicine, Eugenio Litta Foundation, Geneva, Switzerland	126
11	Sites, BD; 2004	The learning curve associated with a simulated ultrasound-guided interventional task by inexperienced anesthesia residents ¹⁴	<i>Regional Anesthesia and Pain Medicine</i> ; 3.459	Research/ Learning Procedures	None	116

Tables

12	Wong, DT; 2003	What is the minimum training required for successful cricothyroidotomy? A study in mannequins ¹⁵	<i>Anesthesiology</i> ; 5.555	Research/ Learning Procedures	None	113
13	Kestin, IG 1995	A Statistical Approach To Measuring The Competence Of Anesthetic Trainees At Practical Procedures ¹⁶	<i>British Journal of Anaesthesia</i> ; 5.616	Research/ Learning Procedures	None	109
14	Schwid, HA; 2002	Evaluation of anesthesia residents using mannequin-based simulation - A multiinstitutional study ¹⁷	<i>Anesthesiology</i> ; 5.555	Research/ Case Management	10 institutions (Departments of Anesthesiology)	105
15	Rowe, R; 2002	An evaluation of a virtual reality airway simulator ¹⁸	<i>Anesthesia and Analgesia</i> ; 3.827	Research/ Learning Procedures	None	104
16	Yee, B; 2005	Nontechnical skills in anesthesia crisis management with repeated exposure to simulation-based education ¹⁹	<i>Anesthesiology</i> ; 5.555	Research/ ANTS; Crisis Resource Management	Grant from the Canadian Anesthesiologists' Society	98
17	Naik, VN; 2001	Fiberoptic orotracheal intubation on anesthetized patients - Do manipulation skills learned on a simple model transfer into the operating room? ²⁰	<i>Anesthesiology</i> ; 5.555	Research/ Learning Procedures	External - Physicians' Services Incorporated Foundation, North York, Ontario, Canada	96
18	Grau, T; 2003	Ultrasound imaging improves learning curves in obstetric epidural anesthesia: a preliminary study ²¹	<i>Canadian Journal of Anaesthesia- Journal Canadien D Anesthésie</i> ; 2.306	Research/ Learning Procedures	Departmental, University of Heidelberg, Heidelberg, Germany; Forschungsförderungsprogramm der Universität Heidelberg	93
19	Boulet, JR; 2003	Reliability and validity of a simulation-based acute care skills assessment for medical students and residents ²²	<i>Anesthesiology</i> ; 5.555	Research/ Case Management	Supported by grant No. 24-9899 from the National Board of Medical Examiners Medical Education Research Fund, Philadelphia, Pennsylvania (to Dr. Murray), and an Education Grant from the Foundation for Anesthesia Education and Research, Mayo Clinic, Rochester, Minnesota (to Dr. Kras)	91
20	Devitt, JH; 2001	The validity of performance assessments using simulation ²³	<i>Anesthesiology</i> ; 5.555	Research/ Case Management	None	88

Table 2. Most Cited Education Articles from Other (Nonanesthesiology) Journals

Tables

Rank	First Author, Year	Title	Journal; Impact Factor	Category/ Topic	Funding	Number of Citations
1	Howard, SK; 1992	Anesthesia crisis resource-management training - teaching anesthesiologists to handle critical incidents ²⁴	<i>Aviation Space and Environmental Medicine</i> ; 0.755	Curriculum – Data/ Crisis Resource Management	External - Anesthesia Patient Safety Foundation; Department of Veterans Affairs	290
2	Abrahamson, S; 1969	Effectiveness of a simulator in training anesthesiology residents ²⁵	<i>Journal of Medical Education</i> ; 3.369	Research/ Learning Procedures	Supported by the U.S. Office of Education, Department of Health, Education, and Welfare, Cooperative Research Project No. D-240, Contract OE 6-10-135.	93
3	Blum, RH; 2004	Crisis resource management training for an anaesthesia faculty: a new approach to continuing education ²⁶	<i>Medical Education</i> ; 3.369	Curriculum - Data/ Crisis Resource Management	External - Risk Management Foundation	80
4	Cahalan, MK; 2002	American Society of echocardiography and society of cardiovascular anesthesiologists task force guidelines for training in perioperative echocardiography ²⁷	<i>Journal of the American Society of Echocardiography</i> ; 4.454/ Reprinted In <i>Anesthesia And Analgesia</i>	Guideline/ Learning Procedures	None	44 (83)
5	Morgan, PJ; 2001	A comparison of global ratings and checklist scores from an undergraduate assessment using an anesthesia simulator ²⁸	<i>Academic Medicine</i> ; 4.194	Research/ Case Management	Grant from Canadian Anaesthetists' Society	43
6	Morgan, PJ; 2000	Evaluation of medical students' performance using the anaesthesia simulator ²⁹	<i>Medical Education</i> ; 3.369	Research/ Case Management	External - Physicians' Services Incorporated Foundation	43
7	Schwid, HA 1987	A flight simulator for general-anesthesia training ³⁰	<i>Computers and Biomedical Research</i> ; 0.852	Other: Description/ Case Management	None	36
8	Gough, HG; 1991	Performance of residents in anesthesiology as related to measures of personality and interests ³¹	<i>Psychological Reports</i> ; 0.414	Research/ Predicting Success	None	30
9	Warrick, SS; 1986	Predictors of success in an anesthesiology residency ³²	<i>Journal of Medical Education</i> ; N/A	Article/Review/ Predicting Success	None	30
10	Holt, MC; 2004	Development and validation of the anaesthetic theatre educational environment measure (ateem) ³³	<i>Medical Teacher</i> ; 2.355	Research/ Educational Environment Evaluation	None	29
11	Cleave-Hogg, D; 2002	Experiential learning in an anaesthesia simulation centre: analysis of students' comments ³⁴	<i>Medical Teacher</i> ; 2.355	Research/ Case Management	Grant from Canadian Anaesthetists' Society research award	25
12	Rhoton, MF 1994	Professionalism and clinical excellence among anesthesiology residents ³⁵	<i>Academic Medicine</i> ; 4.194	Research/ Professionalism	None	25
13	Rhoton, MF; 1991	Influence of anesthesiology residents noncognitive skills on the occurrence of critical incidents and the residents overall clinical-performances ³⁶	<i>Academic Medicine</i> ; 4.194	Research/ ANTS	None	21

Tables

14	Harris, T; 2011	Success in physician prehospital rapid sequence intubation: what is the effect of base speciality and length of anaesthetic training? ³⁷	<i>Emergency Medicine Journal</i> ; 1.836	Research/ Learning Procedures	Statistical analysis funded by London HEMS	21
15	Baker, JD; 1993	Selection of anesthesiology residents ³⁸	<i>Academic Medicine</i> ; 4.194	Article/Review/ Resident Selection	None	21
16	Garfield, J; 1989	An evaluation of the effectiveness of a computer-simulation of anesthetic uptake and distribution as a teaching tool ³⁹	<i>Medical Education</i> ; 3.369	Curriculum - Yes data/ Case Management	None	20
17	Scavone, BM; 2010	A randomized controlled trial of the impact of simulation-based training on resident performance during a simulated obstetric anesthesia emergency ⁴⁰	<i>Simulation in Healthcare</i> ; 1.685	Research/ Case Management	None	20
18	Bello, G; 2005	Online vs live methods for teaching difficult airway management to anesthesiology residents ⁴¹	<i>Intensive Care Medicine</i> ; 10.125	Research/ Case Management	None	19
19	Klemola, UM; 2001	Practice-based criteria for assessing anaesthetists habits of action: outline for a reflexive turn in practice ⁴²	<i>Medical Education</i> ; 3.369	Research/ Case Management	None	17
20	Nyssen, AS; 1998	Improving training in problem solving skills: analysis of anesthetists' performance in simulated problem situations ⁴³	<i>Le Travail Humain</i> ; 0.3	Research/ Case Management	Fond National Belge de la Recherche Scientifique and by the Politique Scientifique Belge	17

Table 3. List of Journals and the Number of Articles per Journal

Anesthesiology Journals	# of Articles
<i>Anesthesiology</i>	10
<i>British Journal of Anaesthesia</i>	3
<i>Anesthesia and Analgesia</i>	2
<i>Regional Anesthesia and Pain Medicine</i>	2
<i>Canadian Journal of Anaesthesia-Journal Canadien D Anesthesie</i>	1
<i>Journal of Clinical Anesthesia</i>	1
<i>Regional Anesthesia</i>	1
Non-Anesthesiology Journals	# of Articles
<i>Academic Medicine</i>	4
<i>Medical Education</i>	4
<i>Journal of Medical Education</i>	2
<i>Medical Teacher</i>	2
<i>Aviation Space and Environmental Medicine</i>	1
<i>Computers and Biomedical Research</i>	1
<i>Emergency Medicine Journal</i>	1
<i>Intensive Care Medicine</i>	1
<i>Journal of The American Society of Echocardiography</i>	1
<i>Le Travail Humain</i>	1
<i>Psychological Reports</i>	1
<i>Simulation in Healthcare</i>	1

Tables

Table 4. Characteristics for Articles from Anesthesiology and Nonanesthesiology Journals

Characteristics	Articles from Anesthesiology Journals	Articles from Nonanesthesiology Journals	Total Articles
	N (%)*	N (%)*	N (%)*
Purpose of Study			
Teaching methods	13 (65%)	11 (55%)	24 (60%)
Learner evaluation of programs	5 (25%)	3 (15%)	8 (20%)
Learner assessment	1 (5%)	5 (25%)	6 (15%)
Intervention description	2 (10%)	1 (5%)	3 (8%)
Environment assessment	0 (0%)	1 (5%)	1 (3%)
Setting			
Simulation	14 (70%)	11 (55%)	25 (63%)
Real life	6 (30%)	9 (45%)	15 (38%)
Study Population			
Residents	17 (85%)	14 (70%)	31 (78%)
Practicing anesthesiologists	8 (40%)	4 (20%)	12 (30%)
Medical students	4 (20%)	3 (15%)	7 (18%)
Topic			
Case management/general practice	6 (30%)	9 (45%)	15 (38%)
Learning procedures (line placement, ultrasound etc.)	10 (50%)	3 (15%)	13 (33%)
Crisis resource management	4 (20%)	2 (10%)	6 (15%)
Anesthesiology non-technical skills	2 (10%)	1 (5%)	3 (8%)
Predicting success	0 (0%)	2 (10%)	2 (5%)
Educational environment evaluation	0 (0%)	1 (5%)	1 (3%)
Professionalism	0 (0%)	1 (5%)	1 (3%)
Resident selection	0 (0%)	1 (5%)	1 (3%)

*Please note that some articles fall into more than one category.

Appendix

Appendix 1

Anesthesiology Education Articles

The Web of Science (Clarivate Analytics) database was searched in March 2017 to capture the top cited articles in anesthesiology education published in anesthesiology and non-anesthesiology journals. The identification of studies, which was based on a modified version of the search methods used in Munzer et al., consisted of two independent searches. The first search crossed a set of 28 peer-reviewed anesthesiology-focused journals, which were identified in Journal Citation Reports (Clarivate Analytics) and approved by the author group, with a set of education-related terms. The second search combined anesthesiology terminology with the education concept block, and excluded articles published in the previously identified set of 28 anesthesiology journals. Results in both searches were sorted by the most frequently cited. Non-English studies were excluded. No date restrictions were included, but the results prioritize older studies that have had time to be cited frequently. See Appendix 1 for the complete, reproducible searches.

Searches

Anesthesiology education articles in anesthesiology journals

#1	SO=(ACTA ANAESTHESIOLOGICA SCANDINAVICA OR ANAESTHESIA OR ANAESTHESIA "AND" INTENSIVE CARE OR ANAESTHESIA CRITICAL CARE PAIN MEDICINE OR ANAESTHESIST OR ANESTHESIA "AND" ANALGESIA OR ANESTHESIOLOGY OR BMC ANESTHESIOLOGY OR BRITISH JOURNAL OF ANAESTHESIA OR CANADIAN JOURNAL OF ANESTHESIA JOURNAL CANADIEN D ANESTHESIE OR CLINICAL JOURNAL OF PAIN OR CURRENT OPINION IN ANESTHESIOLOGY OR EUROPEAN JOURNAL OF ANAESTHESIOLOGY OR EUROPEAN JOURNAL OF PAIN OR INTERNATIONAL JOURNAL OF OBSTETRIC ANESTHESIA OR JOURNAL OF ANESTHESIA OR JOURNAL OF CARDIOTHORACIC "AND" VASCULAR ANESTHESIA OR JOURNAL OF CLINICAL ANESTHESIA OR JOURNAL OF CLINICAL MONITORING "AND" COMPUTING OR JOURNAL OF NEUROSURGICAL ANESTHESIOLOGY OR PAIN OR PAIN PHYSICIAN OR PAIN PRACTICE OR PEDIATRIC ANESTHESIA OR REGIONAL ANESTHESIA "AND" PAIN MEDICINE)
#2	TI=(assess* OR clerkship* OR curricul* OR educate* OR educati* OR evaluat* OR examinati* OR feedback OR graduate OR graduates OR "house officer" OR "house officers" OR housestaff OR "house staff" OR intern OR interns OR learn* OR mentor* OR osce OR pedagog* OR resident* OR residenc* OR student* OR teach* OR train* OR tutor* OR undergraduate*)
#3	#1 AND #2

Anesthesiology education articles in non-anesthesiology journals

#1	TI=(anesthe* OR anaesthe*)
#2	TI=(assess* OR clerkship* OR curricul* OR educate* OR educati* OR evaluat* OR examinati* OR feedback OR graduate OR graduates OR "house officer" OR "house officers" OR housestaff OR "house staff" OR intern OR interns OR learn* OR mentor* OR osce OR pedagog* OR resident* OR residenc* OR student* OR teach* OR train* OR tutor* OR undergraduate*)
#3	#1 AND #2
#4	SO=(ACTA ANAESTHESIOLOGICA SCANDINAVICA OR ANAESTHESIA OR ANAESTHESIA "AND" INTENSIVE CARE OR ANAESTHESIA CRITICAL CARE PAIN MEDICINE OR ANAESTHESIST OR ANESTHESIA "AND" ANALGESIA OR ANESTHESIOLOGY OR BMC ANESTHESIOLOGY OR BRITISH JOURNAL OF ANAESTHESIA OR CANADIAN JOURNAL OF ANESTHESIA JOURNAL CANADIEN D ANESTHESIE OR CLINICAL JOURNAL OF PAIN OR CURRENT OPINION IN ANESTHESIOLOGY OR EUROPEAN JOURNAL OF ANAESTHESIOLOGY OR EUROPEAN JOURNAL OF PAIN OR INTERNATIONAL JOURNAL OF OBSTETRIC ANESTHESIA OR JOURNAL OF ANESTHESIA OR JOURNAL OF CARDIOTHORACIC "AND" VASCULAR ANESTHESIA OR JOURNAL OF CLINICAL ANESTHESIA OR JOURNAL OF CLINICAL MONITORING "AND" COMPUTING OR JOURNAL OF NEUROSURGICAL ANESTHESIOLOGY OR PAIN OR PAIN PHYSICIAN OR PAIN PRACTICE OR PEDIATRIC ANESTHESIA OR REGIONAL ANESTHESIA "AND" PAIN MEDICINE)
#5	#3 NOT #4