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Critical Appraisal of Emergency Medicine Educational Research: The Best Publications of 2015

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ABSTRACT

Objective: The objectives were to critically appraise the medical education research literature of 2015 and review the highest-quality quantitative and qualitative examples.

Methods: A total of 434 emergency medicine (EM)-related articles were discovered upon a search of ERIC, PsychINFO, PubMed, and SCOPUS. These were both quantitative and qualitative in nature. All were screened by two of the authors using previously published exclusion criteria, and the remaining were appraised by all authors using a previously published scoring system. The highest scoring articles were then reviewed.

Results: Sixty-one manuscripts were scored, and 10 quantitative and two qualitative papers were the highest scoring and are reviewed and summarized in this article.

Conclusions: This installment in this critical appraisal series reviews 12 of the highest-quality EM-related medical education research manuscripts published in 2015.

In 2012, the *Academic Emergency Medicine* consensus conference called for an increase in high-quality, hypothesis-driven education research.¹ The intervening years have seen a growth in education research, as described in prior articles in this series.^{2–9} Highlighting this trend, beginning in 2017, *Academic Emergency Medicine* journal devoted an entire separate publication to emergency medicine educational research, *Academic Emergency Medicine Education and Training (AEM E&T)*.¹⁰

Prior installments of this series were published in *Academic Emergency Medicine Journal*,^{2–9} using modifications of methodology for medical education literature

review as described by the Alliance for Clinical Education for other specialties and based on that used for bench and clinical research.^{11,12} In this eighth installment of the annual critical appraisal series, reviewers have critically analyzed and ranked the emergency medicine (EM) education research from 2015. This article will highlight and summarize the most highly rated studies of 2015, which pertain to teaching and education in EM. Of note the focus is on research that advances the science of EM education, not necessarily research that uses education to affect patient care. Current trends in EM education research, as they can be inferred from this review, are summarized

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and compared to the previous year's trends. It is hoped that this article will serve as a valuable resource for EM educators and researchers invested in educational scholarship.¹³

METHODS

Article Identification

A medical librarian reproduced a previously used Boolean search strategy to identify all education research publications relevant to EM education.² Medical subject heading (MeSH) and keyword terms, including keyword variations to ensure completeness, were used. MeSH and keywords incorporated the following: emergency medicine and medical education, medical student, residents, continuing medical education, academic medical center and teaching hospital, to search MEDLINE through PubMed. Other databases searched included Scopus, Education Resources Information Center (ERIC), and PsychInfo. Publications were limited to English-language papers published in 2015. Searches were run in December 2015, January 2016, and February 2016.

Inclusion and Exclusion Criteria

We included publications relevant to the EM education of medical students, graduate medical education trainees, academic and nonacademic attending physicians, and other emergency providers. Relevant studies were defined as hypothesis-testing investigations, evaluations of educational interventions, or explorations of educational problems using either quantitative or qualitative methods. Publications were excluded if they were: 1) not considered to be peer-reviewed research (such as opinion pieces, commentaries, literature reviews, curricula descriptions without outcomes data); 2) not relevant to EM learners (such as reports on education of prehospital personnel, and international studies that could not be generalized to EM training outside of the country in which they were performed); 3) single-site survey studies; and 4) studies that examined outcomes limited to an expected learning effect without a comparison group.

Data Collection

One author reviewed and applied exclusion criteria to the 434 retrieved abstracts. Two authors independently screened and further refined the selection utilizing the exclusion criteria. Differences in opinion were resolved by discussion. Retrieved publications were maintained

in a Microsoft Excel 2010 database. Sixty-one publications were made electronically available for all six reviewers to score independently.

Scoring

Scoring was based on a previously adapted version^{2,8,9} of the Research in Medical Education symposium of the Association of the American Medical Colleges¹¹ and applying additional criteria from Alliance for Clinical Education study reviews.¹² The scoring tool was iteratively modified in 2009 and 2010 to more accurately reflect EM education topics and the development of new areas of research including simulation and other technology. Each publication was assigned to a scoring system based on whether they were primarily quantitative or qualitative studies. Using accepted recommendations and hierarchical formulations,¹⁴⁻¹⁶ qualitative studies were assessed and scored in nine domains, parallel to those applied to the quantitative studies, for a maximum total score of 25 points. These also included the domains of measurement, data collection, and data analysis criteria, as defined specifically for high-quality qualitative research. The scoring criteria for both quantitative and qualitative research studies have been previously published in this review series and are represented in Tables 1 and 2.^{2,5}

It was decided a priori to include 10 quantitative and two qualitative articles, based on the large number reviewed. The top 10 articles from each author were compared. Articles that were in all authors' top 10 were included, as were articles that were in four of five (80%) authors' top 10 lists. To reach 10 quantitative articles, this initial top 10 comparison was extended to the top 20. Authors recused themselves from reviewing articles in which they were co-authors.

Means and standard deviations (SDs) were calculated in Excel. Inter-rater reliability was assessed with intraclass correlation coefficient using a one-way random-effect model in SPSS 24.0.

RESULTS

A total of 434 papers and abstracts satisfied the search criteria, and 61 papers met the inclusion criteria.¹⁷⁻⁷⁷ The authors scored these 61 manuscripts, and the 10 highest scoring quantitative^{20,21,23,41,46,50-53,70} and two qualitative articles^{18,60} are reviewed below, in alphabetical order by first author's last name.

Table 1
EM Education Research Scoring Metrics: Quantitative Research

Domain	Item	Item Score	Maximum Domain Score
Introduction: give 1 point for each criterion met			3
	Appropriate description of background literature	1	
	Clearly frame the problem	1	
	Clear objective/hypothesis	1	
Measurement: give 0 or 1 point for each criterion met			4
1. Methodology			
	Has no pretest or posttest	0	
	Has a posttest only	1	
	Has a pretest and posttest	1	
2. Groups			
	Both experimental and control group	1	
	Random assignment to groups	1	
Data collection: give 0 or 1 point for each criterion met			4
1. Institutions			
	Single institution	0	
	At least two institutions	1	
	More than two institutions	1	
2. Response rate			
	Response rate < 50% or not reported	0	
	Response rate ≥ 50%	1	
	Response rate ≥ 75%	1	
Data analysis: give 0 or 1 point for each criterion met			3
1. Appropriateness			
	Data analysis inappropriate for study design/type of data	0	
	Data analysis appropriate for study design and type of data	1	
2. Sophistication			
	Descriptive analysis only	0	
	Beyond descriptive analysis	1	
	Includes power analysis	1	
Discussion: give 1 point for each criterion met			3
	Data support conclusion	1	
	Conclusion clearly addresses hypothesis/objective	1	
	Conclusions placed in context of literature	1	
Limitations: assign a single best score			2
	Limitations not identified accurately	0	
	Some limitations identified	1	
	Limitations well addressed	2	
Innovation of project: assign a single best score			2
	Previously described methods	0	
	New use for known assessment	1	
	New assessment methodology	2	
Relevance of project: assign a single best score			2
	Impractical to most programs	0	
	Relevant to some	1	
	Highly generalizable	2	
Clarity of writing: assign a single best score			2
	Unsatisfactory	0	
	Fair	1	
	Excellent	2	
<i>Total</i>			25

Table 2
EM Education Research Scoring Metrics: Qualitative Research

Domain	Item	Item Score	Maximum Domain Score
Introduction: give 1 point for each criterion met			3
	Appropriate description of background literature	1	
	Clearly frame the problem	1	
	Clear objective/hypothesis	1	
Measurement: give 1 point for each criterion met			3
1. Methodology			
	Appropriate for study question	1	
2. Sampling of participants			
	Appropriate study population	1	
	Enrolled full range of cases/settings beyond convenience	1	
Data collection: give 0–1 point for each criterion met			3
1. Institutions			
	Single institution	0	
	At least two institutions	1	
	More than two institutions	1	
2. Sample size determination			
	Appropriate sample size determination	1	
Data analysis: give 1 point for each criterion met			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 (e.g., member checking, triangulation)	1	
	Addressed reflexivity (impact of researcher’s background, position, biases on study)	1	
Discussion: give 1 point for each criterion met			3
	Data support conclusion	1	
	Conclusion clearly addresses hypothesis/objective	1	
	Conclusions placed in context of literature	1	
Limitations: assign a score			2
	Limitations not identified accurately	0	
	Some limitations identified	1	
	Limitations well addressed	2	
Innovation of project: assign a score			2
	Previously described methods	0	
	New use for known assessment	1	
	New assessment methodology	2	
Relevance of project: assign a score			2
	Impractical to most programs	0	
	Relevant to some	1	
	Highly generalizable	2	
Clarity of writing: assign a score			2
	Unsatisfactory	0	
	Fair	1	
	Excellent	2	
<i>Total</i>			25

The range of reviewers’ scores for the top articles was from 15 to 24 with a range of mean scores from 15.8 to 21.8. SD of the scores of each article ranged from 0.5 to 3.4. Intraclass correlation coefficient revealed an average measure of 0.771 for all articles scored.

Archambault, PM, Thanh, J, Blouin, D, et al. Emergency medicine residents' beliefs about contributing to an online collaborative slideshow. *CJEM* 2015;17:374–86.

Background: Collaborative writing applications (CWAs) may offer educational benefits to learners, such as knowledge retention, skill acquisition, and collaboration. This study explored Canadian EM residents' beliefs about their intent to contribute summaries of landmark articles to a collaborative slideshow while studying for a certification examination.

Methods: Participating residents were interviewed about the advantages/disadvantages, positive/negative referents and barriers/facilitators or contributing to a collaborative slideshow. Qualitative content analysis was used to identify salient beliefs.

Results: The dominant perceived benefit of contributing to the slideshow was learning consolidation, while information overload was the salient drawback. Writing the certification examination was a positive referent. The most common obstacle to participation was time constraints, while high-quality scientific information facilitated participation.

Strengths of this study: This study lends insight into how residents perceive the use of CWAs for educational benefits. The qualitative design is well suited to exploring an emerging phenomenon.

Relevance for future educational advancements: Knowledge of the barriers to participating in CWA learning may be of use to educators wishing to implement similar interventions. Further exploration of perceptions when CWAs are using for collaborative tasks versus learning would be of interest, as well as further study of the unique benefits of CWAs versus independent learning.

Beeson, MS, Holmboe, ES, Korte, RC, et al. Initial validity analysis of the emergency medicine milestones. *Acad Emerg Med* 2015;22:838–44.

Background: Emergency medicine milestones were developed by the Accreditation Council for Graduate Medicine Education (ACGME) as part of the Next Accreditation System. The EM milestones are used for resident assessment and program evaluation by measuring the acquisition of knowledge, skills, and abilities (KSAs) as an educational outcome. This study sought to measure the reliability and validity of the EM milestones

Methods: Observational study of all ACGME accredited EM programs ratings on all 23 milestone subcompetencies during a single discrete time period. Residents were grouped by postgraduate year (PGY) of

training. Means and 95% confidence intervals (CIs) were calculated for each PGY in aggregate and each individual subcompetency. Internal consistency was measured using a standardized Cronbach's alpha coefficient.

Results: A total of 5,805 residents from 162 EM programs were evaluated on the milestones. The overall mean performance ratings using the aggregate of all subcompetency scores were 2.38 (95% CI = 2.37–2.39) for EM-1 residents, 4.34 (95% CI = 4.32–4.35) for EM-2 residents, 5.95 (95% CI = 5.94–5.96) for EM-3 residents, and 6.79 (95% CI = 6.77–6.81) for EM-4 residents. The mean performance ratings demonstrated discrimination between residency years. The reliability (internal consistency) within each year of training had a Cronbach's alpha coefficient of 0.96 for each year.

Strengths of this study: The large and complete data set involving all EM milestones and EM residents is important to demonstrate internal validity the newly developed milestones. It examined the evaluations from over 150 residencies representing a wide variety of residents and faculty raters. The use of the American Board of Emergency Medicine as an independent authority adds legitimacy to the study. The tight grouping of the milestones for each year of training and the high Cronbach's alpha provide strong evidence of internal validity of the milestones.

Relevance for future educational advancements: Having validated measures of resident assessment is essential to examining educational outcomes and the field of educational research. This study establishes the internal validity of EM milestones and makes EM an example for other specialties. Other studies have been published specifically using EM milestones because of the strength of validation process. Further studies need to examine the external validity of the EM milestones.

Bentley, S, Mudan, G, Strother, C, Wong, N. Are live ultrasound models replaceable? Traditional versus simulated education module for FAST exam. *West J Emerg Med* 2015;16:818–22.

Background: Training in ultrasound (US) during undergraduate medical education is increasing. The use of US simulation has been suggested and shown to be feasible for some US training indications. Simulated models have been shown to be effective for skill acquisition, but limited data exist comparing the use of live models to simulation.

Methods: This was a prospective, blinded, controlled noninferiority study performed on fourth-year

emergency medicine students on the EM clerkship. Students performed ACEP US questions as a pretest and were surveyed regarding comfort. All students received a lecture and hands-on demonstrations and practice sessions, with the control group using live volunteers to practice and the intervention group using an US simulator. An identical posttest and comfort survey was administered, in addition to a proctored objective structured clinical examination (OSCE). Outcomes included knowledge from pretest to posttest as well as OSCE results.

Results: Ninety-three students completed the study. Pre- and posttest scores were similar between groups, and both groups improved from pretesting to posttesting. All students reported increases in comfort levels, with no difference between groups. No significant difference was found between OSCE scores for each group.

Strengths of this study: The authors chose a noninferiority methodology with a prospective, controlled design. They used validated questions from the ACEP US question bank for their pre- and posttest, and outcomes were multimodal (knowledge, skills, attitudes). This allows for high levels of generalizability, with the limitation that the US simulator may be an expensive purchase.

Relevance for future educational advancements: The use of US simulators is similar to the use of live models for US education for at least some indications. Further research can evaluate other indications, as well as investigate the ability of simulators to increase diagnostic capability (i.e., abnormal findings.)

Bhat, R, Takenaka, K, Levine, B, et al. Predictors of a top performer during emergency medicine residency. *J Emerg Med* 2015;49:505–12.

Background: The goal in applicant selection is to obtain the best residents. Prior literature has suggested that EM clerkship grades, letters of recommendation, medical school quality, the interview, and other factors are associated with resident success as measured by various metrics. Little multi-institutional data exist to guide program directors as to which preridency factors are predictive of resident success.

Methods: This was a retrospective cohort of three most recent graduating classes from nine EM residencies. Predictor variables include residency application, interview scores, rank list position, and medical school rankings. The end-of-residency semiannual evaluation was used as the objective measure of residency performance. The top third of residents was determined using the sum of their total evaluation scores.

Results: Data from 277 residents from nine programs were analyzed. EM home rotation grade, away rotation grade, USMLE Step 1 score, interview score, AOA, standard letter of recommendation (SLOR) global assessment, SLOR competitiveness ranking, and more than publications/presentations were all statistically associated with higher resident performance measurements.

Strengths of this study: This was a multi-institutional assessment of preridency variables and which predict resident success. Objective measurements of success were used, in addition to standardized forms of resident assessment and residency variable scoring/rating. These features make this a much more rigorous look at these factors than has been previously performed, and generalizability is high.

Relevance for future educational advancements: The authors used standardized assessments and outcomes measurements to define their variables. Further literature investigating predictive factors of success should strive for this type of rigor. Finding the perfect mix of qualities which predict success in a given program, however, will continue to be challenging.

Gorgas, DL, Greenberger, S, Bahner, DP, Way, DP. Teaching emotional intelligence: a control group study of a brief educational intervention for emergency medicine residents. *West J Emerg Med* 2015;16:899–906.

Background: High emotional intelligence (EI) is said to improve team functioning, communication, decision making, physician–patient interactions, and career longevity. The four primary EI skills include self-awareness, self-management, social awareness, and relationship management. This study sought to determine if a brief education intervention could improve residents' EI scores.

Methods: Residents were randomized, stratified by sex and training year, to intervention and control groups. Both groups completed the 10-item Hay 360 EI Quiz, a free sample of the Hay 360 Emotional Competence Inventory. The intervention group participated in a 2-hour didactic and case-based discussion focused on social perspective taking (SPT), one sub-skill of social awareness. The intervention group completed the 10-item Hay scale immediately following the session and all residents completed the survey 6 months later. All residents in the program continued to receive longitudinal feedback on interpersonal communications, as ACGME mandates. A four-way ANOVA (group, sex, program year, and time) calculation was performed to analyze residents' EI scores.

Paired t-test compared score differences in the intervention group.

Results: Thirty-three of 36 (92%) residents completed the study. Intervention group EI scores improved in a statistically significant manner between preintervention and 6 months postintervention. There was no statistically significant change in scores immediately after the intervention. There was no relationship between sex or training and EI score change.

Relevance for future educational advances: This study was conducted at one program and involved small study numbers, resulting in insufficient power to demonstrate a relationship between sex or training level and EI score. EI score determination was based on a significantly abridged version of the Hay 360 EI scale. Although the intervention focused on only one subskill (SPT) component of EI and all residents received regular feedback on communication skills, the intervention group demonstrated improved EI scores 6 months postintervention. These results indicate that this component of EI may be teachable. The relationship between focused, brief EI education and other components of training and residents' actual clinical practice is yet to be defined.

Strengths of the study: This study used a stratified randomized controlled pre- and postintervention to demonstrate a change in EI scores on an abridged, but validated scale of EI. The authors' analysis of factors that relate to EI score was based on existing conceptual frameworks.

Hoskote, SS, Khouli, H, Lanoix, R, et al. Simulation-based training for emergency medicine residents in sterile technique during central venous catheterization: impact on performance, policy, and outcomes. *Acad Emerg Med* 2015;22:81–7.

Background: Simulation-based training in sterile technique during central venous catheterization reduces the rate of central line-associated bloodstream infection (CLABSI). This study had two objectives: 1) demonstrate the effectiveness of individual simulation-based training in improving EM residents' performance of sterile technique and 2) compare rates of CLABSI in medical intensive care unit (MICU) patients based on whether central venous catheterization was performed by EM residents in the emergency department (ED; Group 1) or by internal medicine (IM) residents in the MICU (Group 2).

Methods: All EM residents underwent simulation-based training in sterile technique to a specified observer-completed checklist of proficiency. MICU patient

data were reviewed and extracted based on CLABSI rate and the placement conditions of central venous catheters (CVCs): Group 1 versus Group 2, as well as individual patient characteristics. Scores for change in resident performance before and after simulation training were compared using Wilcoxon signed-rank test. CLABSI rates and patient characteristics in the two groups were compared.

Results: Seventy-six EM residents completed simulation-based training in sterile technique. Postintervention scores improved with statistical significance ($p < 0.01$) based on interobserver agreement (Cohen's kappa coefficient = 0.98). A total of 184 CVCs were placed under sterile technique by Group 1. A total of 1,270 CVCs were placed under sterile technique by Group 2. There was no difference in the rates of CLABSI between the two groups (EM vs. IM placed CVC): 1.02 versus 1.02 per 1000 catheter-days ($p = 0.99$).

Relevance for future educational advances: This study is limited by the lack of data on CLABSI rate of ED-placed CVC prior to the initiation of the education intervention, making any change in rate of CLABSI in ED-placed CVC difficult to specifically measure. In addition, the retention of sterile technique skills was not studied. The study demonstrates that EM procedural education can improve EM residents' skills to the point that they are comparable to those of other specialties. This has implications for EM training in skills and procedures that may traditionally be considered to only be within the purview of other specialties.

Strengths of the study: This study demonstrates the effectiveness of simulation-based training in EM residents' simulated and clinical performance, directly linked to important patient outcomes.

Jordan, J, Elder, J, Uijtdehaage, S, Coates, WC. Dual learning in an emergency medicine clerkship improves student performance. *J Emerg Med* 2016;50(471–6):e1–2.

Background: As EM clerkships expand around the country, clerkship directors are trying out various methods of education, including lectures, bedside teaching, simulation, asynchronous/online learning, and others. Standardization of clerkship experience and curricula is challenging. Prior literature has shown that directing students to particular chief complaints is an effective method of standardizing a clerkship curriculum.

Methods: This was a prospective study in which students on individual clerkship months were sorted into

dual learning or standard learning groups. All students completed a multiple-choice pretest and were directed to see patients representing 10 specific chief complaints. The dual learning group received didactic lectures regarding five of these chief complaints. All students were directed to readings and other education materials. A posttest was given at the end of the rotation.

Results: Fifty-one students had complete data. Pretest scores were similar between groups. The dual learning group increased their scores on the posttest, while the standard learning group did not. The covariate of “EM-bound” did not affect score improvement.

Strengths of this study: The study used a quasi-experimental design to investigate a curricular change. The pre- and posttests were previously validated with the faculty group. Numerous resources were provided to both the control and the dual learning groups. Variables that may have affected the improvement on the posttest were investigated.

Relevance for future educational advancements: The authors have shown that a rigorous study design can be used to investigate curricular changes. It continues to be unclear what the best method of clerkship education may be, but it appears that multimodal education is necessary. Students who were allowed to self-direct learning did not perform as well as those who got in-person, faculty-facilitated didactic sessions.

Kellogg, AR, Coute, RA, Garra, G. Diagnostic reasoning for ST-segment elevation myocardial infarction (STEMI) interpretation is preserved despite fatigue. *J Grad Med Educ* 2015;7:27–31.

Background: The negative effects of fatigue and night shift work include impaired memory, decreased alertness, diminished psychomotor skills, and increased medical errors. Night shifts are associated with high rates of motor vehicle collisions, surgical complications, and intubation errors. The study examines the impact of fatigue on diagnostic reasoning.

Methods: Prospective pretest–posttest design of EM residents’ ability to correctly interpret electrocardiograms (ECGs) and activate the cardiac cath lab in the setting of STEMI. A test consisting of 10 ECGs with STEMI and STEMI mimics was created and validated on attendings. Various measures of fatigue and sleepiness were also measured. Diagnostic certainty/confidence was also measured. Residents were tested once during daytime and then again after a night shift.

Results: Twenty-three senior EM residents were tested. There was no significant difference in

diagnostic accuracy or confidence between daytime and nighttime accuracy despite have significant difference on multiple measure of fatigue and sleepiness. Interestingly, during daytime testing residents still displayed evidence of fatigue and sleepiness on measurements.

Strengths of this study: Despite its small sample size, the study was multicenter using residents from different years and different centers. The use of well-validated measures of fatigue and sleepiness adds to the power of this study. However, the study may have been underpowered to detect the difference. A power calculation or sensitivity analysis would be helpful to understand the risk of a Type II error.

Relevance for future educational advancements: Understanding the impact of sleepiness and fatigue to education, errors, and safety are critical to developing strategies to minimize risk. The finding of fatigue and sleepiness even during the day should be of concern.

Kessler, CS, Tadisina, KK, Saks, M, et al. The 5Cs of consultation: training medical students to communicate effectively in the emergency department. *J Emerg Med* 2015;49:713–21.

Background: Effective communication is critical to providing safe and high-quality care of patients. Poor communication and/or lack of standard communication processes can lead to errors and worse outcomes. This study examined the impact of training in standardized consultation process on communication in a real-time environment.

Methods: A multicenter randomized controlled trial comparing live training, asynchronous training, or no training of medical students on an emergency medicine rotation. Eight centers participated. Student consults were observed in real time using checklists and rating scales.

Results: A total of 208 students were observed performing 603 consults. Students who received training either live or asynchronous performed better than untrained students. Additionally, there was no difference between live and asynchronous training in student performance.

Strengths of this study: The use of both a multicenter and a randomized, controlled design make the study extremely well designed. Measuring the outcome by direct observation using a checklist in real-time clinical care further enhances the validity of the study.

Relevance for future educational advancements: This study has two important findings for educators. First, communications skills and standardized tools like the

5Cs can be taught. Given strong study design as described above these results are probably generalizable to other tools like IPASS and/or SBAR. Additionally, this study adds to the growing body of literature that standard asynchronous learning is as effective as live training. However, the impact of training on outcomes and error reduction still needs to be defined.

Kessler, D, Pusic, M, Chang, TP, et al. Impact of just-in-time and just-in-place simulation on intern success with infant lumbar puncture. *Pediatrics* 2015;135:e1237–46.

Background: Infant lumbar puncture (LP) is a procedural skill that is unlikely to be successfully achieved prior to internship. This study sought to assess the effectiveness of two educational simulation instructional designs (simulation-based training at the commencement of internship [bundle education] vs. bundle education plus coached, refresher just-in-time and just-in-place [JIPT] practice in the clinical setting) in effecting interns' infant LP success on first clinical attempt.

Methods: Pediatric and emergency medicine interns at 34 centers were prospectively enrolled in the study. Participants comprised two historical cohorts: Cohort A (2009–2010) received bundle education, Cohort B (2010–2012) received bundle education plus JIPT immediately before performing an infant LP. Self-reported data were collected at the time of the clinical procedure. Interns' first-attempt infant LP success rate, secondary procedural data, and participant and procedural characteristics were analyzed via two-sided t-test and chi-square test.

Results: A total of 1,319 interns were enrolled, resulting in 436 first infant LPs. There was no statistically significant difference in procedural success rate between the two cohorts based on the two education design strategies. Cohort B participants, having received JIPT, demonstrated greater use of analgesia, more early stylet removal, and a lower mean number of LP attempts.

Strengths of the study: This multicenter study demonstrated the use of a recognized theoretical framework for an education intervention, drawing on the expertise of educators across 34 sites. A power analysis supported the data collection numbers.

Relevance for future educational advances: The study was limited by several factors, including control of education strategies at the participating sites and iterative changes to the education strategy over time.

Outcome data were based on self-report and the definition and interpretation of successful procedural performance. In addition, the authors note that over time, more interns had been exposed to simulation-based training in LP prior to entering postgraduate training, although this did not seem to affect the outcomes in Cohort B. This study demonstrates the challenges in teaching and sustaining successful performance of procedures that are infrequently performed in the clinical setting. The authors have expanded on prior studies of the use of simulation training for procedures by introducing follow-up, just-in-time refresher training in the clinical setting. However, it remains to be seen what the optimal educational strategy is for maintaining performance competency for infrequently performed procedures.

Reddy, ST, Zegarek, MH, Fromme, HB, Ryan, MS, Schumann, SA, Harris, IB. Barriers and facilitators to effective feedback: a qualitative analysis of data from multispecialty resident focus groups. *J Grad Med Educ* 2015;7:214–9.

Background: Although feedback is critical in medical education, the literature suggests that inadequate feedback occurs. This study explored multispecialty residents' experiences with giving and receiving feedback to identify feedback barriers and facilitators.

Methods: Residents in anesthesiology, emergency medicine, obstetrics and gynecology, and surgery from three institutions were invited to participate in focus groups to explore their feedback experiences and identify feedback barriers and facilitators. A grounded theory approach and constant comparison analysis strategy were used.

Results: Feedback themes identified included teacher factors, learner factors, feedback process, feedback content, and educational context. Barriers included unapproachable attendings, time pressures, and discomfort giving negative feedback, while the main facilitator identified was learner engagement in the feedback process.

Strengths of this study: Despite continued attention to feedback research, educators still struggle to maintain a culture of meaningful feedback in medical education. This study's strengths include the exploratory method and inclusion of multispecialty residents from several institutions. The findings reinforce the importance of learner engagement in feedback.

Relevance for future educational advancements: The feedback themes and barriers identified are consistent with the literature, but highlighting that the major

facilitator of effective feedback is learner engagement may help direct future research. Understanding how to effectively increase learner engagement will be key to improving feedback culture. Future study should also build upon what is known about learner perceptions of feedback to explore how to evaluate feedback effectiveness.

Thoma, B, Sanders, JL, Lin, M, Paterson, QS, Steeg, J, Chan, TM. The social media index: measuring the impact of emergency medicine and critical care websites. *West J Emerg Med* 2015;16:242–9.

Background: Emergency medicine and critical care blogs and podcasts are increasingly being used for educational purposes, but assessing the quality and impact of these resources is challenging. These authors developed the social media index (SMI) to allow learners to identify quality educational websites and facilitate scholarly credit for educators who develop social media–based instructional materials.

Methods: The SMI was developed using data from social media platforms. Three normalized formulas were tested for statistical robustness and assessed for 1) temporal stability using repeated measures and website age and 2) correlation with impact by applying it to emergency medicine/critical care (EMCC) journals and measuring the correlation with known journal impact metrics.

Results: The logarithmic version of the SMI containing four metrics (Google PageRanks, Alexa Ranks, Facebook Likes, and Twitter Followers) was most statistically robust, correlating with website age (Spearman $r = 0.372$; $p < 0.01$) and repeated measures ($r = 0.929$; $p < 0.01$). It also correlated with all impact metrics for EMCC journals except number of articles published.

Strengths of this study: This study addresses a question that is timely, relevant, and of use to both learners and educators. Although the SMI is derived from followership variables, which are a proxy for quality, it provides a method of quality and impact assessment where none previously existed. Furthermore, followership captures a similar concept to the current criterion standards for assessing quality in peer-reviewed journals.

Relevance for future educational advancements: Authors developing blogs or podcasts or publishing papers describing the impact of social media–based innovations may wish to calculate and include the SMI as one outcome measure. Future research should seek to further define quality in Web-based

educational content and seek to understand the relationship between SMI and educational outcomes.

DISCUSSION

Trends in Medical Education Research 2015

In 2015, there was a sharp increase in the number of articles that met our a priori criteria for full review ($n = 61$) compared with 2014 ($n = 25$). Upon discovery of this surge, we verified that our search and inclusion criteria were unchanged, although we formally reviewed 10 papers that employed survey methodology in 2015 (compared to none in 2014). The rate of funding for studies this year increased slightly from 16% to 20%. Reed et al.⁷⁸ demonstrated that studies that were funded tended to be of higher quality when assessed on a validated tool. In 2015, 12 studies (20%) were funded, one received federal funding, two received foundational funding, and eight received support from an institution or unspecified organization.^{18,30,33,46,48,53–59,71,76} Four of the 12 highlighted articles (33%) this year were funded research.^{18,46,53,60}

Emergency medicine journals published 71% of this year's articles, including nine (75%) of the highlighted articles. This represents an increase from last year when 56% of articles appeared in EM journals. Eleven (18%) were published in medical education–focused journals including 17% of those highlighted, and the remaining seven (11%) appeared in a variety of journals (anesthesia, pediatrics, simulation, trauma, and generalist). Almost all papers had at least one EM author (95%), which is an increase from 2014 (84%) but similar to 2013 (91%). Of interest is the growth of representation from different global regions. While 42 (69%) papers reported on studies conducted in the United States and five (8%) in Canada, we noted five U.S./Canadian collaborations and nine papers with global origins (Australia, Brazil/United States, China [Hong Kong], France, Germany, Germany/Switzerland, Iran, New Zealand, and Thailand).

Experimental (hypothesis testing) studies declined in 2015 from 36% of the total to 15% of all reviewed studies.^{30,33,41,46,50,52,57,64,76} Notably, four of these were articles highlighted for excellence^{41,46,50,52} and represent 15% of the featured studies. Six studies (10%) involved qualitative methodology^{18,39,47,54,60,69} of which two were highlighted.^{18,60} There were 10 papers (16%) that employed survey methodology but none met the criteria for a highlighted article.^{36,37,42,61,63,65,67,74,75,77} The remaining 36 papers (59%) were

observational studies^{17,19–29,31–35,38,40,43–45,48,49,51,53,55,58,59,62,66,68,70–73} and accounted for 50% of the highlighted articles.^{20,21,23,51,53,70} It is interesting to note that each study design had representation in meeting the validated criteria to be a highlighted article, with the exception, this year, of survey methodology. In our quest as a specialty to perform high-quality research in medical education, we believe that it is important to have rigorous methodology and high-level outcomes. As outlined by Kirkpatrick and Kirkpatrick,⁷⁹ the most desirable types of educational research studies measure the impact of a training program on modifying learner behavior in real settings and demonstrating independent improvement in metrics targeted by the intervention, such as a decrease in morbidity or an increase in compliance with a quality improvement metric. This year's study by Hoskote et al.⁴⁶ is a good example of this principle. In general, lower Kirkpatrick-level studies that measure learner satisfaction or self-assessment were not likely to have met the criteria for the highlighted articles.

The study populations included medical students (36%),^{19,21–23,33,35,36,38,42,44,45,47,50,52,53,55,66–68,72,73} residents (54%),^{17,18,20,24–29,31,34,37,39,40,43,46,48,49,53,57–61,63,64,68,69,71,74,76} and a variety of others (attending physicians, nurses, interprofessional teams, fellows, midlevel providers, paramedics, validity evidence, and department flow).

Studies that are conducted at multiple institutions are important since they demonstrate that the intervention is effective in a variety of settings and may be more generalizable to others who wish to implement a similar program. This year, 10 (16%) studies were conducted at more than two sites.^{17,20,23,37,43,44,52,53,62,70} Researchers in EM can be more confident in the value of their interventions if they produce excellent results when applied to many different types of learners and taught by a variety of instructors. The authors of this piece advocate for the creation of multi-institutional collaborations to improve the overall quality of EM education research.

The topics of study this year had many similarities to previous years, in that technology^{18,21,24–26,28,30–33,46,56,64,68–72,75,76} and simulation^{25,26,30,33,46,53,57,58,64,71,72,75,76} were prominent. Procedural learning and competency, with or without simulation as the focus, were studied in seven articles.^{21,24,28,31,46,53,76} The biggest gain in topic for study was assessment and competency, likely in an attempt for programs to meet stipulated benchmarks of the Next Accreditation

Table 3

Trends for the Reviewed Medical Education Research Articles Published in 2015

Variable	All Publications (n = 61)	Highlighted (n = 12)
Funding	12	4
Learner groups*		
Medical students	22	4
Residents	33	7
Faculty	4	0
Other	11	1
Study methodology*		
Survey	10	0
Observational	36	6
Experimental	9	4
Qualitative	6	2
Topics of study*		
Assessment/competence	40	10
Technology	21	4
Simulation	13	2
Communications	13	5
Learner satisfaction	12	0
Procedures	7	3
Curriculum	6	3

*It is possible to exceed the total $n = 61$ or $n = 12$ in these categories due to multiple learner categories or study topics.

System. Forty articles (66%) and 83% of the highlighted articles^{20,21,23,41,46,50–53,60} were in this broad category. As usual, some articles focused on pediatric topics.^{25,33,53,56,77} The importance of communication was studied in 13 (21%) of studies, marking a drastic increase over past years.^{18,26,39,41,47,49,52,54,59,60,66,70,77}

The popularity of clinical reasoning studies waned this year with only two studies (3%).^{51,68} A summary of the trends of articles published in 2015 is provided in Table 3.

LIMITATIONS

Despite rigorous searches repeated over several months of the English-language literature for all publications that met review criteria, these searches may have erroneously omitted high-quality studies. The exclusion criteria used may be considered overly rigorous. For example, we excluded single-site survey studies, as well as studies that demonstrated an “expected learning effect” without the inclusion of other learning outcomes. Although the rating metrics used in this analysis have been previously published and iteratively revised over several years, only limited validity evidence exists for the scoring methods. This may

contribute to a ranking cut point of quality articles that may be too stringent. However, the aim of this continuing series is to review high-quality EM education research, and all revisions to the article scoring and selection process have been made to increase the relevance of the papers reviewed, as well as their potential to impact the educational practice of the reader.

CONCLUSIONS

This article presents a critical appraisal of high-quality educational research in emergency medicine. A great increase in articles scored occurred this year, and the 10 quantitative and two qualitative articles represent the most methodologically superior papers. As EM educators strive for higher-quality educational research, they can use these examples for guidance.

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