WestJEM

Volume 20, Number 1, January 2019 Open Access at www.westjem.com ISSN 1936-900X

Western Journal of Emergency Medicine:

Integrating Emergency Care with Population Health

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Western Journal of Emergency Medicine (*West*JEM): Integrating Emergency Care with Population Health (*West*JEM) is the premier open-access Medline-indexed EM journal in the world. As the official journal of California ACEP, American College of Osteopathic Emergency Physicians (ACOEP) and the California chapter of American Academy of Emergency Medicine (AAEM), the journal focuses on how emergency care affects health and health disparities in communities and populations. Additionally, *West*JEM focuses on how social conditions impact the composition of patients seeking care in emergency departments worldwide. *West*JEM is distributed electronically to 19,000 emergency medicine scholars and 2,800 in print. This includes 83 academic department of emergency medicine subscribers and 8 AAEM State Chapters.

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The *West*JEM Education Supplement couldn't exist without our many reviewers. To all, we wish to express our sincerest appreciation for their contributions to this year's success. Each year a number of reviewers stand out for their (1) detailed reviews, (2) grasp of the tenets of education scholarship and (3) efforts to provide feedback that mentors authors on how to improve. This year's "Gold Standard" includes:

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Editorial and Publishing Office: *West*JEM/Depatment of Emergency Medicine, UC Irvine Health, 333 City Blvd, West, Rt 128-01, Orange, CA 92868, USA
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Editorial and Publishing Office: *West*JEM/Depatment of Emergency Medicine, UC Irvine Health, 333 City Blvd, West, Rt 128-01, Orange, CA 92866, USA

Office: 1-714-456-6389; Email: Editor@westjem.org

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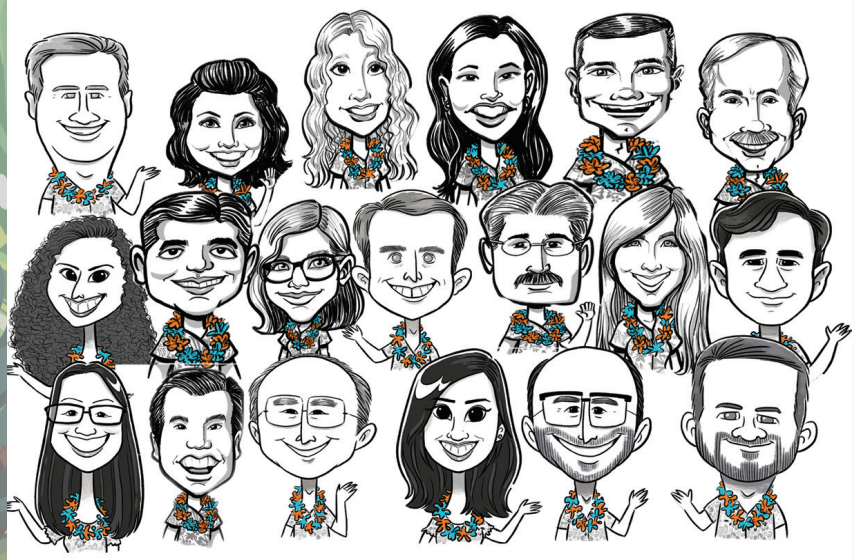

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Improving the Learning Experience through Evidence-based Education

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Section Editor: Douglas S. Ander, MD
Submission history: Submitted October 18, 2018; Accepted October 18, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.41320
[West J Emerg Med. 2019;20(1)1–5.]

Our learners invest a significant portion of their time, energy and financial future to achieve the goal of becoming physicians. In turn, society expects physicians who are well trained and prepared for a career that includes lifelong learning. What both our learners and ultimately their patients get in return too often falls short of what should be a first-rate experience. With the many hours spent in lectures, how often has the information conveyed changed your practice? During your education, how often have you felt like an active participant whose specific needs were being addressed? To what extent has lifelong learning been modeled for you throughout your education? These and many other questions regarding our own educational experiences as physicians can and should be addressed by the practice of ***evidence-based education*.**

For generations, physicians in training have been taught by educators who were content experts but had little, if any, formal training in education. This includes many of today's education leaders who develop their local culture and design the educational experiences. One might argue that we all turned out all right as physicians in a less-than-ideal educational environment, but today's standard demands something more. There is a general move toward competency-based assessment and longitudinal, clinically relevant curricula.[1-2] In this environment where the status quo is no longer sufficient, there is an opportunity to develop experiences based on evidence that provide a high-quality education supporting both our learners in the pursuit of their calling and our mission as educators.

Indeed, there is an increasing emphasis on applying learning theory and best practices in our educational endeavors. This can be seen in the development of educator tracks in medical school and residency, education fellowships, faculty development programs, and advanced degrees in education.[3-5] There is much that can be done to maximize our effectiveness as educators. Toward that end, we advocate for a concerted effort to practice evidence-based education by faculty whenever presented with an educational endeavor. Formal advanced training in education is not required to practice evidence-based education, just as formal training in statistics and epidemiology may not be required for evidence-based clinical practice, but some understanding of educational theory and best practice is critical. Although seeking relevant resources for an educational task, such as current concepts, guidelines, and research can be daunting, the benefit of such an approach to the educator and learner are without measure (Table 1).

Central to success in any educational initiative is an understanding of the importance of ***conceptual frameworks*** (e.g., theories, best practices, models). How to best accomplish an educational goal can be viewed from a number of perspectives; the conceptual framework selected highlights the authors' choice of theory or best practice most likely to accomplish their intended

Table 1. Potential benefits to the use of evidence-based education.

• Increased learning and improved retention from teaching activities.
• Results from questionnaires that accurately reflect what authors are attempting to understand.
• Curricula and programs that successfully meet their intended goals.
• Valid assessments of performance.
• Outcomes that demonstrate success to peers, administration, and the larger education community.
• The oppportunity to publish outcomes if the project is innovative and/or scholarly in its approach.
• Modeling an evidence-based approach for learners to emulate.

goal.[6] Once selected, this framework becomes the basis for decision-making regarding the design of the education experience and outcomes to be measured. Though one dominant conceptual framework is generally selected for any given initiative, a number of additional theories or best practices may be relevant to the design of the experience. From an academic perspective, the lack of a conceptual framework is a common reason for journals to reject scholarly submissions.[7,8]

Educational initiatives, whether a presentation, workshop, rotation, curriculum or program, should include an early determination of the outcomes to be measured demonstrating the value or relative benefit of the initiative. Generally these outcomes reflect the goals of important stakeholders (e.g., learners, teachers, patients, administration). A presentation generally has relatively simple, straightforward outcomes while multifaceted, large-scale initiatives or those intended for scholarly submission require more substantive, objective outcomes. Common means of determining or evaluating appropriate outcomes include ***Kirkpatrick's hierarchy,[9] Bloom's taxonomy,[10] Miller's pyramid,[11] Moore's outcomes,[12] and the logic model***.[13] Although questionnaires[14] and assessment methods such as workplace-based assessments (i.e., clinical competency committees, Standardized Letters of Evaluation)[15] don't provide outcome measures that can be assessed in the same manner, it is no less important that they are based on psychometrically-sound principles in order to perform in the manner intended with the added potential to serve as scholarship.

Several examples from the authors' own experience are provided to demonstrate and clarify the principles discussed:

EXAMPLE 1

A few years after completing residency, this author took a job at a new institution as an assistant program director. It seemed that while the residents were very enthusiastic and eager to learn, they were regularly faced with a dilemma: whether or not to complete their weekly reading assignment. Since all residents were given identical weekly reading assignments, the topics were not always pertinent to what they were doing clinically. As an example, a resident could be on an obstetrics and gynecology rotation but the assigned reading could be on trauma. The resident often had to choose between reading about their patients to prepare for their clinical work, or completing the assigned reading for the week.

As an enthusiastic new faculty member, this author saw a problem and wanted to fix it. The goal was to create a system where everyone was on their own unique reading schedule, and their reading assignments would be coupled with their clinical work. Tempted to create a new reading curriculum and immediately implement it, the author recalled the prior teaching of medical education mentors: one must be deliberate about the changes made and should study the effects of those changes.

The concept of pairing a resident's clinical work with their reading assignments is supported by ***Kolb's theory of experiential learning***.[16] Kolb argued that effective learning occurs as learners' cycle through four stages: concrete experience, active experimentation, reflective observation, and abstract conceptualization. In the case of the reading curriculum, the plan was for the residents to have the concrete experience of readings relevant to what they were experiencing clinically, allowing them to actively experiment and reflect on the application of this newly acquired knowledge. Kolb's theory suggests that this process would lead to more effective learning, which was the goal in changing the way reading was assigned to the residents.

In addition to ensuring that the curricular intervention was grounded in educational theory, the author was deliberate in her intention to evaluate the changes made. The Kirkpatrick outcome levels were very helpful in guiding the project toward these evaluation goals.[9] To begin with, level 1 outcomes were evaluated having to do with the learner's satisfaction with the curricular change. To evaluate this, the residents reported their level of satisfaction with the curriculum both before and after the curricular intervention. Level 2 outcomes measure the learner's acquisition of knowledge. The plan was to improve the learners' acquisition of knowledge by improving their reading schedule. Objectively measuring this outcome will be a long-term goal, perhaps accomplished by evaluating changes in in-training examination scores or some other objective test of knowledge. Level 3 outcomes have to do with changes in learners' behavior. Consequently, the amount of time residents spent reading before and after the intervention was evaluated. It was found that they spent significantly more time reading after the intervention; thus, their behavior (i.e., motivation to read) appeared to have changed. Although levels 1 and 3 outcomes were measured, they were both subjective in that they were self-reported by the residents. As a curricular innovation based on education theory, the author was able to publish her work based on these preliminary findings.[17] There are plans in place for more rigorous, objective outcomes to evaluate the value of this initiative to the residents' education.

EXAMPLE 2

In an effort to create a more compelling presentation, one of us took a previously well-received presentation on anterior segment ophthalmologic trauma and used educational theory and best practices to redesign it. This was done with the goals of improving participants' learning and retention. Successful treatment of such traumas is largely dependent upon proper diagnosis based on pattern recognition, otherwise known as ***non-analytical clinical reasoning***.[18] Much like electrocardiograms,[19] skin disorders,[20] and radiographs,[21] the more examples one sees, the more proficient one becomes. Expertise is based on building a repertoire of examples against which future experiences can be compared. Consistent with the conceptual basis of non-analytical reasoning, this initiative was designed to maximize participants' cognitive schema/catalog development through ***spaced repetition*** involving specific anterior-segment injuries.[22]

Consistent with Kolb's experiential learning theory,[16] the structure of this experience was designed to provide staged, multifaceted, authentic learning experiences to maximize the breadth and depth of what was learned. Additional pedagogical principles were employed in the appropriate circumstances.

Structure

I. Pre-Session: To activate learning, 10 pictures of specific pathological entities, each with clinically related questions, were sent to participants to complete and return one week prior to the presentation.

II. Presentation (one hour): The objective was to create a clinical need to know followed by a case-based, concrete learning experience promoted through ***active learning techniques*** such as "think-pair-share" and "the one-minute paper."[23] This was carried out in a safe environment that facilitated participant decision- making and engagement in the experience. To view the presentation go to: https://chipcast.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=3a0780f2-0218-457b-a9f4-fb9c9ba493a4.

III. Workshop (one hour): To build on prior experiences, small-group sessions were designed to promote learning from one another (***social learning theory***).[24,25] Each group received several case scenarios with pictures and questions related to actual complex presentations. In a ***problem-based learning exercise***, each group worked through the cases provided, including (1) What are your initial concerns; (2) How will you proceed with evaluation; (3) What treatment options would you consider; and (4) What do you believe will be the final disposition of this patient?

IV. Post-session: Ten pictures involving eye trauma not previously seen, each with clinically

relevant questions, were sent to participants to complete one week after the presentation. The purpose of this exercise was to provide additional examples for schema development and retention, not to test participants' post-program knowledge.

Though there were generally multiple examples of most of the entities presented, high-risk presentations such as hyphemas (eight examples) and alkaline burns (five examples) were emphasized to maximize schema formation regarding these high-risk entities.

Participants' post-program assessment of the experience was very positive (Kirkpatrick level 1), particularly in regard to learning clinically relevant information (Kirkpatrick level 2). Most reported specific, intended changes in their practice as a result of the experience (Kirkpatrick level 3). Though generally not substantive enough for scholarly work, such subjective "soft outcomes" are appropriate for evaluating and improving this type of experience. From a personal perspective, trying something new and experiencing an increased level of engagement from participants was both energizing and fulfilling as an educator.

EXAMPLE 3

In 2014, our emergency medicine (EM) residency was faced with redesigning the pediatrics experience for our residents. The traditional model involving EM residents rotating "off-service" on pediatric inpatient wards had proved ineffective and unpopular. Residents voiced their concern that this learning environment did not resemble their intended practice. Significant time was spent in administrative and other tasks that were not germane to the practice of EM, and the educational benefit of the "ward rotation" was not perceived as being worthy of this opportunity's cost. While there was certainly educational opportunity in the pediatric setting that could be valuable to EM residents, it was not clear how precisely to best achieve this benefit.

The decision was made to redesign the experience through the lens of ***situated learning*** – the conceptual framework in which learners are welcomed into a community of practice by participating in authentic work, connecting this experience with prior knowledge, and developing relationships with other professionals.[25] By situating the learning experience in the authentic care of patients in the emergency department (ED), our hope was that residents would begin to understand the importance of pediatric care in the ED. Residents then followed up on all of their admitted patients during a mentored follow-up experience, rounding on the inpatient wards with a pediatric EM attending physician. In this manner, learners could further their understanding of both the longitudinal outcomes of hospitalization, and better recognize the role of the emergency physician (EP) in the continuum of pediatric care.

Framing our intervention in the situated learning framework, we used a common curriculum development rubric described by ***Kern et al***.[26] to develop, design and study the new curriculum. Residents, faculty and alumni were surveyed to identify both general and specific needs related to pediatric care in the ED as well as to gain a perspective on the course of pediatric illness and injury. From this needs assessment, we developed goals and objectives for the new curriculum. These learning objectives then guided the selection of appropriate educational methods and strategies. Once implemented, the identified goals and objectives could then guide evaluation strategies by which to determine effectiveness of the curriculum. With a fresh set of intended outcomes focused specifically on application of pediatric knowledge for the EP, we had the means to evaluate whether the curriculum was achieving its goals.

Beyond designing a curriculum, however, the basis in conceptual frameworks and use of a systematic process to guide the development of goals and objectives had the welcome benefit of allowing our team to communicate our experiences to other educators – even those beyond our specialty. Speaking in the language of educational theory and outlining our goals, objectives and outcomes in the Kern framework, our work became more scholarly. We presented our findings at academic meetings and were able to publish our experience

for others to read, critique, and build upon.[27] To demonstrate the impact of our curriculum to the residency program and medical directorship, we focused on the learners› satisfaction (Kirkpatrick level 1) and on their perceptions regarding positive impact on clinical care in the ED (admittedly a lower-level learning outcome). Residents also reported self-assessed changes in knowledge (Kirkpatrick level 2). To demonstrate the impact of this initiative on behavior (Kirkpatrick level 3), we used ***self-reported, retrospective post-then-pre surveys***[28] in addition to ***direct observation*** using a standardized assessment tool based on entrustable professional activities to provide a more objective, higher-level outcome. Without a firm basis in educational theory, this project would have remained a closed process, perhaps locally successful but surely not generalizable beyond our institution. Depending on the outcome, other curricula may require more objective data, such as tests of knowledge acquisition or changes in behavior, to reach the threshold of scholarly educational innovation. Incorporating education theory from the start, we could improve our product (the curriculum itself) and our scholarly impact.

Our hope is that these three examples will assist those who are interested in making their next educational intervention more evidence based. In addition to the references provided, a "toolbox" of potential resources has been included (Table 2) to facilitate the development of evidence based initiatives and achieving scholarly results.

Table 2. Potential resources for developing evidence-based educational initiatives.

Resource	Website	Description
Best Evidence Medical Education (BEME)	https://www.bemecollaboration.org/Publications+Evidence+Based+Medical+Education/	The BEME Collaboration is an international group of individuals, universities and professional organizations committed to the development of evidence-informed education in the medical and health professions.
"Twelve tips" series	Website for Medical Teacher: https://www.tandfonline.com/loi/imte20	This series provides practical advice in the form of 12 short hints or tips on medical education topics of interest (ex. evaluating educational programs, flipping the classroom).
ALiEM Academic Primer Series	https://www.aliem.com/2017/06/academic-primer-series-curated-collections-for-educators/	Collection of nine narrative reviews on important medical education topics, highlighting the most important literature and their defined importance for junior educators and faculty developers.
Curated Collections for Educators	"Five Key Papers" series – published in both *West*JEM and *Cureus*	This series provides the five most important papers on specific topics of importance in medical education. Topic examples include educational scholarship in junior academic faculty and digital scholarship.
International Clinician Educators (ICE) Blog	https://icenetblog.royalcollege.ca	This blog promotes discussion among clinician educators from around the world, archiving a variety of education resources.
Key Literature in Medical Education (KeyLIME) podcast	https://icenetblog.royalcollege.ca	This is a weekly podcast produced by the Royal College of Physicians and Surgeons of Canada that provides a summary and analysis of a medical education article in under 30 minutes.
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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Asynchronous Curriculum "Socially Synchronized": Learning Via Competition

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Section Editor: Chris Merritt, MD, MPH
Submission history: Submitted July 15, 2018; Revision received October 20, 2018; Accepted October 24, 2018
Electronically published November 30, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39829

Introduction: Now widespread in emergency medicine (EM) residency programs, asynchronous curriculum (AC) moves education outside of classic classrooms. Our program's prior AC had residents learning in isolation, achieving completion via quizzes before advancing without the benefit of deliberate knowledge reinforcement. We sought to increase engagement and spaced repetition by creating a social AC using gamification.

Methods: We created a website featuring monthly options from textbooks and open-access medical education. Residents selected four hours of material, and then submitted learning points. Using these learning points, trivia competitions were created. Residents competed in teams as "houses" during didactic conference, allowing for spaced repetition. Residents who were late in completing AC assignments caused their "house" to lose points, thus encouraging timely completion.

Results: Completion rates prior to deadline are now >95% compared to ~30% before intervention. Surveys show increased AC enjoyment with residents deeming it more valuable clinically and for EM board preparation.

Conclusion: Socially synchronized AC offers a previously undescribed method of increasing resident engagement via gamification. [West J Emerg Med. 2019;20(1)6–8.]

BACKGROUND

Widespread in emergency medicine (EM) residencies, asynchronous curriculum (AC) moves education outside the classic classroom setting, with the majority of current residents choosing to use various forms of AC.[1] Previous studies suggest this model of learning to be non-inferior in comparison to traditional didactic education.[2,3] Our EM residency's prior AC had residents learn in isolation, achieving marks of completion via quizzes before advancing without the benefit of deliberate knowledge reinforcement or discussion with peers. Residents endorsed low levels of enjoyment using this format as well as low confidence in the AC improving their readiness for clinical work or EM board exams. We sought to increase resident engagement and spaced repetition by creating a social AC using gamification.

OBJECTIVES

Our objectives were to increase resident engagement using gamification as well as to encourage spaced repetition. We measured these objectives by resident completion percentage, and by the residents' subjective enjoyment of the new AC and their self-assessment of clinical and board exam preparedness.

CURRICULAR DESIGN

We created a free, open-access website, AlamoCityEM.com, with a variety of monthly options consisting of free open-access medical education (FOAMed) resources and EM textbook chapters based upon our curriculum, broken up into one-month "blocks." Resources were selected based upon an extensive search of available FOAMed performed by a post-graduate year-

2 resident using search terms from key topics in the assigned textbook chapters for that month's block. The resident's search included a custom Google search engine created specifically for this project, which encompassed over 50 unique FOAMed websites and podcasts. These options were then evaluated by a faculty advisor for content suitability prior to being made available to the residency.

Each option was given an estimated time for completion. Time estimates for audiovisual options such as podcasts and videos were based upon actual run time at 1x speed. We input text from the textbook and article options into a website designed to estimate reading time, with resulting time estimates rounded upward to adjust for comprehension time.[4] Residents self-selected a total of four hours' worth of material each month, allowing for adjustment of choice length based on individual resident preferences.

In an innovative step, rather than using pre-created quizzes we asked residents to choose 12 learning points from the material that they deemed valuable. These learning points were submitted to a group Google spreadsheet to count as their mark of completion for the month. By identifying and submitting these learning points, learners were forced to consciously identify what they viewed as most valuable in the material they had covered. To further benefit from this process, residents were able to view learning points from their co-residents who often chose different resources each month. Thus, each month a crowdsourced document of 360 learning points was formed, allowing residents to benefit from each other's asynchronous learning that had previously been performed in isolation.

An issue with our residency's original AC was that once information was learned, there was no deliberate effort to reinforce that knowledge. This was particularly concerning as prior educational literature has shown that "spaced repetition" may be used to encourage knowledge retention.[6] In another innovative step, we used the learning points from all residents to create monthly trivia competitions that were held during didactic conference. Divided into three "houses" (Sherlock, MacGyver, and Hawkeye), residents competed in teams to encourage social engagement and learning via gamification. These competitions have helped to break up traditional didactic learning in grand rounds by offering an interactive learning format that has included diverse styles to keep the competitions fresh and engaging.

Residents late to finish their asynchronous task prior to deadline caused their entire "house" to lose points for that month's competition. Similarly, the first "house" with all members achieving completion received bonus points, giving them a head start in the competition. This camaraderie served to create a social expectation to finish in a timely manner. The overall competition spanned the academic year with the "house" winning the most months being declared the victors with prizes awarded.

IMPACT/EFFECTIVENESS

After implementation of this previously undescribed AC model, our residents achieved completion rates of ~ 95% prior to deadline compared to ~30% preceding intervention. Particularly useful to faculty was encouragement of timely completion via penalty and bonus points. On anonymous, standardized Likert surveys, residents reported markedly increased enjoyment of the curriculum and ranked it as subjectively more valuable for improvement in both clinical practice and board preparation (Figure). Strengths noted by

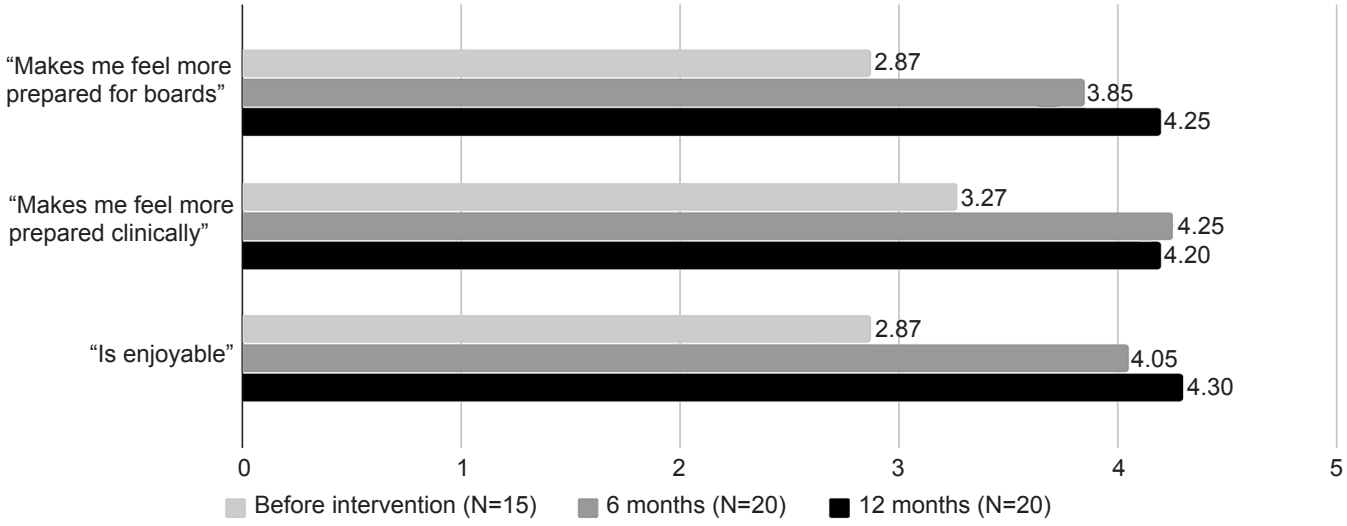

Figure. Resident response to intervention based on standardized Likert scale.

residents included the range of options, variety of choice in time lengths, and the "house" system developed for competitions. Junior residents particularly found it useful to see learning points submitted by senior residents. A specific area for improvement noted by residents was a request for a more streamlined format than Google spreadsheets for submission of their learning points.

The monthly trivia competitions were a well-received deviation from standard didactic lecture during conference. To date we have trialed 10 unique trivia formats with the highest rated formats being those that encouraged discussion between residents prior to answer submission as opposed to formats requiring immediate answer submission. These competitions have been made available as FOAMed on the AlamoCityEM.com website so that residents unable to attend that month may use them, as may learners not associated with our institution. One limitation of the study was that we measured subjective rather than objective outcomes. Future possible directions of study include assessing the effect of the new AC model on in-service examination scores as well as long-term knowledge retention. Another potential area of improvement might be the creation of a standardized method for faculty to evaluate the included asynchronous sources. Another fruitful area for future research would be to examine the trends in residents' preferences of both length and media format.

CONCLUSION

Overall, this socially synchronized AC model offers a previously undescribed method of encouraging resident engagement and spaced repetition. The "socially synchronized asynchronous" model may be easily adapted by other residencies with minimal start-up effort, requiring only creation of spreadsheets unique to their own learners and approximately one hour of didactic time monthly for trivia competitions.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

Intern Passport: Orienting New Travelers to the Emergency Department

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Section Editor: Jeffrey N. Love, MD, MSc, MHPE
Submission history: Submitted June 25, 2018; Revision received October 5, 2018; Accepted October 8, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39479

The objective of the Intern Passport (IP) curriculum was to implement a structured orientation for incoming interns that effectively defined and distinguished various personnel and assets within the emergency department (ED). The method of training was an on-the-job orientation that required interns to obtain "stamps" (signatures) on their passports during visits to eight "countries" (specialists) within the ED. Topics covered during the visit included introductions, tasks and capabilities, expectations, and pearls and pitfalls. Interns obtained stamps after spending 30-minute orientation visits with each country during the first four-week rotation of internship. The ED countries visited were Adult Nursing, Pediatric Nursing, Orthopedics Technician, Respiratory Therapy, Pharmacy, Psychiatry, Observation, and Radiology. Effectiveness was assessed by participant completion of an optional anonymous retrospective survey. The IP was a beneficial addition to our intern orientation curriculum. It effectively defined and distinguished various personnel and assets within the ED. [West J Emerg Med. 2019;20(1)9–10.]

BACKGROUND

The majority of emergency medicine (EM) residency programs offer formal intern orientation. Didactic sessions and social activities are the most common components of intern orientation, but skills training sessions are increasing in frequency.[1] Emergency department (ED) access, exposure, and introduction are key components and areas of focus for intern orientation.[1] During semiannual evaluations, our residency program identified intern self-reported challenges with achieving timely orientation to our ED personnel and resources. Barriers cited included limited number of EM rotations during the first year, large number of specialists and personnel in the ED, and fast pace and restricted free time while working clinically in the ED. A more thorough and structured ED orientation was deemed necessary. We designed the Intern Passport (IP) curriculum to facilitate definition of ED specialists, assets, and resources.

OBJECTIVE

The primary objective of the IP curriculum was to implement a dynamic, structured orientation program for incoming interns that effectively defined and distinguished various personnel and assets within the ED. Secondary goals were to promote early intern socialization and to develop intern relationships with key personnel. A tertiary goal was to encourage active experiential learning by taking the interns out of the classroom and away from didactic lectures and placing them into the energetic learning and work environment of the ED – the same environment that the interns would call home for the next three years.

CURRICULAR DESIGN

The IP curriculum was designed to facilitate definition and familiarization of ED specialists, assets, and resources. We structured this innovative method of training as an on-the-job orientation that required interns to obtain "stamps" (signatures) on their passport from eight "countries" (specialists) within the ED. During the intern orientation rotation (the first four-weeks of internship) interns earned a passport stamp after spending a 30-minute orientation visit within each country. The ED countries visited were Adult Nursing, Pediatric Nursing, Radiology, Orthopedics Technician, Respiratory Therapy, Pharmacy, Observation, and

Psychiatry. General topics covered during each visit included introductions, tasks and capabilities discussion, specialist expectations, and pearls and pitfalls. We selected this "Feel free to travel about the ED!"-themed design because it actively engaged the mostly-millennial learners, and promoted interactivity via experiential learning in contrast to didactic lectures in the classroom. The IP provided the interns with level-specific training that millennial learners prefer, based on the results published by Shappell and Ahn.[2]

Successful curriculum implementation required motivated participation by both the "travelers" and the "countries." After we extended an invitation with accompanying explanation of the curriculum design and philosophy, the countries were quick to buy in to this curriculum and eager to get early exposure to the interns. Countries appreciated the opportunity to discuss common errors, order entry (if applicable), pet peeves, and ways to mutually help each other. The style and format of the visits varied based on the country.

Visits were self-scheduled by the interns and were completed as time was available during the orientation four-week rotation. Eight visits of a 30-minute duration totaled four hours of intern time dedicated to this curriculum. Most interns completed visits before or after scheduled orientation clinical ED shifts as a matter of convenience.

All current countries continue to embrace this curriculum and plan continued involvement. Reasons cited included "benefits of early involvement with interns," "early relationship development," and "the ability to discuss pearls and pitfalls with ways to help each other." Additional ED specialists have shown interest, and as a result three additional countries will be added to the travel itinerary for the upcoming intern classes: Research Team, Administration, and Social Work.

IMPACT

The IP was a beneficial and successful addition to our intern orientation curriculum. A total of 29 out of 30 interns (two consecutive intern classes) completed the IP curriculum. Twenty-four interns completed a retrospective, anonymous, post-participation survey (Survey Monkey®). This study received institutional review board approval at our institution. Of those surveyed, 96% agreed the IP was engaging and relevant to intern orientation; 92% agreed the IP helped establish early relationships and provided a greater understanding and appreciation for ED staff and resources; and 88% agreed the IP made it easier to navigate the ED and locate resources.

Our program plans to continue this easily executed and fun orientation curriculum for future intern orientations. It is beneficial to the" traveler" and "country" alike. The IP may be incorporated into any current EM intern orientation process, and it can be tailored to suit any program, large or small, based on program resources, personnel, and time available.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Evaluation of an Intervention to Improve Quality of Single-best Answer Multiple-choice Questions

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Section Editor: Jonathan Fisher, MD, MPH
Submission history: Submitted July 13, 2018; Revision received November 4, 2018; Accepted November 8, 2018
Electronically published December 3, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39805

Introduction: Despite the ubiquity of single-best answer multiple-choice questions (MCQ) in assessments throughout medical education, question writers often receive little to no formal training, potentially decreasing the validity of assessments. While lengthy training opportunities in item writing exist, the availability of brief interventions is limited.

Methods: We developed and performed an initial validation of an item-quality assessment tool and measured the impact of a brief educational intervention on the quality of single-best answer MCQs.

Results: The item-quality assessment tool demonstrated moderate internal structure evidence when applied to the 20 practice questions (κ=.671, p<.001) and excellent internal structure when applied to the true dataset (κ=0.904, p<.001). Quality scale scores for pre-intervention questions ranged from 2-6 with a mean ± standard deviation (SD) of 3.79 ± 1.23, while post-intervention scores ranged from 4-6 with a mean ± SD of 5.42 ± 0.69. The post-intervention scores were significantly higher than the pre-intervention scores, $x^2(1) = 38$, p <0.001.

Conclusion: Our study demonstrated short-term improvement in single-best answer MCQ writing quality after a brief, open-access lecture, as measured by a simple, novel, grading rubric with reasonable validity evidence. [West J Emerg Med. 2019;20(1)11-14.]

INTRODUCTION

The use of single-best answer multiple-choice questions (MCQ) in examinations is ubiquitous in medical education. Although guidelines for writing MCQs exist, item writers often receive little to no formal training, potentially reducing the validity of examinations by introducing construct-irrelevant variance.[1-3] Extended educational interventions in the area of item writing have been shown to improve written item quality with shorter interventions showing a similar impact.[4-6] The literature suggests learners involved in item writing find it to be a positive learning experience that potentially improves performance on a summative assessment.[7-10]

The National Board of Medical Examiners (NBME) provides both a detailed, open-access guide for exam-question writing and an online training module.[11-13] These tools provide instruction for writing high quality MCQs and are used in the design of basic and clinical science exams, but

they are lengthy and oriented toward experienced question writers. Other tools remain lengthy and either require in-person workshops or are designed for self-study and require a prerequisite of basic question-writing understanding. Additionally, the literature lacks a simple MCQ quality metric with strong validity evidence. The two objectives of this study were to 1) establish validity evidence for a novel MCQ evaluation tool, and 2) evaluate the efficacy of a brief didactic lecture on MCQ question writing.

METHODS

Study Setting and Participants

We sought student and resident volunteers from the American Academy of Emergency Medicine Resident and Student Association, and conducted the educational intervention in September 2017. The study was granted exemption status by the University of Pennsylvania Institutional Review Board.

Multiple-choice Question Quality Assessment Tool Derivation

We created a MCQ quality assessment tool based on expert opinions (AWP, KRS, JJ) of the most important components contained in the question-writing lecture; it is based on multiple, well-accepted sources, supporting content evidence.[11,12] Two of the experts have formal education backgrounds including master's degrees (AWP and KRS) that included advanced training in item writing and quality assessment. The third expert (JJ) has taught question writing for several years to national audiences. We followed current standards that endorse validity based on Messick's model.[14-16] We created six items, each rated on a binary "present" or "not present" scoring system with a total minimum potential scale score of zero and a maximum potential scale score of six (Figure). Two additional educators (AK and ME) reviewed the rubric and shared their interpretations, which were aligned with the item objectives, supporting response-process evidence. A set of 20 questions with intentional errors was created (AWP), available in Appendix A, for the initial validity evidence assessment.

Training Module Creation and Assessment of Impact

The training module was created by an item-writing expert (JJ) using PowerPoint (Microsoft Corporation, Redmond, WA) with recorded voice-over (iMovie, Apple Inc., Cupertino, CA), allowing for independent completion by learners. The training module itself has been previously published in an open- access curriculum database and was based on principles of item writing as described by the NBME.[4,11,12,17] Participants were asked to write three novel, single-best answer MCQs based on a two-page excerpt from an emergency medicine board review textbook about trauma just prior to the lecture. They then watched the question-writing lecture together on YouTube (Google Inc., Mountain View, CA) on a conference call followed by a 10-minute question and answer period with a question-writing expert different than the lecturer (AWP). Participants were then asked to write three new, single-best answer MCQs based on the same excerpt immediately after the lecture.

Pre- and post-intervention MCQ quality scores were determined by two item-writing experts (AK, ME) via the item quality assessment tool. Discrepancies were decided by a third item-writing expert (LC).

Positively worded stem (0=no, 1=yes)

Stem phrased as a question (0=no, 1=yes)

Five answer choices (0=no, 1=yes)

Answer choices are listed alphabetically (0=no, 1=yes)

Foils are similarly complex as answer (0=no, 1=yes)

One clear, correct answer (0=no, 1=yes)

Figure. Multiple-choice questions quality assessment tool.

Statistical Analysis

We first performed descriptive summaries including mean and standard deviation (SD), frequencies, and total responses. Internal reliability was assessed using Cohen's kappa. We decided a priori to compare pre- and post-lecture scores using the non-parametric Friedman's analysis of variance (ANOVA), given the expected range to be relatively small and low likelihood of having an even distribution of the standard error of the mean. Friedman's ANOVA is essentially a non-parametric, repeated measures one-way ANOVA. A p-value less than 0.05 was considered statistically significant. We performed all analyses using SPSS version 24 (IBM Corporation, Armonk, NY).

RESULTS

Multiple-choice Question Quality Assessment Tool Validity Evidence

The internal structure evidence was moderate when the tool was applied to the 20 practice questions (κ=.671, p<.001). The tool demonstrated excellent internal structure when applied to the true dataset of questions created by the students and residents (κ=0.904, p<.001) with only eight discrepancies in 264 cases (48 total requested questions – 4 missing questions = 44 total questions with 6 points each yielding 264 cases), evaluated by two different researchers. Evidence of consequence was demonstrated as part of the other primary objective of this study, in which pre- and post-lecture scores were different. As this was a stand-alone study, we were unable to evaluate for relationships with other variables.

Training Module Impact on Item Quality

A total of eight residents and students consented and participated in the lesson, of whom seven provided both pre- and post-lecture MCQs. One participant provided two pre-

lecture questions rather than three, and another provided no post-lecture questions, thus totaling four total missing questions of the 48 possible total questions (8 x 3 x 2). Missing questions were excluded pairwise since the post questions were edits of the original questions; therefore, four missing questions led to elimination of eight total questions. We analyzed a total of 40 questions (20 pre- and 20 post-lecture). The MCQ quality scale scores for pre-intervention questions written by the learners ranged from 2 - 6 with a mean ± SD of 3.79 ± 1.23, while post-intervention scores ranged from 4 – 6. The post-intervention scores were significantly higher than the pre-intervention scores, $x^2(1) = 38$, $p < 0.001$.

DISCUSSION

The current study supports the efficacy of a short, high-yield lecture to teach best evidence in developing single-best answer MCQs. The study also provides strong validity evidence for a novel tool by which to evaluate the structure of single-best answer MCQs.

Although multiple prior studies have evaluated outcomes from an educational intervention to improve MCQ writing, the current study is the first available remotely, free to the public, and at approximately 30 minutes in length is the shortest.[5,6,18] These differences are important because this efficacious education intervention is replicable in any setting, whereas in-person workshops may vary with the instructor, size of the group, and other factors. The open-access availability through the educational platform at the *Journal of Education and Teaching in Emergency Medicine* (JETem) and its brief duration provide a practical advantage to this educational intervention as well.[17] Future work should directly compare other tools against this one.

Another important contrast to prior studies is the target group. Much focus has been placed on faculty development, yet educators are seeing the benefits of learners writing questions.[5-9,18-21] To this end, the current educational intervention was specifically designed for novice MCQ writers and tested in a sample of students and residents. It can be easily adopted by clerkship directors and program directors to use with students and residents as both a learning tool and as preparation to write questions as junior faculty members in future years.

This study lastly provides a checklist with reasonable validity evidence and strong inter-rater reliability when applied to the real-world questions. This is in contrast to other checklists that exist but are limited to content validity by experts.[18] It is unclear why the instrument had better inter-rater reliability with the real questions than when applied to the sham questions. We suspect this finding simply uncovered the inherent limitation of sham tests in which the author was trying to elicit specific flags in the tool. The strong performance with the live questions is reassuring.

LIMITATIONS

Our study must be interpreted in the context of several limitations. Most importantly, we studied a short-term outcome. This variable must be a precursor to follow-up, long-term learning outcomes to fully elucidate the efficacy of the intervention. It is also important to highlight that the intervention and assessment tool are intended to improve the structure of MCQs. Such proper practices are associated with good question quality as ascertained through psychometric analysis, but they are beyond the scope of our initial study. Additionally, our study recruited volunteers who may have been more motivated to improve their MCQ writing skills than students and residents in the general population. Finally, although the MCQ quality tool was applied against a test group of questions and a real-life group of questions, it was nonetheless a small sample of questions with a small number of participants, and the tool should be tested against more questions and more raters.

CONCLUSION

Our study demonstrated short-term improvement in single-best answer MCQ writing quality after a brief, open-access lecture, as measured by a simple, novel, grading rubric with reasonable validity evidence.

ACKNOWLEDGEMENT

We would like to acknowledge the American Academy of Emergency Medicine (AAEM) and the AAEM Resident and Student Association (AAEM/RSA) for coordinating the study participants and education session.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. Dr. Phillips reports one disclosure as editor in chief at EM Coach LLC. Items written using this particular educational intervention may be incorporated into this board-review product.

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Randomized Controlled Trial of Simulation vs. Standard Training for Teaching Medical Students High-quality Cardiopulmonary Resuscitation

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Section Editor: Edward Ullman, MD
Submission history: Submitted May 15, 2018; Revision received October 11, 2018; Accepted November 14, 2018
Electronically published December 12, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39040

Introduction: Most medical schools teach cardiopulmonary resuscitation (CPR) during the final year in course curriculum to prepare students to manage the first minutes of clinical emergencies. Little is known regarding the optimal method of instruction for this critical skill. Simulation has been shown in similar settings to enhance performance and knowledge. We evaluated the comparative effectiveness of high-fidelity simulation training vs. standard manikin training for teaching medical students the American Heart Association (AHA) guidelines for high-quality CPR.

Methods: This was a prospective, randomized, parallel-arm study of 70 fourth-year medical students to either simulation (SIM) or standard training (STD) over an eight-month period. SIM group learned the AHA guidelines for high-quality CPR via an hour session that included a PowerPoint lecture with training on a high-fidelity simulator. STD group learned identical content using a low-fidelity Resusci Anne® CPR manikin. All students managed a simulated cardiac arrest scenario with primary outcome based on the AHA guidelines definition of high-quality CPR (specifies metrics for compression rate, depth, recoil, and compression fraction). Secondary outcome was time to emergency medical services (EMS) activation. We analyzed data via Kruskal-Wallis rank sum test. Outcomes were performed on a simulated cardiac arrest case adapted from the AHA Advanced Cardiac Life Support (ACLS) SimMan® Scenario manual.

Results: Students in the SIM group performed CPR that more closely adhered to the AHA guidelines of compression depth and compression fraction. Mean compression depth was 4.57 centimeters (cm) (95% confidence interval [CI] [4.30-4.82]) for SIM and 3.89 cm (95% CI [3.50-4.27]) for STD, p=0.02. Mean compression fraction was 0.724 (95% CI [0.699-0.751]) for SIM group and 0.679 (95% CI [0.655-0.702]) for STD, p=0.01. There was no difference for compression rate or recoil between groups. Time to EMS activation was 24.7 seconds (s) (95% CI [15.7-40.8]) for SIM group and 79.5 s (95% CI [44.8-119.6]) for STD group, p=0.007.

Conclusion: High-fidelity simulation training is superior to low-fidelity CPR manikin training for teaching fourth-year medical students implementation of high-quality CPR for chest compression depth and compression fraction. [West J Emerg Med. 2019;20(1)15-22.]

INTRODUCTION

Cardiovascular disease (CVD) accounts for 33.6% of all-cause mortality, or one of every three deaths in the United States (U.S.) annually. On average, more than 2,200 Americans die of CVD each day, approximately one death every 39 seconds.[1] CVD claims more lives each year than cancer, chronic lower respiratory disease, and accidents combined.[2]

The impact of out-of-hospital cardiac arrest (OHCA) is substantial, claiming nearly 300,000 lives annually.[1] Although survival rates vary widely, they are still generally low (<10%) in most areas of the country.[3] However, many communities have significantly improved survival rates. The focus in communities saving the most lives from OHCA has been high-quality cardiopulmonary resuscitation (CPR). Growing evidence suggests that simple changes in CPR technique, with emphasis on ensuring proper compression rate, depth, chest wall recoil, minimizing interruptions and avoiding over-ventilation, markedly improve survival.[4-6]

Although the concepts of CPR are becoming better understood, there remains a large chasm between what we know and how it is performed on patients, in both out-of-hospital and in-hospital settings. Despite the fact that CPR is a critical link in the chain of survival, it is performed with inconsistent quality in both settings.[7-8] The American Heart Association (AHA) CPR Guidelines emphasize that, to close the knowledge-practice gap and save more lives, providers should develop a culture of measuring and ensuring high-quality CPR.[9-10]

Human patient simulation provides the opportunity to address the knowledge-practice gap in the education, training, and implementation of high-quality CPR. Simulation encompasses any technology or process that re-creates a contextual background that allows a learner to experience success, mistakes, receive feedback, and gain confidence in a learner-oriented environment void of patient risk.[11] The Institute of Medicine, the Educational Technology Section of the Academic Emergency Medicine Consensus Conference, and the public have advocated for increased simulation training to reduce medical error.[12-16] Basic life support (BLS) and Advanced Cardiac Life Support (ACLS) have been recognized as the standard criteria for competency to manage patients in cardiac arrest. Written evaluation is not a predictor for skills performance in an ACLS course, and there is a paucity of randomized studies comparing the effectiveness of simulation vs. standard teaching/training in retention of ACLS knowledge, as well as ability to manage critically ill patients.[17-19] Our study compares the effectiveness of high-fidelity simulation vs. traditional low-fidelity manikin training for medical students in the AHA BLS CPR guidelines for chest compression rate, depth, recoil, and compression fraction.

Population Health Research Capsule

What do we already know about this issue?
Although cardiopulmonary resuscitation (CPR) is considered the most vital element in the chain of survival for cardiac arrest, little is known regarding the optimal method of instruction for this critical skill.

What was the research question?
We evaluated the comparative effectiveness of high- vs. low-fidelity simulation training for teaching high-quality CPR.

What was the major finding of the study?
Students trained with high-fidelity simulation performed CPR that more closely adhered to the American Heart Association CPR guidelines.

How does this improve population health?
Optimal CPR education and training for healthcare providers at the curriculum level allows the opportunity to optimize the performance of this critical skill at the population level.

METHODS

Study Design and Setting

We conducted this prospective, randomized, parallel-group study in a simulation center at a University of California (UC) medical school over an eight-month period. The UC Irvine Health Medical Education Simulation Center is a 65,000-square foot, state-of-the-art facility that provides telemedicine and simulation-based educational programs and continuing medical education courses for thousands of healthcare providers each year.[20] Resources for education and training include a full-scale operating room, emergency department (ED) trauma bay, obstetrics suite, and a critical care unit. The simulation center has a complement of full-time staff, including full-time simulation specialists.

Selection of Participants

All fourth-year medical students enrolled in a required emergency medicine (EM) clerkship were eligible. We excluded foreign medical students doing an observation rotation in the ED to evaluate a representative group of U.S. medical students. The EM clerkship includes a simulation component. During clerkship orientation each month, students were offered voluntary participation in the study. Use of the simulator was not restricted to the study, and results of the study did not affect clerkship evaluation. The study was approved by the university's institutional review board, and subjects provided informed consent.

Interventions

Participants were randomized to control or intervention groups with a computerized, random-number generator using block sizes of four. After randomization, all students received an equivalent orientation to the human patient simulator (Laerdal SimMan® 3G full-scale patient simulator [Laerdal Medical Corporation, Wappingers Falls, New York]), which included introducing and reviewing simulator features as well as the physiologic monitoring devices available. Students were instructed to verbalize their thoughts, orders, and actions during the simulated patient scenario. The students were unaware of the simulation case they would manage. All participants had previous experience with the simulator.

Both groups received a didactic lecture via PowerPoint (Microsoft Corporation, Redmond, Washington) on the AHA Guidelines for CPR and Emergency Cardiovascular Care (ECC).[21] The Guidelines for CPR and ECC are based on the International Liaison Committee on Resuscitation (ILCOR) International Consensus on CPR and ECC Science with Treatment Recommendations.[22,23]

The practical skills component took place directly after didactics. This session consisted of training the medical students to perform high-quality CPR as specifically defined and highlighted in the ILCOR guidelines.[23] The components of high-quality CPR pertain to chest compression rate, depth, recoil, and compression fraction. The students practiced CPR with a specific focus on these four components. The education and training during this session was the same between the intervention and control groups, with the exception of the types of manikins used (high-fidelity vs. low-fidelity). The high-fidelity manikin provided real-time feedback during student CPR on chest compression rate, depth, and recoil. The low-fidelity manikin does not provide such real-time feedback.

Feedback to the participants in the control group was given after they performed CPR. This type of post-performance feedback is similar to that given in all CPR training courses in North America where low-fidelity manikins (that do not provide real-time feedback) are used. The instruction during the practical skills component of the course was identical for the intervention and control groups, with the only exception being the type of manikin the students were randomized to. The intervention group received their training on the high-fidelity human patient simulator, and the control group received their training on the standard, low-fidelity CPR procedural tasks trainer Resusci Anne® (Laerdal Medical Corporation, Wappingers Falls, New York).

Methods and Measurements

The performance metrics measured for high-quality CPR in our study were specifically defined in the AHA Guidelines for CPR and ECC and included chest compression rate, depth, recoil, and compression fraction. The high-fidelity simulation software allows real-time collection of chest compression rate, depth, and recoil data. The precision of compression rate is to the nearest full compression, depth to the nearest millimeter, and recoil to the nearest percent (100% release recoil indicating all compressions delivered during a cycle were accompanied by adequate chest recoil). Video capture of each scenario was performed with B-line Medical SimBridge® software (B-line Medical, Washington, District of Columbia).

We defined performance metrics prior to study implementation. Compression rate was defined as the number of chest compressions delivered per minute. Compression depth was defined as depth of chest compression from neutral position of the sternum in centimeters. We defined chest recoil as allowing the sternum to fully (100%) return to its neutral position before the next chest compression. Compression fraction was defined as the proportion of time CPR was delivered while the patient was without a perfusing rhythm. The total time measured for absence of a perfusing rhythm began with the initiation of ventricular fibrillation and ended with the completion of the tenth cycle of CPR. For those subjects who chose the hands-only CPR methods, the end time was marked when they delivered 300 compressions. This allowed measurement of their performance after the same 300 compressions delivered in the 10-cycle CPR group. The time to emergency medical services (EMS) activation was defined as the time from ventricular fibrillation onset to when the participant verbalized request to activate EMS. Activating emergency response is the first step in the AHA adult cardiac arrest algorithm.

The simulation case used was that of an elderly male suffering a cardiac arrest, which was adapted from the AHA ACLS SimMan® Scenarios set. Human resources used for the evaluation scenarios consisted of a full-time simulation specialist, a researcher to oversee correct implementation of the study protocol, and a confederate in the scenario to provide ancillary support.

Data input was done via standardized data abstraction sheets. Data abstractors were trained through an instructional workshop detailing definitions of the performance metrics as well as how to input data into collection sheets. We implemented double data entry to minimize random data abstraction errors. Discrepancies were resolved by reviewing original data in the recordings to check abstraction accuracy. We input all data into a master data spreadsheet file.

Outcomes

The AHA Guidelines for CPR and ECC are based on the ILCOR International Consensus on CPR and ECC Science with Treatment Recommendations.[22,23] High quality for rate was defined as ≥100 compressions/minute, depth ≥5 centimeters (cm), allowing full (100%) chest recoil, and a compression fraction that approached 100%. The guidelines also state that for the treatment of cardiac arrest, ACLS interventions build on the BLS foundation of immediate recognition and activation of EMS.[21] This was the driver

behind our secondary outcome of time to activation of EMS, defined as the time from cardiac arrest (ventricular fibrillation) to the time the student verbalized a request to activate EMS. All outcome data were obtained during a high-fidelity cardiac arrest simulation scenario adapted from the AHA ACLS SimMan® Scenario set.

Analysis

Data from the master data collection sheet were converted to Stata file format and analyzed with Stata (version 12.0; StataCorp, College Station, Texas). We reported continuous variables as means with 95% confidence intervals (CI) using the Kruskal-Wallis rank sum test. A two-tailed alpha <0.05 represented statistical significance. Our sample size calculations were based on an effect size (difference in means) of a 5 millimeter (mm) difference in compression depth between the two groups. With a two-tailed alpha (α) of <0.05, and a beta (β) of 0.2, we needed 34 subjects per group to detect a difference between groups with a power of 0.8.

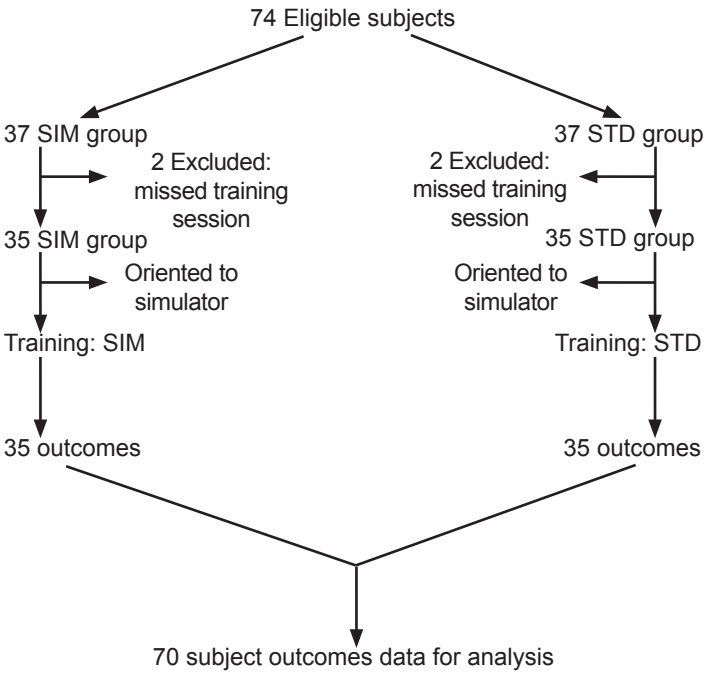

Figure. Flow sheet of participants in study comparing high-fidelity simulation to standard training.
SIM, high-fidelity simulation; *STD,* standard training with low-fidelity Resusci Anne®.

RESULTS

Of 74 eligible participants, data on 70 were available for analysis as four participants were absent for their assigned simulation session (Figure). For our primary outcome, the mean compression depth was 4.57 cm (95% CI [4.30 – 4.82]) for the SIM group and 3.89 cm (95% CI [3.50 – 4.27]) for the standard (STD) group, p=0.02. The compression fraction was 0.724 (95% CI [0.699 – 0.751]) for the SIM group and 0.679 (95% CI [0.655 – 0.702]) for the STD group, p=0.01. The mean compression rate was 123.3 per minute (95% CI [117.9 – 128.4]) for the simulation (SIM) group and 116.1 per minute (95% CI [109.9 – 121.2]) for the STD group, p=0.06. The mean percentage of chest compressions that were accompanied by full chest recoil was 0.954 (95% CI [0.925 – 0.978]) for the SIM group and 0.941 (95% CI [0.874 – 0.985]) for the STD group, p=0.83 (Table).

For our secondary outcome, the time to activation of EMS was 24.7 seconds (95% CI [15.7 – 40.8]) for the SIM group and 79.5 seconds (95% CI [44.8 – 119.6]) for the STD group, p=0.007 (Table).

DISCUSSION

In our prospective, randomized, parallel-group study evaluating the comparative effectiveness of high-fidelity simulation training vs. standard training, we found that high-fidelity simulation training yielded CPR performance that more closely adhered to the AHA CPR guidelines. To our knowledge, this is the first report documenting improved performance of medical students with high-fidelity simulation to teach high-quality CPR. Specifically, we observed superior performance of chest compression depth and compression fraction, metrics explicitly stated by the AHA to be components of high-quality CPR. We also observed a more rapid activation of the EMS system by the simulation-trained group. The AHA's recommendation and emphasis on these metrics are supported by recent studies that have demonstrated improved outcomes from OHCA and have reaffirmed the importance of a stronger emphasis on adequate compression rate, depth, recoil, and compression fraction.[24-31] Conversely, our training innovation had no measured effect on compression rate or recoil.

A few points of emphasis on major recommendations in the guidelines have particular relevance for simulation. First is the recommendation that "manikins with realistic features such as the capability to replicate chest expansion and breath sounds, generate a pulse and blood pressure, and speak may be useful for integrating the knowledge, skills, and behaviors required in ALS training."[32] Second is that "written tests should not be used exclusively to assess the competence of a participant in an advanced life support course," as there needs to be a performance assessment as well. Third, "CPR prompt and feedback devices may be useful for training rescuers and may be useful as part of an overall strategy to improve the quality of CPR for actual cardiac arrest."[32]

Our findings that simulation yields student performance more closely adherent to AHA guidelines are consistent with a growing body of literature supporting simulation in

Table. Main outcome variables according to teaching method.

Variable	Teaching method	Mean	95% CI	P value
Compression rate/min	STD	116.1	109.9-121.2	.06
	SIM	123.3	117.9-128.4	
Depth (cm)	STD	3.89	3.50-4.27	.02
	SIM	4.57	4.30-4.82	
Recoil proportion	STD	.941	.874-.985	.83
	SIM	.954	.925-.978	
Compression fraction	STD	.679	.655-.702	.01
	SIM	.724	.699-.751	
Time to EMS activation (seconds)	STD	79.5	44.8-119.6	.007
	SIM	24.7	15.7-40.8	

SIM, simulation training group; *STD,* standard training group; *CI,* confidence interval; *cm,* centimeter; *EMS,* emergency medical services; *min,* minute.
Compression rate/min = number of chest compressions delivered per minute; recoil proportion = proportion of compressions accompanied by 100% chest recoil; compression fraction = proportion of time compressions performed while patient in a non-perfusing rhythm.

resuscitation research and training. Research integrating high-fidelity simulation with ACLS training has found that a simulation-based ACLS course significantly improved knowledge, psychomotor skills, and performance during resuscitation.[33] A prospective, randomized study across 10 institutions running a standardized simulated cardiopulmonary arrest scenario concluded that using novel and practical technology can improve compliance with the AHA guidelines for CPR that are associated with better outcomes.[34] There has also been simulation-based research showing that real-time resuscitation guidance significantly increases adherence to the AHA guidelines.[35] The use of high-fidelity simulation has also shown benefit in CPR knowledge, skills, acquisition, retention, and advanced resuscitation in the disciplines of nursing and pharmacy.[36,37] A recent systematic review and meta-analysis evaluating simulation technology for resuscitation training concluded that simulation-based training for resuscitation is highly effective.[38]

Our study contributes to the simulation literature that advances scientific knowledge in the area of simulation education, provides guidance for future areas of research, and also offers insight for those stakeholders who play a significant role in the creation of policies, protocols or procedures in the practice of simulation-based education. Our study adds to the body of simulation literature in a number of ways. The majority of interventional studies in simulation-based training use non-experimental study designs (i.e., non-randomized study designs) to evaluate the effect of simulation. Our study consisted of a prospective, randomized controlled trial study design, which carries less risk of bias when compared to non-randomized study designs. Randomization allows the differences in outcome of a study to be attributed to the intervention with more confidence than any other study design. Our study is also unique in that we used performance metrics of high-quality CPR specifically defined by the AHA guidelines as the primary outcome, whereas previous studies did not measure all the performance metrics or found no significant difference in outcomes.[34,35]

There is also literature that has shown no benefit to simulation training in resuscitation. A prospective study evaluating whether simulation-based ACLS training improves performance in managing simulated and actual cardiac arrest found no difference in adherence to the AHA guidelines.[39] Another study evaluated whether participants who receive ACLS training on high-fidelity manikins performed better than those trained on low-fidelity manikins found no difference in groups on written tests scores.[40] Some of the literature pertaining to simulation in resuscitation care has limitations including selection bias, heterogeneity of outcome measures, study design lacking robust methodologies, and small samples leading to underpowered studies unable to detect a true difference between groups.

For our secondary outcome, we observed a more rapid activation of the EMS system by the simulation-trained group, by an average of 55 seconds. Activating emergency response is the first step in the adult cardiac arrest algorithm. Research has shown that for victims of witnessed ventricular fibrillation arrest, early CPR and rapid defibrillation can significantly increase chance of survival to hospital discharge.[41-46] Implementing education and training strategies designed to measure and improve these metrics has the potential to maximize patient outcomes.

We believe that feedback in high-fidelity simulation is a key driver behind performance enhancement as students get to actually experience what the correct compression rate, depth, recoil and compression fraction feel like. The real-time feedback allows the learner to make immediate adjustments to their performance and gain confidence that their actions yield the desired result(s). We believe the feedback that is provided through high-fidelity simulation is what resulted in superior CPR performance in the SIM group. We believe the deeper a learner can be immersed in a training environment, the more closely their actions will reflect what they have learned and practiced.

In training, the SIM group received feedback from the simulator indicating the chest compression rate and depth. We observed what appeared to be fatigue at a faster rate in those students performing at adequate rate and depth and also noted they were quicker to call for help (EMS activation). This observation is quantified in the difference

in time to EMS activation between the two groups. We believe a combination of participant fatigue during CPR performance assessment and the fidelity of immersion during the practical skills training are two variables that contributed to this difference. Research has shown that having the knowledge of CPR is necessary but not sufficient to actually perform with high adherence to the AHA guidelines.[47] Simulation-based training allows the quantitative measurement of performance during CPR and provides a means to measure improvement.

LIMITATIONS

Our study did not evaluate the educational intervention on actual cardiac arrest patients. It may have suffered as well from simulator bias, as the STD training group had less experience with the high-fidelity simulator prior to testing in high fidelity. However, all the participants had high-fidelity simulation incorporated into their core medical school curriculum and were familiar with the simulator at study onset. This experience and familiarity with the high-fidelity simulator strongly argue against any significant potential impact of simulator bias. Furthermore, all students were oriented to the high-fidelity simulator as part of the study protocol to standardize their experience and familiarity with the manikin.

Our primary outcome of high-quality CPR was composed of four performance metrics. Increasing the number of outcome measures increases the potential for a type I error. The AHA emphasizes that high-quality CPR has multiple components, and we felt it important to address each of these metrics independently instead of creating a summary metric.

Instructors were not blinded to the educational modality they were using to teach students as there are readily apparent differences between the high- and low-fidelity simulators. We did not perform a longitudinal study and therefore cannot comment on the long-term benefit of this type of intervention. And finally, we did not find a statistically significant difference between compression rates. Compression rates in both groups were in compliance with the AHA CPR recommendations, so there was no opportunity to find improvement.

CONCLUSION

In our prospective, randomized, parallel-group study evaluating the comparative effectiveness of high-fidelity simulation training vs. standard training, we found that high-fidelity simulation training yielded CPR performance that more closely adheres to AHA CPR guidelines. Simulation-trained participants also had shorter times to EMS activation, the first step in the AHA adult cardiac arrest algorithm. Further research is needed to evaluate the most effective teaching methods for cardiac arrest care.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Behind the Curtain: The Nurse's Voice in Assessment of Residents in the Emergency Department

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Section Editor: Chris Merritt, MD, MPH
Submission history: Submitted July 14, 2018; Revision received October 12, 2018; Accepted October 15, 2018
Electronically published November 19, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39821

Introduction: Feedback provides valuable input for improving physician performance. Conventionally, feedback is obtained from attending physicians; however, residents work in close contact with other members of the care team, especially nurses. Nurses may have more opportunity to directly observe trainees. In addition, they may value different behaviors and provide unique feedback. The objective of this study was to examine the nurse's perspective of resident performance in the emergency department.

Methods: This was a retrospective, mixed-methods study of nursing assessments of residents using a five-point scale from 1 (unsatisfactory) to 5 (outstanding) and providing comments. Analysis included descriptive statistics of the quantitative assessments and content analysis of the nursing comments by a group of attendings, residents, and nurses.

Results: Nurses assessed residents as above expectation or outstanding, especially for the categories of "How would you rate this resident's attitude?" (65%) and "Is this resident a team player?" (64%). Content analysis of the comments yielded nine themes including being kind, communication with nurses, being a team player, work ethic and efficiency, and respect for other team members. Of the comments made, 50% provided positive feedback, and the majority of comments (80%) were determined to be actionable.

Conclusion: Our data indicate that nurses provide feedback on residents' kindness, efficiency and communication. These two aspects of interacting in the healthcare setting may not be highlighted in conventional, attending provider feedback, yet they are clearly noted by the nurse's voice. [West J Emerg Med.2019;20(1)23–28.]

INTRODUCTION

As self-assessment can be flawed, feedback is a valuable input for physician performance improvement.[1] Conventionally, feedback is obtained from residents' attending physicians. However, physicians work in close contact with other members of the care team, most prominently the nursing staff. Nurses may have more opportunity to directly observe residents performing patient care, including aspects of patient care that attending physicians do not routinely observe. Additionally, as nurses

approach patient care from a different perspective, they may observe and remark on different behaviors and attitudes of the residents with whom they interact.[2]

Recognizing the importance of performance input from a variety of sources,[3] many of the Accreditation Council for Graduate Medical Education (ACGME) Milestones recommend multi-source feedback, which is further supported by a mandate from the Emergency Medicine (EM) Residency Review Committee. Nursing perspective is particularly relevant to several of the EM milestones.[4] These include the following: 1) effective communication; 2) working effectively as part of a healthcare team; 3) professionalism; and 4) systems-based practice, including the ability to work in interprofessional teams to enhance patient safety and quality.

Previous studies in other specialties have found that nursing assessments of residents are reliable and may provide information that is different from that provided by attendings.[2,5-10] One study showed that nursing assessments of residents mirror patient assessments, unlike attending, peer, or self-assessments.[7] Another study demonstrated that nurses were able to assess the humanistic qualities of residents, such as respect and integrity.[6] Nurses may be less lenient than attendings, although still correlated.[8] Additionally, nursing assessments of interpersonal skills correlated better with faculty measures, whereas assessments of medical knowledge did not correlate as well.[11] These studies demonstrate the unique and concordant assessment domains compared to standard faculty assessments.

The literature demonstrates that the nursing perspective is both valid and at times correlated with other forms of assessment. Previous studies have not explored the specific behaviors nurses may observe and upon which they may comment. All of the previous studies included an assessment form with quantitative data points, rather than narrative, qualitative data points. The objective of this study was to examine the nurse's perspective of resident performance in the emergency department (ED) by a quantitative analysis of assessments and content analysis of narrative comments. This project will contribute to our understanding of nursing narrative feedback to residents.

Population Health Research Capsule

What do we already know about this issue?
Multi-source feedback is important because self- assessment is flawed. Specifically nursing feedback can be meaningful to guide resident behavior.

What was the research question?
What is the nursing perspective on emergency medicine (EM) resident behaviors? This study examined nursing assessments of EM residents.

What was the major finding of the study?
Nurses provided feedback and valued EM residents when they were kind, efficient, team players and communicated well.

How does this improve population health?
Nurses can provide meaningful feedback to residents to help improve patient care and teamwork.

METHODS

This was a retrospective, cross-sectional, mixed-method study of nursing assessments submitted from July 2010 to October 2013. The setting was an academic, four-year EM program with over 50 residents. Participants were nurses who worked in the ED and completed resident assessments using an online instrument with quantitative and narrative components. The quantitative component asked nurses to score residents on eight items (Table 1), rating them from 1 (unsatisfactory) to 5 (outstanding). Additionally, nurses were invited to provide narrative comments. The assessments were completed online (Medhub™) and were not mandatory. Resident leadership periodically spoke at nursing staff meetings to encourage completion of the assessments. The residents receive these de-identified, aggregated, nurse assessments at each mandatory semi-annual review. The institutional review board determined the study exempt.

Quantitative analysis included descriptive statistics of 1,506 assessment forms to support the findings of the qualitative analysis. The narrative comments were de-identified and analyzed using content analysis.[12-16] The analysis was informed by the literature on multisource feedback and by the expertise of the coding group (two nurses, four residents, and two faculty, including a qualitative expert). We started with team immersion review of the data. From this, we developed an initial set of codes. Given the different perspectives, coding was then done iteratively as a group over multiple sessions using the constant comparative method of analysis and grouping of data chunks. When the team disagreed on how a comment should be coded, this was resolved through dialogue. We recorded and refined emergent themes. Saturation was achieved, as no new themes emerged after the first 150 comments (assessment questionnaires) were coded. We coded an additional 60 for a total of 210 to ensure no new themes. Themes are presented using the nurse's written voice.

Table 1. Nurses' quantitative assessments of residents.

	Outstanding/ above expectation (5 and 4)	At expectation (3)	Below expectation/ unsatisfactory (1 and 2)	Mean (SD)
How would you rate this resident's attitude?	65%	30%	5%	3.96 (1.0)
Is this resident a team player?	64%	30%	6%	3.95 (1.0)
How well does this resident demonstrate ethical and professional behavior in the emergency department?	58%	39%	3%	3.88 (0.9)
How would you rate this resident's interpersonal/communication skills with the ancillary staff (Nurses, techs, clerks)?	62%	28%	10%	3.86 (1.1)
How would you rate this resident's ability to direct other healthcare workers during resuscitations?*	39%	28%	5%	3.74 (1.0)
How would you rate the clarity of this resident's orders and discharge instructions?	51%	43%	5%	3.73 (0.9)
How would you rate the resident's judgment as it applies to patient care (medical decision making)?	52%	42%	6%	3.71 (0.9)
How would you rate this resident's clinical efficiency and ability to maintain patient flow?	53%	38%	9%	3.69 (1.0)

SD, standard deviation.
*27% of residents were not evaluated on this item.

RESULTS

Qualitative Data

For all comments two themes were determined. The first was whether the comment provided feedback that was positive or negative. Based on content analysis, 50% of comments were positive, 50% were negative, and 10% were coded as both. The second theme was whether feedback from the comment was actionable or not. Actionable comments were those that were specific enough that the resident could conceivably choose to change behavior to act upon the comment. The majority of comments (80%) were determined to be actionable. An example of actionable is "This MD might improve by being better aware of the patient care that is completed by the registered nurse (RN) and the timeline it takes to accomplish some tasks."

We identified nine additional themes (Table 2). The most common themes were *nice/kind*, *communication with nurses*, and *work ethic/efficiency* (Table 1). Nurses described the residents both in positive and negative behaviors for each of these themes. The following section will describe the most common themes with direct quotations to demonstrate and clarify the theme.

Nurses frequently commented on *communication with nurses*. This included updating and informing nurses on the plan of care, new orders or tasks, and being responsive to pages. For example, one positive comment mentioned, "He works great with the nurses and keeps them informed of the treatment plan." On the other hand, nurses noticed when this did not occur: "Does not initiate conversations regarding patient care/updates with staff." Multiple nurses commented specifically on residents not responding to pages promptly.

Table 2. Qualitative themes and frequency of each theme in nurses' assessments of emergency medicine residents.

Themes*	Frequency	Negative	Positive
Communication with nursing	97 (21%)	50	47
Nice and kind	81 (17%)	11	70
Work ethic and efficiency	83 (18%)	52	31
Resident judgment	53 (11%)	26	27
Communication with patients	38 (8%)	17	21
Respect	33 (7%)	19	14
Team player	33 (7%)	8	25
Confidence and leadership	30 (6%)	22	8
Nursing clinical judgment	20 (4%)	8	12

*Text comments often contained multiple themes; therefore, the numbers may add up to greater than 100%.

"He rarely responds to pages. It is very difficult to get in touch with him regarding questions and requests. I usually have to give up and go find him, which can be frustrating."

Another common theme was the *work ethic and efficiency* of the resident. Nurses frequently commented on whether residents were able to pick up, evaluate, and disposition patients in a timely manner, as well as the ability to multitask, prioritize, and balance patient load: "Very unorganized. Takes long time to dispo[sition] patients." Many nurses commented on whether residents completed orders in a timely and efficient fashion, specifically whether they placed all necessary orders at one time or staggered them. "Gives verbal orders but doesn't follow through with

written orders." "MD should order appropriately per patient condition and relay to RN. There were many instances with Dr. [ ] where RN had to request imaging orders on a critical patient because she failed to write them – putting patient at risk."

The third theme was *nice/kind***.** Nurses referred to these residents as being generally enjoyable to work with and having qualities such as being approachable, friendly and taking time to address questions and concerns of ED staff. The opposite was being rude, brusque, and unapproachable. Some examples include "Very approachable and great to work with," and "She is not very pleasant to work with […] and also is very short with the nursing staff."

Resident judgment included comments on residents' knowledge base and decision-making capabilities as well as on their procedural skills. Nurses commented on whether residents had the judgment to recognize critical patients and give appropriate guidance to nursing. "I had a patient who was very hypotensive and hypoxic, and he left me with the patient to go to another patient in resus[citation]…he did not give any direction or send in another physician." The nurses also made comments on residents' skills such as, "Awesome pt (patient) positioning when it comes to suturing!" and "Does not know how to administer eye meds."

Nurses are often present as residents *communicate with patients and families*. The nurses noted whether residents had good bedside manner, developed rapport with patients, and updated patients on the plan of care. In a positive example, a nurse commented, "Dr. [ ] has the ability to communicate with his patient and family in a way that informs, encourages, and teaches […] and asks if there is anything more that the patient or family needs." On the other hand, nurses noticed when residents were not communicating with their patients, such as, "I have been put in situations where my patients have wanted to leave because she had not seen them in hours after ordering exams for them." As nurses often go through a resident's discharge instructions with patients, they were able to comment on those as well.

Nurses also commented on whether the resident was a *team player*. This included how the resident worked with all the staff and whether he or she did tasks outside of the usual job of the doctor to help patient care. "He is a fantastic MD - he helped me start a difficult IV - he was helpful and respectful of my time." Another positive example included, "He is one of the few MDs who will help a [patient] walk to the restroom or get them a blanket. He genuinely seems to be a team player, and I appreciate the help he has given me in my patient care." On the other hand, they note when residents are not working well with other members of the team, as evidenced by "does not work with other staff well, just tells them what to do in a strict 'I am better then you' attitude," and another, "Would like the resident to be more of a team player and supportive of the nurses with combative patients."

Nurses note *leadership and confidence*. Specific attributes that the nurses commented upon included decisiveness in voicing orders and plan of care, staying calm in difficult situations, and answering questions with certainty. On the other hand, a lack of confidence included those who were anxious, appeared stressed and unsure of themselves, and were not specific in voicing orders and plan of care. This category also included leadership, and when this was commented upon, it was often in the context of running resuscitations. "Dr. [ ] continues to appear/act in a passive manner while working in the resus[citation] bays. He does not direct well or take on a leadership role during critical times."

There were multiple comments on the manner in which the residents communicated. These were categorized as *respect for other team members*. For example, "Dr. [ ] is condescending to staff and rolls her eyes constantly," and "demonstrates too much arrogance. Does not appear like he wants to listen to nursing staff, not important [sic]." Many of these comments were closely tied to comments about the resident being a team player.

A final category included comments about acknowledging *nursing clinical judgment.* The nurses wanted residents to be open to their suggestions or opinions on patient care and to listen when they expressed concerns. Positive assessments included statements such as "Seems to respect the information that the RN brings to the patient," and "Able to accept questioning of orders from nursing staff…listens to suggestions when offered." In contrast, nurses were aware of and commented about residents who did not acknowledge nursing concerns. "Would like it if he would take the nurse's views, observation into consideration instead of acting solely." This category also included comments about recognizing the nurses' patient load, time constraints and having a good understanding of what nurses in the ED are supposed to do.

Quantitative Data

The quantitative results are found in Table 2. Generally, nurses scored physicians above expectation, especially for the categories of "How would you rate this resident's attitude?" and "Is this resident a team player?" Residents were scored lowest on "How would you rate this resident's clinical efficiency and ability to maintain patient flow?"

DISCUSSION

The nurse's voice in assessment of residents provided unique perspectives and feedback for residents. Their comments suggest that nurses note good communication and the relationship between nurses and doctors (kindness). The advantage to the qualitative analysis of the comments is that they provide a deeper understanding of what nurses observe in the behavior of residents. For example, while we may feel that we understand what "efficiency" means, the specific comments help to enrich our understanding (e.g., putting in all orders at one time so that the nurse does not have to duplicate work by redrawing blood or contacting the laboratory).

The quantitative numbers were primarily positive; however, the narrative comments included a number of negative comments. It is possible that for the survey the nurses may have been providing a socially desirable response by scoring the residents highly. While there is some overlap between the narrative comments and the quantitative questions, nurses also provided additional information to the residents through their voice. Further, there is likely the recognition in the comments that there are still areas of improvement for the residents.

When providing feedback, Tekian et al. noted the importance of linking feedback to an action plan.[17] We found that the majority of nursing assessments comments are actionable and can be as simple as entering lab orders at the same time so that nurses do not have to redraw blood, to more thoughtful behaviors such as getting a patient a warm blanket when the resident recognizes that the nurse is currently busy with multiple pressing tasks. There was a consensus among nursing comments in terms of the specific behaviors directly observed in the clinical setting. The most salient qualities that we found nurses to note were the following: 1) placing orders promptly and at the same time; 2) communicating the plan of care directly with nurses; 3) communicating results and plan of care with patients; and 4) responding to nursing concerns and pages in a timely manner.

Additionally, nurses may also identify patterns of physician behavior that could potentially be detrimental to residents' professional advancement (e.g., speaking to nurses and patients in a condescending tone). The residents may not be aware that this perception or their behavior is negatively affecting others. By highlighting what is important – attitude, teamwork and efficiency – nursing comments could provide stimulus through which residents can inform their own self-assessment and make positive changes. Bringing nurses into the conversation helps physician providers understand domains of performance of which they may not be aware and promotes an interdisciplinary approach to the assessment of residents in the clinical setting that may lead residents to improved self-assessment and team dynamics.

The Joint Commission's report on sentinel events demonstrated that in the majority of events, issues with communication were one of the major root causes.[18] In a culture of safety, attention is focused on effective teamwork and communication between healthcare providers. Therefore, as nurses provide actionable feedback through their comments provided to residents, they are instructing the residents how to become better members of the team. Residents who can incorporate this feedback may have improved interactions with the team and be able to provide improved patient care. The use of nursing feedback in resident assessment by residency programs also indicates the importance of our nursing partners and their role in patient care and the team.

Conventionally, resident feedback comes predominantly from the attending physicians. They are appropriately situated to assess a resident's procedural skills and medical knowledge; however, the resident's learning environment is broader than the attending-resident interaction. To be an effective physician, residents must also display characteristics such as interpersonal and communication skills, professionalism, and systems-based practice.[15] The interactions in which residents display these characteristics may occur more often with other members of the care team as well as with the patients—interactions that attending physicians do not frequently observe. Nursing assessments add color, depth, and context to resident assessments and, when used in conjunction with conventional attending provider feedback, may provide a more holistic picture of a resident's ability to provide effective patient care. Further studies need to compare the comments and scores of the nurses, faculty, and peers for each resident. In addition, it will be important to examine the design of assessments specifically for the purpose of providing feedback.[17] While this paper examined nursing feedback for residents, it is also important to include patient feedback in the multisource feedback for residents.

Future studies should examine if residents' reviews of actionable nursing assessments influence a change in their behavior. From what we know about poor self-assessment, the nursing comments should be part of informed self-assessment.[19,20] If residents were to identify nurses as a respected, "trusted source," nurses could then conceivably help coach those residents with problematic behavior. For example, when a resident does not understand how s/he might be perceived as arrogant, the nursing coach could help provide specific examples and better approaches.

LIMITATIONS

There were several limitations associated with this study. First, the nursing survey contained the eight questions on specific characteristics of physicians before the comment, free-text portion. These specific questions may have influenced the free-text responses. Because we do not have a response rate for nurses completing evaluations there may be some bias. In addition, there may be some social desirability response in the textual comments. Second, this was a single site, which may constrain generalizability. This study did not examine the changes over time for the responses, as the nursing assessments of residents started over a decade ago. Finally, this study is an initial step toward understanding nurses' feedback to residents; however, there are limitations implicit in our qualitative methods. Qualitative studies are not intended to test inferences about causation or associations.

CONCLUSION

Nurse-physician relationships form the basis of effective interprofessional practice and patient care. Nurses' comments suggest that they remark on communication and the relationship between nurses and doctors as well as teamwork and efficiency. Nurses' assessments can provide feedback and direction for resident professional development.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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The Impact of a Standardized Checklist on Transition of Care During Emergency Department Resident Physician Change of Shift

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Section Editor: Douglas S. Ander, MD
Submission history: Submitted May 15, 2018; Revision received September 9, 2018; Accepted October 4, 2018
Electronically published November 20, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39020

Introduction: Transitions of patient care during physicians' change of shift introduce the potential for critical information to be missed or distorted, resulting in possible morbidity. The Joint Commission, the Accreditation Council for Graduate Medical Education, and the Society of Hospital Medicine jointly encourage a structured format for patient care sign-out. This study's objective was to examine the impact of a standardized checklist on the quality of emergency medicine (EM) resident physicians' patient-care transition at shift change.

Methods: Investigators developed a standardized sign-out checklist for EM residents to complete prior to sign out. This checklist included topics of diagnoses, patient-care tasks to do, patient disposition, admission team, and patient code status. Two EM attending physicians, the incoming and departing, assessed the quality of transitions of care at this shift change using a standardized assessment form. This form also assessed overall quality of sign-out using a visual analog scale (VAS), based on a 10-centimeter scale. For two months, we collected initial, status quo data (pre-checklist [PCL] cohort) followed by two months of residents using the checklist (post-checklist [CL] cohort).

Results: We collected data for 77 days (July 1, 2015 – November 11, 2015), 38 days of status quo sign-out followed by 39 days of checklist utilization, comprised of 1,245 attending assessments. Global assessment of sign-out for the CL was 8 compared to 7.5 for the PCL. Aspects of transition of care that implementation of the sign-out checklist impacted included the following (reported as a frequency): "To Do" (PCL 84.3%, CL 97.8%); "Disposition" (PCL 97.2%, CL 99.4%); "Admit Team" (67.1%, CL 76.2%); and "Attending Add" (PCL 23.4%, CL 11.3%).

Conclusion: Implementation of a sign-out checklist enhanced EM resident physician transition of care at shift end by increasing the frequency of discussion of critical tasks remaining for patient care, disposition status, and subjective assessment of quality of sign-out. [West J Emerg Med. 2018;20(1)29-34.]

INTRODUCTION

The process of communicating high-quality patient information from one clinician to the next represents one of the ongoing challenges in healthcare.[1] Providing continuous, round-the-clock patient care mandates effective, succinct, and informative communication between healthcare providers during change of shift.[2] These clinical handoffs, also known as sign-outs, shift reports, or handovers, occur between multiple providers with various clinical responsibilities throughout the healthcare system. Sign-outs, which are often complex and multifaceted communications, mark the beginning or end of clinical shifts and patient

care duties.[3] They mark the transmission of professional accountability for some, or all, aspects of patient care from one clinician or clinical team to another.[4] If done poorly, sign-outs can have deleterious clinical impact. The Institute of Medicine attributes a substantial proportion of preventable adverse events to communication errors during sign-out.[5] These errors are among the root causes of nearly two thirds of potentially significant, preventable adverse clinical outcomes in hospitals.[6,7]

Only recently has data become available that demonstrate improvements in sign-outs reduce the rate of subsequent clinical care error.[8] Substantial variability exists across, and sometimes within, institutions regarding preferred formats and processes for verbal and written handoffs. Research of residency training programs indicates that handoff standardization has not been aggressively implemented or has been implemented with variable compliance.[2,9] The Joint Commission, the Accreditation Council for Graduate Medical Education, and the Society of Hospital Medicine jointly encourage compliance with a structured format for verbally communicating sign-out information.[10]

Population Health Research Capsule

What do we already know about this issue?
Transitions of patient care introduce the potential for critical information to be missed or distorted, resulting in possible patient morbidity.

What was the research question?
Does a standardized checklist impact the quality of Emergency Medicine (EM)resident physicians' transition of patient care?

What was the major finding of the study?
Use of a sign out checklist enhanced EM resident physician transition of care.

How does this improve population health?
By enhancing the quality of resident physician sign out, there is the potential to limit miscommunication between providers which ultimately can affect patient care and safety.

OBJECTIVE

Our primary objective was to determine the impact of a standardized checklist on the quality of emergency medicine (EM) resident physicians' patient care transition at shift change. Secondary objectives included evaluation of the level of EM resident training on perceived quality of transition of care and whether utilization of a sign-out checklist impacted sign-out duration.

METHODS

After institutional review board (IRB) approval, this single-center prospective study was conducted at an EM residency-affiliated, Level I trauma center emergency department (ED) in Northeastern Pennsylvania. We collected data from July 1, 2015 – November 11, 2015. The cohort consisted of a consecutive sample of EM resident sign-out sessions of all patients present at the time of transfer of care. The departing residents transfer responsibility of all ED patients to the oncoming team under the oversight of attending physicians at the 7 a.m. change of shift. At our institution, morning sign-out is the only time when there is a complete change of shift with attending and resident physicians. Throughout the remainder of the day, there is overlap in the treatment team.

Investigators developed a standardized sign-out method and checklist based on literature review, departmental meetings, and the Joint Commission's recommended handover communication mnemonic in order to identify key aspects of transition of patient care sign-out (Figure 1).[11-13] Essential aspects of sign-out included the following: diagnoses; patient care tasks to do; patient disposition; and admission team and patient code status. Necessity for patient care clarification from the attending was also noted.

Two EM attending physicians, the incoming and departing, independently assessed the quality of transitions of care at this shift change using a standardized assessment form (Figure 2). This form assessed overall quality of sign-out using a visual analog scale (VAS), which is a 10 centimeter (cm) scale ranging from poor (1cm) to excellent (10 cm). We then evaluated VAS scores overall, as well as a subgroup for each post-graduate year (PGY). Attendings also documented discussion of essential aspects of transition of care issues: primary ED diagnoses; "To Do" (essential tasks to complete); "Disposition" (awaiting discharge, evaluation ongoing, or admission); "Admit Team" (admission service for patient); "Code Status" (regarding living will statements); and "Attending Add" (whether the nocturnal attending needed to clarify the sign-out). A checkmark indicated the topic was mentioned, while a cross-hatched zero indicated it was not discussed.

Assessment of status quo sign-out occurred for 38 days to establish baseline practice patterns, the pre-checklist (PCL) cohort. Resident and attending physicians were given verbal instructions on how to complete the checklist prior

Patient sticker	Room number	Brief summary ED events	To do	Disposition	Other
		HPI/DX: ED course: Anticipated issue(s):	All done: ☐ Pending study: ☐ Pending consult: ☐ Tethering note: ☐	TBD ☐ D/C ☐ Admit ☐ By: Home ☐ Transfer ☐	Code status: Full ☐ DNR ☐ DNI ☐ Psych ☐

Figure 1. Sign out checklist.
ED, emergency department; *HPI,* history of present illness; *DX,* diagnoses; Psych, psychiatric; *TBD,* to be determined; *D/C,* discharge; *DNR,* do not resuscitate; *DNI,* do not intubate.

to initiation of its use. The following 39 days, residents completed a sign-out study checklist (Figure 1) prior to giving sign out (post-checklist [CL] cohort) to aid in the transition-of-care process.

Time duration of sign-out was also recorded by the attending physicians, defined as the time from first patient sign out to last. Time for the resident to complete the checklist was not included in this measure, as residents were still actively involved in patient care and completed the checklist between their regular shift duties.

Data Analysis

We completed statistical analysis using SPSS version 25 (Armonk, NY: IBM Corp.). Non-normally distributed continuous data were reported as medians and ranges, with separate Wilcoxon signed rank tests conducted as appropriate. Categorical data were reported as frequencies and percentages. For all analyses, $p < 0.05$ denotes statistical significance, with no adjustment for multiple testing.

RESULTS

Assessment of ED departmental resident sign-out occurred for 77 days, 38 days of unstructured, status quo sign-out, and 39 days of using a sign-out checklist. A total of 18 attending physicians, including two nocturnists and 16 rotating day-shift physicians, and 40 resident physicians participated. The total number of days remained consistent before and after initiation of the checklist; however, due to ED census a greater number of assessments was completed in the CL cohort. Table 1 lists a summary of the results with a comparison between the two cohorts, pre- and post-sign out checklist.

Attending physicians completed a total of 1,245 sign-out assessments of EM residents: 548 attending VAS assessments in the PCL and 697 assessments in the CL cohort. Global assessment of transition of care for the CL was 8 (range 2.5 to 10) compared to 7.5 for the PCL (range 0.5 to 9.5) ($p < .0001$). Aspects of transition of care that implementation of the sign-out checklist impacted included the following (reported as frequencies and percentages): "To Do" (PCL 578/686, 84.3%; CL 482/493, 97.8%; $p < 0.0001$); "Disposition" (PCL 683/703, 97.2%; CL 518/521, 99.4%; $p = 0.004$); "Admit Team" (PCL 392/584, 67.1%; CL 321/421, 76.2%; $p = 0.03$); and "Attending Add" (PCL 100/427, 23.4%; CL 39/345, 11.3%; $p < 0.0001$). Issues not impacted by the sign-out checklist included "Diagnosis" (PCL 714/727, 98.2%; CL 522/527, 99.1%; $p = 0.1$) and "Code Status" (PCL 45/505, 8.9%; CL 52/357, 14.6%; $p = 0.13$).

VAS scores for each PGY are reported at medians and ranges. VAS scores for PGY-1 in PCL cohort was 7.0 (4.0-8.75) and CL 8.0 (6.0-9.5). For PGY-2, PCL cohort median VAS scores were 7.25 (2.25-9.50) and CL cohort 8.5 (4.75-9.75). Lastly, for PGY-3 median VAS PCL was 7.25 (0.75-9.0) and CL 8.0 (4.25-10.0). Results are summarized in Table 2.

Use of a sign-out checklist significantly decreased duration of sign-out by nine minutes mean for the CL cohort, compared to the PCL cohort ($P < 0.03$).

Room number	Resident	Dx	To do	disp discussed	Admit to whom	Code status	Serial sign out	Add info from att/chart

Global assessment of Pt sign out (poor) ├----------┤ (excellent)

Figure 2. Attending physician scorecard.
DX, diagnoses; *disp,* disposition; *Psych,* psychiatric; *med,* medical; *att,* attending; *Pt,* patient.

Table 1. Impact of a sign-out checklist on outcomes regarding transitions of care at shift end.

	Pre-checklist	Post-checklist	P value
Attending assessment of sign out VAS	7.5 (range 0.5 to 9.5) (n = 548)	8.0 (range 2.5 to 10) (n = 697)	< .0001
+ Diagnosis	714/727, 98.2%	522/527, 99.1%	0.1
- Diagnosis	12/727, 1.7%	5/527, 0.9%	
+ "To do"	578/686, 84.3%	482/493, 97.8%	< .0001
- "To do"	60/686, 8.7%	8/493, 1.6%	
+ Disposition	683/703, 97.2%	518/521, 99.4%	<0.004
- Disposition	14/703, 2%	3/521, .6%	
+ Admit to	392/584, 67.1%	321/421, 76.2%	<0.03
- Admit to	83/584, 14.2%	35/421, 8.3%	
+ Code status	45/505, 8.9%	52/357, 14.6%	0.13
- Code status	295/505, 58.4%	187/357, 52.4%	
+ Attending add	100/427, 23.4%	39/345, 11.3%	<.0001
- Attending add	327/427, 76.6%	306/345, 88.7%	
Sign out duration	13 minutes (mean)	9 minutes (mean)	< 0.03

(+) topic mentioned by resident; (-) topic omitted by resident.
VAS, visual analog scale.

Table 2. Visual analong scale (VAS) assessments of sign-out quality.

	VAS PCL	VAS CL
PGY-1	7.0 (4.0-8.75)	8 (6.0-9.5)
PGY-2	7.25 (2.25-9.5)	8.5 (4.75-9.75)
PGY-3	7.25 (0.75-9)	8.0 (4.25-10.0)

PGY, post-graduate year; *PCL,* pre-checklist; *CL,* post-checklist.

DISCUSSION

Prior research has demonstrated that omission or distortion of important clinical information occurs during transition of care.[5,6,9,11] This study sought to address issues of miscommunication during sign-out through utilization of a standardized checklist. By using a shared departmental model, such as a sign-out checklist, situational awareness of complex information during handoffs is enhanced.[11] Compared to the status quo unstructured sign-out, implementation of a standardized checklist improved attendings' perception of the quality of resident transition of care ($P < 0.001$), discussion of patient care tasks requiring completion ($P < 0.001$), disposition confirmation ($P < 0.004$), necessity for attending clarification ($P < 0.001$), and shorter duration of sign-out process ($P< 0.03$).

Our checklist did not impact discussion of the working diagnosis and code status. The patient's working diagnosis is typically one of the first items discussed during sign-outs, which is why we believe this did not improve with implementation of the checklist. In this study a standardized checklist was used; however, during the study time period we found that not all topics, such as code status, were applicable to every patient. All patients present in the ED were signed out during morning sign-out, regardless of acuity. For patients with a lower acuity, it can be suggested that code status does not need to be discussed with patients and members of their treatment team, which likely explains the findings in this study.

Other studies have proposed methods to improve patient transition of care. These include various mnemonics, such as I-PASS (Illness severity; Patient summary; Action list; Situational awareness and contingency plan; Synthesis by receiver) and SIGNOUT (Sick; Identifying data; General course; New events of the day; Overall current clinical status; Upcoming possibilities with plan; Tasks to complete after handoff), which have been evaluated in the inpatient setting. These studies created curriculums and workshops to focus on improving communication during sign out.[12-14] The American College of Emergency Physicians (ACEP) also created a "Safer Sign Out Protocol," which included the five key components of record, review, round, relay information to the team, and receive feedback.[15] ACEP has recently provided a similar sign-out checklist; however, we chose a tool that was more tailored to our ED.

Dubosh et al. used an electronic sign-out checklist to evaluate resident sign-out in the ED and found improvements in sign-out without increasing length of time to complete handoff.[16] Although their study was conducted in the ED, they included residents from various medical specialties and only those in their first and second year of training, unlike our study, which included only EM residents.

Overall, there was slight improvement in each PGY's VAS assessment following implementation of the checklist. PGY-2 gained the largest improvement, while the residents in their final year of training gained the least improvement. The improvement among first-year residents may have been limited due to the study being conducted during their first few months of residency, when the learning curve is immense in all areas of training. Overall, interns see fewer patients than senior residents and therefore have fewer VAS scores, which can impact their final average. Also, we found that residents in their final year of training were less open to changing how they completed sign-out. Rayo et al. also demonstrated similar findings in their study, which evaluated various team members during sign-out in the critical care setting. Rayo et al. reported that practitioners with higher levels of training provided fewer interjections and a higher proportion of interactive questions.[10]

This study demonstrates that using a sign-out checklist decreases time to complete transition of care. These findings are both statistically and clinically significant, as most providers would like to leave at the end of their shifts. Although the time it took for residents to complete the checklist was not recorded, overall group involvement between the attending and residents was shorter.

LIMITATIONS

Due to the lack of blinding in the study design, observer bias may have influenced the attending physicians' assessments of quality, or perceived lack of quality, during the observational and intervention phases of the trial. The Hawthorne effect may have altered the quality of sign-out, as awareness of the trial may have influenced the quality of the subjects' transition-of-care efforts. Furthermore, participants received a brief verbal instruction on how to complete the checklist and attending scorecard prior to their first time using it. Since a formal group introduction was not given, there may have been inconsistency among the instructions. Although subjects were not randomized into checklist vs. no-checklist cohorts, use of consecutive data of all residents present in the department over three months of data collection controlled for sampling bias.

Attrition bias may have impacted results, as 482/1,245 assessments were incomplete; the most common incomplete assessments were the code status assessments (though this would not apply to all patients) and attending clarifications of clinical information. In addition, due to ED census during the study period, there was a greater number of assessments in the CL cohort. Finally, although implementation of a sign-out checklist resulted in significantly decreased sign-out duration, investigators did not monitor clinician time to complete the checklist. Due to the fact that this was the first study evaluating use of our ED sign-out checklist, further studies will need to be conducted to validate its accuracy and use.

CONCLUSION

Implementation of a sign-out checklist enhanced EM resident physician transition of care at shift end by increasing the frequency of discussion of critical tasks remaining for patient care, disposition status, and subjective assessment of quality of sign-out, while concurrently decreasing duration of sign-out discussion.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Integration of Entrustable Professional Activities with the Milestones for Emergency Medicine Residents

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Section Editor: David P. Way, MEd
Submission history: Submitted May 6, 2018; Revision received October 29, 2018; Accepted November 12, 2018
Electronically published November 30, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.38912

Introduction: Medical education is moving toward a competency-based framework with a focus on assessment using the Accreditation Council for Graduate Medical Education Milestones. Assessment of individual competencies through milestones can be challenging. While competencies describe characteristics of the person, the entrustable professional activities (EPAs) concept refers to work-related activities. EPAs would not replace the milestones but would be linked to them, integrating these frameworks. Many core specialties have already defined EPAs for resident trainees, but EPAs have not yet been created for emergency medicine (EM). This paper describes the development of milestone-linked EPAs for EM.

Methods: Ten EM educators from across North America formed a consensus working group to draft EM EPAs, using a modified Glaser state-of-the-art approach. A reactor panel with EPA experts from the United States, Canada and the Netherlands was created, and an iterative process with multiple revisions was performed based on reactor panel input. Following this, the EPAs were sent to the Council of Residency Directors for EM (CORD-EM) listserv for additional feedback.

Results: The product was 11 core EPAs that every trainee from every EM program should be able to perform independently by the time of graduation. Each EPA has associated knowledge, skills, attitudes and behaviors (KSAB), which are either milestones themselves or KSABs linked to individual milestones. We recognize that individual programs may have additional focus areas or work-based activities they want their trainees to achieve by graduation; therefore, programs are also encouraged to create additional program-specific EPAs.

Conclusion: This set of 11 core, EM-resident EPAs can be used as an assessment tool by EM residency programs, allowing supervising physicians to document the multiple entrustment decisions they are already making during clinical shifts with trainees. The KSAB list within each EPA could assist supervisors in giving specific, actionable feedback to trainees and allow trainees to use this list as an assessment-for-learning tool. Linking each KSAB to individual EM milestones allows EPAs to directly inform milestone assessment for clinical competency committees. These EPAs serve as another option for workplace-based assessment, and are linked to the milestones to create an integrated framework. [West J Emerg Med.2019;20(1)35–42.]

INTRODUCTION

Postgraduate medical education (GME) programs in the United States (U.S.) are moving toward a competency-based medical education (CBME) framework. In this system, GME programs will ensure that trainees demonstrate competence across the full spectrum of specialty-based work activities required to independently provide safe, quality patient care.

Milestones, KSABs, Competencies and Competence

In 2012, the Accreditation Council for Graduate Medical Education (ACGME) in conjunction with the American Board of Emergency Medicine (ABEM) released the emergency medicine (EM) Milestones as a framework for training programs to guide the development of assessment of trainees' progress towards competence in each domain.[1] There are 23 domains, known as "sub-competencies" within the EM Milestones, each residing within one of the original six "core competencies" (medical knowledge [MK], patient care [PC], interpersonal and communication skills [ICS], professionalism [PROF], systems-based practice [SBP], and problem-based learning and improvement [PBLI]).[2,3] Demonstrating "competence" in all of these milestone "sub-competencies" is required for graduation into unsupervised practice. Competence is defined by the Merriam-Webster dictionary as "the state of being competent," and competent is defined as "having requisite or adequate abilities or qualities." Each sub-competency is divided into five developmental levels (levels 1-5, also known as proficiency levels), containing descriptors of knowledge, skills, attitudes and behaviors (KSAB) appropriate for each level ranging from novice to expert provider. Each individual descriptor of the trainee, their KSABs, or their performance at a particular developmental level is known as an individual milestone (Figure). Individual milestones describe the KSABs required to progress from novice (level 1) to competent (level 4); they also detail a higher, aspirational level (level 5).[2]

Entrustable Professional Activities and Observable Professional Activities

Entrustable professional activities (EPA) are observable, measurable, work-based activities. They have been defined as "units of professional practice that can be fully entrusted to a trainee, as soon as he or she has demonstrated the requisite competence to execute the activity unsupervised."[4] While competencies and milestones describe abilities or characteristics of the trainee (i.e., obtains an accurate and thorough history and exam, successfully performs intravenous line placement, communicates respectfully with patients), EPAs describe broader work-based activities (i.e., manages a critically ill patient).[4-7] EPAs, when taken collectively, are "the essential professional activities that describe a specialty."[5]

Population Health Research Capsule

What do we already know about this issue?
Medical education is moving towards a competency based framework (CBME). Entrustable professional activities (EPAs) are one way to assess competence, and can be linked to the Milestones.

What was the research question?
To develop Milestone-linked EPAs for emergency medicine (EM) residents.

What was the major finding of the study?
Eleven core EPAs were developed for EM. Each EPAs has associated knowledge, skills, attitudes and behaviors (KSABs), which are linked to individual milestones or are milestones themselves.

How does this improve population health?
These EPAs give programs a method of workplace based assessment that may be more intuitive to use than milestones. Linking of KSABs to individual milestones allows for an integrated framework.

The levels of EPA-related supervision are listed in Table 1.[4-6,8] Since supervising physicians are already making decisions about how much supervision a particular trainee needs (in other words, how much they "trust" that trainee) multiple times per shift, EPAs may provide a more intuitive route to competency-based assessment.[4,9] Since emergency departments (EDs) with trainees in the U.S. are staffed with attending physicians 100% of the time, making them generally "immediately available," the Level 4 rating for EM trainees in the ED is more conceptual, with supervisors asking themselves, "Do I feel it would be appropriate for this trainee to perform this task if they were practicing independently, such as moonlighting at an external institution?" Level 5 may also not follow Level 4 sequentially in the ED, since senior residents supervising others are still supervised by an ED attending.

Observable practice activities (OPA) are defined by Warm et al. as "learning objectives/activities that must be observed in daily practice in order to form entrustment decisions."[10] OPAs are smaller units of directly observable practice than EPAs. Multiple OPAs are nested within each EPA, meaning that multiple OPAs would contribute to the entrustment decision for each larger EPA.

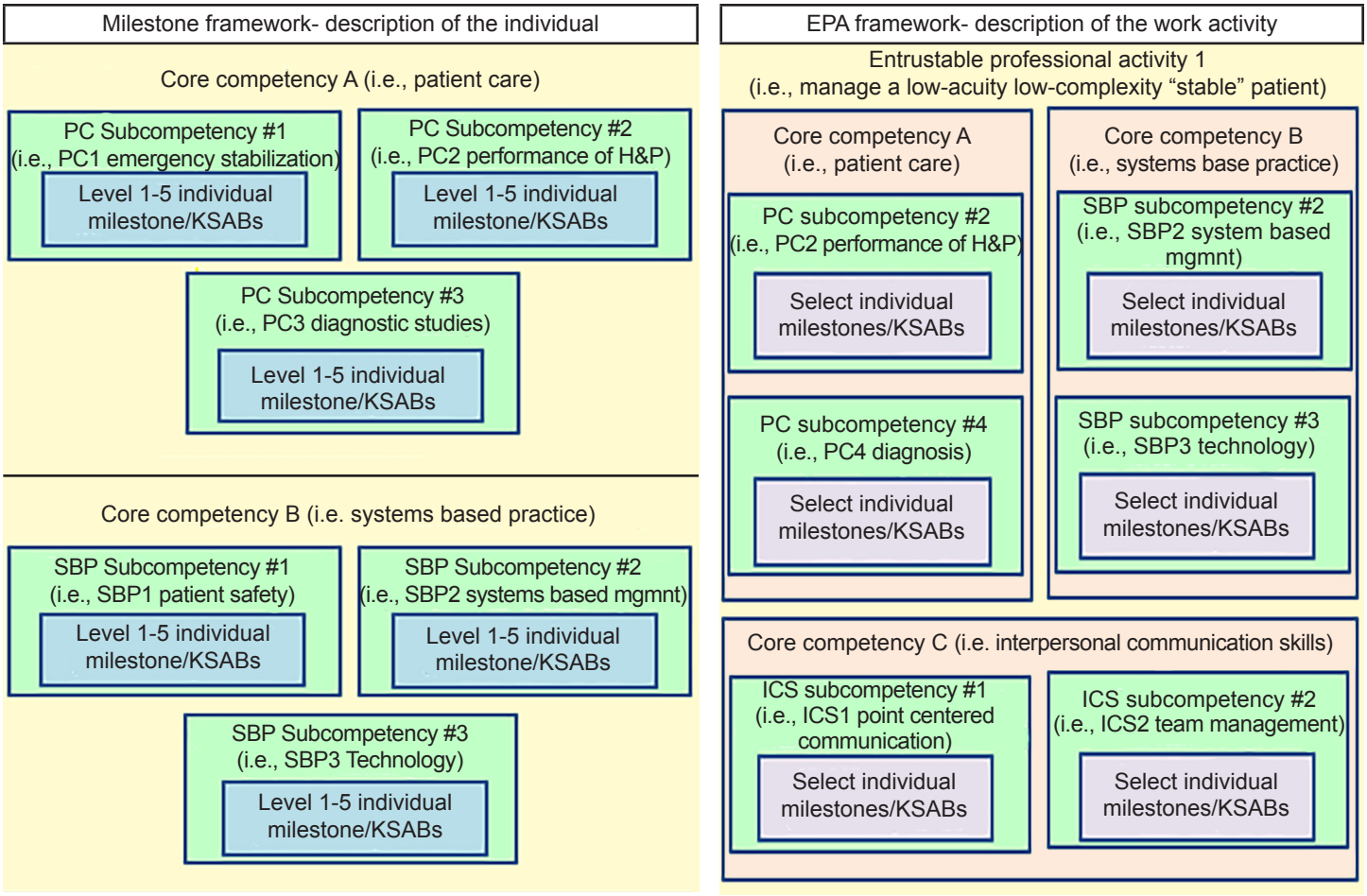

Figure. Milestone and EPA frameworks.
EPA, entrustable professional activity; *KSAB,* knowledge, skills, attitudes, behaviors; *PC*, patient care; *H&P*, history and physical examination; *MK,* medical knowledge; *ICS*, interpersonal and communication skills; *PROF*, professionalism; *PBLI*, problem based learning and improvement; *SBP*, systems based practice; *mgmt*, management.

Table 1. Entrustable professional activity (EPA) levels.

EPA level	Description
Level 1	Trainee is not allowed to perform the activity at all.
Level 2	Trainee is allowed to perform the activity with direct supervision (supervisor present and proactive in the room).
Level 3	Trainee is allowed to perform the activity with indirect supervision (supervisor not present but is immediately available if needed).
Level 4	Trainee is allowed to perform the activity independently (with distant supervision not immediately available).
Level 5	Trainee is allowed to provide supervision to junior learners doing the activity.

Inter-relationship of the Competencies, Milestones, KSABs and EPAs

Most work-related activities require the integration of multiple competencies, sub-competencies and individual milestone items as well as some additional KSABs (Figure).[8,11] For example, to decide that a trainee can manage a resuscitation with indirect supervision, the trainee must have previously demonstrated multiple KSABs described by the milestones within PC, SBP, ICS and PROF arenas. Thus, when assessing whether or not a trainee is capable of performing a work-based activity independently, the supervisor is indirectly deciding whether or not that trainee has attained those requisite milestones

or competencies. EPAs and competencies are, therefore, interrelated. EPAs are not a replacement for the ACGME Milestones; rather they can be linked to individual milestones within their respective proficiency levels to create a unifying framework and provide more learner-centered information.[4,5,7,12]

EPAs for Emergency Medicine

Many GME specialties are creating EPAs to augment their assessment landscape. Internal medicine (IM), family medicine (FM), psychiatry, radiology, anesthesia, pediatrics, and various fellowships have developed EPAs for their trainees.[11,13-24] To our knowledge, EM EPAs have not yet been developed. We sought to develop EPAs for EM using a consensus process to encompass the full spectrum of work activities performed by emergency physicians in the cognitive and affective domains.[4,25] We also aimed to link each EPA to the contributing, individual KSABs and milestone items, creating this unifying framework.[7,12]

METHODS AND RESULTS

Glaser's state-of-the-art approach to consensus has been recommended as an appropriate method for EPA development.[4,25] We implemented Glaser's approach to consensus in an iterative fashion with three modifications: 1) the group leader was a participant and a physician educator; 2) the consensus group members were not hand-picked by the group leader;[25] and 3) not all members of this work group had experience with EM EPAs prior to this project. A group of 10 EM educators from across North America responded to a call for volunteers that was sent to the Council of Residency Directors for EM (CORD-EM) to serve on this work group to develop EPAs in EM. Using ten Cate's recommendations, initial discussions centered around developing a guiding framework on which to structure the EPAs and to consider what work-based activities EM practitioners complete on a daily or weekly basis.[4]

To determine the content of the EPAs, the researchers drew from the Model of the Clinical Practice of Emergency Medicine and the EM Milestones.[26,27] Given the broad scope of EM, a primary area of discussion was determining appropriate levels of focus and granularity. After the group initially considered writing EPAs for discrete patient complaints (similar to the approach taken by Shaugnessy et al. for FM), we realized this list would be too large and not sufficiently comprehensive. We also felt that narrowing the list of patient complaints through some form of nominal group technique would leave content gaps.[14] This type of patient complaint-based assessment schema also seemed more consistent with OPAs, such as the 350 identified for IM.[10] The granularity seen in sets of EPAs developed for less-advanced learners (i.e., medical or physician's assistant students) also seemed inappropriate for resident trainees, because they would then not represent significant steps towards unsupervised practice, as recommended by ten Cate.[4,22,23,28] Therefore, we made an a priori decision to broaden the scope of each EPA, with a goal of keeping the total number of OPAs to less than 30.[4] We decided to develop examples of OPAs that would nest within each EPA, but not to develop a complete set of OPAs for this project.

We decided to exclude psychomotor procedural skills (including ultrasound) from our process, as the EM procedural milestones already can be used as a task-based assessment tool, and many other procedural assessment tools already exist. Further, entrustment decisions about individual procedures can be made independent of a trainee's progress in other areas.

We also decided not to develop EPAs solely revolving around patient communication and professionalism. At the EM resident level of training, these do not represent an independent work-based activity separate from other aspects of a patient encounter. Communication and professionalism are intertwined into each patient encounter and are integral to many work-based activities, or EPAs. For example, a learner is not fully entrustable to care for a low-acuity, low-complexity "stable" patient unless they are able to communicate discharge instructions effectively to the patient. They are similarly not entrusted to manage a high-acuity, high-complexity patient unless they are able to effectively communicate with other healthcare team members, specifically nursing staff, ancillary staff, and consultants. Due to concerns that important professionalism and communication skills could get overlooked by assessors within these larger EPAs, we created a sub-section of EPA KSABs for ICS/PROF/SBP. We hope this will prompt assessors to recall the importance of accounting for these competencies in their overall EPA assessments.

Additionally, we decided not to create EPAs for performance improvement tasks such as creating one's own performance improvement plan because, while extremely important, it would not make sense for a learner to only be allowed do this with close supervision until "entrustment," precluding it from being a true EPA. Similarly, we did not create EPAs for wellness topics such as nutrition, exercise and psychological care because while these topics are important, they are not work-based activities nor must they be overseen until the trainee demonstrates competence; therefore, they should be assessed by different means. EPAs are not the mechanism to assess all personal aspects of being a good physician; they are solely intended to assess work-based activities.[4]

Over a period of approximately six months, using ten Cate's recommended guidelines, we created a list of 29 EPAs.[5] The list initially started with 19 EPAs, which was iteratively refined through multiple group meetings. Some EPAs were subdivided and additional new EPAs were suggested. We mapped the underlying KSABs to each EPA, and each KSAB was then

mapped to the individual ACGME EM Milestone items. Level 5 milestones were generally excluded since these are not expected of trainees. We associated examples of OPAs, such as "manage acute coronary syndrome," with each EPA to give the users a better understanding of what type of patient interactions or work-based activities would be included within each EPA.[10]

We formed a reactor panel of 15 individuals including EM program directors, thought leaders in EM education, and EPA experts from the U.S., Canada, and the Netherlands. All non-EM EPA experts (seven) had extensive experience with and previous publications on EPAs, and most EM experts (six) had extensive experience with and previous publications in medical education (reactor panel individuals are named in the "Acknowledgments" section). They suggested that several of the proposed EPAs be combined. The drafting panel revised the initial EPAs based on this expert feedback into a set of 11 EPAs. We returned the revised EPAs to the reactor panel for additional feedback and approval. We then sent this draft of 11 EPAs to the CORD-EM general membership listserv for additional comment and revision. Based on input from 61 respondents, subsequent minor revisions were made.

We feel that every trainee from every EM program should be able to perform these 11 core EM EPAs independently by the time they graduate to independent practice (Table 2, Appendix 1). Appendix 1 includes the details of the 11 core EPAs, including examples of patient presentations or situations (OPAs) that nest within each EPA, and the mapping of each EPA to the related milestones and KSABs. We have ensured that all milestone items within proficiency levels 1-4 have been mapped to KSABs within each EPA for all non-procedural patient care (PC1-8), interpersonal communication (ICS1-2), and systems-based practice (SBP1-3) sub-competencies. KSABs do not map to all level 1-4 milestones for MK, PBLI, and accountability (PROF2) as these milestones either primarily reflect qualities of the person or are not a work-based activity. This milestone in PROF2 "consistently recognizes limits of knowledge in common and frequent clinical situations and asks for assistance," as well as a few others, are incorporated into our prerequisites for trust. Certain EPAs build on each other. For example, to achieve EPA #2 (managing a low-acuity, high-complexity "stable" patient), the learner must also have achieved the KSABs of EPA #1 (managing a low-acuity, low-complexity "stable" patient). These progressive EPAs are labeled as such in Appendix 1.

We also identified six baseline characteristics that are prerequisites to entrustment, meaning that a trainee would not be entrusted with any EPA until they have demonstrated these attitudes or behaviors (Appendix 2). As such, these are not included in the individual EPAs. These characteristics include three of ten Cate's general conditions for trust: a) integrity, b) reliability, and c) humility, plus three additional factors: a) respectfulness, b) self-monitoring and resilience, and c) self-assessment and self-improvement. Ten Cate's fourth condition for trust is ability, which is developed throughout residency and is addressed by our EPAs.[29]

For each EPA in Appendix 1, we provide five of the components of an EPA described by ten Cate: 1) title; 2) specifications and limitations; 3) relevant competency domains; 4) required KSAs; and 5) expected level of training for entrustment.[4,5] Regarding "the expected level of training for entrustment," our timeline is simply a suggestion, and different programs may adjust their own individual timelines to match their programmatic structure. We did not include ten Cate's section of "expiration date." This does not seem relevant to individuals still in residency programs, since EM trainees will continue practicing and demonstrating all of these skills for the entirety of their training.

We also did not include ten Cate's "assessment information sources" section, because it should be left up to each program to determine how they can most feasibly and reliably assess each EPA. For all EPAs, when feasible, trainees should be observed in the clinical environment multiple times in varied contexts with a range of presenting patient complaints to ensure the trainee is able to reliably perform the EPA in differing circumstances. However, this is not always possible with less-common situations. Simulation and other sources such as standardized direct observation of training can also be used as contributing data sources.[30] As with other competency decisions, no isolated assessment should result in a summative programmatic-level entrustment decision.This requires an integration of multiple data points or streams.[31]

We also recognize that individual residents may have specific areas of interest and individual programs may have specific areas of focus. Therefore, it would be appropriate for training programs to add program-specific or elective EPAs as appropriate for their specific setting, areas of focus or tracks, when available.[4,32]

Table 2. Core emergency medicine entrustable professional activities.

1	Manage a low-acuity, low-complexity "stable" patient.
2	Manage a low-acuity, high-complexity "stable" patient.
3	Manage a potentially high-acuity complaint in a "stable" patient.
4	Manage a high-acuity patient with a well-defined presentation, illness, or injury.
5	Manage a high-acuity, high-complexity patient (i.e., the undifferentiated unstable patient).
6	Manage multiple patients in the emergency department (ED) concomitantly.
7	Lead an ED team.
8	Transition patient care to other healthcare providers.
9	Manage interactions with consultants.
10	Manage complex and difficult situations.
11	Use recommended patient-safety and quality improvement processes.

DISCUSSION

While milestones have moved us towards CBME in the U.S., the assessment of individual milestones has proven difficult, as evidenced by more programs than expected submitting straight-line scoring.[33,34] This may be due to assessors having difficulty translating the level of trust they have for a trainee to perform a specific work-based activity into the multiple requisite competency domains. We hope that these EM EPAs may streamline this work-based assessment process.

EPAs could be more intuitive to assess than milestones because they capture assessment decisions that are already being made by supervising physicians dozens of times each shift.[9] For example, with every patient, supervisors decide how much of the history and exam they need to confirm themselves, whether they need to double-check order entry or results, whether they need to be in the room for procedures or other patient-care related tasks, as well as other types of entrustment decisions. We are therefore not suggesting that EPAs replace milestones but rather should be used as a way of capturing assessment decisions in a format that is accessible to the learner, the supervisor and program leadership.

We also compiled baseline characteristics or competencies that are prerequisites to entrustment, instead of adding this list to each individual EPA. (Appendix 2).[29,35] We feel these prerequisites are quite important, as without demonstrating these attitudes and behaviors the trainee should not be entrusted with any of the EPAs. For example, if a trainee lacks integrity and is not truthful or accountable for their actions and words, or lacks reliability in following through on tasks, the attending physician would not likely want to entrust them with any of the EPAs.

While part of the appeal of EPAs is their intuitive nature, we associated the requisite KSABs with each EPA for two reasons. First, if the supervisor is not comfortable with the learner performing the specific work activity (EPA) independently, the associated KSAB list can assist the supervisor in giving specific actionable feedback to trainees regarding what they need to work on in order to move towards the next level of entrustment. This allows the EPA to function as both an assessment of learning and an assessment-for-learning tool, allowing the program to gather data on which milestones are being met while assisting the learner in identifying areas that need further development.[36] Second, in the U.S., we must report each trainee's milestones to the ACGME bi-annually. Having each KSAB be an individual milestone, or be linked to an individual milestone, allows this assessment to directly translate into trainee progress in the milestones.

We recommend that, when possible, each EPA be assessed multiple times in various contexts with varying patient presentations and varied assessors. Our rationale for this is multifold. First, for example, regarding a low-acuity, low-complexity patient, one trainee may be entrusted to manage a patient with an earache but not a sore throat, or may be entrusted to manage a patient with lumbar but not thoracic back pain. Residents would need to be observed managing an array of low-acuity, low-complexity patients to ensure they should be entrusted to manage this type of patient independently or with distant supervision. This phenomenon may lead us to developing multiple OPAs for EM in the future, to nest within these overarching EPAs.[10]

Second, variables such as ED patient volume or internal or external stressors on the trainee may affect his or her ability to be entrusted with a certain task at various points in time. For example, a trainee may be able to manage a high-acuity, high-complexity patient in isolation, but when adding five other patients to care for concomitantly, the trainee may no longer be able to provide the level of care required to that high-acuity, high-complexity patient. Additionally, variables related to the supervisor may also impact the decision for entrustment in any one circumstance, such as internal or external stressors on the supervisor, the supervisor's predilection for trust and risk tolerance, the relationship between the supervisor and the trainee, the amount of time the supervisor has spent observing the trainee previously, and the expertise the supervisor has in clinical and assessment arenas.[6,37]

Having some of the EPA KSABs describe performance expectations differently than the exact milestones allows these KSABs to serve as a complementary learning tool for trainees. EPA-labeled milestone assignments viewed by the clinical competency committees (CCC) may provide both CCCs and learners with more information, such as seeing that the learner is able to meet certain milestones for lower-acuity patients but not higher-acuity ones. This could allow improved coaching or goal generation for subsequent shifts.

Thus far, this group has developed and collected content validity evidence for this set of EM EPAs. Internal structure, response process, and relations to other variable validity evidence has not yet been evaluated. This requires further study. It is possible that subsequent validity testing could lead to future revision of these EPAs, addition of separate EPAs, or development of OPAs. While the breadth of each EPA may initially be concerning for a lack of specificity and utility, the specificity of the included KSAB/milestone lists within each EPA should make this useful to both the learners and the residency programs. Our group had significant debate about "lumping vs. splitting" and the level of granularity that should be encompassed by each EPA. In discussions with ten Cate and other EPA experts within our reactor panel, it was suggested that we opt for a lower level of granularity so that each EPA represents a significant "unit of EM practice" and a significant step toward increased entrustment for unsupervised practice.[4]

CONCLUSION

This set of 11 core, EM resident EPAs can be used as an assessment tool by EM residency programs, allowing supervising physicians to document the multiple entrustment

decisions they are already making during clinical shifts with trainees. The KSAB list within each EPA could assist supervisors in giving specific actionable feedback to trainees and allow trainees to use this list as an assessment-for-learning tool. Linking each KSAB to individual EM milestones allows EPAs to directly inform milestone assessment for CCCs. These EPAs serve as another option for programs to use for workplace-based assessment and are linked to the milestones to create an integrated framework.

ACKNOWLEDGEMENTS

For assistance with the early phases of this project: Patrick Brunett, MD, Barry Brenner, MD, Lori Winston, MD.

For being members of the reactor panel: Olle Ten Cate, PhD, Eric Warm, MD, Claire Touchie, MD, MHPE, Joe Gilhooly, MD, Eric Holmboe, MD, MACP, Karen Hauer, MD, PhD, Robert Englander, MD, MPH, Louis Ling, MD, Sarah Stahmer, MD, Gloria Kuhn, MD, PhD, Felix Ankel, MD, Sally Santen, MD, PhD, Philip Shayne, MD, Micelle Haydel, MD, Chris Fee, MD.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Defining the "Problem Resident" and the Implications of the Unfixable Problem: The Rationale for a "Front-door" Solution

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Section Editor: Jonathan Fisher, MD, MPH
Submission history: Submitted July 15, 2018; Revision received November 3, 2018; Accepted November 8, 2018
Electronically published December 12, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39867

Introduction: Problem residents are common in graduate medical education, yet little is known about their characteristics, deficits, and the consequences for emergency medicine (EM) residencies. The American Board of Internal Medicine (ABIM) defines a problem resident as "a trainee who demonstrates a significant enough problem that requires intervention by someone of authority, usually the program director [PD] or chief resident." Although this is a comprehensive definition, it lacks specificity. Our study seeks to add granularity and nuance to the definition of "problem resident," which can be used to guide the recruitment, selection, and training of residents.

Methods: We conducted semi-structured interviews with a convenience sample of EM PDs between 2011 and 2012. We performed qualitative analysis of the resulting transcripts with our thematic analysis based on the principles of grounded theory. We reached thematic sufficiency after 17 interviews. Interviews were coded as a team through consensus.

Results: The analysis identified diversity in the type, severity, fixability, and attribution of problems among problem residents. PDs applied a variety of thresholds to define a problem resident with many directly rejecting the ABIM definition. There was consistency in defining academic problems and some medical problems as "fixable." In contrast, personality problems were consistently defined as "non-fixable." Despite the diversity of the definition, there was consensus that residents who caused "turbulence" were problem residents.

Conclusion: The ABIM definition of the problem resident captures trainees who many PDs do not consider problem residents. We propose that an alternative definition of the problem resident would be "a resident with a negative sphere of influence beyond their personal struggle." This combination acknowledges the identified themes of turbulence and the diversity of threshold. Further, the combination of PDs' unwillingness to terminate trainees and the presence of non-fixable problems implies the need for a "front-door" solution that emphasizes personality issues at the potential expense of academic potential. This "front-door" solution depends on the commitment of all stakeholders including medical schools, the Association of American Medical Colleges, and PDs. [West J Emerg Med. 2019;20(1)43-49.]

INTRODUCTION

Graduate training programs have a responsibility to both the trainee and the public to ensure resident physicians develop the knowledge, skills, and attitudes required to practice medicine independently. Although it is expected that individual trainees will reach Accreditation Council for Graduate Medical Education (ACGME) Milestones at different stages during their training,[1] some residents

will struggle to maintain progress and will need additional resources to meet the established standards of the training program.[2] Among these struggling residents are a subset that have been labeled "problem residents." Problem residents challenge educators in graduate medical education with regard to training, remediation, resident and faculty resources, and patient safety.

The American Board of Internal Medicine (ABIM) defines the problem resident as "a trainee who demonstrates a significant enough problem that requires intervention by someone of authority, usually the program director [PD] or chief resident."[3] Although the ABIM definition is comprehensive, it lacks granularity, thus prohibiting nuanced discussion and the development of strategies for specific subsets. "Problem residents" account for 7% of all residents and the vast majority of residencies have problem residents.[3,4] While others have classified resident problems in other specialties,[2,4-7] there have been no studies to date in emergency medicine (EM) further characterizing the problem resident. The objective of this study was to develop a taxonomy of "problem residents" to inform recruitment, selection, evaluation, and remediation practices.

Population Health Research Capsule

What do we already know about this issue?
"Problem residents" account for 7% of residents in graduate medical education. However, very little is known about how these residents are defined or their characteristics.

What was the research question?
Our objective was to add granularity to the discussion of "problem residents."

What was the major finding of the study?
We found a wide range of thresholds for the definition as well as a variety of problems and causes underlying the label"problem residents."

How does this improve population health?
Our finding of "unfixable" problems supports the use of a "front-door" approach to the applicant selection process, emphasizing personality over academic performance.

METHODS

We employed a constructivist grounded theory approach to our data collection and analysis. This approach requires that the researchers bring their own backgrounds and assumptions to bear on their analysis.[8] We would like to provide this contextual information. The lead author (TT) worked in residency administration and has been responsible for resident remediation. Two authors (TT and SS) are emergency physicians who work in academic institutions with residencies. Two authors (NR, and SS) have PhDs in education and are employed in the medical school Dean's office.

One investigator (TT) performed in-depth, semi-structured interviews with a sample of emergency medicine PDs between 2011 and 2012. We employed a purposeful sampling approach to identify the richest data source.[9] We chose PDs because they have firsthand knowledge of problem residents. Additionally, PDs know the greatest amount of detail about resident actions, remediation, and resolution of problems. We initially recruited current PDs who attended the 2011 Council of Residency Directors (CORD) Academic Assembly meeting. After the initial round of interviews, we again employed purposeful sampling to include PDs with greater experience and to insure adequate sampling of both dually-accredited and three-year programs.

Interviewees were initially asked to describe a specific resident they trained who they considered to be a "problem resident." The interviewer followed up with questions aimed at obtaining as much detail as possible surrounding the PD's recall of his/her experience including the resident's actions, their response, the program and departmental response, and the PD's attributions and reflections. At the conclusion of the interviews, the PD was asked to define the term "problem resident." Interviews were recorded and transcribed verbatim by the interviewer. All identifying information was removed from the transcripts.

Each of the interviews was transcribed and uploaded into Atlas.ti™. We used a grounded theory approach (Glaser and Strauss)[10,11] to explore the PD's description and definitions of the problem resident. We began analyzing transcripts after the initial five interviews were completed. Subsequent interviews were analyzed on completion. Insights from coding informed future interviews using Glaser's constant comparative method of qualitative analysis.[12]

All coding was done as a group, either in person or over conference calls. One author would read the transcript aloud to the group followed by discussion and coding. We discussed the stories each PD presented as a whole, and then subsequently discussed each semantic unit to reach consensus. As we coded, we tracked emerging themes. We reviewed and consolidated the ensuing code list to develop overarching themes to describe the data. Disagreements were resolved through consensus. Interviews and coding were continued until we reached thematic sufficiency (i.e.,

until no new insights or codes emerged from the data). This resulted in 17 interviews. This study was approved by the Stony Brook University Medical Center Institutional Review Board.

RESULTS

The 17 interviews ranged from 11-42 minutes, with an average of 22 minutes per interview. This sample includes PDs from the beginning of their directorship to PDs with more than 20 years of experience with a mean of 8.9 years of experience. Programs included eleven four-year programs, six three-year programs, and two dually-accredited programs.

Themes

Performance

All PDs described problem residents based on a resident's problematic behaviors in both the clinical and non-clinical areas. Some descriptions were closely aligned with a deficit in a single ACGME competency, while others crossed multiple competencies. We found a continuum of the severity of the problematic behaviors with some PDs describing minor clinical struggles that resulted in no patient harm, while others provided examples of egregious dereliction of duty:

> *"…over the next month basically ignored 90 charts that were anywhere from 30 to 90 days old […] just ignored them completely. Didn't respond to emails from me to do them, didn't respond to emails from the chair to do them, and just didn't return phone calls, voicemails or text messages…"*

Within the theme of performance, the examples centered in the clinical areas, clustered around clinical performance, professionalism, and inter-personal communication. Clinical performance issues touched on multiple EM milestones including medical knowledge, cognitive reasoning, difficulty with the EM acuity, and difficulty with the EM environment. Non-clinical performance problems centered around difficulty with practice-based learning and improvement (PBLI) and non-clinical professionalism.

Characterizing Problems

PDs characterized problems along two descriptive axes according to their amenability to remediation (fixable/ unfixable) and according to their perception of the source of the problem (inherent/acquired).

Fixable Problems

Fixable problems were those that could be addressed to the PD and faculty's satisfaction. These residents graduated with limited or no concerns. Within the fixable problems, PDs most commonly described academic performance problems, especially with test taking. These were typically addressed with reading programs and easily verifiable with performance on in-training examinations and the EM board exam. PDs also described successful interventions on issues ranging from communication, mental health, medical issues, and drug addiction. A PD discussed getting an addicted resident into treatment:

> *"My very first meeting with him, I had my department administrator sitting with me. I expressed what my concerns were and he expressed in the very next sentence that he was addicted to narcotics and what he was doing is find medication in the sharps box that had not been fully used and had been wasted […] he went off for 3 months and got inpatient therapy and returned to the residency and continued to crush his rotations and the in-training examination and with the help of the physician monitoring apparatus here in [name of state] went on to become licensed and he got a job in his home state in [name of state] and he continues to do well."*

Unfixable Problems

PDs were doubtful or unsure if "unfixable" problems were satisfactorily remediated. If residents with "unfixable" problems were allowed to graduate, PD/ faculty had ongoing concerns. In contrast to the "fixable" problems, "unfixable" problems tended to be associated with personality traits, lack of professionalism, and lack of insight. PDs also described a variety of other issues ranging from poor fit for EM, lack of sufficient intelligence, and lack of motivation to improve. For example, one PD described a resident with a non-fixable problem:

> *"We just realized that he was unable […] at the end of every shift people would be pissed off at him. The patients were pissed off at him, the nurses were pissed off at him, he had no sense of what he was doing, he agreed into therapy, he had therapy and despite the therapy we saw no movement whatsoever."*

Although there were residents with communication difficulties in both the fixable and unfixable categories, the unfixable problems were attributed to stable traits that were not amenable to intervention.

Inherent Problems

The majority of the PD examples were of inherent problems. Inherent problems included areas such as personality problems, communication patterns, lack of intelligence, lack of innate ability, medical/ psychiatric issues, and being a poor fit for EM.

Acquired Problems

Acquired problems comprised a minority of the data. These were problems that arose during the course of residency or were stimulated by some external force. The

causes of these problems could not be predicted *a piori*. Examples of acquired deficits included issues stemming from neurological injuries, as well as problems at home. Sometimes the distinction between acquired and inherent problems was unclear, often stemming from situations brought on and/or exacerbated by the environment of the emergency department. One PD described addressing a resident's attention deficit hyperactivity disorder (ADHD):

> *... finally we sent him for cognitive testing [which] ultimately demonstrated by this testing which was that he had fairly significant ADHD. What's interesting about this guy was that he was so intelligent and he worked so hard for all of those years during college and medical school that he was able to overcome his capacity to not attend well by working hard at being smart until we basically outstripped his capacity when he was a third year resident [...] we flipped the switch with this guy as soon as we got him started on medication he was functional beyond belief [...] he was finally able to reach his full potential.*

Threshold

PDs described a wide variability in their threshold for defining a problem resident. Several PDs' threshold matched the ABIM definition of a resident requiring action, remediation, or intervention.

> *"...the problem resident [...] is the person who requires much more management than the average resident whether that be in the clinical environment because of their cognitive skills or because their interpersonal skills or their systems and professionalism stuff such as turning in things on time, showing up for conference without whatever else..."*

Similarly, another PD defined it:

> *"I would define it as loosely as the residents that sit in my office and I just think... you are killing me... they are memorable for the wrong reasons."*

However, there were many PDs who directly rejected the ABIM definition. One PD noted, "There is no such thing as a problem resident, only problem programs." Other PDs demonstrated a higher threshold to define a problem resident. These PDs saw intervening to assist trainees as an expected part of residency training:

> *"...the resident who doesn't do well on the in-service exam or is bad with compliance. No, I don't think they are problems at all, I think that they are residents who are on the evolutionary scale that are going to evolve at some point in time but I do not consider them to be problems."*

The threshold for when a non-problem resident turns into a problem resident was PD and program specific. It depended upon how much intervention the PD was willing or able to engage in, the support of the department, the departmental and PD experience with previous success and failure with problem residents, and the PD's educational philosophy.

Turbulence

Despite the range of views, the theme of turbulence provided one of the more definitive thresholds. Residents who created turbulence were universally considered problem residents. Turbulence went beyond the minor, commonplace disruption that many residents cause by failing to perform some of the paperwork tasks associated with documenting education (i.e., logging procedures). Instead, these residents caused disruptions that extended beyond the resident and the residency office to impact the department as a whole.

> *"I would describe her as a problem resident because initially of the amount of disruption that she caused within the program. A few other people characterized her as being like a toxic person and so the effect that she had on other people was toxic. The effect on the program morale was just horrendous."*

Another PD described them this way:

> *"When I think about the problem residents, the problem resident [...] negatively influences, or negatively impacts, you know, causes, for a lack of a better word, turbulence around them."*

The majority of the examples of turbulent residents centered around issues of personality and inter-personal communication.

> *"Then it seems to continue to get worse and she moved into her final year where she did have a supervisory role and more interns were reporting, were crying just after bad interactions with her and I decided that this is enough of the personality problem here."*

Resolution

The final theme addressed the resolution of managing the problem resident. PDs were notably hesitant to terminate residents despite knowing that the problem may not be fixable. This was true even with residents who caused significant turbulence. There were a few examples of PDs who terminated residents due to gross misconduct, such as failure of a drug policy, unprofessional behavior, or lack of clinical competency. For the most part, even problem residents graduated and entered independent practice. In these cases, PDs accepted a "good enough" solution.

"...we extended his residency the proper amount of time to get him his training [...] then we got him out of the program and we graduated him, and I wrote in his final letter and spoke to his future employers that I felt that a low acuity environment without critical patients, without a trauma center was the place for him..."

Another PD described their "good enough" solution:

"And we were thinking that we would gear it to some level of competence where she could finish the program but not be eligible to sit for the boards and maybe work as an urgent care physician or something like that..."

Many PDs acknowledged the hesitancy and the difficulty with terminating a resident. One PD described their solution as a "front-door solution" which emphasizes not selecting applicants with unfixable problems:

"I haven't had a resident with real interpersonal problems yet, which is nice. It may [be] attribute[d] to the fact that we do decent screening on our interview days or we do homework on people making calls, but I haven't had any people with interpersonal problems."

Another PD said:

"I haven't had to train any sociopaths; that's a selection process that's incumbent on the program director not the applicant."

DISCUSSION

In our data, PDs described a range of problematic behaviors. These behaviors ranged in their severity, their "fixability," and whether they were inherent or acquired. These issues were not limited to issues in the clinical areas, but also included non-clinical duties. There was variability in whether residents with "fixable" problems should be considered problem residents. There was universal agreement that residents who caused disruption or turbulence within a program were problem residents. This turbulence extended to both the clinical and non-clinical settings.

The ABIM definition of "a trainee who demonstrates a significant enough problem that requires intervention by someone of authority, usually the program director or chief resident" does not capture the nuance reflected in this data. This definition centers around the need for intervention and does not encompass the severity of the issue, its effect on those around the resident, and the response to intervention. In our data, there were residents that many PDs considered to be residents with problems, not problem residents, who would be labeled as problem residents using the ABIM definition.

An ideal definition should acknowledge the diversity of thresholds used by PDs as well as incorporate the importance of disruption. Conceptualizations of "problem residents" in EM should consider those residents with a negative sphere of influence beyond their personal struggle. That negative influence can be limited to the program leadership, who are struggling to remediate the resident, or extend to impact the entire department. This framework allows for variation between PDs' educational philosophies and environments, as well as incorporation of the concept of turbulence.

In our study, PDs consistently expressed an unwillingness to terminate residents even when there was persistent concern about their ability to practice independently. This reluctance to terminate learners is consistent with other studies in both undergraduate and graduate medical education,[13,14] where progress, promotion, or graduation are rarely made on attributes other than grades.[15] This "failure to fail"[14,16] results in potentially unqualified physicians being allowed to practice and shifts the risks to the future patients and the responsibility to the state medical boards.

In the face of the combination of unfixable problems and an unwillingness to terminate learners, several PDs in our study advocated for a "front-door solution." This approach focuses on the prevention of the selection of applicants with unfixable problems, thereby preventing them from entering the front door. Although this approach may seem like common sense, it is not the current practice.[17] The majority of PDs focus on academic performance and do not emphasize professionalism during the application screening, even when the information is available.[18-21] PDs instead rely heavily on the residency interview to identify personality issues,[22] despite its lack of sensitivity for detecting problem applicants.[23]

Even for those who would like to implement this approach, there are major barriers to identifying these issues at the "front door." The residency application can highlight exceptional performance in humanism, professionalism, and interpersonal communication, but issues or concerns are rarely expressed.[24,25] When medical schools report concerns in the Medical Student Performance Evaluations (MSPE) they employ "linguistic gamesmanship" in an effort to "obfuscate rather than to inform the reader."[19] PDs are also overwhelmed with data about academic performance in the Electronic Residency Application Service (ERAS®) with little data about "professionalism, integrity, teamwork, and reliability."[18] PDs also have concerns about the difficulty and time needed for application review as well as the potential decrease in the academic potential of the residency.[26]

In our data, the unfixable problems were often related to issues surrounding professionalism and the lack of interpersonal skills. Unfortunately, it continues to be a challenge

to identify applicants who will go on to have issues in these domains. Currently many groups are working to improve the quantity and quality of the data about medical student professionalism and inter-personal skills. Most notably, the Association of American Medical Colleges (AAMC) developed the Standardized Video Interview (SVI) as a tool to identify both high- and low-performing applicant proficiency in the core competencies of professionalism and inter-personal communication.[27] Additionally, the AAMC MSPE Task Force called for the MSPE to do the following:

> *"Standardize, to the extent possible, information in the MSPE across schools, and present it clearly, concisely, and in a way that allows it to be easily located Include details on professionalism—both deficient and exemplary performance."*

Similarly, the Council of Residency Directors Standard Letter of Evaluation (SLOE) Task Force has modified the SLOE to provide greater information about issues such as work ethic, teamwork, and communication. Although there is a clear momentum toward improving the quantity and quality of this data, it is unclear if PDs value and trust, or are willing to act on this information. It is unclear if these changes will also lead to the improved identification of applicants who will go on to be problem residents.

LIMITATIONS

Our study cohort consisted of a convenience sample of PDs. As a result, there was an over-representation of four-year, urban academic EM programs. Due to the nature of the semi-structured interviews, the interviews focused on details surrounding one or two memorable examples, leading to a recall bias that may have skewed the data toward the most extreme or most recent. However, we believe that this allowed us to gather detailed accounts, which provided sufficient specificity to adequately describe "problem residents."

CONCLUSION

These findings are a step toward classifying problem residents in EM. While they had different thresholds for what constituted a "problem," PDs defined a problem resident differently than existing definitions. They characterized issues of clinical performance as either fixable or unfixable, and inherent or acquired. PDs particularly struggled to resolve behaviors that caused turbulence within a residency or department. We hope that our study adds nuance to the overall discussion across specialties. Additionally, we hope that the description of the fixable and unfixable problems will give all of the stakeholders the confidence to collectively create "front-door solutions" to the benefit of the resident, the medical community, and society.[14]

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Development of a Clinical Teaching Evaluation and Feedback Tool for Faculty

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Section Editor: Edward Ullman, MD
Submission history: Submitted August 8, 2018; Revision received November 20, 2018; Accepted November 20, 2018
Electronically published December 12, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39987

Introduction: Formative evaluations of clinical teaching for emergency medicine (EM) faculty are limited. The goal of this study was to develop a behaviorally-based tool for evaluating and providing feedback to EM faculty based on their clinical teaching skills during a shift.

Methods: We used a three-phase structured development process. Phase 1 used the nominal group technique with a group of faculty first and then with residents to generate potential evaluation items. Phase 2 included separate focus groups and used a modified Delphi technique with faculty and residents, as well as a group of experts to evaluate the items generated in Phase 1. Following this, residents classified the items into novice, intermediate, and advanced educator skills. Once items were determined for inclusion and subsequently ranked they were built into the tool by the investigators (Phase 3).

Results: The final instrument, the "Faculty Shift Card," is a behaviorally-anchored evaluation and feedback tool used to facilitate feedback to EM faculty about their teaching skills during a shift. The tool has four domains: teaching clinical decision-making; teaching interpersonal skills; teaching procedural skills; and general teaching strategies. Each domain contains novice, intermediate, and advanced sections with 2-5 concrete examples for each level of performance.

Conclusion: This structured process resulted in a well-grounded and systematically developed evaluation tool for EM faculty that can provide real-time actionable feedback to faculty and support improved clinical teaching. [West J Emerg Med. 2019;20(1)50–57.]

INTRODUCTION

Formative evaluations of clinical teaching for emergency medicine (EM) faculty are limited and inadequate.[1,2] Current EM faculty evaluations of teaching are usually based on an entire year and evaluate faculty across a range of teaching, patient care, and research activities using an ordinal scale (e.g., 1 = below expectations, 9 = exceeds expectations).[3] These summative, end-of-year evaluations of faculty are usually high stakes with linkage to promotion, tenure, awards, and personnel decisions. Summative assessments may be beneficial in determining whether a faculty member is meeting performance standards and can lead to improvements in teaching performance.[4] However, with summative assessments, faculty are not given the opportunity to integrate feedback into their teaching practice until after receiving results, which doesn't usually occur until the end of the academic year. Furthermore, summative evaluations tend to focus on broad characteristics of effective teachers vs. specific teaching strategies used to help

residents master certain competencies (e.g., communication, procedural skills). Lastly, the results of summative evaluations are often limited in terms of comments with specific feedback.

In contrast to summative evaluations, formative evaluations are typically low stakes and primarily used to provide ongoing feedback for the purpose of performance improvement.[5] End-of-shift evaluations or daily encounter cards are a commonly used method for providing competency-based feedback to EM residents and medical students about their performance after a shift.[6] Despite the widespread use of competency-based shift card evaluations for residents and medical students, similar methods have not been applied to faculty. Although one study[2] describes the feasibility and acceptance of an end-of-shift evaluation for EM faculty, the measure used was not based on well-established teaching competencies nor was it created using scientific standards for instrument development.

EM faculty teaching evaluations and feedback can be improved with the use of proper tools, such as behaviorally-anchored rating scales (BARS). BARS use specific, observable behaviors (i.e., behavioral anchors) that align with competencies at various levels of proficiency. BARS have several benefits compared to traditional rating scales. For one, the use of behavioral anchors helps raters focus on behaviors pertinent to the evaluation and discern what behaviors constitute, for example, "average" vs. "above average" performance.[7] Furthermore, when raters use a common reference point, inter-rater reliability is improved and evaluation bias is reduced.[8]

Not only can BARS help the resident evaluator but they can also lead to more useful feedback for the faculty member being evaluated.[9] BARS ensure that faculty are provided with specific and actionable feedback linked to teaching competencies. This would alleviate the frequent problem of residents providing feedback that is vague and nonactionable such as "great teacher" or "not flexible."[2] BARS can provide rich feedback to the evaluatee including information about why he or she received a certain rating (e.g., below expectations) and what specific behaviors would lead to improvements in teaching (e.g., exceeds expectations).[10] We are not aware of any existing measures that use BARS to evaluate and provide EM faculty with feedback about their effectiveness in teaching residents certain skills (e.g., clinical decision-making, patient-centered communication) during a shift. Although the objective structured teaching exercise (OSTE) has been used to evaluate real-time teaching skills of faculty in various specialties, the OSTE was developed for use with standardized teaching encounters and is resource and time intensive.[11]

Thus, there is a need to develop a practical, competency- and behaviorally-based tool for evaluating and providing feedback to EM faculty based on their teaching skills during a shift. We expect that development of a robust evaluation and feedback took will facilitate the provision of specific and actionable feedback and ultimately lead to improvements in clinical teaching. With this in mind, the goal of the present study was to apply the National Institutes of Health (NIH) standards of test development (ie, Patient-Reported Outcome Measurement Information System [PROMIS]) [12] to develop an innovative, semi-quantitative, behaviorally anchored Clinical Teaching Evaluation and Feedback Tool, which will be referred to as a "Faculty Shift Card."

Population Health Research Capsule

What do we already know about this issue?
While competency-based formative evaluations exist for residents, behaviorally-anchored tools for the assessment of attending bedside teaching are lacking.

What was the research question?
Can we develop a valid semi-quantitative, behaviorally-anchored clinical teaching evaluation and feedback tool?

What was the major finding of the study?
A brief, four-item, well-grounded tool was developed to assess major domains relevant to bedside teaching.

How does this improve population health?
Standardized assessment using formative evaluations may allow for more actionable feedback in domains related to clinical teaching and benefit medical learners.

METHODS

Study Design

We used processes outlined in the NIH PROMIS standards to develop the Faculty Shift Card. These guidelines are considered the "gold standard" for instrument development. The Faculty Shift Card was developed in three phases: 1) Develop an item bank using focus groups and the nominal group technique (NGT); 2) edit and finalize items using modified Delphi procedure; and 3) finalize the instrument (Table 1).

Study Setting and Population

We invited a local group of EM educators and EM residents to participate in Phase 1 of this project through two focus groups. A purposive sample included six EM residents and six EM faculty. Resident participants were chosen based on chief status, postgraduate year (PGY) level, and interest in participating. Faculty participants were chosen based on current

Table 1. Phases of faculty shift card development.

Phases of development	Actions
Phase 1 – develop an initial item bank	Conducted faculty and resident focus groups using the nominal group technique
	Developed preliminary item list by aggregating faculty and resident items and removing redundant items
Phase 2 – finalize items using modified Delphi method	Conducted four Delphi rounds:
	Delphi Round 1: Content validity index of initial resident and faculty participants used to determine item inclusion
	Delphi Round 2: Emergency medicine education experts surveyed for item inclusion
	Delphi Round 3: Residents surveyed to classify items into novice/intermediate/advanced
	Delphi Round 4: Classification repeated for non-consensus items from round 3
Phase 3 – finalize the instrument	Conducted literature review to ensure no key constructs were missing
	Refined final instrument

work in resident education and/or previous teaching awards or nominations. Residents and faculty who participated in the focus groups were compensated for their time. In Phase 2, a national group of seven education experts and a local group of five residents (distinct from Phase 1) were invited to participate via email. We identified experts through networking during the Council of Emergency Medicine Residency Directors (CORD) annual conference and through recommendations from colleagues in CORD. These individuals were not compensated for participating.

Phase 1: Develop an Initial Item Bank

We conducted two semi-structured focus groups (one with faculty and one with residents) using a modified version of the NGT to develop a comprehensive list of effective teaching behaviors. Following the NGT, each group was presented with specific questions aimed to identify effective and ineffective strategies for clinical teaching in the emergency department (ED). Participants independently generated responses to open-ended questions (Table 2) aimed to identify strategies for teaching skills in the following areas: 1) clinical decision-making; 2) procedures; 3) interpersonal and professional; and 4) multitasking. Each group member privately wrote down his or her response to each question. Then, one-by-one in a round-robin fashion members shared their responses with the group. The group then discussed each idea. After an exhaustive list of potential items was developed, the group anonymously voted "Yes" or "No" on whether or not each item would be able to discriminate among outstanding, average, and poor clinical teachers. If at least two members voted that the item had discriminative value, then the item was maintained for Phase 2.

The focus group co-facilitators (Erin Dehon and Ellen Robertson) developed a list of the items identified during the focus groups. We combined similar items listed by the faculty and resident groups. The results were collated and used to develop a survey for Phase 2.

Phase 2: Edit and Finalize Items Using Modified Delphi Procedure

Delphi Round 1

An anonymous survey of the items developed in Phase 1 asked resident and faculty group participants to review and rate each item on a scale from 1-4 (1 = not important, 2 = somewhat important, 3 = moderately important, 4 = extremely important).

Table 2. Focus group interview questions.

1. What are effective teaching strategies that faculty use during shifts that help you master clinical decision-making (e.g., selecting the most appropriate diagnostic test, developing a differential diagnosis, choosing the most appropriate treatment, practicing evidence-based medicine)?
2. What are effective teaching strategies that faculty use during shifts that help you master procedural knowledge/skills (e.g., ultrasound, airway management, performing a history and physical examination)?
3. What are effective teaching strategies that faculty use during shifts that help you master interpersonal skills (communicating effectively with nurses, patients, families, breaking bad news, etc.)?
4. Task-switching is a core skill in emergency medicine — What are the best strategies for teaching task-switching and how to manage multiple patients?
5. What are ineffective teaching strategies that faculty use during shifts?

*The faculty group was asked a slightly modified version of the same questions.

We used the responses to calculate a content validity index (CVI) to determine which items to retain.[13] The CVI for each item is the proportion of individuals who rated the item as 3 or 4 (extremely or moderately important) vs. 1 or 2 (somewhat or not important). For example, if five out of 15 reviewers rated an item as a 3 or 4, then the CVI would be 5/15 = 0.33. As recommended in the literature, items with a CVI less than 0.83 were dropped.[13]

Delphi Round 2

In Phase 2 we solicited feedback via email from a select group of six expert educators in EM residency training about the items generated in Phase 1. Specifically, we invited experts to participate in an anonymous survey to review each potential item and rate each item's level of importance in terms of helping residents develop competency in the following: 1) clinical decision-making, 2) procedural skills, 3) multitasking, and 4) interpersonal communication. Items were rated on a three-point scale (1 = extremely important, 2 = somewhat important, 3 = not important). Experts were also asked to list any additional items that they felt were important but missing. If the majority of experts (four or more) rated an item as extremely important, it was maintained for round 3. Items rated by only one or two experts as extremely important were dropped. Items rated by three experts as extremely important and three experts as somewhat or not important were evaluated by the study authors for potential deletion.

Delphi Rounds 3 and 4

The goal of these rounds was for a group of residents (separate from those in Phase 1) to reach consensus about the category of expertise for each of the teaching behaviors previously identified. First, they were sent a survey and asked to classify the identified teaching strategies into one of three options for level of expertise: novice — everyone does this; intermediate — majority of good teachers do this; and advanced — only the top 25% of teachers do this. The survey responses were then returned to all participants and they were asked once again to categorize the teaching behaviors, taking into account everyone else's responses. This round was repeated once for the items that did not reach consensus. Consensus was defined as at least four of the five residents agreeing on the classification level.

Phase 3: Finalizing the Instrument

In the final phase we conducted a literature review to ensure no key constructs were missing. Then, we created a prototype of the Faculty Shift Card and invited residents from the previous phase to provide feedback on it.

RESULTS

Phase 1: Develop an Initial Item Bank

The faculty focus group included six faculty members including the program director, two associate program directors, and two other faculty who were recipients of the yearly teaching award. The resident focus group included six residents comprised of three chief residents and one resident from each of the other classes (PGY1-PGY3). During the NGT session, resident participants identified a total of 52 teaching behaviors that are able to discriminate among outstanding, average, and poor clinical teachers. Faculty participating in the NGT session identified a total of 52 teaching behaviors deemed as having discriminative value.

Two study authors aggregated the content of the 52 resident and 52 faculty responses. There were 22 unique resident responses and 23 unique faculty responses. We pared down the remaining 59 items to 16 items based on redundancy between groups or overlap with other items. The resulting 61 items were organized based on one of the four domains: teaching clinical decision-making (n=19); teaching interpersonal skills (n = 12); teaching procedural skills (n = 10); and teaching task-switching (n = 9). General items that did not apply to any of these specific teaching domains were grouped together and labeled as general teaching strategies (n =11) (e.g., showing an interest in teaching, being available). The full list of items and the Delphi process are in the Supplemental Table.

Phase 2: Modified Delphi

Delphi-Round 1: Resident and Faculty Review

All 12 faculty and residents who participated in the focus groups from Phase 1 completed the survey for the first round. This round began with 61 preliminary items. Participants rated the majority of these items as extremely or moderately important. In this round, 10 items had CVIs less than 0.83 and were deleted, leaving 51 items.

Delphi-Round 2: Expert Review

Of the seven experts invited to participate, six agreed and completed the survey in full. All experts were emergency physicians working in an academic medical center with experience teaching EM residents. All experts were members of CORD and included a program director, simulation director, ultrasound director, and faculty members with publications in medical education. Delphi round 2 began with 51 preliminary items. The six expert participants did not rate any of the items as "not important." In this round, nine items were dropped due to low ratings of importance by experts (≤3). The experts also added two items to the domain teaching clinical decision-making, which resulted in a list of 44 items.

Delphi-Rounds 3 and 4: Item Classification

The five residents who participated in these rounds included three chief residents, a PGY-2 resident, and a PGY-4 resident. Delphi round 3 began with 44 items that residents were asked to classify into categories. After round 1, residents reached consensus on 24 of the 44 items. After round 2, 39 of 44 items reached consensus. The five items that did not reach consensus were dropped (Table 3).

Table 3. Stages of the nominal group technique and modified Delphi process used to develop the faculty shift card.

	Item pool development (number of items remaining at conclusion of each round)			Classification of items by level of teaching expertise (number of items consensus reached at the conclusion of each round)		
Teaching domains for instrument	Initial item set	Delphi round 1	Delphi round 2	Delphi round 3	Delphi round 4	Consensus not reached (items dropped)
Clinical decision making	19	12	*12	9	11	1
Task-switching	9	6	3	0	3	0
Communication	12	12	10	6	8	2
Procedural	10	10	8	2	7	1
General teaching	11	11	11	7	10	1
Total items	61	51	44	24	39	5

*2 removed, 2 added.

Phase 3: Finalize the Instrument

After 39 important teaching behaviors were established and categorized by the consensus groups, we conducted a thorough literature review focused on identifying the behaviors and characteristics of effective clinical teaching in the ED, the features of effective written feedback for faculty, and existing validated clinical teaching instruments (including those designated for other specialties). This review helped ensure that no items were missing and informed fine-tuning of the final instrument (Figures 1 and 2). The items on the instrument were found to be in line with the existing literature on teaching competencies in graduate medical education,[14] as well as with EM faculty strategies for good teaching.[15] Fine-tuning involved combining items on the Faculty Shift Card, as well as rephrasing several positive items to reflect less-desirable behaviors to place in the novice category (e.g., "providing autonomy" to "micromanages"). Items were also edited to ensure use of concrete behavior anchors to facilitate more consistent and actionable feedback across residents of varied program years and educational needs.

We were able to incorporate all of the teaching behaviors identified as important in the previous stages into a brief four-item tool. Each of the four items focused on a specific domain: 1) clinical decision-making skills; 2) procedural skills, 3) communication skills, and 4) general teaching strategies. As can be seen in Figures 1 and 2, the task-switching domain was dropped from the final Faculty Shift Card. The investigators decided to drop this domain since faculty, residents, and a literature search did not lead to identifying clearly defined strategies for teaching task-switching.

In response to suggestions from residents, an optional comment box was added and we divided the items into two, two-item shift cards to shorten them. Shift Card 1 includes clinical decision-making and procedural knowledge, and Shift Card 2 includes interpersonal skills and general teaching.

DISCUSSION

We developed two, two-item faculty shift cards using the NIH PROMIS standards of test development. This article describes a systematic and iterative process of developing an innovative Faculty Shift Card. Ultimately, the aim of this tool is to improve clinical teaching in EM by providing EM attendings with more frequent specific and actionable feedback about their clinical teaching practices during a shift.

To ensure content validity, the Faculty Shift Card was developed systematically through a thorough literature review and input from residents, faculty, experts using qualitative and survey methodology. We used the NGT and modified Delphi method to obtain opinions from residents, faculty, and expert educators about important strategies that faculty use to teach certain fundamental skills: clinical decision-making; procedural; interpersonal; and task-switching. Overall, resident and faculty perceptions of effective clinical teaching strategies were remarkably similar. It is worth noting that regardless of the specific skill being taught, all respondents emphasized the importance of the core characteristics of effective teachers, which included being available, supportive and approachable, and demonstrating an interest in teaching. This led to the development of an item focused on general teaching strategies.

Given that both faculty and residents had a difficult time identifying clear strategies for teaching task-switching, we excluded this item from the final tool. Although task-switching is a core competency that residents are expected to develop throughout their training, effective practices for teaching task-switching are lacking.[16] Role modeling was noted as the main method of teaching task-switching, but it was not explicitly clear how role modeling was being used to teach how to manage multiple patients and tasks. Before we can properly evaluate faculty's ability to teach task-switching, we need better-defined strategies to effectively teach this skill.

During this shift, how well did the selected attending facilitate the development of your clinical decision making skills?				
Novice	□	Intermediate	□	Expert
Ensures that the resident structures the patient presentation appropriately Rarely includes the resident in clinical decision-making Allows resident complete autonomy and rarely participates in clinical decision-making		Models clinical decision-making skills and explains decision-making process Elicits the resident's diagnosis and plan and avoids giving the answer Engages in collaborative decision-aking with the resident Has the resident provide rationale for decision (not allowing a shotgun approach) Facilitates responses from the resident through leading questions or provision of choices		Uses illness scripts and data from the literature Changes a scenario to maximize teaching opportunities or discuss unusual diagnoses Points out multiple ways to work up or treat a patient Encourages evidence-based medicine dialogue on cognitive errors Directs resident to helpful resources, especially algorithms, decision rules, treatment protocols
What should this faculty member do to improve their procedural teaching skills? Select all that apply. □ Coach in real time □ Provide feedback in timely fashion after procedure □ Reiterate key steps, preparation, patient positioning □ Allow resident to respond in difficult situations □ Nothing □ N/A-no procedures done this shift Comments:				
During this shift, how well did the selected attending facilitate the development of your procedural skills?				
Novice	□	Intermediate	□	Expert
Performs procedure without resident participation Rarely or never observes resident while they perform procedures		Determines/assesses level of trainee knowledge before procedure Coaches in real time with a calm demeanor Debriefs after procedure and provides feedback Reiterates key steps		Ensures that preparation and patient positioning is done correctly Points out real-time tricks Allows resident to respond to difficult situations; provides guidance but does not take over (assuming it's safe for the patient)
What should this faculty member do to improve their procedural teaching skills? Select all that apply. □ Coach in real time □ Provide feedback in timely fashion after procedure □ Reiterate key steps, preparation, patient positioning □ Allow resident to respond in difficult situations □ Nothing □ N/A-no procedures done this shift Comments:				

Figure 1. Faculty shift card 1.

The Faculty Shift Card has several advantages. It is a short yet comprehensive tool for evaluating and providing formative feedback to EM faculty aiming to improve their clinical teaching skills. This four-item tool incorporated all 38 teaching behaviors identified as essential to effective clinical teaching in the ED. It was divided into two, two-item shift cards after receiving feedback from residents that the four-item tool may be too time-consuming. The tool could also be easily adapted to four one-item shift cards. The brevity of this tool lends itself to routine use in the ED setting. Furthermore, each item on the shift card provides a list of specific and actionable feedback that residents can select to give faculty,

During this shift, how well did the selected attending facilitate the development of your interpersonal skills?				
Novice	□	Intermediate	□	Expert
Does not address the importance of communication skills Models poor communication with patients, residents, consultants, and/or staff		Models effective and professional communication with nurses and rest of team Ensures the resident is prepared before talking to consultants or breaking bad news Provides specific feedback about communication skills		Coaches the resident through difficult conversations Debriefs following difficult social interactions Provides opportunities for residents to observe attending handling a difficult situation
What should this faculty member do to improve their interpersonal teaching skills? Select all that apply. □ Provide more coaching on difficult conversations □ Model effective and professional communication □ Provide more specific feedback about communication □ Ensure that resident is prepared prior to difficult conversations □ Nothing Comments:				
Rate the attending's general teaching skills during this shift.				
Novice	□	Intermediate	□	Expert
Micromanages Is overcritical of resident Is unavailable or appears disinterested in teaching Does not provide feedback		Shows up to shift excited to work and teach Creates a safe learning environment Varies teaching methods and information based on resident level of training and knowledge Provides timely feedback, but mainly praise		Provides in-person specific, timely, and actionable feedback Demonstrates interest in teaching (e.g., often uses downtime to teach and is more involved) Sets learning goals for each shift Stands up for residents when disagreements with patients or other staff/consultants arise
What should this attending to improve his or her general teaching skills? Select all that apply. □ Provide me with more autonomy □ Provide more specific, timely, and actionable feedback □ Use downtime to teach and be more involved in education □ Vary teaching method to resident level □ Nothing Comments:				

Figure 2. Faculty shift card 2.

thereby resolving the problem of residents' tendency to provide faculty with vague feedback.[2]

LIMITATIONS

There are several limitations to consider. First, the shift card was developed at a single institution. Thus, the proposed set of criteria may be influenced based on local priorities and culture. However, we mitigated these limitations by the engagement of national experts and a thorough literature review. Evaluation of the local face and construct validities of the instrument should be considered prior to its use in other settings. Additionally, members of the focus groups were chosen based on factors such as chief status, engagement in resident education, faculty teaching award recipients, and overall interest. Although we were able to include residents of all PGY levels in Phase 1 of the development process, Delphi rounds 3 and 4 did not include representation from the intern class due to a lack of volunteers from that class. Without reliable assessment tools already developed, these persons may or may not represent the most effective teachers or the most insightful in identifying effective teaching behaviors. Further testing of the instrument, specifically to assess whether the instrument is effective in discriminating between effective and ineffective clinical teachers and whether actionable feedback leads to changes in faculty teaching behaviors, is indicated.

Nevertheless, the approach to the development and application of a valid instrument for this purpose does have some novelty.

CONCLUSION

Using a modified Delphi approach with local departmental leaders in education with input from national experts, we developed a semi-quantitative, behaviorally-anchored clinical teaching evaluation and feedback tool, the Faculty Shift Card, which can provide real-time actionable feedback to faculty and support improved clinical teaching. Testing the efficacy of the tool to affect faculty teaching behaviors is indicated.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. This work was supported by an Education Research grant (EF2016-002) from the Society for Academic Emergency Medicine Foundation.

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Factors Affecting Entrustment and Autonomy in Emergency Medicine: "How much rope do I give them?"

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Section Editor: David P. Way, MEd
Submission history: Submitted July 15, 2018; Revision received October 22, 2018; Accepted October 24, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39843

Introduction: During residency, the faculty's role is to provide supervision while granting the trainee autonomy. This concept is termed entrustment. The goal is appropriate progression from supervision to autonomy while decreasing oversight as residents train. The objective of this study was to better understand the factors affecting the degree of autonomy or supervision faculty choose to provide residents.

Methods: This was a qualitative study of resident and faculty perceptions. We conducted two faculty and two resident focus groups. We then transcribed the transcripts of the audiotaped discussions and coded them using grounded theory.

Results: Analysis of the transcripts yielded four major factors affecting entrustment of residents.
Patient Factors included the acuity of the patient, sociomedical issues of patient/family, and complexity of risk with patient or procedure. For example, "sometimes there are families and patients who are exceedingly difficult that immediately sort of force me [to allow less autonomy]."
Environmental Factors included patient volume and systems protocols (i.e., trauma). "If you're very busy and you have a resident that you already trust, you will give them more rope because you're trying to juggle more balls."
Resident Factors included the year of training, resident performance, clinical direct observation, and patient presentations. "But if you have a resident that you do not trust […] I tell them you're going to do this, this, this, this, this."
Faculty Factors included confidence in his/her own practice, risk-averse attitude, degree of ownership of the patient, commitment to education, and personality (e.g., micro-manager). Significant variability in entrustment by faculty existed, from being "micromanagers" to not seeing the patients. One resident noted: "There are some attendings, no matter how much they like you and how much you've worked with them, they're always going to be in your face in the trauma bay. And there's some attendings that are going to be ghosts."

Conclusion: Multiple factors affect the amount of autonomy and entrustment given to residents and their level of supervision by faculty, leading to wide variability in entrustment. In the end, regardless of resident, patient, or environment, some faculty are more likely to entrust than others. [West J Emerg Med. 2019;20(1)58-63.]

INTRODUCTION

The day residents graduate, they begin independent practice. However, in residency there is wide variability in the amount of autonomy they are given. For faculty, deciding when a resident is ready for unsupervised patient care is not easy. Inappropriate, unsupervised patient care can risk patient safety and increase liability.[1,2] In contrast, a lack of autonomy will impede the resident's learning and progress toward independent practice.[3] Faculty need to both entrust residents to practice autonomously, while ensuring safe care. This crucial decision should be founded on the assessment of the resident's competence in managing the specific task and patient.[4]

Patient care is complex. The collaborative process of patient care between a trainee and an attending is a series of usually tacit decisions on the part of the attending to trust the trainee's contribution to the patient's care. The level of trust may be to obtain data such as patient allergies as well as to communicate with patients, accurately interpret diagnostic results, make diagnostic/therapeutic decisions, and perform procedures,[5] in other words, entrusting the trainee to care for patients autonomously.

The underlying foundation of medical training is that residents receive appropriate, graded responsibility with decreased supervision leading to independent practice when they graduate.[6,7] To complement the Accreditation Council for Graduate Medical Education (ACGME) assessment of competencies, ten Cate and others have proposed entrustable professional activities (EPA).[8] EPAs are professional tasks that trainees need to master and that require entrustment decisions by clinical supervisors. Degrees of supervision range from 1) the trainee being limited to observing due to limited knowledge or an inability to act to the trainee acting 2) under direct supervision, 3) under indirect supervision or supervision as needed, 4) acting independently, and ultimately 5) supervising others.[9] As training programs develop and implement competencies such as the ACGME Milestones, ensuring that residents are ready for independent practice is key; understanding entrustment and autonomy will help to facilitate the process to independent practice.[10]

While medical educators advocate entrustment as an assessment decision, the problem lies in how much autonomy is granted to the resident or in other words: "How much rope do we give residents before they hang themselves?" The amount of autonomy and entrustment allowed is a dynamic and fluid process, with a variety of influencing factors. Sterkenburg and ten Cate first examined entrustment by anesthesia faculty in the Netherlands and found that there were four factors affecting entrustment: nature of the task (patient), supervisor, trainee, and circumstances.[11] This study brought into the foreground the complex process of entrustment.

Population Health Research Capsule

What do we already know about this issue?
Entrustment is the process where facutly vary degrees of supervision while granting the trainee autonomy.

What was the research question?
The objective of this study was to better understand the factors affecting the degree of autonomy or supervision faculty allow residents.

What was the major finding of the study?
There are four factors affecting entrustment: the resident (e.g., ability), the patient or family (e.g., acuity), the environment (e.g., business of emergency department) and the faculty (e.g., micromanager).

How does this improve population health?
Training excellent emergency physicians to provide care is an important role of residency. To achieve this goal faculty need to progressively allow residents autonomy so that they are safe for independent practice.

This initial study was conducted in the Netherlands; however, the medical, legal, and insurance environment is different in the United States (U.S.). Medicare and commercial insurers mandate confirmation of medical care by attendings, and with the occasional litigious environment there may be less room for entrustment. This study sought to build on the work of Sterkenburg and ten Cate to investigate the factors affecting how much entrustment or autonomy faculty give residents in a U.S. emergency department (ED).

METHODS

This was a qualitative study investigating the factors that affect entrustment.[11] The setting was a four-year, academic emergency medicine (EM) residency program. Residents work in three settings: a public university tertiary-care center; an under-resourced, inner city hospital; and a community ED. In each setting, the faculty is present at all times. The study was determined to be exempt by the university's institutional review board.

Our study team included two residents and two faculty members to enable us to represent and understand both

experiences. We invited all residents and faculty to participate in a focus group and informed all participants about the process. To assure confidentiality and provide an open environment for the residents, we conducted separate focus groups of five to eight people, two for residents and two for faculty. The focus groups were facilitated by the respective study team members; i.e., the residents (NJ and KS) led the resident group. Participants were each given a $15 gift card for their involvement.

The focus groups were semi-structured, audiotaped, and lasted about 60 minutes. As part of the semi-structured questions we used 1 - 3 case vignettes as triggers to explore factors that influence entrustment decisions.[11] In addition to the case vignettes, we presented to the faculty focus group a trio of residents' names and asked them how their entrustment would vary based on these residents – specifically, what factors would make them trust one resident over another? The residents were given faculty trios and asked how these individuals managed resident autonomy differently. Our purpose in using names was to ground the discussion in real experiences using specific examples.

Each of the focus group conversations was transcribed and coded without names of participants or the people named in the discussion. Each participant was assigned a number and letter (A or B) depending on their focus group. The data were analyzed using grounded theory[12,13] and informed by the literature on entrustment. Using the constant comparative method of analysis and grouping of data chunks, we recorded emergent themes and refined them after each batch of coding. In contrast to most quantitative research, grounded theory is inductive; the data are used to form the theory by pulling out themes from the focus-group narratives. The faculty and resident teams were coded together to facilitate discussion and deepen understanding of perspectives using Nvivo (QSRv11). Our local and nationally-presented workshops on entrustment with faculty and trainees have served as a member check.

RESULTS

Four themes emerged with regard to the factors that affect the decision to entrust: the faculty's underlying disposition toward entrustment; the resident; the patient/family; and the environment. Each of these had specific dimensions (Table).

Table. Themes and subthemes of factors affecting faculty entrustment of patient care to residents.

Resident
Performance
Oral presentation/plan or overview of the case
Familiarity and preconceived view of the resident
Level of training
Resident's apparent self-confidence
Environment
How busy was department
Systems factors - (e.g., stroke alert requires faculty presence)
Nursing capability
Culture of supervision
Faculty
Personality and approach
Comfort with own skills/experience
Disposition to micromanage
Risk averse
Sense of medical responsibility vs. educational responsibility
Patient/family
Acuity/severity
Difficulty of problem or task
Risk to patient (procedures)
Socially complex patients and family issues

Resident Factors Affecting Entrustment

Multiple resident characteristics affected entrustment, including *resident performance*. Faculty observe performance both directly and through patient presentations and then determine how much autonomy the resident should have based on these factors. Lack of ability to orally present a patient is interpreted as poor clinical judgment and grounds for more intensive supervision. In contrast, when a resident is assertive and confident in the initial care of a patient, faculty are more likely to entrust.

> "And it's all, to my mind, dictated by are they demonstrating the ability to take care of the patient with what the patient needs at the moment. And I would step in at any point in time if either they were doing something unsafe or they were missing something that the patient needed, or the patient's status changed and they failed to recognize it. But so long as they continued to care for the patient appropriately, I would stand there quietly and watch if I had the time to do that." (faculty 3A)

Another characteristic is the faculty's *familiarity with and preconceived view* of the resident, which affects their trust. This may be based on working with the resident in the past or by concerns raised in resident assessment meetings. Knowing the resident well will lead the faculty to supervise less or more depending on the circumstances.

> "One stands out as having made more mistakes in the past that I personally experienced, and so that one I'm going to supervise much more. And then like [R1] I don't really know – I haven't worked with him that much so I have less experience so I'm probably going

to [do] more hovering over him." (faculty 1A)
"I think there's a lot of preconceived expectations for, you know, this is somebody we know, we've worked with them before, we've sat in faculty meetings, we've evaluated them together, we know what other people think about them as well; so that flavors my experience." (faculty 6B)

In the absence of specific knowledge of a resident, yet another characteristic includes the *level of training* of the resident. Faculty may intentionally vary their entrustment based on the resident's post-graduate year. If faculty do not know the resident well, the amount of entrustment may be granted based on performance expectations for the resident's level of training.

"So, if it was a One [first-year resident], I'd follow them into the room and watch what they were doing. As long as the patient's vital signs were appropriate I would basically watch them do their assessment, get their history. Once they start to deviate or waste time, or if the patient's vital signs change, I would jump in. But I would trust them to start the history, start the physical exam, talk to the nurse, you know, get an IV, that sort of thing. A Two [second-year resident], if I knew about it, you know, came overhead, I'd walk in, watch them, same kind of thing, but hopefully they could go further than the One. A Three [third-year resident] I'd probably walk over, vital signs are okay, everything looks fine, I'd go back to whatever I was doing and catch up with them. Same thing with a Four [fourth-year resident]." (faculty 2A)

Patient

Several patient factors affect the autonomy given to residents. The primary characteristic is based on the *acuity of the patient*. If the patient is acutely ill, faculty are more likely to step in and take control of the care of the patient. On the other hand, if patients are not sick, the faculty will allow more resident autonomy. Similarly, patients in need of *high-risk procedures* such as intubation will require more supervision. *Socially complex patients* such as those with overly concerned parents, the potential for complaints from patient or family, or the need for end-of-life discussions can decrease the amount of autonomy allowed.

"Let's say a child comes, let's say it's an end-stage, end-of-life kind of issue that is horrific and just being sorted out at the moment; that's just not the time for a trainee, whether he's seasoned or not, to make a misstep." (faculty 5A)
"If an attending perceives that there could be a complaint or a problem coming from the family they may not give you as much leeway because they're afraid of litigation or complaint or other things." (resident 5A)

Environment and System

The environment of the clinical setting can have significant effect on the entrustment of trainees. Factors include how busy the department is, the skills or experience of the nursing staff, whether there are systems factors that affect entrustment, and the culture. When the volume and acuity of patients is high and the department is *busy*, for some faculty it means that they allow more autonomy while others become more directive.

"I think that when the department is really busy […] sometimes you have to send somebody in to go do something that you can't stand there and hold their hand about." (faculty 5A)
"If you're very busy and you have a resident that you already trust, you will give them more rope because you're trying to juggle more balls. But if you have a resident that you do not trust, you're going to do what (faculty 4A) basically said, I tell them you're going to do this, this, this, this, this, because I've gone [in], I've checked the patient and I know what needs to be done, and I don't have time to have you mucking around because I need you to do these things and report back to me when you've completed them." (faculty 2A)

There are also *system factors* that affect entrustment. For example, patients presenting with potentially life-threatening disorders such as trauma, stroke, and acute myocardial infarction necessitate near-immediate involvement of consultants and diminish the amount of time that faculty can allow the resident to make his or her own decisions. Another systems factor is *nursing capability*. Sometimes while the faculty might not completely trust the resident, they trust an experienced nurse. In the ED, nurses frequently contribute significantly to the care and monitoring of patients. "If [name of nurse] is in the room with a sick patient I'm going to supervise more than if a good nurse is in the room. Because I know that the nurse is going to come get me if the resident does something stupid."

Finally, in this study the trainees worked at three sites. They noted different *cultures of supervision* between the university setting and increased autonomy and sometimes-minimal supervision at the inner city, under-resourced site.

Faculty Personality and Approach

As entrustment is a faculty behavior, the final common pathway for the amount of entrustment given to residents was based on faculty factors. Faculty appeared to have a certain approach to entrustment that ranged from those who tended toward a micromanaging supervisory style to those who barely interacted with the residents' patients, allowing for complete autonomy.

"There's a general risk tolerance. You could probably

> put people on a curve and there's a certain amount of risk that people are willing to tolerate, or I guess like deviation from the plan. And some people are just more relaxed about letting things happen, that … are out of their control and that probably dictates how much autonomy they give to people in general. Even like the same resident will experience different levels of autonomy when they're with different attendings right across the board, and they can probably predict that even across cases that they'll get different levels of autonomy because some people will be called micromanagers and some people are just like more laissez-faire about things." (faculty 1B)

The origin of faculty approach is complex. At times faculty attributed it to their own *risk aversion, lack of comfort with their own skills,* or *their experience as an attending.*

> "Especially in a situation where I know that I can probably get them out of it almost no matter what they do, to let them back it up, let them try again, let them talk through it, that sort of thing." (faculty 4B).
> "So, I think my last miss probably plays a huge role in how I let someone work something out." (faculty 4B)
> "I think some of it is their own confidence level, especially at [ ]. One physician in particular that we/I don't feel has much trust in their own capabilities and so they kind of cast a wide net, want a lot of consults brought in, want every test to be done just because they aren't confident in their own self. And I think a couple of the others that are very, very conservative, like one in particular, has said he's been burnt so many times he just doesn't want to have it happen to him again, and so he knows that he overdoes everything and he will admit that, but he won't change anything about that. So, again, I don't know what that is in his personality; maybe it's a bit of a stubbornness." (resident 1A)

In contrast, some faculty allow significant autonomy in patient care. At times this is due to a commitment to education, while at other times it is a "laissez-faire" attitude.

> "So, I think the independent resident experience is valuable and I think, to get on the soapbox, the way that we supervise everybody now has impacted the degree of training or the quality of training that our current residents get. For that reason, I try and give them as much autonomy and free rein as they need." (faculty 5B)
> "He doesn't want to know information; he just wants you to take care of the patient and him not see it." (resident 3B)

DISCUSSION

We found four themes regarding the factors that affect the autonomy and entrustment of residents: resident, patient, environment, and faculty. While these themes are similar to those noted by Sterkenberg, the manner in which they manifest in EM is different than in anesthesia due to the differences in the environmental context. Since faculty are always present in the ED and patients may be acutely ill or quite stable, there are a series of entrustment or supervision decisions on the part of the faculty. In contrast to Sterkenberg who framed the factors as equal,[11] we found three of the factors (resident, patient and environment/system) were channeled through the faculty (Figure) as a final common pathway. This means that different attendings choose to allow more or less autonomy regardless of resident and acuity of patient, etc. Where some faculty are comfortable entrusting a lower-level resident with a very sick patient, some faculty will not even trust a fourth-year resident with a less-sick patient. Entrustment decisions are a series of dynamic decisions made by the faculty based on the three factors of resident, patient, and environment.

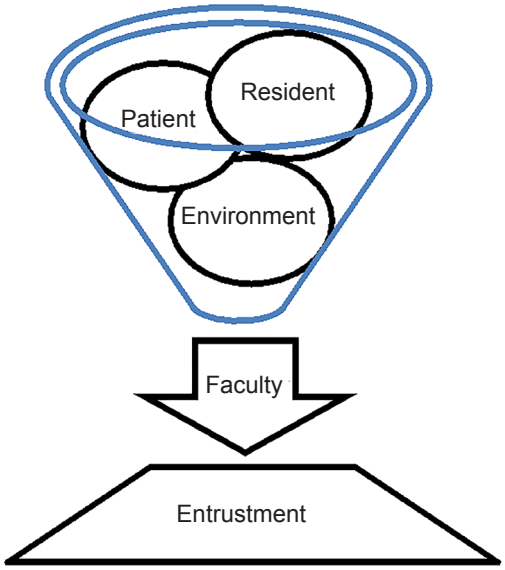

Figure. Dynamic relationship of entrustment.

While this is not the first study of entrustment in EM,[14,15] we believe that our efforts contribute to a deeper understanding of the factors involved in entrustment decisions, particularly of the faculty factor. Given our findings of the strong role of faculty personality and approach, future work will be needed to determine how an individual faculty's predilection for entrustment affects their entrustment decisions.

LIMITATIONS

This study was an initial step toward understanding entrustment in the ED. However, there are limitations implicit in our qualitative methods. Qualitative studies are descriptive and are not intended to test inferences about causation or associations.

Respondents may have felt a need to provide answers showing a social desirability toward entrustment. We conducted four focus groups, but it is possible that we might have found more or different subthemes if we had continued with more focus groups or if we had combined residents and faculty in the same groups. To control for power dynamics, we chose to keep residents and faculty separate. In addition, because participants were recruited from a single program, generalizability is limited.

CONCLUSION

Important factors affect the amount of autonomy and entrustment that faculty give to residents and the level of supervision residents get from faculty, leading to wide variability in entrustment. The four key factors are resident, patient, environment, and faculty. In the end, regardless of resident, patient, or environment, some faculty are more likely to entrust than others.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Assessment of Emergency Medicine Resident Performance in an Adult Simulation Using a Multisource Feedback Approach

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Section Editor: Edward Ullman, MD
Submission history: Submitted July 15, 2018; Revision received December 6, 2018; Accepted December 9, 2018
Electronically published December 17, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.12.39844

Introduction: The Accreditation Council for Graduate Medical Education (ACGME) specifically notes multisource feedback (MSF) as a recommended means of resident assessment in the emergency medicine (EM) Milestones. High-fidelity simulation is an environment wherein residents can receive MSF from various types of healthcare professionals. Previously, the Queen's Simulation Assessment Tool (QSAT) has been validated for faculty to assess residents in five categories: assessment; diagnostic actions; therapeutic actions; interpersonal communication, and overall assessment. We sought to determine whether the QSAT could be used to provide MSF using a standardized simulation case.

Methods: Prospectively after institutional review board approval, residents from a dual ACGME/osteopathic-approved postgraduate years (PGY) 1-4 EM residency were consented for participation. We developed a standardized resuscitation after overdose case with specific 1-5 Likert anchors used by the QSAT. A PGY 2-4 resident participated in the role of team leader, who completed a QSAT as self-assessment. The team consisted of a PGY-1 peer, an emergency medical services (EMS) provider, and a nurse. Two core faculty were present to administer the simulation case and assess. Demographics were gathered from all participants completing QSATs. We analyzed QSATs by each category and on cumulative score. Hypothesis testing was performed using intraclass correlation coefficients (ICC), with 95% confidence intervals. Interpretation of ICC results was based on previously published definitions.

Results: We enrolled 34 team leader residents along with 34 nurses. A single PGY-1, a single EMS provider and two faculty were also enrolled. Faculty provided higher cumulative QSAT scores than the other sources of MSF. QSAT scores did not increase with team leader PGY level. ICC for inter-rater reliability for all sources of MSF was 0.754 (0.572-0.867). Removing the self-evaluation scores increased inter-rater reliability to 0.838 (0.733-0.910). There was lesser agreement between faculty and nurse evaluations than from the EMS or peer evaluation.

Conclusion: In this single-site cohort using an internally developed simulation case, the QSAT provided MSF with excellent reliability. Self-assessment decreases the reliability of the MSF, and our data suggest self-assessment should not be a component of MSF. Use of the QSAT for MSF may be considered as a source of data for clinical competency committees. [West J Emerg Med 2019;20(1)64–70.]

INTRODUCTION

An advantage of high-fidelity simulation is the provision of a variety of case presentations ranging from commonly-seen presentations to rare but critical pathologies while maintaining a clinical sense of urgency in a low-stakes environment.[1] Simulation has evolved for formative and summative assessment.[2] Assessment of residents in Emergency Medicine (EM) is required by the Accreditation Council for Graduate Medical Education (ACGME), and this has been codified with the release of the ACGME Milestones.[3] Milestone guidelines recommend simulation as a means of assessment of EM residents for milestones 1-11 and 16-23.[3]

The Queen's Simulation Assessment Tool (QSAT) was developed and subsequently validated in a multicenter study using EM residents, with the distinct purpose of using simulation as a means of assessment of resident performance in resuscitation.[4,5] The QSAT displayed its ability to discriminate between junior and more-senior residents in performance in several case types, with senior residents consistently performing better in all but one of 10 case types previously measured. The authors also studied the use of the QSAT tool in a formalized Objective Structural Clinical Examination to be used for assessment within their residency program.[6]

Another ACGME-recommended means of EM resident assessment is multisource feedback (MSF). MSF is recommended by the ACGME to assess 10 of the 23 milestones.[3] MSF would then be forwarded to the residency programs' clinical competency committees (CCC), which would use the data as part of their process to determine milestone progression during semi-annual resident evaluation.

A relatively unexplored area of research in the use of simulation is the addition of other evaluating parties in a MSF, or 360-assessment model. Outside of the simulation environment, the feasibility and reliability of MSF within EM has been demonstrated.[7] Here the instrument was more complex than the QSAT. Using similar questionnaire methodology, one study noted that MSF may bias toward favorable responses for physicians.[8] Systematic review of several MSF studies shows adequate reliability with only eight coworkers or eight medical colleagues when surveyed.[9] MSF is listed among potential options for evaluating residents for various ACGME core competencies.[3]

There is limited study of the use of MSF for resident assessment. A previous small trial with 10 residents assessed showed acceptable inter-rater reliability involving 44 nurse evaluations and 13 faculty evaluations. The trial demonstrated good interclass reliability between faculty and nurse assessments;[10] however, that occurred with assessment of resident performance over several non-standardized cases.[10] To date, little has been published on MSF evaluation of residents in general and in the simulation lab in particular. Our study sought to determine the concordance of rater evaluations of the QSAT assessment tool when used in MSF to assess EM resident simulation performance in a standardized, adult-simulation resuscitation performed in a simulation center setting.

Population Health Research Capsule

What do we already know about this issue?
In the toolbox of suggested types of resident evaluation offered for Emergency Medicine (EM) Milestones, the Accreditation Council for Graduate Medical Education includes Multi-Source Feedback (MSF). MSF is often referred to as 360 feedback.

What was the research question?
This study sought to determine the degree of concordance of MSF using the Queen's Simulation Assessment Tool (QSAT) in the simulation lab using a standardized adult resuscitation case.

What was the major finding of the study?
Compared to faculty evaluation as the gold standard, a peer resident, emergency medical services provider, and nurses provide concordant MSF with excellent inter-rater reliability. Self-evaluation was less reliable.

How does this improve population health?
This cohort suggests that the QSAT could be used to provide MSF data to EM Residency Clinical Competency Committees. The lower concordance suggests self-evaluation should not be a component of MSF.

METHODS

After institutional review board approval, we conducted this prospective study at a postgraduate year (PGY) 1-4 EM residency training 13 residents per year at a suburban healthcare network. The program is dually approved by both the ACGME and the American Osteopathic Association. All participants were consented prior to participation in the simulation cases, which were performed in the simulation lab during educationally protected grand rounds time. As part of the consent process, the contact information for an independent party at the hospital's department of education was provided to each study participant. To further protect the participants, each had the ability to privately contact this independent party after the simulation to be anonymously removed from the study.

One designated adult Advanced Cardiac Life Support case was developed for this study by a panel of simulation-trained physicians using standard simulation templates (Appendix). All EM residents in their PGY 2-4 levels of training were eligible

to be enrolled to serve as team leaders for the case. The team leader resident directed the simulation and resuscitation of the case and asked for telephone communication with consultant providers (toxicology and critical care) whenever appropriate. As team leader, he or she received MSF using a previously validated rubric. This instrument, the QSAT, was previously studied with attending physicians evaluating residents.[4,5,6] The QSAT assesses resident performance on four factors of resuscitation leadership: primary assessment of the patient; initial diagnostic testing; treatment of the underlying condition; and interpersonal communication with staff and consultants. There is a fifth and final overall performance category. These aspects are rated on a 1-5 Likert scale, with a score of 1 representing delayed or incomplete performance of all aspects of care and 5 signifying competent performance of all aspects of care. The QSAT modified for this study simulation case is shown in Figure.

Primary assessment				
Vital signs: heart rate/blood pressure/O_2 saturation/respiratory rate/ temperature Glucose, Cardiac monitor		Level of consciousness assessment Airway assessment, Rhythm assessment Intravenous access		
1	2	3	4	5
Delayed or incomplete performance of all criteria	Delayed or incomplete performance of many criteria	Delayed or incomplete performance of some criteria	Competent performance of most criteria	Competent performance of all criteria

Diagnostic actions				
History of present illness, past medical history, medications, allergies. Physical exam. Electrocardiogram, Post-intubation chest x-ray		Bloodwork: complete blood count, comprehensive metabolic panel, glucose, lactate, toxicology screen, urinalysis		
1	2	3	4	5
Delayed or incomplete performance of all criteria	Delayed or incomplete performance of many criteria	Delayed or incomplete performance of some criteria	Competent performance of most criteria	Competent performance of all criteria

Therapeutic actions				
Emergent antiepileptic treatment (benzodiazepines) Rapid sequence intubation with medication		Post-intubation sedation Sodium bicarbonate bolus and infusion Resuscitation with fluid bolus		
1	2	3	4	5
Delayed or incomplete performance of all criteria	Delayed or incomplete performance of many criteria	Delayed or incomplete performance of some criteria	Competent performance of most criteria	Competent performance of all criteria

Communication				
Introduces self and explains clinical situation Clear and concise orders and direction Prioritizes tasks and anticipates further steps		Demonstrates leadership in managing crisis Appropriate specialist consultation: toxicologist, intensive care unit		
1	2	3	4	5
Delayed or incomplete performance of all criteria	Delayed or incomplete performance of many criteria	Delayed or incomplete performance of some criteria	Competent performance of most criteria	Competent performance of all criteria

Overall assessment				
1	2	3	4	5
Delayed or incomplete performance of all criteria	Delayed or incomplete performance of many criteria	Delayed or incomplete performance of some criteria	Competent performance of most criteria	Competent performance of all criteria

Figure. Modified Queen's simulation assessment tool.

In this study, multiple healthcare staff members present during the performance of the case completed the QSAT. Two designated EM core teaching faculty ("faculty") members, defined a priori as the gold standard, both completed a QSAT on each simulation. MSF was provided by nurses (RN), a resident peer ("peer"), and an emergency medical services (EMS) provider. As a PGY-1, the resident peer served as the junior resident for the enrolled team leader. The team leader ("self") performed self-evaluation when completing the MSF. The QSAT was completed immediately upon conclusion of the simulation. The participants were not specifically trained on the QSAT. For the purposes of statistical analysis, the resident peer, the EMS provider, and the two faculty did not vary. All cases were performed using high-fidelity simulation mannequins that are age-appropriate for adult cases. We recorded demographics from all participants.

Data Analysis

We used descriptive statistics to describe the sample, and counts and percentages to describe categorical variables. The mean and standard deviation was used to describe continuous variables found to be normally distributed, and we described non-normally distributed variables using the median. Normality was assessed by determining if the skew statistic was less than +1 and greater than -1 and upon visual inspection of a histogram plot. To avoid issues with repeated measures analysis secondary to unequal response rates, participating groups were either present for all simulations (defined as faculty, peer, EMS) or were enrolled for only one case (defined as self and RN).

The QSAT was cumulatively scored by adding the scores for each section, resulting in one total score ranging from 5-25. To test the hypothesis, we assessed inter-rater reliability (ie, the reliability of two or more raters measuring the same resident), by obtaining intraclass correlation coefficients (ICC) for the groups of raters. We used two-way random ICCs to determine the average level of absolute rater agreement between all raters within each simulation. Interpretation of the ICC was based on prior publication, with results less than 0.40 noted as poor, 0.40 to 0.59 fair, 0.60 to 0.74 good, and ≥ 0.75 excellent.[11] We then calculated an ICC for the two attending physicians as one group with another ICC calculated for self, peer, RN, and EMS raters as a separate group. We also generated ICCs for the group as a whole after systematic removal and replacement of RN, peer, EMS, and self-raters from the whole group. An observer group was defined as the RN, peer resident, and EMS evaluators.

All analyses were two-tailed with alpha set at 0.05. We performed all statistical analyses using SAS version 9.3 (SAS Institute, Cary, NC) and SPSS version 24 (IBM SPSS Statistics for Windows, Armonk, New York). The study was supported by an unrestricted educational grant from the Dorothy Rider Pool Health Care Trust.

RESULTS

We conducted four designated simulation sessions spanning six months. Thirty-four residents were enrolled as designated team leaders, 12 of whom were female (35.3%). The median age was 31. Twenty-five had a Doctor of Osteopathic Medicine (DO) degree (73.5%) with the remaining having a Doctor of Medicine (MD) degree; one participant (2.9%) held another advanced degree (Master in Business Administration). Nine residents were sampled at the end of their PGY-4 years (26.5%), 11 at the start of their PGY-4 years (32.4%), 10 during the start of their PGY-3 years (29.4%), and four at the start of their PGY-2 years (11.8%).

We used 34 different nurse-raters during the study; 30 were female (88.2%). The median number of years of experience was 4.5. Ten (32.3%) were nurses in their first year, enrolled in the healthcare network's "nursing residency." The remaining 21 nurses (67.7%) were recruited from the emergency department and had 9.5 median years of experience (IQR 4.5 -10.0). The median age of the nurses was 28.5. Most held Bachelor of Science degrees (82.4%), while three (8.8%) had another advanced degree (Master of Science). The EMS, peer resident and faculty raters were all male. Their experience was 13 years of EMS, PGY-1 level of training, and for faculty 14 and 15 years, respectively,..

The QSAT score averages and cumulative totals for resident team leaders in each category as rated by the evaluators are presented in Table 1. Self-evaluation scores were the lowest in all categories. Attending scores tended to be the highest in each category, with a few exceptions. The average total QSAT score for the self-evaluator was nearly 3.5 points lower than the total averaged score between the two attending evaluators. Remaining evaluators provided similar total scores as compared to the attending evaluators for the residents as a whole.

Total QSAT scores for individual residency levels were prepared in subgroups by PGY level of training (Table 2). The trend of lower total QSAT scores amid resident self-evaluation remained at all PGY levels. Total scores were high for all residents despite the PGY level. Despite differences in their levels of training, resident team leaders each performed very similarly according to each type of evaluators.

The ICCs for total QSAT scores are shown in Table 3. The ICCs for the inter-rater reliability of all raters across residents evaluated showed excellent correlation, with an ICC of 0.754 including all groups. ICCs for a group of observers including the RN, EMS provider and peer evaluator were calculated to be 0.806 (0.660-0.897) for inter-rater reliability.

We also calculated subgroup ICCs with individual categories of raters removed systematically (Table 3). The ICCs for inter-rater reliability were similar no matter what groups were removed, and 95% confidence intervals (CI) for all subgroups overlapped, showing no statistically significant difference. The lone exception was in the subgroup in which

Table 1. QSAT Likert scores for resident evaluation for individual categories.

	Primary assessment mean (SD)	Diagnostic actions mean (SD)	Therapeutic actions mean ((SD)	Inter-personal communication mean (SD)	Overall assessment mean (SD)	Total QSAT scores mean ((SD)
Self	4.06 (0.49)	3.79 (0.69)	4.06 (0.81)	4.09 (0.67)	3.88 (0.59)	19.88 (2.58)
Peer	4.79 (0.48)	4.18 (0.80)	4.26 (0.96)	4.62 (0.55)	4.38 (0.65)	22.24 (2.69)
Nurse	4.56 (0.50)	4.29 (0.68)	4.62 (0.60)	4.68 (0.59)	4.41 (0.50)	22.56 (1.93)
EMS	4.76 (0.50)	4.41 (0.61)	4.47 (0.71)	4.71 (0.58)	4.50 (0.75)	22.85 (2.63)
Attg 1	4.88 (0.33)	4.62 (0.49)	4.50 (0.66)	4.88 (0.41)	4.74 (0.45)	23.62 (1.56)
Attg 2	4.94 (0.24)	4.56 (0.66)	4.12 (0.98)	4.88 (0.33)	4.47 (0.79)	22.97 (2.11)

QSAT, Queen's simulation assessment tool; *Attg*, attending physician; *SD*, standard deviation; *EMS*, emergency medical services.

Table 2. Total QSAT scores for resident evaluation by PGY year.

PGY Year	Evaluator	Score; mean (SD)
End of PGY-4	Self	19.44 (1.74)
	Peer	21.00 (3.57)
	Nurse	21.89 (1.69)
	EMS	22.11 (2.71)
	Attending 1	23.67 (1.00)
	Attending 2	23.44 (1.24)
End of PGY-3 / Start of PGY-4	Self	19.55 (2.66)
	Peer	23.00 (2.32)
	Nurse	22.45 (2.21)
	EMS	22.55 (3.17)
	Attending 1	24.00 (1.79)
	Attending 2	23.27 (2.24)
End of PGY-2 / Start of PGY-3	Self	20.90 (2.96)
	Peer	22.00 (2.26)
	Nurse	22.70 (1.95)
	EMS	23.90 (2.18)
	Attending 1	23.00 (1.89)
	Attending 2	22.60 (2.76)
Start of PGY-2	Self	19.25 (3.20)
	Peer	23.50 (1.73)
	Nurse	24.00 (1.15)
	EMS	22.75 (1.71)
	Attending 1	24.00 (0.82)
	Attending 2	22.00 (1.63)

QSAT, Queen's simulation assessment tool; *PGY*, postgraduate year; *SD*, standard deviation; *EMS*, emergency medical services.

the self-evaluators were removed. Inter-rater ICCs increased markedly, although no statistically significant difference was shown between this and the overall ICCs with all groups.

We also compared ICCs of individual types of healthcare provider rater groups to each other (Table 4). The two attending physicians showed excellent inter-rater reliability with each other. When comparing the attending physicians to other rater groups, the least agreement was noted between attendings and nurses, while the strongest agreement came between attendings and the EMS provider. With 10 (32.3%) of enrolled nurses coming from the nursing training program, this agreement was explored further. Nurse residents had higher ICC inter-rater with the attendings (.680, .093-.913) than the more experienced nurses (.649, 0.300-.843). Comparing attendings to an observer group (RN, EMS and peer) showed good agreement in inter-rater reliability. No statistically significant difference was noted between any of these subgroup analyses, as all 95% CIs overlapped.

DISCUSSION

In this study, all raters using the QSAT to assess performance on a standardized adult simulation case provided scores with excellent inter-rater reliability. Given that inter-rater reliability, or the ability to have one source of feedback agree with another, was excellent in this cohort suggests that the QSAT may be a viable instrument for MSF. Prior research has suggested that at least 30 measures from at least three raters should be used to calculate ICCs.[12] This cohort met both of these criteria, lending further support to this finding.

The inter-rater reliability improved when self-assessment scores were removed. This is reflected in the raw data, which showed significantly lower self-rated evaluations compared to the other groups. Prior study of EM resident self-assessment in the simulation lab demonstrated variability in the accuracy of assessment as compared to attendings.[13] This study found that agreement with attending evaluation increased with increasing attending scores. In general, physician self-assessment has been demonstrated to be of limited value.[14] In this systematic review, as compared to objective measures, self-assessment has a wide range of variability. This cohort suggests that when using the QSAT, MSF should not include self-assessment. It may be reasonable to extend that conclusion to MSF more broadly.

Table 3. Interrater reliability by intraclass correlation coefficients for total QSAT scores with 95% confidence intervals .

All raters	Self removed	Peer removed	Nurses removed	EMS removed	Attendings removed
0.754 (0.572-0.867)	0.838 (0.733-0.910)	0.667 (0.412-0.822)	0.715 (0.484-0.850)	0.660 (0.408-0.817)	0.680 (0.423-0.831)

QSAT, Queen's simulation assessment tool; *EMS*, emergency medical services.

Table 4. Intraclass correlation coefficients between attending physicians and other healthcare providers for total QSAT score with 95% confidence interval.

	Attendings only	Attendings + observers	Attendings + peer	Attendings + nurse	Attendings + EMS
Interrater reliability	0.840 (0.634-0.925)	0.680 (0.423-0.831)	0.779 (0.594-0.885)	0.651 (0.394-0.812)	0.812 (0.670-0.900)

QSAT, Queen's simulation assessment tool; *EMS*, emergency medical services.

When evaluating the specific sources of MSF in this cohort, the agreement between the two faculty evaluators was the highest. To add to this traditional source of resident feedback, the addition of EMS feedback performed the best. The EMS provider in this study helps run the healthcare network simulation lab, as well as teaching and assessing performance in life support classes to a range of providers including physicians. As such, the performance of EMS MSF in this cohort may not be generalizable.

The performance of the peer evaluator was very similar to that of the EMS provider, achieving excellent inter-rater agreement with the faculty. (The participation of the single peer began at the end of his PGY-1 year, and the study was completed during the first half of his PGY-2 year.) In contrast, the agreement of the RN evaluators had the lowest agreement with the faculty. This agreement actually decreased with increasing years of experience. This finding may suggest there are fundamental aspects of training and experience, which increases agreement for resident sources of MSF but decreases it for nursing. Differences in the evaluation of resident performance by physicians and nurses have been previously demonstrated.[15] This finding may have implications for the inclusion of nursing in MSF moving forward. Alternatively, since both faculty evaluators as well as the peer and EMS evaluators were male, and the nurses overwhelmingly female (88.2%), another possible explanation for the differences in agreement is that gender may play a role. Previous study of the role of gender of faculty and residents as it relates to resident evaluation in internal medicine has not been conclusive.[16,17] In EM specifically, the gender of the resident being evaluated has been shown to influence milestone evaluations by faculty.[18]

To determine if MSF from other healthcare providers could replace faculty evaluations, we created an observer group. This group comprised the peer, EMS, and RN evaluators. The inter-rater reliability of this group independently was excellent (.806). While the group did have excellent agreement among themselves, agreement with the faculty did not perform as well (.680). Having defined a priori that the faculty scores defined the gold standard, this suggests that attending input should consistently be a component of MSF.

Regarding individual QSAT categories, the one receiving the lowest overall score was "diagnostic testing." The categories of "primary assessment" and "therapeutic actions" were the most highly rated among the evaluators. This may be the result of the specifics of the case, the qualities of the training program, the attributes of the residents enrolled, or a combination of the three. The scoring of the residents by PGY level did not demonstrate significant differentiation with increasing experience. This lack of heterogeneity may have impacted the calculation of the ICCs.[12] Prior studies have demonstrated the ability of the QSAT differentiate resident performance.[6,19] The inability to discriminate between residents in this cohort as they progressed, therefore, may be the result of the simulation case.

The chosen gold standard of a two-attending evaluation for the study is based on use of multiple attending physicians in previous QSAT studies. The agreement between the two faculty in our study was excellent (.840). However, one explanation for this high inter-rater reliability from the attending physicians could be due to bias resulting from their prior experience as faculty in the residency program. The original QSAT studies used independent, attending physician raters who were not faculty at the residents' sites in order to minimize bias from familiarity with residents.[6] For reasons related to availability, we used simulation-trained EM attending physicians who were known faculty; however, this could have led to them scoring residents highly due to their previous experience with these residents. While this may limit the results, it likely represents the manner in which the QSAT would be used by residency programs to gather MSF. This may increase the external validity of the study.

LIMITATIONS

We performed this study at a single site. The details of the resuscitation case were developed internally and not validated, which may explain the observed inability to discriminate between

more- junior vs more-senior residents. To avoid issues with repeated measures analysis, some of the sources of MSF were fixed to specific individuals, while other sources were random. The residents running the case were known to the faculty evaluators, which may have increased the scores provided. The sampling of resident team leaders was by convenience; and to ensure that the peer evaluator was junior to the team leader, we enrolled no PGY 1 residents in that role. Participants did not receive training on the use of the QSAT in an attempt to have the study reflect how the QSAT would likely be used for MSF. This lack of training may have impacted the findings.

CONCLUSION

In this single-site cohort using an internally developed, standardized adult simulation case, we found that the QSAT can provide MSF with excellent interrater reliability. EM residency CCCs may consider using the QSAT to provide ACGME-recommended multi-source feedback. Nurses as a group had lower inter-rater reliability than other evaluators present during the case, which may have been the result of training or gender, or both. Self-evaluation should not be a component of MSF given that this cohort demonstrated the lowest inter-rater reliability.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. Please note that this study did receive unrestricted grant funding from a community non-profit philanthropic trust, the Dorothy Rider Pool Health Care Trust, Grant 1573.

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Show Me the Money: Successfully Obtaining Grant Funding in Medical Education

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Section Editor: Jeffrey N. Love, MD
Submission history: Submitted October 15, 2018; Revision received October 15, 2018; Accepted October 26, 2018
Electronically published November 19, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.41269

Obtaining grant funding is a fundamental component to achieving a successful research career. A successful grant application needs to meet specific mechanistic expectations of reviewers and funders. This paper provides an overview of the importance of grant funding within medical education, followed by a stepwise discussion of strategies for creating a successful grant application for medical education-based proposals. The last section includes a list of available medical education research grants. [West J Emerg Med. 2019;20(1)71-77.]

INTRODUCTION

Promotion of faculty in academic institutions is critical and includes service, education, and research agendas. The development of faculty researchers has been a topic of interest and debate. Studies in this arena have primarily focused on leadership practices,[1] theoretical frameworks,[2] and barriers to success.[2,3] A recurrent theme in these works is the importance of obtaining significant extramural research support in an increasingly competitive funding environment.[4] In fact, early career researchers who successfully obtain funding have nearly twice the likelihood of achieving full professorship compared to those without funding, even with similar pre-award backgrounds.[5]

Interestingly, the ability to initially predict successful grant applicants from non-successful applicants based upon their qualifications alone can be difficult, as they often have similar backgrounds and credentials.[6] However, once funding has been achieved, the likelihood of receiving subsequent grants significantly increases.[7] This phenomenon, the degree to which the successful become ever more successful, has even been given its own term in the social sciences and is referred to as the Matthew effect.[7,8] While emergency medicine is a young field, funded research is gaining importance and recognition.[9] Achieving grant funding can be incredibly important to building and gaining momentum in one's academic career.

Grant funding is particularly important in the field of medical education research, where funding is even more scarce[10-12] and the work itself is often under-recognized.[13-15] Additionally, medical education research is striving to be more rigorous. Experts have suggested that the majority of medical education research is either unfunded or underfunded,[1,2] which may negatively impact the quality of the studies.[3] The scientific community, including professional organizations, journal editors, and investigators, have all called for a higher caliber of methodological rigor, multi-institutional studies, and clinically-relevant outcomes for medical education research.[3,16,17] To achieve these goals we believe that educational researchers must have the tools and information necessary to successfully apply for grant support. We created this document to provide an overview of the grant application process, including mechanics of a grant,

key sections and how to apply, as well as to provide a list of potential medical education funding mechanisms. We hope this will help early career investigators obtain medical education funding.

ANATOMY OF A GRANT APPLICATION

Overview

Completing a grant application can be a large and arduous task. Grant applicants will often need several experts to formulate their team. The grant development team should include a principal investigator (PI), a primary mentor who is ideally from the same institution, and at least one content expert in the topic of interest. A content expert could be a clinical, translational, educational, or statistical expert either within or outside your institution. It is also important to include a methodological expert early in the process, particularly if the PI does not have significant expertise with the technique. For example, if an investigator is performing a qualitative study, it would be important to include someone who has significant experience with this approach to ensure that the qualitative approach (e.g., phenomenology, grounded theory) and specific methodology is appropriate and rigorous. It is also important to establish strong collaboration with the team, rather than merely listing prominent names without previous collaboration. Therefore, we strongly recommend that the PI start the preliminary work early by assigning specific roles among team members and involving them in the grant process.

While the specific structure of individual grants can vary by sponsoring institution, many grants use similar requirements and formats. The specific format typically includes but is not limited to a project description with references, biosketches of the investigative team, a complete budget with justification of the financial expenditures, a description of the facilities and resources, and letters of support. The following sections of this paper provide a brief summary of each of these commonly included elements within grant applications; however, the reader is advised to spend additional time reviewing the individual funders' websites and application resources to ensure that all required forms are completed appropriately and included within the final grant application. It is also important to check with your institution's grant office, which often requires approval to submit a grant. This process can take up to a month, so it is important to start the work early on grant applications.

Project Description

The project description section serves as the body of the grant and clearly defines the work to be performed. The allotted length varies by the funding mechanism, but often ranges from 6-12 pages. The first page of the application is typically the specific aims page where the project is summarized in two or three paragraphs and the hypotheses and objectives are explicitly defined. Well-designed aims ensure that success is not dependent upon any single outcome and that more than one possible outcome is acceptable. Success of a subsequent aim should not be dependent upon the prior aim. Depending upon the funding mechanism, the specific aims page may or may not be included in the page count for the project description. This section is often considered the most important page in the entire grant application. Significant time should be spent on this page by all members of the grant team to ensure that it clearly and accurately articulates all aspects of the proposal. This page often requires several revisions before reaching the final version that is submitted. A nice review of the approach to writing the aims section is available at https://www.niaid.nih.gov/grants-contracts/draft-specific-aims for those who are interested in learning more. A sample aims section from a successful medical education grant application has also been included as an Appendix to this paper.

The remainder of the project description section is frequently divided into three components: significance, innovation, and approach. The significance section describes the background literature and highlights the knowledge gap that will be addressed by completing the proposed project. Within medical education it is essential to include a discussion of the underlying educational theory or conceptual framework upon which the study is based.[18,19] The innovation section should describe why the proposed project is novel and how this will contribute to the medical literature in the proposed area. This can include contributions to both learner education and patient care. It is also important to consider the review audience for your grant. Compositions of grant review committees vary greatly but are often primarily comprised of researchers in areas outside of medical education. Therefore, when composing the significance and innovation sections within the grant, the argument must be clear and persuasive to a reviewer unfamiliar with the current state of professional education.

Finally, the approach section details how the work will be completed. This should include details on study design, recruitment and sample size, outcome measures, analytic techniques, and consideration of the potential limitations. The clarity and technical accuracy of this section can be an important signal to a reviewer of the probability of an applicant successfully completing their proposed research program. Funders generally place a significant weight on a high likelihood of a successful return on their investment; so concerns that the analytical approach is underdeveloped or flawed can be fatal. Of special consideration for educational researchers is the description of methods less common in clinical or bench research; for example, qualitative research methodology may encounter a negative bias from quantitatively focused scholars.

In general, reviewers expect to be able to understand your project without having to read substantially about your methods elsewhere. Including appropriate references is mandatory but making reviewers work harder than they expected to is counterproductive to your goal of achieving funding. A complete bibliography may be included either at the end of the project description section or as a separate document within the application. Once again, it is important to note that the grant reviewer may not be familiar with the specific topic or may be from a different specialty or field. Therefore, it can be valuable to have a non-physician review the application to ensure that it is easily understood.

Biographical Sketches

Biographical sketches, or biosketches, are often required for all key personnel within the investigative team. These differ in format from traditional curriculum vitaes, especially in that there generally is an expectation that they will be formatted per the National Institutes of Health (NIH) requirements. Biosketches consist of the investigator's professional positions and educational history along with their respective publications that are most relevant to the field of medical education. These publications often include a short description of how they have impacted the relevant field of research. These may also include publications demonstrating the investigator's experience with the specific methodology proposed for the study (e.g., qualitative, systematic reviews). Examples of well-written biosketches can be found in several locations, including on the NIH website (https://grants.nih.gov/grants/forms/biosketch.htm).

Budget

Funding opportunities can range from hundreds to millions of dollars depending upon both the agency and the scope of the work being performed. Typically, medical education grant programs award smaller funding amounts when compared to strictly clinical or laboratory grant programs. In part, this may be due to the higher expected costs incurred with patient care and laboratory maintenance. Whatever the underlying reasoning, medical education researchers must be conscious of this difference in order to adequately budget their research resources and advocate for commensurate consideration when undergoing promotional review. Often, the funder will define the total amount of the award to be given, including the amount allowed for both direct and indirect costs.

Funding related to direct costs is paid directly to the investigative team for the study and can include investigator salaries, statistical support, supplies, simulation laboratory time, and subject recruitment. Funding for indirect costs is paid to the university or institution as overhead to cover the overall costs associated with supporting research. It is important to review the specific budget requirements, as some grants do not allow salary support or indirect costs. The budget should specifically and deliberately delineate any areas where funds are needed and how they will be used. This should be complete with the specific amounts and justification for each budgeted item to ensure that the funds are appropriately distributed. The requested amount should not exceed the maximum allowed by the funding agency.

Facilities, Resources, and Environment

Most grant applications will request a description of the available facilities, resources, and the intellectual environment where the work associated with the project will be conducted. This should include specific details of the available resources as they pertain to the proposed project (e.g., computers, laboratory space, and office space). Specific to medical education research, one might also want to include the educational environment, including access to the learners and logistics of training. This can also include the number of learners available and prior medical education research conducted in this location. In addition to the above components, this section must also include support services available within the institution. These resources can include medical librarians to help with literature searches, a clinical translational science institute to assist with study design, or a statistician to assist with data analysis.

Finally, this section should discuss the research environment within the department and the greater institution. This may include a list of collaborators, recent publications, and other funded projects as a way to highlight the successful completion of other work. Here again, this section can be an important signal to reviewers that the proposed research project will be successfully completed. Institutions with well-documented histories of successfully completing funded research demonstrate an environment that is conducive to a successful return on the investment made by the funder. This can be especially important for more junior researchers and for educational researchers with whom grant reviewers may be less familiar with their work.

Letters of Support

Letters of support further illustrate the level of commitment from the investigative team, the leadership of their respective departments, and the universities involved in the project. Depending upon the funding agency, letters of support may be required from key personnel involved in the project (e.g., department chairs or division chiefs, medical school deans, or other leadership within the requesting institution). These letters should clearly document the necessary resources, the commitment from the investigative team, and the institutional support to ensure success of the proposed work.

Additional Grant Application Materials

Depending upon the type of funding mechanism sought, there are several other important documents that may be required. These may include a project timeline, description of the ethical treatment of subjects, and proof of institutional review board submission or approval. Similarly, for training awards a specific plan for career development is a necessary and vital component of the grant application process. These awards are often fundamentally different from grants that fund a specific medical education research question. Rather, training awards can fund specific professional development programs, such as a fellowship. Applicants seeking a training award must clearly delineate a specific and achievable plan for professional development, as well as how the funds will be used to achieve this plan. This is also required for certain career development (K) awards that are available through the NIH.

Grant Evaluation

Grant applications are evaluated using multiple different methods; however, the most common scoring method is that used by the NIH. The NIH scoring tool evaluates several areas of the grant (i.e., significance, innovation, approach, investigators, environment, and overall impact), with each given a score from 1 (exceptional) to 9 (poor). The reviewer scores are averaged and multiplied by 10, resulting in an overall score.[20] Lower numerical scores equate to a more competitive grant application. The funding range using the NIH rubric is typically 10-30, though this can depend on several factors. Funding is ultimately determined by the final score and is rated based on its congruence with the institution's mission, available funding, and comparison to the application cohort. Given that the NIH approach is often the underlying rubric for application review, it may be beneficial to review the specific criteria and questions used in the reviews. This is especially true for educational researchers who may not have previously submitted to the NIH or similar organizations. Additional information is on this available at https://grants.nih.gov/grants/peer/guidelines_general/Review_Criteria_at_a_glance.pdf.

Available Grant Opportunities

While there are a number of grants available for research, significantly fewer are available in medical education. One of the more significant challenges to obtaining grant funding is awareness of which grants are available. The accompanying Table provides a list of grants focusing on medical education research (Table). This includes a variety of regional, national, and international grants with website links, their missions, funding amounts, and annual submission deadlines. While most grants are annual, readers should note that some occur less frequently, while others have rolling deadlines. Researchers should also seek out local opportunities, as many institutions also have internal grant-funding opportunities. Finally, novice grant writers may not realize that funding program officers generally welcome contact prior to the application submission. Reaching out, especially when potentially coming from a non-traditional researcher background, may help improve your application and, ultimately, the chance for successful funding.

LIMITATIONS

It is important to consider several limitations with respect to the current paper. First, this publication serves as a primer for medical education researchers interested in obtaining grant funding. While this is intended to provide an overview of the major components of grant funding, readers are advised to read *The Grant Application Writer's Workbook* by Russell and Morrison if they are interested in learning more. Additionally, many of the recommendations are based upon the authors' combined experience, as there is limited empirical data on effective grant-writing. However, the authors are experienced grant writers, having received over $4 million in grant funding. Finally, the grant list in the Table includes the majority of medical education grant funding opportunities. However, it is possible that there are additional medical education grant opportunities that are not included in the Table.

CONCLUSION

Obtaining grant funding is a fundamental component of a successful research career, but it can also be challenging, especially in the field of medical education. Successful applications must meet specific structural requirements. This paper provides an overview of grant opportunities within medical education and strategies for successful grant applications. After reading this paper, researchers should feel more knowledgeable and confident with applying for medical education research grants.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

Table. Available medical education grant opportunities.

Name of Grant	Website	Mission	Funding amount	Submission deadline
AMEE Seed Grants	https://amee.org/awards-prizes/research-grant-award-programme	To promote scholarship in healthcare professions education to advance knowledge and best practices in education as well as to build a community of scholars working in the field.	£10,000	February
AstraZeneca Medical Education Research Grants	https://www.astrazenecagrants.com/home.html	To support quality independent medical and scientific education and sponsorships that enhances patient care.	Variable	Varies by grant
Bristol-Myers Squibb Independent Medical Education Grants	https://www.bms.com/about-us/responsibility/IME.html	To support innovative, high quality medical education that closes gaps in health care professional knowledge, strengthens their professional competence, and improves patient health outcomes.	Not listed	Not listed
NBME Stemmler Grant	http://www.nbme.org/research/stemmler.html	To support research or development of innovative assessment approaches that will enhance the evaluation of those preparing to, or continuing to, practice medicine.	$150,000	July* January**
SACME Research Grant	https://sacme.org/SACME_Grants/	To promote the highest value in patient care and health of the public through the scholarship of continuing medical and interprofessional education.	$50,000	December* March**
SDRME Synthesis Paper Grant	http://sdrme.org/scholarship.asp	To support the writing of review/synthesis papers that make a substantial contribution to advancing practice, theory, or research in medical education.	$4,000	September
Spencer Small Research Grants	https://www.spencer.org/small-research-grants	To support academic work that will contribute to the improvement of education, broadly conceived.	$50,000	February, May, August, November
Lyle Spencer Research Award	https://www.spencer.org/lyle-spencer-research-awards	To support intellectually ambitious research oriented to improving the practice of education, independent of any particular reform agendas or methodological strictures.	$1,000,000	October
Teleflex Medical Education Grants	https://www.teleflex.com/usa/about-us/grants/medical-educational-grants/	To support genuine medical education that meets defined clinical educational needs.	Not listed	No due date requirement
The Alfred P. Sloan Foundation Higher Education Grant	https://sloan.org/grants/apply	To support original research and education related to science, technology, engineering, mathematics, and economics.	Not listed	Not listed
AAMC MESRE Grant	https://www.aamc.org/members/gea/gea_sections/mesre/	To enhance the quality of research in medical education and to promote its application to educational practice.	$20,000	February* May**
AHRQ Grants	https://www.ahrq.gov/funding/process/index.html	To produce evidence to make health care safer, higher quality, more accessible, equitable, and affordable.	Variable	Varies by grant
AMA Foundation Grant	https://www.ama-assn.org/about/community-health-programs	To improve the health of all Americans by supporting community health and medical education programs.	$40,000 - $60,000	December
CORD EMF Grants	https://www.cordem.org/opportunities/cord-grants/	To provide a vehicle for emergency medicine education researchers early in their career that promotes the development of well-conceived projects while allowing for grant writing experience and recognition of successful grant applications.	$10,000 $25,000	February

AMEE, Association for Medical Education in Europe; *NBME,* National Board of Medical Examiners; *SACME,* Society for Academic Continuing Medical Education; *SDRME,* Society of Directors of Research in Medical Education; *AAMC,* Association of American Medical Colleges; *MESRE,* Medical Education Scholarship Research and Evaluation; *AHRQ,* Agency for Healthcare Research and Quality; *AMA,* American Medical Association; *CORD,* Council of Emergency Medicine Residency Directors; *EMF,* Emergency Medicine Foundation.

*,Due date for letter of intent.

**, Due date for full proposal.

Table. Continued.

Name of Grant	Website	Mission	Funding amount	Submission deadline
Gold Foundation Picker Gold Challenge Grant	http://www.gold-foundation.org/programs/picker-gold-challenge-grants-for-residency-training/	To support the research and development of successful patient-centered care initiatives and best practices in the education of our country's future physicians.	$15,000 - $25,000	March* May**
Gold Foundation Mapping the Landscape Grant	http://www.gold-foundation.org/programs/research/mtl/	To promote widespread understanding of the state of research on humanism in healthcare; catalyze further research in this area; and promote the integration of humanistic principles into health professions education, clinical learning environments, accreditation standards and healthcare policy.	$5,000	June
Hearst Foundations Grant	https://www.hearstfdn.org/applying-reporting/how-to-apply/	To fund educational institutions demonstrating uncommon success in preparing students to thrive in a global society with a focus on higher education.	$50,000	Not listed
SAEM Education Project Grant	http://www.saem.org/saem-foundation/grants/funding-opportunities/what-we-fund/educational-research-grant	To foster innovation in teaching, education, and educational research in emergency medicine for faculty-, fellow-, resident- and medical student-level learners.	$20,000	August
The Josiah Macy, Jr. Foundation Grants	http://macyfoundation.org/apply	To support research in interprofessional education and teamwork, new curriculum content, new models for clinical education, career development in health professions education, and education for the care of underserved populations.	Not listed	No due date requirement
USDOE FIPSE Grant	https://www2.ed.gov/about/offices/list/ope/fipse/index.html	To spur the development of innovations that improve educational outcomes, makes college more affordable for students and families, and develops an evidence base of effective practices.	Variable	June
AAMC GEA Regional Grants	https://www.aamc.org/members/gea/regions	To advance medical education and medical educators through faculty development, curriculum development, educational research, and assessment in undergraduate, graduate, and continuing medical education.	$3,000 - $7,000	Varies by region

SAEM, Society for Academic Emergency Medicine; *USDOE,* United States Department of Education; *FIPSE,* Fund for the Improvement of Post-secondary Education; *GEA,* Group on Educational Affairs.
*,Due date for letter of intent.
**, Due date for full proposal.

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A Review of Natural Language Processing in Medical Education

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Section Editor: Jonathan Fisher, MD, MPH
Submission history: Submitted July 12, 2018; Revision received November 7, 2018; Accepted November 16, 2018
Electronically published December 12, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39725

Natural language processing (NLP) aims to program machines to interpret human language as humans do. It could quantify aspects of medical education that were previously amenable only to qualitative methods. The application of NLP to medical education has been accelerating over the past several years. This article has three aims. First, we introduce the reader to NLP. Second, we discuss the potential of NLP to help integrate FOAM (Free Open Access Medical Education) resources with more traditional curricular elements. Finally, we present the results of a systematic review. We identified 30 articles indexed by PubMed as relating to medical education and NLP, 14 of which were of sufficient quality to include in this review. We close by discussing potential future work using NLP to advance the field of medical education in emergency medicine. [West J Emerg Med. 2019;20(1)78-86.]

INTRODUCTION

We use the term natural language processing (NLP) to refer to the field that aims to enable computers to parse human language as humans do. NLP is not a single technique; rather, it is composed of many techniques grouped together by this common aim. Two examples of NLP at an individual level are International Business Machine's Watson™ and Apple's Siri®. For example, Watson used NLP to convert each question on *Jeopardy!* into a series of queries that it could ask its databases simultaneously.[1] Siri uses NLP to translate speech into commands to navigate the iPhone® or search the Internet.[2]

NLP reformats text to make that text amenable for subsequent analysis with techniques from machine learning or artificial intelligence. That text may come from clinician documentation, billing documentation, transcripts of patient-provider or provider-provider interactions, or even social media discussions. It converts text into a textual data stream that may be paired with data streams from physiological monitors (cardiac monitors, pulse oximetry), wearables, or laboratory tests. NLP has been successful in scaling up some components of medical decision-making, developing tools for risk stratification,[3] identifying postoperative complications after inpatient surgery from physician notes,[4] and triaging patients by identifying syndromes.[5]

A Primer on Natural Language Processing

An important use of NLP is to translate, or map, words or phrases onto concepts. We want the computer to look past the sequence of letters to the concept denoted. We do not parse *hypoxia* as merely a string of letters. Mapping from words or phrases to concepts involves: 1) breaking a sentence into tokens (tokenization); 2) lemmatizing each token (lemmatization); and 3) mapping each lemma (the standard form of a word) onto one or more concepts. Some applications of NLP only perform steps 1 and 2, analyzing lemmata instead of concepts. This is appropriate for a domain where there is no accepted mapping between lemmata and concepts, or where the mapping is very close to one-to-one.

Tokenization

A *token* is a word or phrase that refers to one concept; for example, *cell* and *mast cell* are both tokens. A common algorithm for breaking a sentence into tokens, termed tokenization, is to break a phrase on spaces. Breaking on spaces converts the sentence *the quick fox jumped over the lazy dog* into the list of tokens [*the*, *quick*, *fox*, *jumped*, *over*, *the*, *lazy*, *dog*]. Breaking a string on spaces is inadequate for technical vocabulary where a token may involve multiple words, for example *mast cell* or *red blood cell*. Most modern programming languages, including C, R, Python, Ruby, Java, and Clojure have libraries or plugins that can tokenize English words.

Lemmatization

The lemma of a word is the form of that word that would be found in a dictionary. Standardization, or (preferably) lemmatization, refers to the process of mapping a token, for example *red blood cells*, onto a lemma, here *erythrocyte*. Lemmatizing may also include standardizing spelling (e.g., mapping "tonight" and "tonite" both to "tonight") and expanding abbreviations (e.g., mapping DOE to dyspnea on exertion). The word lemma is the linguistic term for the base form of a word. Most modern programming languages, including C, R, Python, Ruby, Java, and Clojure have libraries or plugins that can lemmatize English words.

The traditional order of NLP is first to tokenize and then lemmatize the text. It may be more productive to lemmatize, tokenize, and lemmatize texts that contain medical vocabulary. The first lemmatization maps all words or phrases to their dictionary form. Before tokenization, phrases from the text can be removed if they occur on a list. This provides a transparent way to identify in the text and move to a list of tokens phrases, such as *mast cell* or *red blood cell*, without having to enumerate all lexical (spelling) variants of each phrase. A similar approach can be used to create lists of words that are to be removed from the text and discarded. These words, termed stopwords, are words that are considered noise for the topic at hand. In our experience we've found that it is better to leave stopwords in, if possible. The most common words in the English language are stopwords. Leaving stopwords in provides an internal control for analysis methods that hinge on comparing the frequencies of tokens.

Mapping a Lemma to a Concept

The mapping of a word to a concept is difficult. A word has many meanings and many words express the same meaning, a phenomenon termed polysemy. The mapping can change over time as the meaning or popularity of a word changes. The meaning of a word may depend on the speaker and context.

One successful and automated approach groups lemmata together based on their patterns of occurrence in a body of text (corpus). The underlying conceptual hypothesis is that lemmata whose patterns of occurrence are statistically significantly correlated are describing the same thing. The term *topic* is usually used instead of concept to denote that words found by statistical co-occurrence may not share as close a meaning as the phrase "referring to the same concept" implies. Although this approach is quick and not overwhelmed by large amounts of data, its conceptual hypothesis suffers from the same weakness, as do all approaches that attempt to infer meaning from the frequency of tokens or lemmata. The most frequent words may not be the most important words. While words such as *unremarkable* or *normal* are ubiquitous in clinical documentation, they are less informative than rarer phrases such as *absent lung sounds*.

Latent Dirichlet Allocation

Latent Dirichlet allocation (LDA), also called topic modeling, expresses a piece of text as a weighted linear combination of topics, just as a generalized linear model expresses a dependent variable as a weighted linear combination of independent variables. All documents are composed by mixing the same topics. One document differs from another in the relative weight it gives to each topic. In LDA, topic denotes a group of words that occur together more often than would be expected by chance. The set of words [coronary, artery, disease], for example, could be a topic. LDA topics are correlated because they share words and so cannot be considered independent variables. This may make it difficult to include the results of topic modeling in multivariate regression models.

How Natural Language Processing Could Help Medical Education in Emergency Medicine (EM)

NLP could help medical education in EM in the following ways:

1. By applying techniques used to analyze trainee documentation in other areas to analyze documentation in the emergency department
2. By applying NLP techniques to FOAM.

Analyzing EM Documentation to Track Resident Performance

Graduate medical education in EM aims to produce emergency physicians. The assessment of medical knowledge occurs, traditionally, through standardized oral and written exams. NLP provides a way to infer the development of medical decision-making from the documentation that residents routinely generate. This evaluation occurs continuously, unobtrusively, and in the resident's usual working environment.

Figure 1 is our schematic of how NLP could be used to compare three residents as they progress in training. The upper left corner shows sample inputs, which could be evaluations completed by attendings after a shift. Performing LDA on that text, after preprocessing, tokenizing, and lemmatizing, yields the topics in the upper right. A lemma can belong to more than one topic, although Figure 1 shows parts of topics with unique words for the sake of exposition. The labels for each topic (underbrace text) are generated by expert review, not the LDA algorithm. The manual review of topics provides a natural point for investigators to check the quality of their data and analysis. The topics are the same across all residents. The weights differ, as the subscripts indicate. One can track the value of these weights cross-sectionally (lower right panel) or longitudinally (lower left panel). This tracking can be done automatically and continuously, allowing each resident to be compared with an ever-growing reference database.

Free Open Access Medical Education (FOAM)

FOAM is an increasingly prominent source of asynchronous education materials.[6] FOAM resources include websites, podcasts, or blog posts where those interested in emergency care discuss, comment, and provide access to content related to emergency care. Few FOAM resources are peer-reviewed. FOAM and social media provide a way for residents to engage with the dissemination and incorporation of (new) knowledge into EM. The structure, scale, and variable

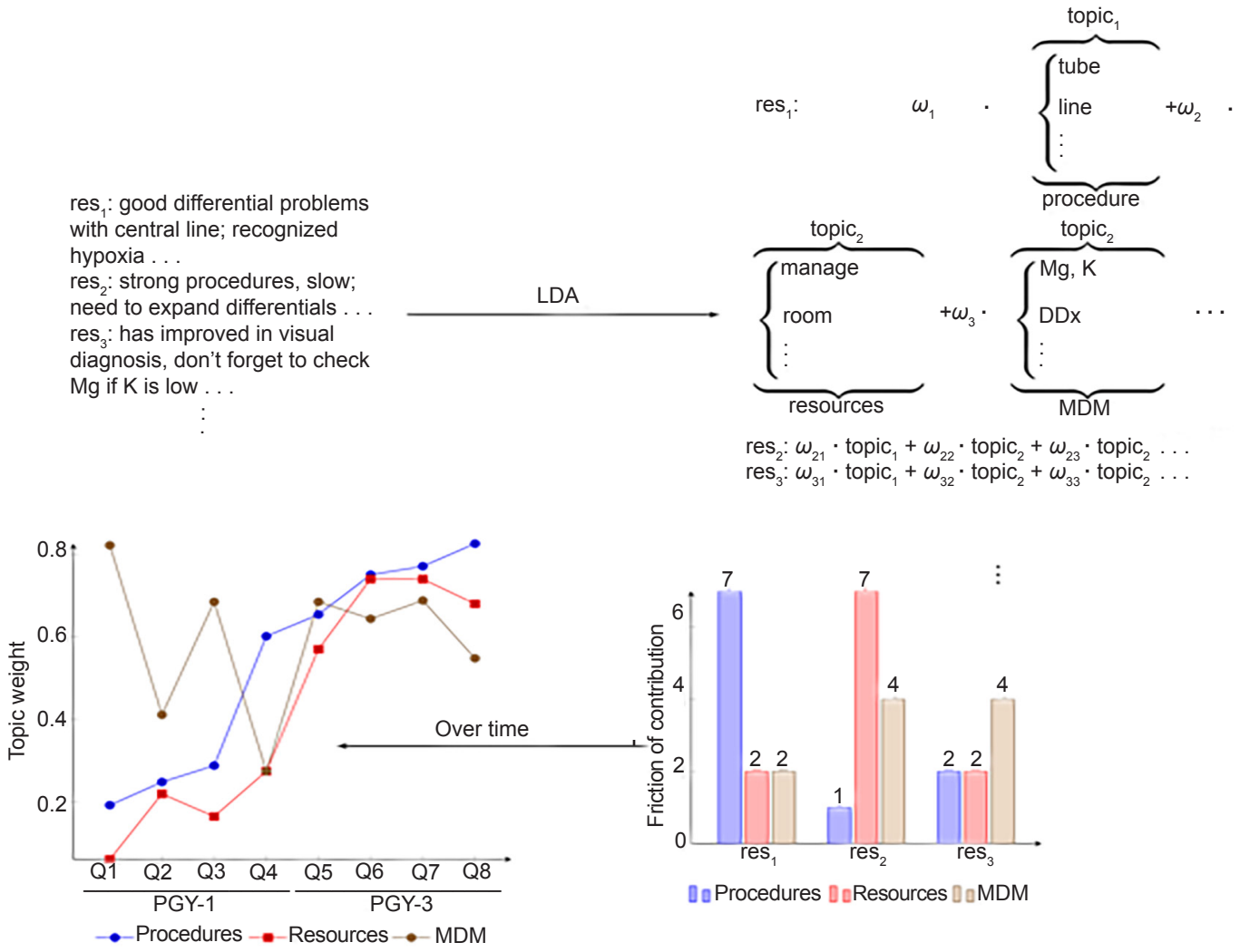

Figure 1. Hypothetical example of the use of natural language processing to quantify the evolution of resident medical decision-making as assessed by attending evaluations. [Schematic made by authors].
PGY; post graduate year; *Q*, quarter; *MDM*, medical decision making; *Mg*, magnesium; *K*, potassium; *DDx*, differential diagnosis; *ω*, topic weight; LDA, latent Dirichlet allocation.

quality of FOAM, however, make these resources difficult to include in residency training. NLP could provide structure to FOAM and social media, making it easier to incorporate these resources into residency curricula. Manual curation of parts of FOAM risks missing resources and is time-consuming.

NLP could help residents prioritize FOAM resources in the following way: A group of experts constructs topics it agrees is essential for any FOAM article to have; we would then use topic modeling to identify which FOAM resources have enough of these topics. An alternative method is to determine which topics are present in FOAM resources to see whether there is any intrinsic ordering to FOAM resources.

NLP could help organize FOAM by identifying which topics were most prevalent. A cross-sectional analysis of the relative prevalence of topics could be informative in identifying areas relatively lacking in discussion. A manual curation of those topics could identify lemmata that were markers of quality. A subsequent algorithm could use these markers of quality to automatically rate each website, in effect scaling up the efforts by Academic Life in Emergency Medicine (ALiEM), which currently rely on a panel of experts to review each blog post.[7,8] In addition, NLP could quickly reassess resources whose content has changed.

METHODS

To gauge how researchers are using NLP to evaluate medical students or residents, we searched PubMed for all English-language full-text case reports, clinical trials, or original research articles that contained the text "natural language processing in medical education." Our search identified 30 articles. We divided the studies into five categories: patient simulation, evaluation of documentation, tracking clinical exposure, question banks, and "not related." From those 30 articles authors MC and AM identified, through manual curation, 13 that described the use of NLP in medical education. Figure 2 summarizes our acquisition of data in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISM-A) format. Table 1 describes the 17 studies excluded from further analysis because they did not involve the analysis with NLP of resident or medical student textual output. Table 2 lists the 13 studies that were analyzed. The rest of this article discusses only those manuscripts related to the evaluation of documentation.

RESULTS

Evaluation of Documentation

Zhang et al. demonstrated that latent Dirichlet allocation could be used to quantify the degree to which attending

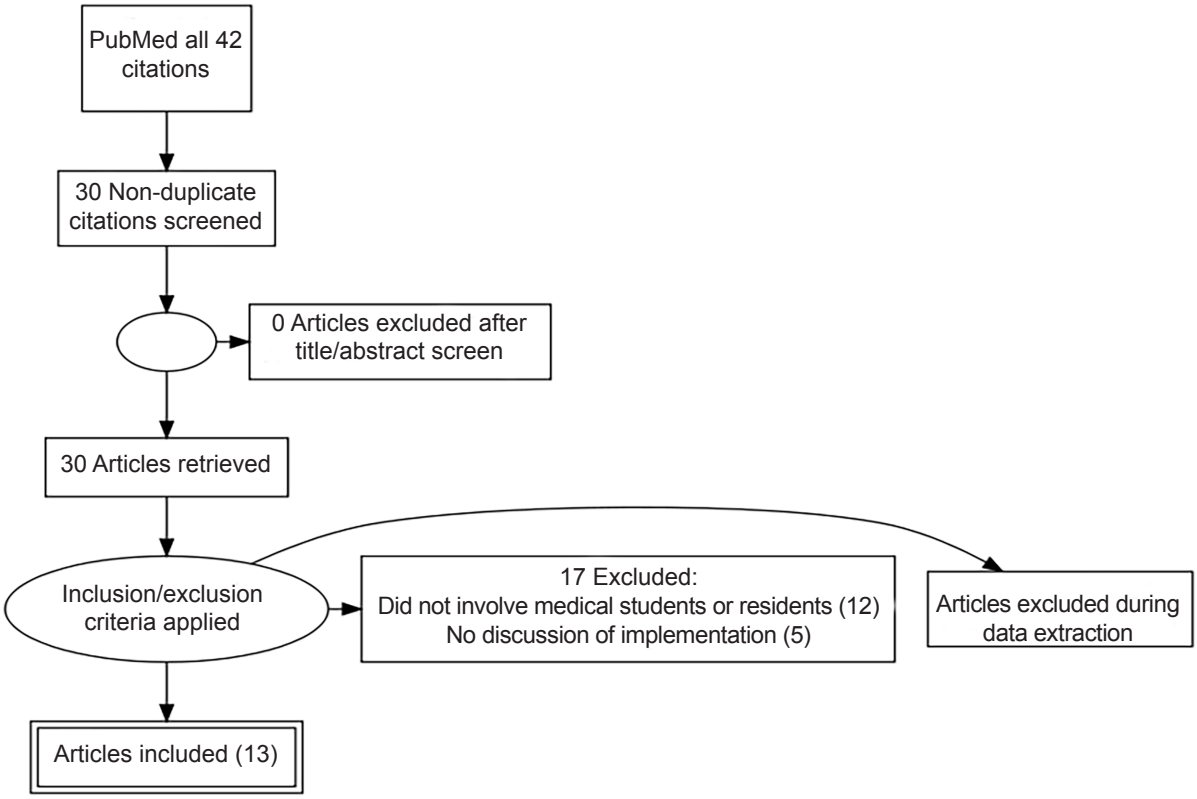

Figure 2. Preferred reporting items for systematic reviews and meta-analyses (PRISM-A) style flowchart detailing extraction, screening, and inclusion of articles.

Table 1. Seventeen studies that were excluded from further analysis.

Citation	Title	Level of evidence	Reason excluded
Evaluation of documentation			
Madhavan et al. (2014). *J Grad Med Educ.* 2014;6(3):577-80. doi: 10.4300/JGME-D-13-00267.1. PMID: 26279789	Evaluation of Documentation Patterns of Trainees and Supervising Physicians Using Data Mining	2	Analyzes when trainees and attendings document, not what they document
Divita et al. (2017) *Stud Health Technol Inform.* 2017;245:356-60. doi: 10.3233/978-1-61499-830-3-356 PMID: 29295115	General Symptom Extraction from VA Electronic Medical Notes	4	Does not discuss medical education
Park et al. (2015) *AMIA Annu Symp Proc*. 2015:1024-33. eCollection 2015. PMID: 26958240	Homophily of Vocabulary Usage: Beneficial Effects of Vocabulary Similarity on Online Health Communities Participation	4	Does not involve medical students or residents
Park et al. (2015) *J Med Internet Res*. 2015;17(8):e212. doi: 10.2196/jmir.4612. PMID: 26323337	Automatically Detecting Failures in Natural Language Processing Tools for Online Community Text	4	Does not involve medical students or residents
Karmen et al. (2015) *Comput Methods Programs Biomed*. 2015;120(1):27-36. doi: 10.1016/j.cmpb.2015.03.008. PMID: 25891366	Screening Internet forum participants for depression symptoms by assembling and enhancing multiple NLP methods	3	Does not involve medical students or residents
Turner et al. (2015) *J Biomed Inform.* 2015;53:136-46. doi: 10.1016/j.jbi.2014.10.005. PMID: 25445922	Modeling workflow to design machine translation applications for public health practice	5	Does not involve medical students or residents
Turner et al. (2015) *Stud Health Technol Inform.* 2015;216:979. doi: 10.2196/publichealth.4779 PMID: 26262281	Machine assisted Translation of Health Materials to Chinese: An Initial Evaluation	4	Does not involve medical students or residents
Radiology			
Solti et al. (2009) *Proceedings (IEEE Int Conf Bioinformatics Biomed)*. 2009:314-19. doi: 10.1109/BIBMW.2009.5332081 PMID: 21152268	Automated Classification of Radiology Reports for Acute Lung Injury: Comparison of Keyword and Machine Learning Based Natural Language Processing Approaches	4	Does not involve medical students or residents
Hersh et al. (2001). *J Biomed Inform.* 2001;34(4):262-73. doi: 10.1006/jbin.2001.1025 PMID: 11977808	Selective automated indexing of findings and diagnoses in radiology reports	4	Does not involve medical students or residents
Overby et al. (2009) *BMC Bioinformatics.* 2009;10 Suppl 9:S8. doi: 10.1186/1471-2105-10-S9-S8. PMID: 19761578	The potential for automated question answering in the context of genomic medicine: An assessment of existing resources and properties of answers	5	Not a primary research article Does not involve medical students or residents Duplicate of prior article
Rosse and Mejino (2003). *J Biomed Inform.* 2003;36(6):478-500. doi: 10.1016/j.jbi.2003.11.007 PMID: 14759820	A reference ontology for biomedical informatics: the Foundational Model of Anatomy	5	Does not involve medical students or residents

doi, digital object identifier; *PMID*, PubMed IDentifier; *VA*, Veterans Affairs.

Table 1. Continued.

Citation	Title	Level of evidence	Reason excluded
Wehbe et al. (2003) *AMIA Annu Symp Proc.* 2003:1049. PMID: 14728552	Formative evaluation to guide early deployment of an online content management tool for medical curriculum	5	Does not involve medical students or residents Describes content development, but no implementation or evaluation
Distelhorst et al. (2003). *AMIA Annu Symp Proc.* 2003:200-4. PMID: 14728162	A prototype natural language interface to a large complex knowledge base, the Foundational Model of Anatomy	4	Does not involve medical students or residents, interface intended for "domain experts in anatomy"
Chu and Chan (1998). *Comput Biol Med.* 1998;28(5):459-72. doi: doi.org/10.1016/S0010-4825(98)00027-4 PMID: 9861505	Evolution of web site design: implications for medical education on the Internet	5	Not a primary research article
Séka et al. (1998). *Stud Health Technol Inform.* 1998;52 Pt 2:772-6. doi: 10.3233/978-1-60750-896-0-772 PMID: 10384566	A virtual university web system for a medical school	4	Describes content development, but no implementation or evaluation
Webhe and Spickard (2005). *AMIA Annu Symp Proc.* 2005:794-8. PMID: 16779149	How students and faculty interact with a searchable online database of the medical curriculum	3	Compares trainee and attending interaction with a previously created database Creation of database involved NLP
Patient simulation			
Persad et al. (2016). *Med Educ.* 2016;50(11):1162-63. doi: 10.1111/medu.13197. PMID: 27762013	A novel approach to virtual patient simulation using natural language processing	4	Structured abstract incorrectly marked as a manuscript
Oliven et al. (2011) *Stud Health Technol Inform.* 2011;169:233-7. doi: 10.3233/978-1-60750-806-9-233 PMID: 21893748	Implementation of a web-based interactive virtual patient case simulation as a training and assessment tool for medical students	4	No description of NLP techniques used

doi, digital object identifier; *PMID*, PubMed IDentifier; *NLP*, natural language processing.

feedback to a resident evaluated that resident from the perspective of each of the Accreditation Council for Graduate Medical Education (ACGME) milestones and the degree to which the feedback was positive or negative.[9] An improved methodology could be used to track this sentiment for each milestone over time to automatically identify residents with a change in resident sentiment. The improvements would be to use lemmata instead of words, allow words to be associated with more than one milestone, and to validate the evaluations of residents the algorithm produces against the actual evaluations of those residents. Such an automated curation of attending evaluations could provide objective context as to whether one incident was isolated or one in a long train of similar incidents. Because software identifies the problem, it removes the question of personal bias and may help to focus the discussion more about the issue than who identified the issue.

Denny et al. used NLP to evaluate the ability of third-year medical students to develop a full differential for altered mental status in the elderly patient and discuss advance directives.[10] In that study a computer program analyzed the notes each student wrote every day to identify whether the medical student had participated in a goals-of-care discussion if the patient was over 65, and the patient was being evaluated for altered mental status. If the patient was being evaluated for altered mental status, the algorithm also assessed whether the medical student had generated a comprehensive differential.

This study mapped text to medical concepts by tokenizing the student notes, normalizing those tokens to lemmata, and mapping each lemma from each note onto Unified Medical

Table 2. Studies included for further analysis.

Citation	Title	Level of evidence
Evaluation of documentation		
Denny et al. (2015). *J Biomed Inform.* 2015;56:292-9. doi: 10.1016/j.jbi.2015.06.004. PMID: 26070431	Using natural language processing to provide personalized learning opportunities from trainee clinical notes	3
Denny et al. (2010). *AMIA Annu Symp Proc.* 2010;2010:157-61. PMID: 21346960	Comparing content coverage in medical curriculum to trainee-authored clinical notes	3
Spickard et al. (2014). *Med Teach.* 2014;36(1):68-72. doi: 10.3109/0142159X.2013.849801. PMID: 24195470	Automatic scoring of medical students' clinical notes to monitor learning in the workplace	
Zhang et al. (2012). *AMIA Annu Symp Proc.* 2012;2012:1459-68. PMID: 23304426	Automated assessment of medical training evaluation text	3
Da Silva, Dennick (2010). *Med Educ.* 2010;44(3):280-8. doi: 10.1111/j.1365-2923.2009.03575.x. PMID: 20444059	Corpus analysis of problem-based learning transcripts: an exploratory study	4
Tracking clinical exposure		
Denny et al. (2009). *J Biomed Inform.* 2009;42(5):781-9. doi: 10.1016/j.jbi.2009.02.004. PMID: 19236956	Tracking medical students' clinical experiences using natural language processing	3
Chen et al. (2014). *AMIA Annu Symp Proc.* 2014;2014:375-84. eCollection 2014. PMID: 25954341	Automated Assessment of Medical Students' Clinical Exposures according to AAMC Geriatric Competencies	3
Question banks		
Wedgwood (2005). *AMIA Annu Symp Proc.* 2005:1150. PMID: 16779436	MQAF: a medical question-answering framework	4

PMID, PubMed identification; *doi*; digital object identifier; *AAMC*, Association of American Medical Colleges.

Language System (UMLS) tags. (Lemma refers to the standard form of a word; see "An Introduction to Natural Language Processing" below.) The authors used the same system to assess the prevalence of key concepts, as defined by the American Association of Medical Colleges, a medical student must-see during his or her medical clerkship.[12,13] The authors used the UMLS Metathesaurus, a graph of semantic relationships between words, to map a lemma to the concepts it likely represents. Each concept is represented by a basket of lemmata.[14] The algorithm marks a student note as containing that concept if that note contained a lemma. The software uses context clues to choose which lemma-concept mapping is the most likely. This study provides an example of how NLP may also improve documentation by medical students by providing an "enhanced spell-checker" while providing real-time feedback that has educational value. The Center for Medicaid Services allows physicians to document the review of systems, past family history, and past social history documented by medical students.[11]

Zhang et al. used latent Dirichlet allocation, also called topic modeling, to quantify how much of each ACGME milestone was reflected in free-text evaluations by attending internists on medical residents and whether the reflection was positive or negative.[9] The authors used topic modeling to identify clusters of thematically-related words in attending free-text evaluations. They then manually inspected each cluster, labeling each cluster as indicative of only one ACGME milestone (e.g., problem-based learning and instruction, or professionalism, or systems-based practice). The authors then calculated the relative prevalence of each

cluster/milestone in each note and sentiment, also called emotional valence, associated with those prevalences. The authors, however, did not assess whether the calculated prevalences or the cluster assignments agreed with attending impression. The requirement that each word belong to only one cluster simplifies the calculation of prevalence, but may be an oversimplification. A word can have multiple meanings. The ACGME milestones are not entirely separate domains. For example, some overlap is to be expected in words used to evaluate a resident in the domains of professionalism, patient-based care, and systems-based practice.

Da Silva and Dennick tokenized transcripts from problem-based learning sessions involving attending physicians and a group of first- or second-year medical students.[15] The authors identified common medical words or phrases, such as hepatitis or red blood cell. Across three sessions, the authors demonstrated an increase in the interposition of subordinating conjunctions between tokens representing medical concepts – hepatitis (medical token) caused by (subordinating conjunction) alcohol (medical token). This suggests that participants were verbalizing, and perhaps integrating, more clinical reasoning as the sessions progressed.

LIMITATIONS

The purpose of this article was to provide medical educators with an introduction to NLP and survey current applications of NLP that may be of interest to educators. A limitation ubiquitous in any survey of a field is publication bias. This article only considered published manuscripts, which may provide a biased representation of the scope and success of the field. Some researchers may release source code for software to online platforms such as GitHub or describe their research via social media.

CONCLUSION

This article reviewed recent applications of natural language processing to medical education, introduced concepts from NLP used in those applications, and then suggested avenues for its application to medical education in EM. Incorporating NLP into residency education could help program directors better track the progression of their residents across quantitative and qualitative domains, automatically and continuously. Residents with diverse backgrounds, from the humanities to programming, and diverse interests, from international EM to informatics, could contribute to the development of NLP tools, the incorporation of existing NLP tools into the clinical workflow, or the inclusion of FOAM resources into residency education. NLP provides a way to represent clinical reasoning in a form that computers can understand, perhaps one day creating something that can access data at the speed of a computer and reason with the abstraction of an outstanding clinician.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Standardized Video Interviews Do Not Correlate to United States Medical Licensing Examination Step 1 and Step 2 Scores

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Section Editor: Jonathan Fisher, MD, MPH
Submission history: Submitted July 12, 2018; Revision received October 8, 2018; Accepted November 16, 2018
Electronically published December 12, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39730

Introduction: In 2017, the Standardized Video Interview (SVI) was required for applicants to emergency medicine (EM). The SVI contains six questions highlighting professionalism and interpersonal communication skills. The responses were scored (6-30). As it is a new metric, no information is available on correlation between SVI scores and other application data. This study was to determine if a correlation exists between applicants' United States Medical Licensing Examination (USMLE) and SVI scores. We hypothesized that numeric USMLE Step 1 and Step 2 Clinical Knowledge (CK) scores would not correlate with the SVI score, but that performance on the Step 2 Clinical Skills (CS) portion may correlate with the SVI since both test communication skills.

Methods: Nine EM residency sites participated in the study with data exported from an Electronic Residency Application Service (ERAS®) report. All applicants with both SVI and USMLE scores were included. We studied the correlation between SVI scores and USMLE scores. Predetermined subgroup analysis was performed based on applicants' USMLE Step 1 and Step 2 CK scores as follows: (≥ 200, 201-220, 221-240, 241-260, >260). We used linear regression, the Kruskal-Wallis test and Mann-Whitney U test for statistical analyses.

Results: 1,325 applicants had both Step 1 and SVI scores available, with no correlation between the overall scores (p=0.58) and no correlation between the scores across all Step 1 score ranges, (p=0.29). Both Step 2 CK and SVI scores were available for 1,275 applicants, with no correlation between the overall scores (p=0.56) and no correlation across all ranges, (p=0.10). The USMLE Step 2 CS and SVI scores were available for 1,000 applicants. Four applicants failed the CS test without any correlation to the SVI score (p=0.08).

Conclusion: We found no correlation between the scores on any portion of the USMLE and the SVI; therefore, the SVI provides new information to application screeners. [West J Emerg Med. 2019;20(1)87-91.]

INTRODUCTION

Residency program directors (PD) screen large volumes of applications each recruitment season. A significant portion of each application is subjective, leaving ambiguity in data interpretation. Additionally, the medical student performance evaluation (MSPE) includes selected quotations from clinical clerkships and may or may not make a summative comparison of students to their peers. Emergency medicine (EM) has attempted to standardize recommendation letters and clerkship-grading transparency through the Standardized Letter of Evaluation (SLOE).[1] Without standardization, letters of recommendation showed grade inflation, lack of meaningful comparison between applicants, and the inability to use them as discriminatory tools for success in residency.[2-4] Inconsistencies in grades and evaluations by gender have also been demonstrated in other specialties.[5] Even with standardized letters in several specialties, the use of the full spectrum of global assessments has not been found consistently nor has the accurate prediction of an applicant's position on the rank list.[1,6,7]

The only fully objective data on the residency application are the licensing examinations (United States Medical Licensing Examination [USMLE] and the Comprehensive Osteopathic Medical Licensing Examination [COMLEX]). These exams allow for direct applicant comparison as opposed to grades, which vary between schools. USMLE Step 2 Clinical Skill (CS) and COMLEX Step 2 Performance Evaluation (PE) require medical students to perform a history and physical examination on standardized patients. Step 2 CS "uses standardized patients to test medical students on their ability to gather information from patients, perform physical exams and communicate their findings to patients and colleagues."[8] These exams also incorporate communication skills to patients and colleagues into the final pass/fail grade. In its rationale for the Step 2 CS portion, the USMLE reports that poor communication and interpersonal skills are a reason for complaints against physicians. The scores on this portion of the examination also predict the success of these skills in first-year residents.[9]

During the 2017-2018 application season, the Association of American Medical Colleges (AAMC) instituted the Standardized Video Interview (SVI) as part of the EM residency application process. Using six questions, the SVI sought to provide objective information related to interpersonal and communication skills, and knowledge of professional behaviors.[10] Applicants answered each question for up to three minutes, and a trained rater scored each video on a scale of 1-5, yielding a summative score of 6-30. Trained raters used anchors based on behavioral examples defining the proficiency level for each competency. Additionally, in their training raters examined PDs' ratings of video examples to understand their perspective and develop consistency with their thought processes.[11] On the Electronic Residency Application Service (ERAS®) application, the AAMC provided the numerical score and full video recordings for review. Developers of the SVI sought to provide a more holistic presentation of the applicants beyond traditional test scores.[12]

Given the new data available to PDs, we sought to identify whether a correlation exists between any component of the USMLE examinations and the summative SVI score. Of particular interest was Step 2 CS, which incorporates interpersonal and communication skills into its evaluation. If no correlation between USMLE and SVI scores exists, this suggests that the SVI provides a new piece of information not previously available on the residency application. We hypothesized that numeric Step 1 and Step 2 Clinical Knowledge (CK) scores would not correlate with the SVI score, but that performance on the Step 2 CS portion may correlate with the SVI since both test communication skills.

METHODS

This was a prospective, cross-sectional study during the 2017-2018 residency application cycle. The study included nine Accreditation Council of Graduate Medical Education (ACGME)-accredited EM residency programs. Each site exported data directly from the ERAS applications, including the SVI score and scores for each component of the USMLE. Unique applicants were identified by their AAMC identification numbers and only included once in the analysis. We included only applicants with an SVI score and at least one score on the USMLE. We studied correlations between USMLE scores and SVI scores. Predetermined subgroup analysis was performed based on applicants' USMLE Step 1 and Step 2 CK scores as follows: </= 200, 201-220, 221-240, 241-260, >260. USMLE Step 2 CS is graded pass or fail.

We used linear regression to examine correlation between SVI score and USMLE Step 1 and Step 2 CK scores. The Kruskal-Wallis test was used to compare SVI scores with USMLE subcategory scores. We performed the Mann-Whitney U test to compare SVI scores and USMLE Step 2 CS scores.

The study was reviewed by the institutional review board at the primary site.

RESULTS

A total of 1,329 unique applicants had an SVI score and at least one USMLE step score and were included in the analysis (Table 1). Of these, 1,325 had USMLE Step 1, 1,275 had USMLE Step 2 CK, and 1,000 had USMLE Step 2 CS scores available. Mean scores were as follows: SVI 19.6 (+/- 3.0, range 9-28); USMLE Step 1 231 (+/- 16.0, range 191-273); USMLE Step 2 CK 244 (+/- 14.8, range 188-282).

Using linear regression we found no correlation between

the SVI score and overall USMLE Step 1 (p=0.58) or Step 2 CK score (p=0.56, Figure). In subgroup analysis, there was no correlation with specific scores for either Step 1 (p=0.29) or Step 2 CK (p=0.10, Table 2).

Four of the 1,000 students who had a CS score failed the examination. This did not correlate with the SVI score (p=0.08, Table 2).

DISCUSSION

During the 2017-2018 application season, the SVI score provided an additional objective metric to the EM residency application. This score was intended to measure interpersonal and communication skills, and knowledge of professional behaviors, features not otherwise captured in an objective way on the application. The evaluations of students during their undergraduate medical education are difficult to compare, as schools have varied grading policies and distributions. Data suggest varied correlations between elements of the application and prediction of success in residency, including the USMLE and induction into honor societies such as Alpha Omega Alpha.[13,14]

The USMLE provides PDs with a standardized metric as a result of a uniform grading system across all test-takers. In Step 1 and Step 2 CK, examinees answer multiple choice questions related to the basic sciences and then clinical medicine. In this analysis, we found that both overall score on the USMLE as well as individual ranges of score did not correlate with performance on the SVI. Given that the SVI was designed to specifically assess interpersonal and communication skills, as well as knowledge of professional

Table 1. Demographics of emergency medicine residency programs and applicants.

Screener demographics	
Residency programs	
Number of programs	9
University	8 (89%)
Community	1 (11%)
Northeast	4 (40%)
South	3 (30%)
West	2 (30%)
Three-year training programs	7 (78%)
Four-year training programs	2 (22%)
Applicant demographics	n=1329
Mean age	27.6 +/- 3.1 (Range 19-51)
Gender	
Male	64.8%
Medical school location	
Northeast	34.3%
Central	18.7%
South	31.0%
West	12.3%
International	3.3%
Medical school type	
US private	35.7%
US public	51.9%
Osteopathic	9.0%
International	3.3%

US, United States.

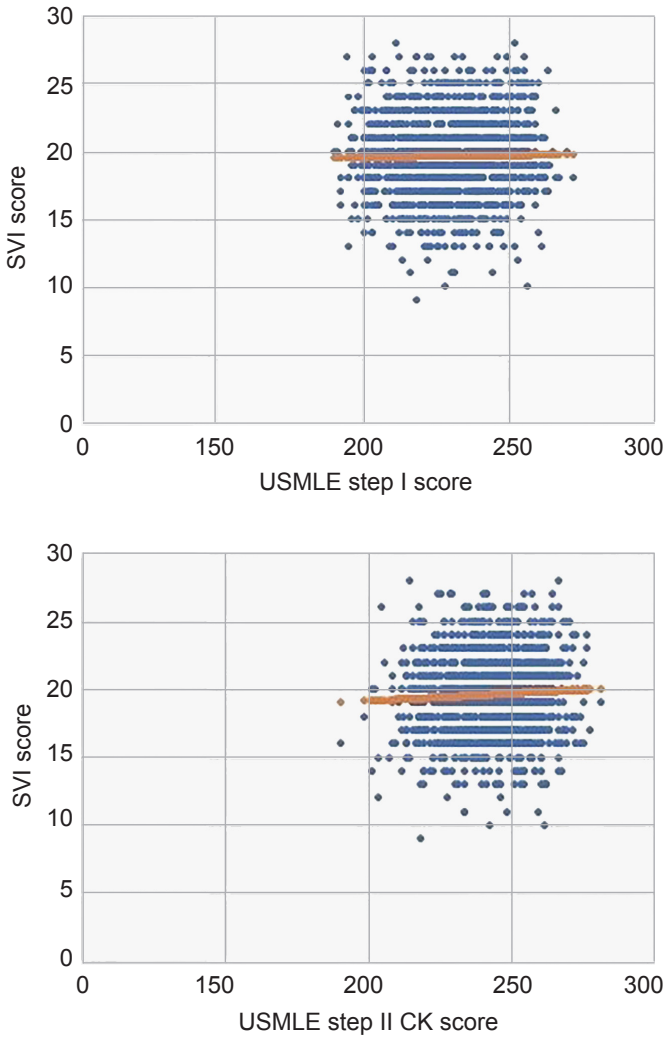

Figure. USMLE step I score versus SVI score (top). USMLE step II CK score versus SVI score (bottom).
USMLE, United States Medical Licensing Examination; *SVI*, standardized video interview; *CK*, clinical knowledge.

Table 2. USMLE score range with mean SVI score.

	n	Mean SVI (95%CI)	P value
USMLE Step 1 score			
≤200,	30	19.7 (18.6-20.9)	0.29
201-220,	323	19.7 (19.4-20.0)	0.29
221-240,	591	19.5 (19.2-19.7)	0.29
241-260,	354	19.8 (19.5-20.1)	0.29
>260	27	19.0 (18.0-26.0)	0.29
USMLE step 2 CK score			
≤200	3	16.7 (13.8-19.5)	0.10
201-220	98	19.1 (18.4-19.8)	0.10
221-240	402	19.6 (19.3-19.8)	0.10
241-260	610	19.6 (19.4-19.9)	0.10
>260	162	19.8 (19.4-20.3)	0.10
USMLE step 2 CS score			
Pass	996	19.8 (19.6-20.0)	0.08
Fail	4	16.8 (11.5-22.0)	0.08

USMLE, United States Medical Licensing Examination; *SVI,* standardized video interview; *CK,* clinical knowledge; *CS,* clinical skills; *CI,* confidence interval.

behaviors, it is not surprising that we found no correlation between the USMLE Step 1 and Step 2 CK scores and the SVI score.

The CS portion of the USMLE Step 2, however, assesses communication skills using a standardized patient encounter. Since the SVI also focuses on components of communication, we hypothesized that a correlation could exist between these two scores. In this dataset, only four out of 1,000 (0.4%) applicants who had a CS score available failed the examination. This analysis suggested a trend towards a correlation more than the other analyses; however, it did not achieve statistical significance. Given the extremely low failure rate on the CS examination, it is difficult to assess this correlation. Additionally, the correlation is limited by our inability to break out the analysis by specific USMLE Step 2 CS subcomponent (Communication and Interpersonal Skills; Spoken English Proficiency; and Integrated Clinical Encounter) score ranges. Our results support the notion that the SVI may provide unique information on the residency application. At least in comparison with the USMLE – the only other standard score on the application – we found no correlation between the two scores.

Our results are consistent with those reported by the AAMC.[15] The AAMC contends that Step 2 CS and the SVI measure related but different constructs.[10] For example, Step 2 CS measures spoken English proficiency, which is not measured by the SVI. Similarly, the SVI measures teamwork, which is not measured by Step 2 CS. Over time, PDs will benefit from more SVI data including its ability to predict in-person interview scores, success during residency, chief resident selection, and professionalism or communication remediation.

LIMITATIONS

Given the study design with nine EM residency programs, only 1,329 of the 2,901 total applicants to United States EM residency programs in the 2017-2018 application season were included.[16] This may limit the overall generalizability of the data set. Additionally, in the cohort of 1,000 applicants in which USMLE Step 2 CS scores were available, only four persons failed the examination, which may have impacted the ability to detect any correlation between this examination and the SVI score.

CONCLUSION

In this analysis, we found no correlation between the SVI score and any component of the USMLE. As a result, the SVI may provide a unique piece of data for PD interpretation. It is unclear how it will correlate long term with resident performance or success. Additionally, further investigation will help to determine whether the SVI score impacts the decision-making of PDs both in the interview offer and ultimate applicant selection.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Intra-Articular Catheter Placement: A Novel Approach for Simulating Ankle Effusions in Cadaver Models

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Section Editor: Douglas S. Ander, MD
Submission history: Submitted July 14, 2018; Revision received September 5, 2018; Accepted September 29, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.9.39810
[West J Emerg Med. 2019;20(1)92–93.]

BACKGROUND

Arthrocentesis is a clinical procedure employed by a number of medical subspecialties. Two techniques are commonly used for arthrocentesis: landmark and ultrasound. A number of different models exist to teach arthrocentesis including gel, plastic, and cadaveric types. Evidence suggests that cadaver types may be superior.[1] Cadavers are an excellent model to teach arthrocentesis because their joints can be filled with fluid, creating simulated effusions.[1-3] Creating and maintaining consistent effusions for large groups of students can be challenging. The volume required to create a clear effusion varies with each cadaver, and joint capsules are prone to leakage after numerous procedure attempts.[4] Inadvertent air infiltration from repeated filling can create artifacts that limit visualization by ultrasound. Medical educators seek an arthrocentesis training model that is easily modifiable and can withstand multiple procedure attempts.

OBJECTIVE

The primary objective of this project was to develop a simple method of creating and maintaining ankle joint effusions in cadavers. Ideally, this method would allow for volume modification and be suitable for both landmark and ultrasound-guided arthrocentesis.

DESIGN

The method we present here was initially developed to address a problem that we encountered during cadaveric research. We were conducting an ankle arthrocentesis study that required simulated joint effusions. Research personnel experienced difficulty maintaining ankle joint effusions with a single-shot technique. This technique involved temporarily inserting a needle into the joint space and filling it with saline. These simulated effusions tended to leak, inhibiting successful arthrocentesis. We solved this problem by inserting a plastic intravenous (IV) catheter into the joint space. The catheter allowed us to create and maintain a consistent effusion while avoiding interference with arthrocentesis. Recognizing its utility, we adopted this method as the primary means of creating simulated, ankle-joint effusions for this study.

The ideal location for catheter placement is the anterior-lateral joint space as most arthrocentesis techniques involve a more medial approach. We used an ultrasound machine equipped with a linear transducer to help locate the lateral tibiotalar joint space. A 20G 1.75inch (Braun) IV catheter was inserted by ultrasound guidance into the tibiotalar joint. We then connected a short segment of extension tubing (with Luer Lock) to the IV catheter, and both devices were sutured to the skin (Figure). A syringe was used to aspirate free air and any synovial fluid. Using the catheter-tubing setup, 15-20 milliliters of saline was injected directly into the joint. We used ultrasound to confirm a joint effusion and guide size adjustments. Occasionally, fluid would slowly leak from the synovial capsule. This was addressed by slow saline instillation by applying steady pressure to the plunger of a 60cc syringe. The effusion size and consistency were confirmed simultaneously under ultrasound.

IMPACT/EFFECTIVENESS

We describe a method to create simulated, ankle-joint effusions. Its effectiveness was demonstrated in an ongoing research project. All ankles were filled using this method

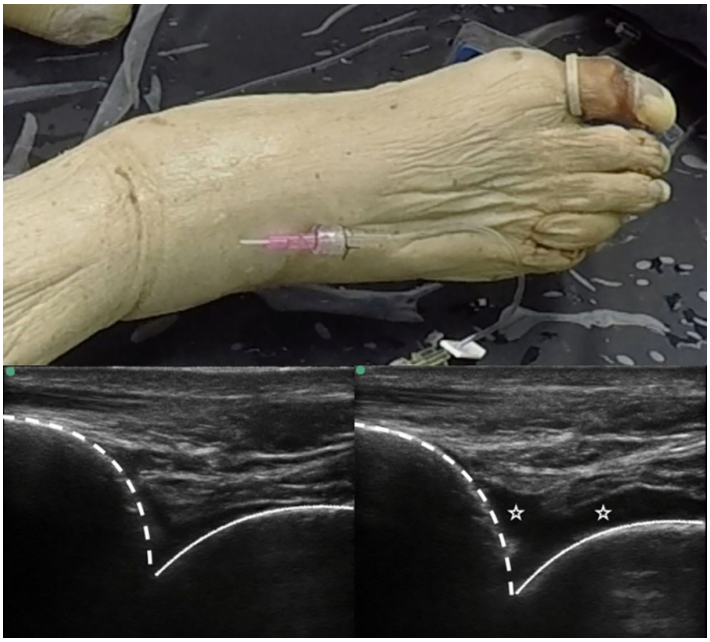

Figure. The catheter within the joint used to create effusion. Also shown are examples of an ankle pre- and post- effusion creation. The tibia (dotted line) and talus (solid line), as well as effusion (stars), are shown on ultrasound.

and each effusion was confirmed by ultrasound. A total of 14 ankles were filled and each ankle joint was aspirated at least once and, in some cases, multiple times. One ankle was aspirated 17 times with no loss of tissue integrity.

Thirty participants attempted both landmark and ultrasound-guided arthrocentesis on these ankles. In total, 60 arthrocentesis procedures were performed. Of the participants, 18 were pre-clinical medical students and 12 were emergency medicine attending physicians. None of the medical students had previously performed an arthrocentesis. Twenty-nine of 30 (97%) participants were successful using both techniques. One participant was unsuccessful in both techniques despite the presence of a confirmed effusion.

Although the participants had varying levels of experience, nearly all were able to complete arthrocentesis using this model. Multiple arthrocentesis attempts were performed successfully without comprising the model's quality. We think this model has educational benefit especially when teaching large groups. Institutions with limited access to cadavers may be able to use this technique to teach multiple learners. While fresh frozen cadavers may be preferred due to their closer approximation to live-patient tissue qualities, the logistics of having readily available specimens renders this option suboptimal. Obstacles include the high cost of acquisition and subsequent maintenance of the specimens and their relatively short time frame of usefulness once thawed.

Our method of creating simulated joint effusions performed well in embalmed cadavers. Indeed, cadavers have been shown to be a preferred model for teaching arthrocentesis.[1] We have developed a method that offers a novel way to create and maintain joint effusions in embalmed cadavers while allowing learners with various levels of experience to practice this important procedure.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Asteroids® and Electrocardiograms: Proof of Concept of a Simulation for Task-Switching Training

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Section Editor: Chris Merritt, MD, MPH
Submission history: Submitted July 12, 2018; Revision received October 5, 2018; Accepted October 13, 2018
Electronically published November 16, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39722

Introduction: Emergency physicians are interrupted during patient care with such tasks as reading electrocardiograms (ECGs). This phenomenon is known as task-switching which may be a teachable skill. Our objective was to evaluate the potential of a video game for simulating the cognitive demands required of task-switching.

Methods: Emergency medicine residents took a pretest on ECG interpretation and then a posttest while attending to a video game, Asteroids®.

Results: The 35 residents (63%) who participated, scored worse on the ECG posttest then they did on the pretest ($p<.001$; effect size=1.14). There were no differences between genders or training level.

Conclusion: Interpreting ECGs while playing the Asteroids® game significantly lowered ECG interpretation scores. This shows the potential of this activity for training residents in task-switching ability. The next phase of research will test whether ECG reading performance while task-switching improves with practice. [West J Emerg Med. 2019;20(1)94-97.]

BACKGROUND

Emergency physicians (EPs) are continuously interrupted during patient care.[1] Chisholm et al. found that EPs are interrupted nearly 10 times per hour requiring frequent shifts of attention across tasks.[2-3] How EPs respond to interruptions is just beginning to be better understood.[4] One such interruption involves the screening of electrocardiograms (ECGs) for life-threatening pathologies.

Task-switching varies with regard to the cognitive load requirements (Figure).[5-6] The ability to task-switch during patient care is something all EPs must learn.[7-8] As they progress through training, more responsibility and larger patient loads require more frequent task-switching. A method for deliberate practice of task-switching is needed to improve performance.[9]

We designed our task-switching simulation "Asteroids® and ECGs" to simulate a situation that required considerable cognitive processing while patient care related tasks (such as ECG interpretation) are gradually introduced. Our goal was to acclimate learners to shifting attention across cognitively demanding tasks.[10] Ultimately, our hope is that resident performance will improve through deliberate practice with task-switching.

OBJECTIVES

We sought to evaluate a task-switching simulation between two cognitively demanding activities with the hope that practice with the simulation might reduce the time required to switch tasks.

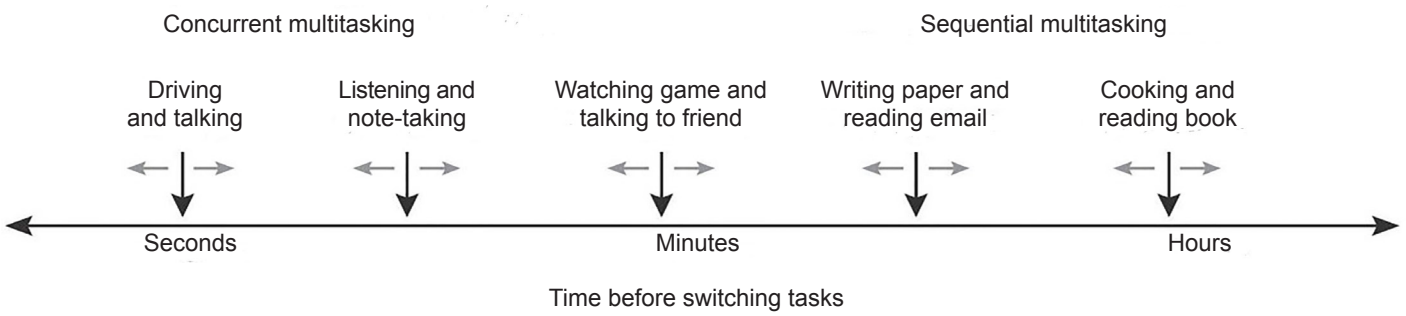

Figure. The multitasking continuum.[6]

CURRICULAR DESIGN

This study was a one-group pretest-posttest design that compared resident performance on ECG interpretation with no distractions to their performance on ECG interpretation while engaged in the video game Asteroids®.

Population

The subjects were residents from our emergency medicine (EM) and EM / internal medicine (EM/IM) programs (N=56).

Measurement/Instrumentation

The ECGs included a normal sinus rhythm or one of these patterns of pathology.

- ST-elevation myocardial infarction (STEMI)
- Complete heart block
- Ventricular tachycardia
- S1Q3T3/R-heart strain
- Brugada
- Electrical alternans
- Sinus tachycardia
- Atrial fibrillation with rapid ventricular rate or response
- Inferior-posterior STEMI
- Wellen's syndrome
- Right bundle branch block
- Mobitz II Heart Block

ECG interpretation experts reviewed each strip and labeled them with the pathology and rating of difficulty. The pretest and posttest were equated for level of difficulty. A survey specialist familiar with the project developed an evaluation questionnaire.

Study Procedure

The study was conducted during October 2017 with residents rotating through this activity on conference days.

Asteroids® (available at: http://www.freeasteroids.org/) is a video game in which the object is to prevent the player's "spaceship" from being destroyed by asteroids. The player avoids asteroids by "shooting" or dodging them and receives points for the each asteroid destroyed. Residents were allotted time to try the game. Then they had 15 minutes of uninterrupted time to read eight ECG strips, circle the abnormality, provide a diagnosis, and make a patient management decision.

After the pre-test, residents were instructed to start the video game and treat it as if it were an important clinical task. Once residents started playing, they were provided with ECG strips at random intervals throughout the 15 minutes of the exercise. As in the pretest, residents had to interpret the ECG strips; however under this condition they had to maintain the game. Subjects turned in score logs and completed a survey at the end.

Scoring

ECG pre- and post-tests were scored by assigning one point for identifying the ECG abnormality, and one point for the correct triage decision. Points were summed and converted to a percentage. We also recorded the resident's video game score.

Data Analysis

We performed analyses using IBM SPSS.[11] We first conducted a preliminary three-factor (2x2x3) analysis of variance (ANOVA) with one repeated measure: pre- and post-test score (TIME) by resident post-graduate year and gender. The subsequent significant effect of TIME was analyzed with a paired t-test and effect size.[12]

IMPACT/EFFECTIVENESS

Of 46 eligible residents, 35 (76.1%) participated in the study. Sixty percent were women, and all levels of training were equally represented.

The ANOVA resulted in no significant main-effects or interactions involving gender or postgraduate year (PGY) Level (Table). However, we observed a significant and large TIME effect, suggesting that residents performed worse on the ECG test while task-switching with the video game than they did on the ECG pretest (pre-test mean=63.2, standard deviation [SD]=13.7; Asteroids® mean=47.7; SD=12.5; t= 6.04, degrees of freedom=34, p<.001; effect size=1.19).[13]

Table. Results of a three factor (2x2x3) analysis of variance with one repeated measure involving 35 emergency medicine residents.

Source	df	Mean square	F-value	p-value
Between-subjects effects				
Gender	1	102.5	.909	.348
PGY	1	161.1	1.43	.256
Gender x PGY	2	226.3	2.00	.153
Error	29	112.8		
Within subjects effects				
Time	1	7890.9	35.07	.000*
Time x gender	1	27.0	.120	.732
Time x PGY	2	170.2	.756	.478
Time x gender x PGY	2	67.3	.299	.744
Error	29	225.0		

*Based on pretest mean and standard deviation of 63.2 (13.7) and posttest mean and standard deviation of 47.7 (12.4). Associated Cohen's d effect size for the main effect of time within this repeated measures designs was: 1.07 (95% confidence interval [.52-1.52]).[11]
PGY, postgraduate year; *df,* degrees of freedom.

All residents said the game made ECG reading more difficult. Most (91.7%) thought task-switching was difficult and more than half (53%) thought they could improve with practice.

The results confirm that the video game served as an effective distractor, requiring a cognitive load to compel EM residents to spend significant amounts of time switching between playing Asteroids® and reading ECGs. Results were similar for residents of both genders and all levels of training. The Asteroids® game yielded substantially lower ECG reading scores for everyone, regardless of their Asteroids® score or experience with gaming. We interpreted this to indicate that the Asteroids® game served as an adequate distractor regardless of previous experience or skill in video gaming. Based on this finding, we believe that this video game could be used to create an inexpensive simulation to practice task-switching. We hope that with deliberate practice under these simulated conditions the residents' task-switching improves, since cognitive psychology researchers have found evidence that multitasking is a trainable skill.[14]

LIMITATIONS

We recognize that while the Asteroids® video game serves as a significant distractor to reading and interpreting ECGs, the cognitive load of actual clinical disruptions may result in more "time to switch tasks" when compared to playing a video game.

CONCLUSION

Interpreting ECGs while playing the Asteroids® lowered ECG reading performance. Our goal was to show that this simulation could be used to improve resident's task-switching performance.

ACKNOWLEDGEMENT

The authors would like to thank the residents of the Ohio State University Wexner Medical Center Emergency Medicine Residency Program for their support of this project.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Implementation of a Departmental Female Emergency Medicine Physician Group

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Section Editor: Andrew W. Phillips, MD, MEd
Submission history: Submitted July 14, 2018; Revision received October 31, 2018; Accepted November 7, 2018
Electronically published December 10, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39827

Gender disparities exist in academic emergency medicine (EM). We developed and implemented a female EM physician group – Women in Academic Emergency Medicine (WAM) – to support female EM residents, fellows, and faculty. The goal of WAM is to provide a support system through mentorship, education, and outreach. A targeted needs assessment was completed to identify goals and objectives specific to our department. In the first full year of implementation, WAM hosted eight events, including three topical dinners and one formal panel. Of 42 female faculty and residents, 40 (95%) attended at least one WAM event, and all (20/20) of the female faculty strongly supported WAM. WAM advocated for increased female physician representation on the department's Physician Executive Leadership Group and preservation of dedicated lactation space in the emergency department. Using a needs assessment, the process of developing WAM can be replicated in any department to create a female physician group. [West J Emerg Med. 2019;20(1)98-99.]

BACKGROUND

Despite an increased number of female physicians in the workforce, gender disparities continue to exist in academic medicine, and the specialty of emergency medicine (EM) is no exception.[1] Within EM, disparities have been found in regard to salary, career advancement, and resource allocation.[2-4] A proposed method to address these disparities is the promotion of supportive environments with a focus on the organizational context and culture in which women work.[5] To support female emergency physicians (EP) in our department, we developed and implemented Women in Academic Emergency Medicine (WAM). Although female faculty groups often exist at the national and institutional level, we found no description in the EM literature of the development of a formal female faculty group at the departmental level. Thus, we present a description of our developmental process, implementation, and initial outcomes to serve as a model.

OBJECTIVES

The goal of WAM is to provide a support system for female physicians through mentorship, education, and outreach. Our objectives are to 1) promote professional advancement and leadership skills of female EPs; 2) provide mentorship opportunities and mutual support; 3) develop and present educational programming pertinent to female EPs; 4) connect members with other female physicians locally and nationally; and 5) engage the greater community through outreach opportunities.

CURRICULAR DESIGN

We used Kern's six steps of curriculum development to create the curriculum for WAM, and all female EPs were invited to participate in the development process.[6] We conducted a general needs assessment via literature review, and completed a targeted needs assessment through an anonymous online survey of female faculty and focused interviews of female residents (Appendix).[7] Goals and objectives were developed in an iterative fashion over email and subsequently deliberated among female faculty in small group sessions. Based on our targeted needs assessment, the guiding principles in implementation were to empower female physicians, maximize social contact, and leverage available resources.

Two leaders (KP, TO) planned events that covered the three pillars of WAM, and the chair agreed to support the events. Events were planned in advance, and the clinical schedule was reviewed to ascertain dates and times when the fewest female EPs were working in the emergency department (ED). In the first full year of implementation (2016-2017 academic year), WAM hosted eight formal activities, including three topical dinners and one formal seminar (Table).

Table. Activities in the first year of implementation of Women in Academic Emergency Medicine.

Month	Activity
July	Welcome dinner (topic: time management)
August	Discussion of needs-assessment results
September	Emergency medicine day of service at Project Cure
October	Faculty dinner (topic: sexism in medicine)
December	Mentoring breakfast with grand rounds speaker
December	Holiday cookie exchange
January	Mentoring breakfast with grand rounds speaker
January	Winter wellness week
April	Educational series: Money Matters
May	Graduating resident appreciation dinner

IMPACT/EFFECTIVENESS

We used Kirkpatrick's model to evaluate WAM in the first year of implementation.[8] Completion of events as scheduled and attendance at events measured reaction to the group. All scheduled events were successfully completed with 95% (40/42) of female faculty and residents attending at least one WAM event, and 90.5% (38/42) attending more than one event. All (20/20) of the female faculty strongly or very strongly supported WAM.

Through informal measures, WAM influenced behavior and demonstrated results. By hosting a virtual meeting with resident alumna, two physicians obtained professional opportunities that were not previously available. From a departmental perspective, WAM increased open conversations about disparities among male and female physicians. WAM gave a voice to female faculty and advocated for increased female physician representation on the department's Physician Executive Leadership Group and for preservation of dedicated lactation space in the ED. We believe the specific goals and objectives coupled with the formal planning and departmental support of WAM allowed for a broader impact than an ad hoc faculty group.

Lessons learned in the first year of implementation included the following: ensuring inclusivity and not focusing solely on motherhood; engaging faculty in multiple ways; thinking critically about which activities are best for resident inclusion; and empowering female faculty as agents of institutional change. In response to these challenges, we have increased the diversity and timing of events, created time for faculty-only events, appointed a director of wellness, and developed a resident liaison position.

The process of developing WAM can be replicated in any department to develop a female physician group. The detailed needs assessment serves as the cornerstone of successful implementation. WAM has the potential to impact recruitment of female faculty and residents as well as faculty retention, promotion, and wellness. Data collection in these areas is ongoing and further research is needed to explore the full impact of the program on female physicians.

ACKNOWLEDGEMENT

We would like to acknowledge our department chair Dr. Corey Slovis for his continued support and Dr. Brian Zink for his support at the ExCITE forum.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Transition to Practice: A Novel Life Skills Curriculum for Emergency Medicine Residents

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Section Editor: Jeffrey N. Love, MD
Submission history: Submitted July 15, 2018; Revision received October 7, 2018; Accepted October 18, 2018
Electronically published [date]
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39868
[West J Emerg Med. 2019;20(1)100–104.]

BACKGROUND

Transitions are a familiar topic in medical education. Of particular interest to medical educators in recent years has been the need to ease the intense and stressful experience of transitioning from preclinical to clinical undergraduate medical education and from medical school to residency, while relatively little attention has been paid to examining the transition from residency to independent practice.[1-2]

The transition from residency to independent academic or community practice as an attending physician is a vulnerable time that presents significant challenges including final responsibility for patient care, management and leadership tasks, the education of residents, a new workplace environment and colleagues, and practice management skills.[3] In addition to these workplace-based challenges, graduating residents often cite deficiencies in practical life and job skills such as preparing a curriculum vitae (CV) and cover letter, contract negotiation, personal finance, and time management.[3-4] Many residency programs touch on some of these topics throughout each resident's time in training; however, despite the gravity and generalizability of the subject matter, there is little published evidence of broad-based, fully-developed, evidence-based curricula in emergency medicine (EM) devoted to teaching senior residents to successfully navigate these issues while transitioning to independent practice.[4-7]

GOAL OF CURRICULUM AND OBJECTIVES

We developed a multi-modal, learner-driven, interactive curriculum to address the unique nonclinical challenges senior EM residents face during the transition from residency to independent practice. The overarching goal of this curriculum is for residents to cultivate the necessary life skills in each of these domains to successfully navigate the transition to independent practice and beyond. Specific objectives were determined by the targeted needs assessment of the residents and junior faculty (Table 1).

CURRICULAR DESIGN

We used the framework of Kern's six-step model for curriculum development in medical education in developing this curriculum.[8] A targeted needs assessment of current residents and junior faculty in both academic and community settings in our geographic area identified nine topics for inclusion in this pilot curriculum, one to be covered each month over the course of the curriculum in a just-in-time format. These topics are shown in Table 1.

The first session of the curriculum preceding the topic sessions is an interactive panel with recent graduates in academic positions, fellowships, and community practice to discuss how to obtain a position in each of these practice areas and answer questions. This is followed monthly by sessions that use learner-driven instructional methods including group processes such as team-based learning and role-playing, self-directed learning via reflection and learning plan development, and practical application of skills by developing artifacts and obtaining feedback for improved performance. Table 1 demonstrates the objectives, instructional design, and implementation strategies for each session.

We chose an interactive format as residents needed to produce tangible products and learn to use these skills as part of the curriculum. A largely learner-driven strategy was selected due to limitations in available resources. The most significant resource required for this curriculum is time. Faculty time is needed to review documents or role-play scenarios and provide feedback to the residents. We unfortunately lacked dedicated conference time for this content; thus, this curriculum was delivered outside of typical didactic time on various evenings at faculty homes or restaurants. If time were allotted during didactic conference for class-specific content, this would be an ideal curriculum for senior residents. Obtaining buy-in from program and departmental leadership to support this curriculum is crucial to its success.

Table 1. Objectives, instructional methods, and implementation strategies for each session of the transitions-to-practice curriculum.

Session topic	Objective	Instructional design and implementation
Developing a CV and cover letter	Design a cover letter that includes a statement of intent, your unique qualifications, and how these qualifications fit with your target position. Prepare a CV with sufficient detail and appropriate sections based upon the position for which you are applying.	Artifact development and feedback[9] - Residents review the cover letter and CV of recent graduates who were successful in obtaining a position in their desired practice environment. They then produce their own CV and cover letter and receive feedback from faculty on their work.
Interview strategies	Employ interview strategies to provide appropriate answers based upon question type and the job for which you are applying.	Role-playing[9-10] - Faculty role-play interview questions with the residents based upon the practice setting they intend to enter.
Contract negotiation	Use key contract-negotiation strategies when discussing salary, benefits, shift count, new role, expectations, and other key aspects of your first contract after residency.	Role-playing[9-10] - Residents review sample contracts within their target practice setting and market with a faculty member to review pearls and pitfalls. Residents then role-play with faculty how to negotiate various aspects of their contract.
Time management	Develop a system for task prioritization, time blocking, and saying yes or no to new opportunities. Apply time management strategies to maximize productivity and minimize distractors.	Group discussion and think-pair-share[9-10] - Residents discuss time blocking and task prioritization systems and develop a Covey 2x2 table based upon their priorities. They then think-pair-share to identify ways in which to maximize their productivity to achieve their goals.
Burnout prevention	Analyze prospective difficulties in your first year of independent practice and how these may put you at risk for burnout.	Narrative medicine[11-13] - Residents and faculty present stories of difficult cases and life situations and use reflective writing to process each other's stories. This is followed by debriefing and discussing useful tools for mindfulness and burnout prevention.
Medicolegal pitfalls	Compare approaches to clinical cases that are at high risk for litigation in emergency medicine.	Team-based learning[9,14-15] - Using real-life, de-identified cases that have led to litigation in the past, residents form teams to discuss and debate their approach to these scenarios. If no cases are available, there are books with several examples.
Personal finance management	Apply principles from the book The White Coat Investor to develop a personal budget for your first year out in independent practice.	Book club and budget preparation[9] - Residents read The White Coat Investor prior to attending the session. They then discuss it in a book club format. Finally, they develop a personal budget based upon the book and their discussion.
Billing and coding	List the necessary elements from the history of present illness, review of systems, physical exam, and medical decision-making sections of a chart required to bill for each level (1-5).	Chart review[16-17] - Residents review their own charts and those of their faculty and assign a level to each chart for billing purposes. They then compare their results to that of the medical coders and discuss the results and strategies for improvement as a group.

CV, curriculum vitae.

IMPACT/EFFECTIVENESS

To evaluate the outcomes of this pilot curriculum we used a program-oriented approach, focusing on the extent to which the curricular objectives were successfully delivered and achieved via the tangible outcomes associated with each session, which were observed in real time. The deliverables of each session were achieved as stated in the objectives, as determined by the curriculum director and the session faculty leaders. Additionally, we employed a participant-oriented evaluation approach using a mixed-methods, survey-based format, including quantitative questions regarding the importance of the content covered in the transition to independent practice, whether the objectives were met during the session, and how well residents felt prepared for each component of the transition to practice after participating. This was followed by an open-ended feedback section for descriptive comments regarding the benefits and areas for improvement of each session.

The quantitative evaluation survey questions employed a five-point Likert scale with the following anchors: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree. Using Messick's framework of validity,[18] we addressed two areas of validity evidence in developing our evaluation survey questions. By developing the evaluation to match the content delivered in direct consultation with the content experts for each session, as well as receiving feedback on the questions from two medical education experts outside our department at our institution, this provided content validity. We piloted the survey on five second-year residents and three members of the residency

education leadership team for clarity of the questions, relevance to the content covered, and grammatical errors. Edits were made based upon critiques received from the respondents, addressing response process validity.

The survey was administered to the residents in attendance at each session. There were eight residents at each workshop out of 11 members of the senior class (due to some covering clinical responsibilities). All eight residents in attendance at each session completed the survey. The results of this evaluation are presented in Table 2. Other key stakeholders including residency program leadership and core faculty who taught or provided feedback to the residents within the curriculum also provided valuable feedback regarding the curriculum that mirrored the resident responses.

This curriculum was piloted on 11 senior EM residents. Post-curriculum implementation surveys were analyzed and coded for themes by the author. During the evaluation phase, residents expressed greater confidence in the application, interview, and

Table 2. Post-session evaluation questions with quantitative responses rated on a 1-5 point Likert scale (mean and standard deviation reported) and representative qualitative comments from the evaluation forms.

Session topic	This topic was very important for me to learn as part of my transition to practice (n=8) mean (SD)	The session organizers met the objective(s) for this session (n=8) mean (SD)	I feel prepared in this content area after attending this session n=8 mean (SD)	Please provide your feedback regarding the benefits of this session and suggestions for improvement
Developing a CV and cover letter	4.75 (0.46)	4.87 (0.35)	4.5 (0.53)	"It was extremely helpful to have faculty review my CV and cover letter before applying for fellowship."
				"It would be useful to have more community partners review our CVs to tailor them more to what community hiring directors are looking for."
Interview strategies	5 (0)	4.62 (0.52)	4.75 (0.46)	"This really takes the guesswork out of interviewing for jobs!"
				"It would be awesome to have more faculty, so we could have the opportunity to do more of these mock interviews kind of like when we do oral boards practice."
Contract negotiation	5 (0)	4.87 (0.35)	4.62 (0.52)	"This is something I was so afraid of going into the job search - without this, I would have had no idea what to do!"
				"It would be helpful to see sample contracts from all of the groups in the area."
Time management	4.5 (0.53)	4.87 (0.35)	4.62 (0.52)	"I thought I knew everything about time management, but this session gave me a whole new approach! I wish I would have learned this sooner in residency!"
				"It would be even better next time if we had a follow-up session to get feedback on how we are doing and what to adjust to get the most out of our system."
Burnout prevention	4.87 (0.35)	5 (0)	4.75 (0.46)	"I went into this thinking we would be meditating (yuck) - sharing our stories amongst the faculty and residents and the camaraderie that was built really helped me realize what I need to do to take care of myself both personally and professionally well into the future."
				"We should have more of these sessions on a regular basis!"

CV, curriculum vitae; *SD,* standard deviation.

Table 2. Continued.

Session topic	This topic was very important for me to learn as part of my transition to practice (n=8) mean (SD)	The session organizers met the objective(s) for this session (n=8) mean (SD)	I feel prepared in this content area after attending this session (n=8) mean (SD)	Please provide your feedback regarding the benefits of this session and suggestions for improvement
Medicolegal pitfalls	5 (0)	4.75 (0.46)	4.37 (0.52)	"This session was extremely eye opening - it really helped me realize how I need to approach every patient, every chart." "This session was somewhat stressful - it would be great to have a debriefing and normalizing portion afterward."
Personal finance management	5 (0)	4.87 (0.35)	4.62 (0.52)	"This is by far the most important thing I needed to know for my life prior to graduation!" "It would be helpful to have follow-up resources or contacts where we are going to be living/working in order to follow up on these principles."
Billing and coding	4.87 (0.35)	5 (0)	4.87 (0.35)	"This session was really helpful for getting us ready to go out and practice in the real world since this is not something we think about as residents at all!" "I really wish we would have had this as interns, so I could have been charting like this all along!"

SD, standard deviation.

contract negotiation process for their first position after residency due to participating in the pilot of this curriculum. All stated that they felt this curriculum had prepared them to face the transition to independent practice and alleviated much of their anxiety. Additionally, they felt that they could apply many of these topics to their current practice in residency, specifically citing the billing and coding and time management sessions.

Residency program leadership evaluated the positive feedback from these sessions and is working to make them a regular component of the EM didactic curriculum. Additionally, our core faculty have expressed regret at not having received similar training when they were residents.

LIMITATIONS

While there are few published curricula covering the transition to practice within EM, there are likely several programs covering some or potentially all of this content already. A national needs assessment and survey to identify what is currently being done across all programs may inform the literature further on this topic. Additionally, the conference and faculty time required to implement this curriculum proved onerous to our program during the pilot phase, requiring outside time for implementation. A significant investment on the part of the program and faculty for class-specific content during conference time and incentivization of the faculty to participate may be necessary to make this a successful endeavor at each program. Finally, selected comments were provided from the evaluations of each curricular session. These comments were reviewed and selected by the author, and while attempting to remain impartial and report comments that are representative of all those received, this may have resulted in selection bias. The reporting of the quantitative post-implementation evaluation data as well as the constructive feedback was provided in an attempt to ameliorate this potential for bias.

CONCLUSION

This multi-modal, learner-driven, interactive curriculum was well received within our EM residency program. It could also be adapted to any graduate medical education training program with minor, specialty-specific adjustments given the wide applicability of these skills for residents in all specialties as they navigate the transition to independent practice. Going forward, it will be important to

gather more objective outcomes in order to determine the ultimate value of this and other future curricular initiatives addressing the transition to practice.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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The Council of Emergency Medicine Residency Directors Academy for Scholarship Coaching Program: Addressing the Needs of Academic Emergency Medicine Educators

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Section Editor: Sally A. Santen, MD, PhD
Submission history: Submitted June 30, 2018; Revision received September 14, 2018; Accepted September 20, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.9.39416

Introduction: Didactic lectures remain fundamental in academic medicine; however, many faculty physicians do not receive formal training in instructional delivery. In order to design a program to instill and enhance lecture skills in academic emergency medicine (EM) physicians we must first understand the gap between the current and ideal states.

Methods: In 2012 the Council of Emergency Medicine Residency Directors (CORD) Academy for Scholarship designed a novel coaching program to improve teaching skills and foster career development for medical educators based on literature review and known teaching observation programs. In order to inform the refinement of the program, we performed a needs assessment of participants. Participants' needs and prior teaching experiences were gathered from self-reflection forms completed prior to engaging in the coaching program. Two independent reviewers qualitatively analyzed data using a thematic approach.

Results: We analyzed data from 12 self-reflection forms. Thematic saturation was reached after nine forms. Overall inter-rater agreement was 91.5%. We categorized emerging themes into three domains: participant strengths and weaknesses; prior feedback with attempts to improve; and areas of desired mentorship. Several overlapping themes and subthemes emerged including factors pertaining to the lecturer, the audience/learner, and the content/delivery.

Conclusion: This study identified several areas of need from EM educators regarding lecture skills. These results may inform faculty development efforts in this area. The authors employed a three-phase, novel, national coaching program to meet these needs. [West J Emerg Med. 2019;20(1)105–110.]

INTRODUCTION

Despite multiple changes in medical education in recent years, didactic lectures remain a fundamental modality for instruction in academic medicine.[1] However, many academic physicians lack formal training in instructional methods when assuming faculty positions. To meet this need, the creation and evolution of faculty development programs have helped faculty achieve specific skills.[2] One example shown to be effective in improving teaching and lecturing skills in medicine is observation and feedback.[1,3,4] Peer mentoring has also been shown to positively impact academic skills and professional development.[5-9]

Coaching has been described as a learner-centered method of evaluating performance, clarifying the meaning of outcomes and identifying strategies for success, with the ultimate goal of fostering insight and life-long learning skills.[10] Coaching has been used in other fields to support professional development but only recently has emerged in medical education.[10,11] Limited data suggest that coaching can improve clinical and teaching skills, enhance collaboration, decrease burnout, and positively impact professional development.[11-16] Models for peer coaching in simulation debriefing and large-group teaching have been proposed.[17,18]

The Council of Emergency Medicine Residency Directors (CORD) sought to create a novel, national, faculty peer-coaching program to improve lecture skills and foster career development. The program was purposefully developed to take advantage of existing educational theories, including experiential learning, reflective learning, and deliberate practice.[19-21] In order to inform program design and refinement, an understanding of the gap between the current and ideal states is essential. The objective of this study was to evaluate the needs and prior experiences of emergency medicine (EM) educators participating in the program.

METHODS

We conducted a needs assessment of EM educators participating in the CORD Academy for Scholarship Coaching Program. The program was made available to all CORD members presenting at national meetings. Prior to participation, presenters completed a self-assessment form regarding their teaching experience and areas of desired mentorship (Appendix A). Responses were qualitatively analyzed using a thematic approach. Data were independently reviewed line by line by two investigators experienced in qualitative methods (JJ and SJW) to identify recurring concepts and assign codes, which were then further refined into themes using the constant comparative method.[22] After independent review, the two investigators met to establish a final coding scheme that was applied to all data.

Analysis continued until thematic saturation was achieved, defined as no additional emerging themes.[23] Discrepancies were resolved by in-depth discussion and negotiated consensus. This study was deemed "exempt" by the Central Michigan University Institutional Review Board.

RESULTS

We analyzed data from 12 available self-reflection forms. Thematic saturation was reached after nine forms; however, we analyzed an additional three forms to ensure that no additional important themes were missed. Inter-rater agreement was 91.5%.

Strengths and Weaknesses

Regarding strengths and weaknesses, as well as effective and ineffective teaching behaviors, three themes (factors pertaining to the lecturer, factors pertaining to the audience/learner, and factors pertaining to content and delivery) emerged. These themes were further broken down into 10 subthemes (Table 1). Generally, presenters felt that their lectures went well when they were well prepared, organized, spoke eloquently, effectively engaged their audience, highlighted the relevance of the information, aligned their content with education theory, incorporated active learning techniques, and optimally used audiovisual or supporting materials. Conversely, when they failed to do this, they felt their sessions were less effective. Presenters also noted challenges with larger groups and felt that their self-perception impacted their lectures.

Prior Feedback and Attempts to Improve

Many presenters (7/12) had received positive feedback in the past. It is important to note that several commented on how they were motivated to improve and strive for excellence despite receiving this positive feedback. This sentiment is captured in the following statement:

This year, I won the New Speaker's Forum at AAEM [American Academy of Emergency Medicine] and the Rising Star Award at ACEP [American College of Emergency Physicians]… However, I really do feel like there is room for improvement.

Themes for improvement were in line with what presenters had previously identified as weaknesses or ineffective teaching behaviors (Table 2). Regarding efforts that presenters had tried in order to improve their teaching, three major themes emerged: self-evaluation; informal education; and formal education.

Mentorship Sought

Regarding desired mentorship, the majority (9/12) sought assistance in improving specific teaching skills. Multiple themes emerged that were congruent with identified weaknesses (Table 2). The most prominent subtheme that emerged was speaking style. Several participants remarked on their desire for excellence; for example, one presenter remarked:

I've given around a dozen or so national talks….I am looking for that 'next level' of improvement…I think I'm at the stage of being an 'average national speaker' and want to get to that 'great speaker' stage.

Table 1. Results of qualitative analysis regarding strengths and weaknesses of physician lecturers.

Theme	Subtheme	Number of comments	Exemplar quotes
Factors pertaining to the lecturer	Self-perception	12	"I generally consider myself to be an above average speaker."
			"…Then, I begin to doubt myself and my talk which negatively impacts the talk."
			" …I get nervous in front of crowds in which I may not be the most expert person in the room…"
	Preparation and knowledge	11	"Seems to go well when I am well prepared, have in-depth knowledge of a subject, know my learners…"
			"I feel uncomfortable with spontaneous, ad lib, or dynamic settings."
			"The last [lecture] I felt did not go well was clearly for a lack of preparation and rehearsal."
	Speaking style	11	"Great command of language, cadence, and presence."
			"…did all my usual talk tics: too frequent consultation of notes, [too many] 'um's', long pauses, speaking too fast and too low…"
Factors pertaining to the audience/ learner	Engagement	16	"…it opened with a personal story…so everyone's attention was captured right away and I was able to form a connection with the audience."
			"…it was harder to get the 'connection.' There were only a few in the front who were engaged."
	Relevance	6	"…the information resonated with people."
			"My strengths are in framing the importance of a problem…"
			"I felt the session went well because it is a topic that our medical students are rarely exposed to and thus highly motivated to learn about."
			"… make points relevant to the residents, and make points that were relevant to our hospital."
	Large groups	4	"I would like to develop techniques to help me do better with larger groups."
Factors pertaining to content and delivery	Alignment with educational theory	6	"I try and focus on no more than 5 take-home points to keep the cognitive load manageable for the audience."
			"The content was also very well matched to the knowledge level of the learners…"
	Audio visual/ supporting material	7	"I used minimal slides, all of which had little to no text, so the attention was on me."
			"My general teaching strengths are… the use of a whiteboard to visually present information."
			"PowerPoint/presentation dedication and wizardry"
			"Some of [the low fidelity simulation] worked, but some of it didn't….my slides were also too wordy…"
	Organization	10	"My lectures are well organized and present a central theme or story effectively."
			"I can come across as disorganized at times."
	Use of active learning techniques	7	"I try to use case-based methodology…"
			"Flipped classroom for initial information, synthesis of given material, active participation of audience in an activity."
			"Teaching behaviors that worked well were the use of learner involvement through 'think-pair-share,' case-based activities and the building of comparison charts."

Table 2. Results of qualitative analysis regarding prior feedback and desired mentorship.

Theme	Subtheme	Number of comments	Exemplar quotes
Prior feedback			
Factors pertaining to the lecturer	Preparation and knowledge	2	"More advanced prep."
	Speaking Style	3	"My delivery may be too fast…or my speaking style may be too familiar."
Factors pertaining to the audience/learner	Engagement	1	"I also get the sense I could do more as far as really engaging or entertaining the audience."
Factors pertaining to content and delivery	Audio visual/ supporting material	4	"I recently did give a talk and tested my audio-visual equipment ahead of time and still had problems."
	Organization	2	"Constructive feedback: better organization"
Areas of desired mentorship			
Factors pertaining to the lecturer	Self-perception	2	"…to decrease my anxiety around giving talks…to be more comfortable speaking…Additionally, when I do receive feedback, I am working on how I interpret feedback and trying not to internalize and generalize negative feedback"
	Speaking style	8	"…I really haven't gotten much feedback on technical aspects like how clearly I speak, the rate of which I speak, or how effectively I use the room space. This would also be helpful to get feedback on."
Factors pertaining to the audience/learner	Engagement	3	"The big thing I want to work on is audience engagement…I could do more to draw the audience in….Are there ways in which I cannot just give a lecture but moderate an audience?"
	Large groups	2	"I would like to improve my ability to give a talk, particularly in a formal, large group setting."
Factors pertaining to content and delivery	Audio visual/ supporting material	2	"I would love feedback on my use of visual aids…"
	Organization	3	"I would like to improve specific teaching skills, particularly scaffolding/ sequencing my learning materials…"

DISCUSSION

In this study, EM educators identified multiple areas of need regarding lecture skills that were categorized into three major themes (factors pertaining to the lecturer, the audience/learner, and content and delivery), which can be used as a framework and organizational strategy for faculty development programs in this area. Within these major themes, multiple subthemes were identified. These subthemes can serve as specific areas for skill development. Several participants remarked on their desire for excellence, hoping to distinguish themselves nationally and improve their skills. This attitude lends itself well to the coaching model in which the goal is to help one achieve his/her personal best rather than a certain level of competency. Another interesting theme was self-perception. Several participants commented on the anxiety they experienced when lecturing and their lack of confidence. This highlights that psychological factors may have an impact on teaching ability. This is another opportunity where coaching can have a meaningful impact.

Based on the results of this study, the authors employed a three-phase coaching program to enhance teaching skills for medical educators involved in national speaking engagements:

I. **Pre-observation phase**: The pre-observation phase serves as an opportunity for goal-setting and delineation of expectations for the presenter, coach, and the program. Presenters will complete a structured self-reflection form focusing on previous teaching experiences, feedback, and desired goals. In doing so, presenters engage in reflective practice and learning, setting the stage to build from previous experiences. Reflection has been shown in prior literature to have multiple benefits in medical education including increased learning, engagement, and comfort with difficult material.[24] This reflection will guide a pre-observation meeting between the coach and presenter. The coach should note details in the specific content areas identified in this study (self-perception, preparation and knowledge, speaking style, engagement, relevance, large groups, alignment with educational theory, audiovisual and supporting material) provided by presenters and use this information to target

observation efforts and frame post-observation feedback.

II. **Observation phase**: The observation phase is directed at data collection. The trained coach critically observes the teaching session, attending to specific needs described in this study. Data can be collected as written observations, pictures, videos, or audio recordings. Significant emphasis should be placed upon documenting specific examples. Coaches need to be inconspicuous during their observation to assure that they are not affecting the delivery of the session.

III. **Post-Observation phase**: This phase consists of a debriefing session where the coach leads a discussion of the opportunities for improvement, framed within the major themes highlighted in this study. The coach targets specific, desired skill areas outlined by the subthemes elucidated and by individual participant needs identified in the pre-observation session. This meeting should be reasonably proximate to the teaching session to minimize the impact of diminished recall. The coach should analyze his/her notes and develop formative themes before the debriefing. When leading this discussion, the coach should use multiple examples, allowing the feedback to be maximally meaningful and relevant.

The field of medicine embraces lifelong learning, and physician educators should strive to go beyond competency and achieve excellence. Coaching has the potential to be a valuable tool in faculty development for physicians at all stages of their careers. This novel, multi-institution, national faculty coaching program for lecture skills can address the perceived needs of EM physician educators.

LIMITATIONS

This was an exploratory, qualitative needs assessment and the findings must be interpreted through that lens. The sample size was small and consisted of EM educators who desired coaching to improve their lecture skills; thus, the results may not be generalizable. Additionally, while thematic saturation was achieved, it is possible that important information was not captured in the analysis. Despite these limitations, the findings of this study may serve as an important foundation from which to build upon for how to improve the lecture skills of physician educators. Future, well-designed research studies evaluating objective outcomes of the program, such as lecture evaluations, number of invited speaking engagements, audience engagement, benefits to coach and presenter, and impact on professional development, are needed.

CONCLUSION

This study identified several areas of need from EM educators regarding lecture skills including factors pertaining to the lecturer, the audience or learner, and the content and delivery. These results may inform faculty development efforts in this area. The authors support a three-phase, novel, national coaching program to meet these needs.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Recommendations from the Council of Emergency Medicine Residency Directors: Osteopathic Applicants

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Section Editor: Eric Shappell, MD, MHPE
Submission history: Submitted July 14, 2018; Revision received September 12, 2018; Accepted September 22, 2018
Electronically published November 19, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.9.39814

The Council of Emergency Medicine Residency Directors (CORD) Advising Students Committee (ASC-EM) has previously published student advising recommendations for general emergency medicine (EM) applicants in an effort to disseminate standardized information to students and potential advisors. As the shift to a single graduate medical education system occurs by 2020, osteopathic students will continue to represent a larger portion of matched EM applicants, but data shows that their match rate lags that of their allopathic peers, with many citing a lack of access to knowledge EM advisors as a major barrier. Based on available data and experiential information, a sub-group of ASC-EM committee sought to provide quality, evidence-based advising resources for students, their advisors, and medical leadership. The recommendations advise osteopathic students to seek early mentorship and get involved in EM-specific organizations. Students should take Step 1 of the United States Medical Licensing Exam and complete two EM rotations at academic institutions to secure two Standardized Letters of Evaluation and consider regional and program-specific data on percentage of active osteopathic residents. [West J Emerg Med. 2019;20(1)111–116.]

BACKGROUND

Historically, there have been two paths for the osteopathic student pursuing emergency medicine: osteopathic-affiliated residency programs through the American Osteopathic Association (AOA) match or Accreditation Council for Graduate Medical Education (ACGME) residency programs through the National Resident Matching Program® (NRMP®). In February 2014, the ACGME, AOA and American Association of Colleges of Osteopathic Medicine announced a path toward formation of a single graduate medical education accreditation system. Under this plan, AOA-approved programs must apply for ACGME accreditation by June 2020, at which time the AOA will cease all primary accreditation activities.[3] As of May 2018, 50 of the prior 62 AOA programs have completed the ACGME accreditation process, bringing the total number of ACGME-accredited emergency medicine (EM) programs to 231. This process did lead to the closure of a handful of AOA programs that did not seek ACGME accreditation, decreasing the overall number of residency spots available to osteopathic candidates in traditional AOA programs.[3] A 2017 survey of program directors from the American College of Osteopathic Emergency Physicians showed that a handful of their programs are also planning to pursue "osteopathic recognition," reflecting their intention to maintain an osteopathic-focused learning environment.[4, 5]

The popularity of EM as a specialty has been growing over the last few years, and with the single graduate medical eduation

(GME) accreditation system under the ACGME we are seeing a greater number of osteopathic students entering the overall pool of applicants. This will increase the overall number of applicants to each program and increase the competitiveness for osteopathic students. Over the last two years of match data, available spots for osteopathic students specifically have decreased. In 2017 there were 51 AOA programs that participated in the National Matching Services Inc. (NMS) match with 310 available; but in the 2018 match only 30 programs participated with 172 spots available specifically for osteopathic students.[6] These students are now entering the NRMP match with competitive allopathic counterparts. In 2018, 81% of osteopathic applicants achieved a successful match in EM compared to 91% of their allopathic counterparts.[7] Figure 1 shows the percentage of osteopathic as well as non-traditional United States (U.S.) allopathic graduates matched over time.[2] Between the years 2009 and 2016, a stable 10-12% of osteopathic seniors matched into ACGME EM programs with a jump noted in 2017 and 2018 due to the aforementioned transition of AOA- accredited programs to the ACGME.[7,8]

Less than one-third of osteopathic medical schools (11/39) note affiliations with EM residency training programs on their respective websites; as a result, osteopathic students may not have ready access to EM program leaders for guidance. A recent study showed that 70% of current EM residents from allopathic schools had EM-specific mentorship available, but only 20% of osteopathic graduates had EM-specific mentorship available.[2] These students must take the initiative to seek out those familiar with the ACGME match process, even if it means looking outside their home institutions. Many prospective applicants find an advisor late or do not have an advisor before the application process.[9]

OBJECTIVES

The goals of the CORD ASC-EM in creating these recommendations are to provide consensus, evidence-based advice specifically for osteopathic students pursuing an ACGME-accredited residency and to equip advising faculty with the knowledge and resources to provide high-quality guidance.

CURRICULAR DESIGN

To develop best-practice advising information for osteopathic students, an ASC-EM Osteopathic Advising Team was formed from members self-selected based on interest and expertise. The team was made up of 12 faculty members with specific interest in advising osteopathic students as well as residents. The faculty and residents ranged in experience from two years to over 20 years participating in both ACGME and AOA residency leadership. The team included program directors, EM residents, clerkship directors, core faculty members, medical education fellows, and

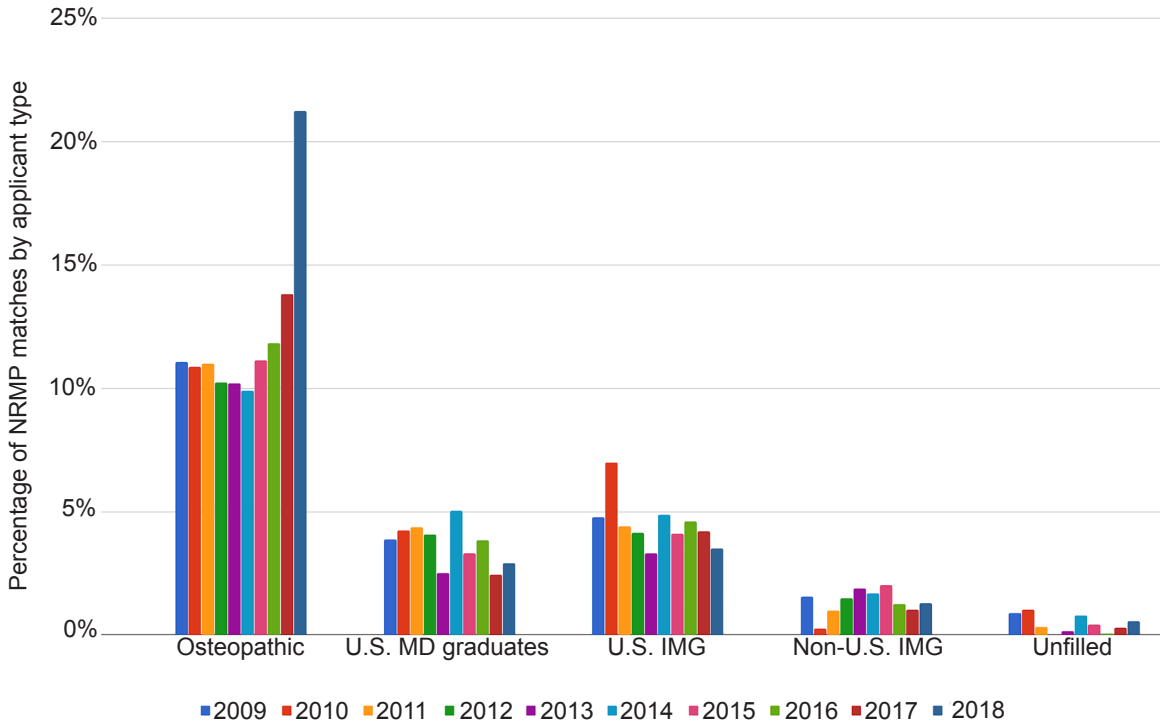

Figure 1. Longitudinal data from the National Resident Matching Program® showing the percentage of match positions secured by types of applicants who are not allopathic U.S. seniors. (U.S. MD graduates are those re-entering the match).[8]
IMG, international medical graduate.

chief residents from across the country. Much of the group hailed from the Northeastern region of the U.S., but there was also representation from Colorado, Michigan, Missouri, and Texas. One-third of the group are practicing osteopathic physicians. Additionally, osteopathic students worked with faculty to provide their input.

Development of the consensus recommendations was by collation of available literature, existing advising resources, active ongoing research and experience. Literature included available NRMP data and the AOA's guide to the single GME accreditation system.[10] It also included non-published documents created by individual medical student interest groups and residencies, many of which were creating their own recommendations based on the NRMP data and experience. Most of the formal advising resources were from the Emergency Medicine Residents' Association (EMRA), Society for Academic Emergency Medicine, and the Association of American Medical Colleges websites. These sources were catalogued and researched for the evidence behind them vs. those noted as experiential in nature. Those with clear evidence were more highly regarded, while the experiential sources were thought to be areas for further research.

Drafted recommendations by the ASC-EM Osteopathic sub-group were made available for commentary to the entire ASC-EM, a group of 40 members representing EM faculty and residents across the country. Members were given several weeks to provide feedback on a shared Google document. The recommendations were also available for commentary to the entire CORD community and the public on the CORD blog.[11] Feedback was received from members as well as a senior vice president for education within the AOA. We were contacted directly by administrators from the National Board of Osteopathic Examiners (NBOME). Subsequent communications between AOA and NBOME leadership with our team fostered a multi-faceted and collaborative approach for advising osteopathic students. Our recommendations remain on the CORD website and blog for continued commentary.

The following recommendations are offered as best-practice advising for osteopathic students and are intended to serve as a general guide, as each student needs an individualized approach.

1. **Pre-Clinical Years:** Students who have identified an interest in EM should seek out advisors within academic EM even if that means outside their own institution. If able, they should be active in their school's Emergency Medicine Interest Group (EMIG) or chapter of the American College of Osteopathic Emergency Physicians resident-student section (ACOEP-RSO). For students at institutions without an EMIG or EM faculty advisors, we recommend that they consider joining the EMRA Student Council, where students can request to be paired with volunteer mentors anywhere in the country.[11] They can also participate in monthly, virtual advising sessions using EMRA Hangouts where ASC-EM members regularly provide advice.[13] The ASC-EM has also put together an osteopathic student-specific planner for both pre-clinical and clinical years, which is easily accessible on its website.[14]
2. **Comprehensive Osteopathic Medical Licensing Examination (COMLEX) and U.S. Medical Licensing Examination (USMLE):** Osteopathic students are required to take the COMLEX levels 1, 2CS/PE, and 3 as part of their education. To allow direct comparison to their allopathic peers, it is recommended that an osteopathic applicant take the USMLE exams (Step 1 and/or Step 2 Clinical Knowledge [CK]). A study from 2014 showed that osteopathic students who took the USMLE were more likely to successfully match at an ACGME program, and that 39% of program directors felt that taking the USMLE was extremely important.[15] The NBOME does offer a percentile calculator to help transition the three-digit COMLEX score to a percentile rank. However, there is no accurate conversion of a COMLEX score to a USMLE score, which makes it difficult to provide direct comparison to the student's allopathic peers.[16-18] This challenge for ACGME programs may lead to some being unwilling to accept only a COMLEX score; this applies for both residency and medical student rotation applications.[19] Students can use EMRA Match for specific program requirements. It is a web-based search created as a collaboration between EMRA, CORD, Clerkship Directors in EM (CDEM), and the American College of Emergency Physicians. It is updated regularly and has specific data on programs that prefer or accept only USMLE.[20]
While taking both USMLE steps is ideal, taking at least Step 1 is preferable to not taking either. It is recommended that osteopathic applicants study specifically for the USMLE exam because, while it is similar to the COMLEX, there are enough differences that studying for one exam may not be sufficient preparation for the other. Programs will be more likely to grant interviews to students with a USMLE Step 1 score >235 or Step 2 CK score > 240.[19, 20] Any student (osteopathic and allopathic) with a Step 1 score < 220 may have difficulty obtaining interviews and should be encouraged to take Step 2 CK early, to allow for results to be included in their initial application or begin to consider back-up plans in consultation with a faculty advisor.[19]
3. **Emergency Medicine Rotations:** Students should aim to perform two EM rotations during the summer or early fall months of their senior year at institutions with ACGME training programs in order to obtain standardized letters of evaluation (SLOEs) prior to the opening of the Electronic ResidencyApplication Service (ERAS®).The student should complete a home rotation if the school hosts an academic EM program, along with two visiting away rotations if no home rotation is offered. Many academic programs use the Visiting Student Learning Opportunities website to schedule audition electives, and begin accepting applications in early March. Some programs will have

program-specific application requirements, such as submission of a USMLE Step 1 score or a brief personal statement. While community EM months can be a great learning experiences and expose an applicant to how emergency physicians practice, these rotations will not assist an applicant to nearly the same degree as they are not able to generate a SLOE.

4. **Letters of Recommendation:** These are one of the most highly valued parts of the EM application to programs when selecting applicants to interview.[19] The letters of recommendation that carry the most weight are in the SLOE format and come from residency program leadership.[21] It is recommended that applicants obtain at least two SLOEs – one from each EM rotation, with at least one uploaded by the time ERAS opens. These letters carry substantially more weight than traditional letters because they provide context for direct comparison of the applicant to his or her EM-bound peers.
5. **Program Selection:** The biggest obstacle to an osteopathic student's application to the ACGME system is perceived competitiveness. According to the 2018 NRMP Program Director Survey, 80% of traditionally allopathic programs will typically interview and rank osteopathic students, narrowing the number of programs available overall.[19] An osteopathic applicant would be well served to look at the composition of an individual program's current residency classes to see whether there are osteopathic students represented. Having only a few, or no, current osteopathic residents means that an applicant should be realistic about the lower likelihood of an interview. Another resource for finding programs hosting current osteopathic graduates is EMRA Match,[20] which has a filter for sorting programs by the percentage of osteopathic students training there. Students might also benefit from focusing on geographical areas that have historically matched higher percentages of osteopathic medical school graduates. As shown in Figure 2, between the years 2012 and 2016, Indiana, Iowa, Mississippi, Ohio, and Texas matched the most osteopathic students per ACGME residency program per year.[22]
6. **Electronic Residency Application Service (ERAS®) Application:** Students should aim to submit their application as early as possible, after ERAS opens. Programs begin reviewing applications almost immediately and may begin offering interviews even before the Medical Student Performance Evaluations (previously known as the Dean's Letter) are released on October 1.[19] Based on the NRMP program director data, osteopathic applicants should apply to between 20-40 programs that have a track record of training osteopathic graduates. Applications to >40 programs is rarely warranted and leads to diminishing returns at increased personal cost.[23] The "numbers question" of applications to be made is particularly individualized and is best discussed directly with an advisor familiar with the student and the EM application process.
7. **Rank List:** Applicants should apply with the goal of obtaining approximately 12 interviews in order to rank approximately 12 programs. Data show that overall applicants (allopathic, osteopathic, and independent graduates) who ranked nine programs had ~90% match rate in EM. Those with 12 or more programs pushed that match rate up to 95-99%.[22, 23] Because programs rank the clear majority of applicants they interview and the considerations that go into creating the exact order of the match list are highly variable and institution specific, there are no meaningful guidelines specific to osteopathic applicants regarding the interview process itself. There is

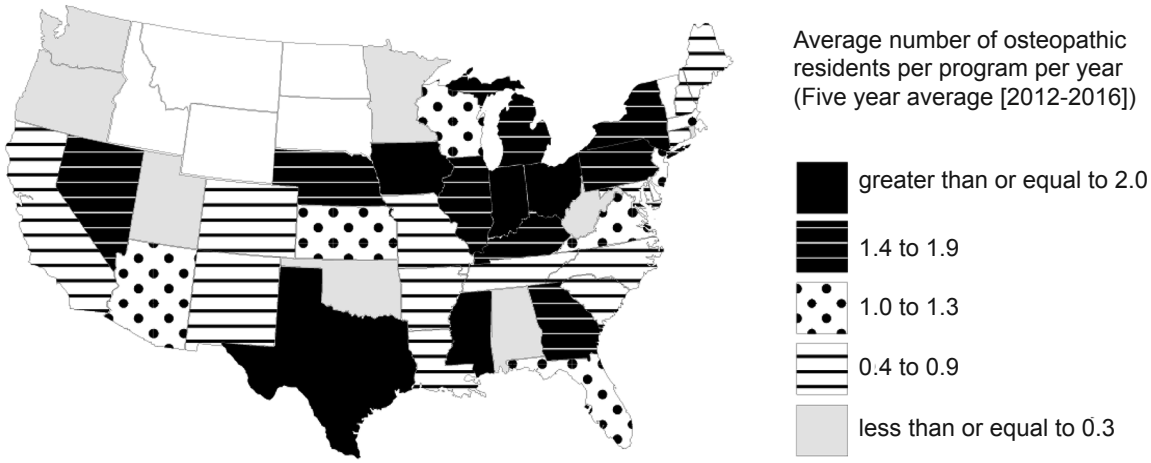

Figure 2. The geographic distribution of NRMP-matched osteopathic medical school graduates per ACGME-accredited emergency medicine residency program between the years 2012 and 2016.[22]
NRMP, National Resident Matching Program; *ACGME*, Accreditation Council for Graduate Medical Education.

limited information as to what degree interviews may affect a student's rank-list placement; thus, this is an area for further study when comparing programs that interview both osteopathic and allopathic graduates.

While no guidelines can exactly fit the needs of every student, these recommendations represent consensus, best-practice advice generalized to the majority of osteopathic applicants. Students are encouraged to seek out well-informed advisors to address his or her specific circumstances and application goals. These recommendations were developed based on the most recent available literature. Because these recommendations are largely informed by the experience and expertise of our committee members, they remain subject to inherent prejudice and bias. As with the original advising document and recommendations, the ASC-EM will be seeking approval of our advising resource from CORD, CDEM, and the American Academy of Emergency Medicine for this year's updates. The ASC-EM also seeks to capitalize on these relationships to more widely disseminate and make available these application resources.

IMPACT/EFFECTIVENESS

The CORD ASC-EM developed the above recommendations based on a perceived need for specific advising aimed at osteopathic applicants. As the applicant pool merges, both osteopathic and allopathic graduates will funnel toward the same ACGME-accredited programs. We hope that these consensus recommendations will educate the osteopathic students and their advisors to direct their energies appropriately to maximize their EM applications in preparation for the NRMP match. This resource, in addition to the original consensus guidelines for the general EM applicant, will hopefully contribute to a better-informed pool of applicants who will apply wisely, as well as to a decrease in the overall number of excess applications per student.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Yogaman: An Inexpensive, Anatomically-detailed Chest Tube Placement Trainer

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Section Editor: David P. Way, MEd
Submission history: Submitted June 22, 2018; Revision received September 29, 2018; Accepted September 29, 2018
Electronically published November 20, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.9.39456

Introduction: Opportunities for chest tube placement in emergency medicine training programs have decreased, making competence development and maintenance with live patients problematic. Available trainers are expensive and may require costly maintenance.

Methods: We constructed an anatomically-detailed model using a Halloween skeleton thorax, dress form torso, and yoga mat. Participants in a trial session completed a survey regarding either their comfort with chest tube placement before and after the session or the realism of Yogaman vs. cadaver lab, depending on whether they had placed <10 or 10 or more chest tubes in live patients.

Results: Inexperienced providers reported an improvement in comfort after working with Yogaman, (comfort before 47 millimeters [mm] [interquartile ratio {IQR}, 20-53 mm]; comfort after 75 mm [IQR, 39-80 mm], p=0.01). Experienced providers rated realism of Yogaman and cadaver lab similarly (Yogaman 79 mm [IQR, 74-83 mm]; cadaver lab 78 mm [IQR, 76-89 mm], p=0.67). All evaluators either agreed or strongly agreed that Yogaman was useful for teaching chest tube placement in a residency program.

Conclusion: Our chest tube trainer allowed for landmark identification, tissue dissection, pleura puncture, lung palpation, and tube securing. It improved comfort of inexperienced providers and was rated similarly to cadaver lab in realism by experienced providers. It is easily reusable and, at $198, costs a fraction of the price of available commercial trainers. [West J Emerg Med. 2019;20(1)117-121.]

BACKGROUND

As the number of learners in teaching institutions increases, live procedure opportunities are on the decline.[1] This trend is especially concerning when uncommon procedures are considered. Chest tubes in emergency departments are becoming less common, and patterns of chest tube placement are evolving. Clinical practice has transitioned toward smaller-diameter Seldinger chest tube placement and observational management of small pneumothoraces.[2] Chest tube placement is associated with serious complications, including placement into the liver and chest wall, disruption of the diaphragm, injury to the lung, and damage to the intercostal neurovascular bundle.

Faculty at teaching institutions may be hesitant to allow learners with no practical experience to place a chest tube in a critical situation, when time is short and the risk of

complications is high. Opportunities to learn and practice the procedure outside of live patient care settings are therefore important. Simulation models, when part of a structured approach to procedural learning, are one potential solution.[3] In our training program, we did not previously have a good option for simulating chest tube placement outside of our yearly cadaver lab. Current simulation models that allow chest tube placement are some of the most expensive on the market, ranging from thousands to tens of thousands of United States dollars.[4-6] Animal-based models have been proposed as a less expensive option, but are messy and not reusable.[7] These models simulate only the chest wall and do not provide human anatomic landmarks or simulate the lungs.

OBJECTIVES

We constructed a do-it-yourself chest tube model built around a Halloween skeleton, plastic dress-form torso, and yoga mat. We named the trainer Yogaman. We evaluated the model's realism and effect on provider comfort with chest tube placement in a trial session. We were considering ending our yearly cadaver lab, and were interested to see how perceived realism compared with chest tube placement in cadaver lab.

CURRICULAR DESIGN

Model Construction

Construction of the model is straightforward. The only tool needed is a heavy-duty cutting device. We used tin snips, but a sturdy pair of trauma shears will also work. All of the materials were purchased on amazon.com, and the total cost was $198 (Table). The plastic dress-form must be cut to allow for the insertion of the skeleton thorax (Figure 1). We marked the cuts in pencil prior to cutting. We made cuts to expose the "triangle of safety" on either side of the thorax. The yoga mat must be folded in half and cut, and then cut again lengthwise into six-inch strips to simulate the chest wall. One yoga mat supplies eight chest-wall strips. The memory foam mattress pad is cut in a 10-inch strip and rolled to the center from both ends to simulate lungs.

Table. List of materials for the chest tube placement model.

Material	Anatomy/function	Price paid
5/8" red yoga mat	Chest wall	$18
3" pink surgical tape	Skin	$14
Plastic skeleton torso	Ribs	$83
White gaffer tape	Pleura	$15
Torso dress form	External landmarks	$25
1" memory foam mattress topper	Lungs	$12
2" binder clips	Fastener	$9
Resealable sandwich bags	Pneumothorax	$4
	Total	$198

Figure 1. Cutting the dress form torso with tin snips to create the Yogaman chest tube trainer.

Assembly of Yogaman is an eight-step process (Figure 2). In use, the model allows learners to make the initial skin incision, bluntly dissect the chest wall, puncture the pleura, and advance the chest tube to the desired location. The yoga mat chest wall can be sutured. Gaffer tape can be used as a less-expensive substitute for chest tube tape so that learners can practice securing the tube, and has the additional benefit that it does not leave behind residue. Once tube placement is complete, the model can be taken apart to determine exact tube placement. The chest wall can be rotated until there are too many cuts to reuse it, at which time a new chest wall is placed. Yogaman takes approximately two minutes to assemble. We created a video that demonstrates the construction and assembly of Yogaman in greater detail and posted it on YouTube (https://youtu.be/TtNIqda4x_8). Links to materials appear on the page.

Assessment

We trialed Yogaman with a group of practitioners of varying experience after an educational meeting. The group consisted of 18 emergency medicine (EM) residents and faculty. Aside from open thoracostomy tube placement, the model also allowed for Seldinger chest tube placement and needle thoracostomy practice. The yoga mat allowed for the application of negative pressure during needle insertion and location of the pleural space. We discovered that a resealable sandwich bag can be placed between the lung (rolled memory foam mattress topper) and chest wall to make needle decompression of a tension pneumothorax audible. The mattress topper places the sandwich bag under pressure, which results in a pop and rush of air when the "pleura" is punctured. Yogaman can be placed on a gurney or table; we prefer an adjustable-height bedside table. Because the model is light, we find it helpful for observers

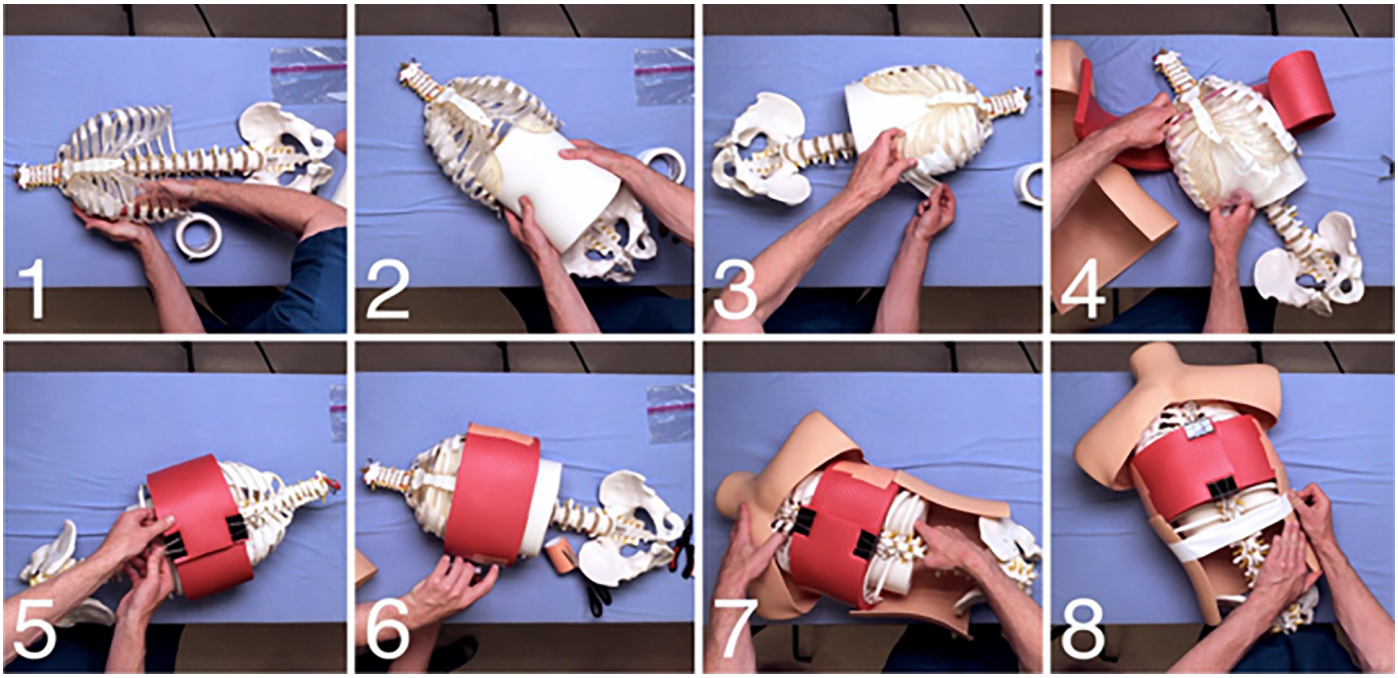

Figure 2. Yogaman assembly. The eight-step Yogaman assembly process. 1) Line the inside of the upper thorax with gaffer tape to allow the tube to slide along the ribs once in the pleural space. 2) Insert the memory foam lungs. 3) Place gaffer tape on the area to be punctured. 4) Insert the resealable sandwich bag to act as a pneumothorax (optional). 5) Wrap the chest wall and clamp with binder clips. 6) Place pink surgical tape to act as skin on the lateral chest wall. 7) Place the thorax into cut plastic, dress-form torso. 8) Cinch the dress form to the thorax with gaffer tape.

Figure 3. The Yogaman chest tube model in use.

to hold the model down. Alternatively, gaffer tape run from one side of the gurney or table across Yogaman's waist to the other side can also act as an anchor. We created a second YouTube video to demonstrate Yogaman in use (https://youtu.be/oLp74QCKBgw).

After the session, we asked the attendees to complete an evaluation. Separate evaluations were created for practitioners who had performed less than 10 ("inexperienced") or 10 or more ("experienced") chest tubes in live patients. We chose 10 because that is the number the Accreditation Council for Graduate Medical Education Emergency Medicine Residency Review Committee requires for graduates of EM training programs.[8] The experienced evaluation asked the evaluator to rate the realism of Yogaman on a 100-millimeter (mm) visual analog scale (VAS), anchored with "not realistic at all" on the left and "as realistic as possible" on the right. It then asked if the participant had placed a chest tube in cadaver lab. If so, the participant was asked to rate the realism of cadaver lab for chest tube placement on a VAS. For participants who had placed fewer than 10 chest tubes in live patients, the survey asked for a rating of comfort in placing a chest tube before working with Yogaman on a 100-mm VAS, and comfort after the session on a 100-mm VAS. This scale was anchored with "not comfortable at all" on the left and "as comfortable as possible" on the right. All evaluators were asked to rate agreement with the statement "Yogaman is useful for teaching chest tube placement in a residency program" on a five-point Likert scale ("Strongly Disagree" to "Strongly Agree"). We gave participants a gift certificate for a beverage from a campus café as appreciation for completing the survey.

IMPACT/EFFECTIVENESS

Of 18 meeting attendees, 16 completed an evaluation (89%). We compared comfort before and after using a

Wilcoxon matched-pairs test, and compared realism with a Mann-Whitney test. Inexperienced providers (N=8) reported an improvement in comfort after working with Yogaman (median comfort before 47 mm [IQR, 20-53 mm]; median comfort after 75 mm [IQR, 39-80 mm], p=0.01). All participants who had placed 10 or more chest tubes in live patients (N=8) had also placed a chest tube in cadaver lab. These providers rated the realism of Yogaman and cadaver lab similarly (median realism of Yogaman 79 mm [IQR, 74-83 mm]; median realism of cadaver lab 78 mm [IQR, 76-89 mm], p=0.67). All evaluators either agreed or strongly agreed that Yogaman was useful for teaching chest tube placement in a residency program.

Prior to creating this model, we were challenged to allow our residents to practice chest tube placement in a simulation environment. Our program consists of over 40 residents, and we hold bimonthly skills labs with up to half of our residency complement working on one procedure simultaneously. Multiple models are a necessity to minimize downtime, which makes the use of commercial models cost prohibitive. To date, we have created and used three models with our EM trainees.

Previously, cadaver lab was our primary modality for chest tube teaching. We experienced several limitations with this strategy. Each cadaver is limited in the number of times a chest tube can be placed. Also, the lab is time intensive to arrange and costly; hence, we were not able to offer the teaching activity more than once per year. This made repeat practice difficult. Yogaman solved these problems. Due in part to the success of Yogaman, we plan to end our yearly cadaver lab.

We find that live chest tube experience varies from trainee to trainee. Occasionally, those who feel they have not had enough opportunities to perform live chest tube placement will ask for addition simulation time, and until now we did not have a good option for practice. Now, if a trainee has difficulty or would simply like more practice, we are able to offer additional simulation opportunities with Yogaman. In this way, his lower cost and portability allows us to deliver teaching and practice when and where it is needed.

Our evaluation of Yogaman was intended to be a pilot demonstration of the feasibility of our do-it-yourself model. Accordingly, there were some limitations. While validity evidence exists for the VAS in the settings of self-reported pain,[9] anxiety,[10] and quality of life,[11] it does not exist for confidence with a technical skill. Similarly, our choice of wording for the assessment of learner achievement was not ideal. The term "confidence" is preferable to "comfort" when measuring the learner's self-assessment of achievement in situations that involve a complicated, high-risk procedure. We would hope that no practitioner becomes comfortable with inserting a chest tube for fear that they will become complacent or non-vigilant.

CONCLUSION

Our chest tube model was much less expensive than commercial trainers and allowed complete performance of a critical emergency procedure. It was well-received by a group of faculty and residents. Other training programs may wish to use Yogaman to increase flexibility in teaching, learning and practicing chest tube placement.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Qualitative Analysis of Well-being Preparedness at an Emergency Medicine Residency Program

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Section Editor: Chris Merritt, MD, MPH
Submission history: Submitted July 13, 2018; Revision received October 30, 2018; Accepted October 31, 2018
Electronically published November 26, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39764

Introduction: There is significant variability in the preparedness of incoming interns at the start of residency training with regard to medical knowledge, procedural skills, and attitudes. Specialty-specific preparatory courses aimed at improving clinical skills exist; however, no preparatory courses targeting wellness promotion or burnout prevention have previously been described. Resident well-being has gained increasing attention from the Accreditation Council for Graduate Medical Education, and numerous studies have demonstrated high levels of burnout among resident physicians. The American Medical Association (AMA) divides resident well-being into the following six categories: nutrition, fitness, emotional health, financial health, preventative care, and mindset and behavioral adaptability. Using the AMA's conceptual framework for well-being in residency, we performed a targeted needs assessment to support the development of a "pre-residency" well-being curriculum. Our aim was to discover what current residents and faculty felt were the perceived areas of under-preparedness, in relation to resident well-being, for incoming interns at the start of their residency training.

Methods: Using a grounded theory approach, we conducted a series of semi-structured, focus group interviews. Focus groups consisted of junior residents (postgraduate years [PGY] 1-3), senior residents (PGY-4), and current faculty members. A standardized interview guide was used to prompt discussion and themes were identified from audio recording. We modified theories based on latent and manifest content analysis, and we performed member checking and an external audit to improve validity.

Results: Participants noted variable exposure to both formal and informal well-being training prior to residency. Regardless, participants uniformly agreed that their past experiences did not adequately prepare them for the challenges, specific to burnout prevention, faced during residency training. Of the six domains of resident well-being described by the AMA, emotional health, mindset and behavioral adaptability, and financial health were the domains most cited for interns to be underprepared for at the start of residency training.

Conclusion: Despite variability in prior medical school and life experiences, incoming interns were underprepared in several domains of well-being, including emotional health, mindset and behavioral adaptability, and financial health. Targeted interventions toward these areas of well-being should be piloted and studied further for their potential to mitigate effects of burnout among resident physicians. [West J Emerg Med. 2019;20(1)122-126.]

INTRODUCTION

There is significant variability in the preparedness of incoming interns at the start of residency training in terms of medical knowledge, technical skills, professional skills, and attitudes.[1,2] While many specialty-specific, preparatory (boot camp) courses have been developed to increase intern confidence in their knowledge and skills, and to standardize a level of competence and performance prior to direct patient care, the authors are unaware of any published curricula targeting strategies to promote wellness, prevent burnout, and foster resilience.[3,4]

Resident well-being has gained increasing attention from the Accreditation Council for Graduate Medical Education (ACGME),[5] and numerous studies have demonstrated high levels of burnout among resident physicians,[6-8] with nearly 50% of incoming interns reporting burnout.[9] The American Medical Association (AMA) states that resident well-being can be divided into the following six categories: nutrition; fitness; emotional health; financial health; preventative care; and mindset and behavioral adaptability.[10] Little has been reported on emergency medicine (EM) resident preparedness in these domains, although there is evidence that the vast majority of EM residents receive no financial education in medical school or residency training.[11] Using the AMA's conceptual framework for well-being in residency, we performed a targeted needs assessment to support the development of a "pre-residency" well-being curriculum. The purpose of this study was to discover what current residents and faculty felt were the perceived areas of under-preparedness, in relation to resident well-being, for incoming interns at the start of their residency training.

Population Health Research Capsule

What do we already know about this issue?
Little data exist regarding well-being preparedness among incoming emergency medicine interns.

What was the research question?
What are the perceived areas of under-preparedness, related to resident well-being, for interns beginning residency?

What was the major finding of the study?
Interns were underprepared in several domains of well-being, including emotional health, mindset and behavioral adaptability, and financial health.

How does this improve population health?
It provides a needs assessment for future pre-residency well-being curricula.

METHODS

Using a grounded theory approach,[12,13] we conducted a series of semi-structured, focus group interviews in our EM residency program at the Los Angeles County + University of Southern California Medical Center, a large, urban, Level I trauma center. Focus group participation was voluntary, responses were kept confidential, and data were made anonymous. The University of Southern California Institutional Review Board approved the study under exempt status.

We used a convenience sample of junior residents (postgraduate years [PGY] 1-3), senior residents (PGY-4), and current faculty members to generate three focus groups. Recruitment was performed through a series of emails and announcements at didactic conference. The junior resident focus group consisted of one PGY-3 resident, one PGY-2 resident, and four PGY-1 residents. The senior resident focus group consisted of seven PGY-4 residents. The faculty focus group consisted of eight faculty members. Interview data were audio-recorded and collected in a private conference room within the hospital. The study authors each independently conducted a separate focus group using a standardized interview guide (Appendix A). To establish standardization and reliability across the three focus-group sessions, the authors met regularly to establish a homogenous approach. Additionally, after the principal investigator performed the initial focus group, the additional authors listened to the audio recording of the initial focus group prior to the recording of their individual focus-group sessions, to allow for further standardization. Only the respective interviewer and participants were present at each focus group.

As the study authors served as individual focus-group facilitators, it is important to note their individual qualifications, as focus group facilitation requires an important set of skills.[14] All study authors serve as residency directors, with two of the authors (RT, DD) having completed medical education fellowships. Additionally, two of the authors (RT, DD) are currently enrolled in advanced degree programs in medical education and have taken courses specific to qualitative research methodology. The study authors all have professional interests in resident well-being research and curriculum development, and one of the authors (RT) has developed both institutional and specialty-specific national leadership roles within this domain. Although participants had knowledge about the researchers, they were unaware as to the reason the research was being conducted or the goals of the study. Finally, the primary author

had specific interests in assessing the financial preparedness of residents, as this was the only domain within the AMA well-being conceptual framework that had previously-published content suggesting a need for improvement. With a recent increase in physician-specific, personal finance websites and books[15] the primary author recognized the opportunity to use these resources as a component of the financial preparedness section of a "pre-residency" well-being curriculum. Accordingly, a series of questions within the interview guide specifically focused on the area of financial preparedness.

Non-verbatim transcription and coding was manually performed by the primary author directly from the audio recordings. Given the relatively small volume of focus-group content, the decision was made to forego the use of full-transcription software services, and rather focus on selective manual transcription and coding directly from the audio files, to better capture not only what interviewees were saying but also how they were saying it.[16] To improve validity, audio recordings were listened to three times to ensure commentary was not omitted from the initial transcription and coding. Themes and sub-themes from both manifest and latent content analysis of the focus-group sessions were independently performed by each study author. Preliminary themes were consolidated by the primary author, and all three authors reviewed the consolidated document to ensure congruity to their independent analysis. We modified theories based on two rounds of content analysis and member checking to allow for codification and identification of common themes, which were agreed upon by all study authors through discussion and consensus (Appendix B).

RESULTS

Prior Experiences

Participants noted variable exposure to both formal and informal well-being training prior to residency training. Some participants received training during medical school, while others gained knowledge from prior life experiences. Training in medical school varied from longitudinal curricula that spanned the course of a semester to occasional lectures dispersed throughout the four years. Prior experiences that participants noted as preventative toward burnout included involvement in sports and regular exercise, adequate sleep and nutrition, yoga and meditative practices, and maintaining the activities or interests that formed one's individual identity prior to residency training. Additionally, engagement through social interactivity, peer bonding, and mentorship were noted to be beneficial in promoting wellness and preventing burnout.

Regardless of past experiences, participants agreed that their past experiences did not adequately prepare them for the challenges specific to burnout prevention faced during residency training. For some, it was not a lack of knowledge regarding specific well-being domains (i.e., emotional health, financial health, nutrition, fitness), but the inability to apply their knowledge given the extrinsic challenges faced in residency training (e.g., clinical workload, financial pressures, psychological burden).

Under-Preparedness in Well-being Domains

Of the six domains of resident well-being described by the AMA, emotional health, mindset and behavioral adaptability, and financial health were the domains most cited for interns to be underprepared for at the start of residency training. Participants noted that interns were unprepared to deal with the emotional exhaustion, the psychological burden of increased responsibility, and the ability to manage their self-doubt and feelings of imposter syndrome. In addition, interns were ill-equipped to manage their time effectively, both in terms of balancing clinical responsibilities with studying as well as achieving a healthy work-life balance. Participants felt that incoming interns were most knowledgeable with regard to fitness, nutrition, and preventative health, although the translation of this knowledge to practice was difficult given the time constraints and clinical workload of residency training.

The majority of participants acknowledged that incoming interns (and residents in general) had complete financial illiteracy in terms of their ability to manage debt, plan for retirement, budget, and invest. Opinions varied in how much financial illiteracy contributed to personal stress and burnout with one participant stating that it was "*the number one source of anxiety and frustration"* in his life, while another participant commented that of the aforementioned categories, her lack of financial understanding contributed the least to her "*emotional devastation.*"

Variability in Responses Between Demographic Focus Groups

While common themes emerged from the content analysis, sub-themes existed between the three demographically selected focus groups (junior residents, senior residents, faculty). Junior residents commented on feelings of emotional exhaustion, difficulties with time management, and trouble dealing with both the psychological burden of increased clinical responsibility and feelings of self-doubt. Meanwhile senior residents noted difficulties with compassion fatigue, the cumulative psychological effects of having to constantly cope with tragedy, and their limited ability to self-identify symptoms of burnout. Faculty provided additional commentary, noting the psychological burdens of clinical documentation, the isolation from family and friends experienced during residency training, and the neglect of on-shift nutrition, all of which contribute to increased resident burnout.

DISCUSSION

Incoming interns were underprepared for residency training with regard to several aspects of well-being including emotional health, financial health, and mindset and behavioral adaptability. Regardless of prior well-being training in medical school or past life experiences, focus group participants

voiced both a need and a demand for a longitudinal well-being curriculum. We postulate that an opportune time to implement such a curriculum could be in the two-three month window between when medical students match into their chosen specialty and they begin their internship. This period of time has been described as having significant variability and questionable benefit to learners.[17] With almost 50% of incoming interns experiencing some degree of burnout,[9] intervention prior to residency training is prudent. Asynchronous, web-based, well-being curricula have previously been reported[18-21] and would be an ideal modality for a well-being curriculum targeting incoming interns prior to the start of residency training.

The variability in responses between demographically separated focus groups suggests that the various elements of burnout affect physicians differently dependent on their level of training. Although this study was not designed to look at this phenomenon, intuitively it makes sense. As the most novice physicians in the emergency department, interns may inherently feel overwhelmed and emotionally exhausted. As residency progresses, feelings of emotional exhaustion and self-doubt may improve as more junior learners arrive, only to be replaced by compassion fatigue and depersonalization as the demanding training schedule progresses.

LIMITATIONS

There were several notable limitations to this study. The study was conducted at a single residency program and limited additional demographic information was obtained from study participants, which limits its generalizability, although participants attended different medical schools and had a vast array of prior life experiences. We performed convenience sampling, as opposed to purposive sampling, due to limited group availability given clinical schedules. The sample size was relatively small, decreasing the statistical power of the study; additionally, the distribution of residents across focus groups (PGY 1-3 residents and PGY-4 residents as two separate groups) allowed for potential acquiescence bias within the former group. The groups were created in this manner to preserve equal numbers of focus-group participants across the study. However, the actual study population was relatively skewed towards PGY-4 residents and faculty, which also limits generalizability. Additionally, although we performed member checking, methods such as an external audit and triangulation would have been helpful to increase the rigor of the analysis.

By omitting software-facilitated verbatim transcription of audio recordings there was the potential for diminished capture and preservation of data fidelity as well as a reduction in the standardization of the data as displayed to the coders. However, prior research has questioned the necessity for verbatim data transcription in qualitative research,[22,23] and the necessity and modality of data transcription remains an area of debate.

Regardless, this study's results were promising. Future research should include a more robust sampling of interns/residents from different institutions and/or specialties to support the conclusions reached from this study. Additional research should include investigating targeted interventions to address well-being prior to interns commencing their residency training. A mixed-methods study using both validated well-being assessment metrics (e.g., wellness, burnout, resilience, mindfulness, etc.) alongside qualitative analysis in a multicenter or multi-specialty prospective study would be a preferred methodology to assess the efficacy of any piloted interventions. Further research should also be directed to assess the effect and influence of the institutional culture on residents' well-being.

CONCLUSION

Despite variability in prior medical school and life experiences, incoming interns were underprepared in several domains of well-being, including emotional health, mindset and behavioral adaptability, and financial health. Targeted interventions toward these areas of well-being should be piloted and studied further for their potential to mitigate effects of burnout among resident physicians.

ACKNOWLEDGMENT

The authors would like to thank Dr. Jan Shoenberger and Dr. Aarti Jain for their contributions.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Predictors of an Initial Academic Position in Emergency Medicine

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Section Editor: Sally A. Santen, MD, PhD
Submission history: Submitted May 21, 2018; Revision received July 26, 2018; Accepted October 8, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39096

Introduction: Each year, emergency medicine (EM) residency graduates enter a variety of community and academic positions. For some training programs, the potential for an academic career is a consideration during the interview process; however, no studies have looked at factors that might predict an academic career. Our goal was to identify variables present during the EM application cycle that predict an initial academic position.

Methods: We retrospectively reviewed application materials from 211 EM graduates at Emory University from 2003-2013. We analyzed biographical variables, board scores, personal statements, and both undergraduate and medical school research experience and publications. An academic position was defined as working at a site with residents rotating in the emergency department, full or part-time appointment at a medical school, or a position with research required for promotion. We used a logistic regression model to determine the impact of these predictors on obtaining an initial academic position.

Results: A total of 79 (37%) graduates initially chose an academic job, and 132 (63%) took a community position. We identified the following statistically significant variables: younger age (odds ratio [OR] [0.79], 95% confidence interval [CI] [0.67-0.93], p=0.01); undergraduate publications (OR [1.41], 95% CI [1.08-1.83], p=0.01); and medical school publications (OR [3.39], 95% CI [1.66-6.94], p<0.001). Of note, mention of an academic career in the personal statement showed no statistical correlation (p = 0.41).

Conclusion: Younger age, and undergraduate and medical school publications were the variables most associated with an initial academic position. As this is a single-institution study, more studies are needed to validate these findings. [West J Emerg Med. 2019;20(1)127–131.]

INTRODUCTION

Each year approximately 2,000 emergency medicine (EM) residents will graduate and obtain positions at academic, community, or fellowship sites.[1] Of these graduates, approximately 39.6% will take either an academic or fellowship position, while 57.1% will take a community position and the remainder will pursue other careers.[2] The only related EM-based study, done by Burkhart et al. in 2011, found that larger programs, location, and resident academic productivity may lead to more graduates choosing an academic career.[2] This study received survey responses from 103 of 147 residency programs and found a greater proclivity for a career in academic medicine from EM programs with more than eight residents as well as programs located in the Northeast/Mid-Atlantic and Southwest regions.

To date, there have been no studies that have examined whether any factors on an individual's Electronic Residency Application Service (ERAS®) file might predict an initial position in academic medicine. Studies from a variety of other specialties suggest that factors such as female gender,

undergraduate and medical school research, United Stated Medical Licensing Examination (USMLE) scores, and peer-reviewed, pre-residency publications may be associated with a higher likelihood of an academic career.[3-8] These results, however, are inconsistent, and likely the factors that influence an individual's career choice may be distinct for each specialty.

Although EM residency programs were initially more clinically oriented with only 30% of programs in 1994 affiliated with an academic center,[9] there has been a general push to grow EM as an academic specialty that balances clinical care with research and education.[10] For many programs, an applicant's potential career choice plays a factor in recruitment, with different programs seeking to train varying numbers of academic clinicians; however, there are no studies in the field of EM that have looked at which factors on a candidate's application would predict an academic position. Based on studies from other fields, our hypothesis was that applicants who published more papers in undergraduate and medical schools would more likely choose to initially pursue a position as an academic clinician. Furthermore, we sought to seek any other variables present in residency applications that are associated with taking an initial position in academics, and we looked at variables known to be associated with an academic career based on previously published studies, such as attendance at more research-oriented medical schools and an applicant's USMLE step score.[3-5]

Our overall objective was to determine if any factors present on an EM residency application would be a predictor of an initial career in academics. Our goal is to use this data in the future, along with the interview process, to help with resident recruitment as well as help shape resident professional development during training.

Population Health Research Capsule

What do we already know about this issue?
In the field of EM, there are no studies investigating what factors on residency applications would lead to graduates taking initial academic jobs.

What was the research question?
Is research experience prior to residency a predictor of initial academic jobs after graduation?

What was the major finding of the study?
Younger age and publications prior to residency are independent predictors of an initial academic position.

How does this improve population health?
Analysis of residents' career choices could allow for improved mentorship and selection that will better reflect each program's mission and the communities they serve.

METHODS

This was a retrospective, single-institution study of the application materials of residents who graduated between 2003 and 2013 from the Department of Emergency Medicine at Emory University. Residents were grouped for analysis with their entering class, and we excluded from the study those who did not complete training at the program. All graduates of the program during this time period were included in the study. Biographical, undergraduate, and medical school data were recorded from residency application materials of these classes archived onsite. This study was deemed exempt by the institutional review board. For the purposes of this study we defined an academic setting as a site that require supervision of residents in the emergency department (ED), full-or part-time appointment at a medical school, or a position with academic research required for promotion. This definition is similar to previous studies[2] and was chosen to broadly include all physicians who would define themselves as academic clinicians.

Factors were chosen based on findings in other fields associated with a likelihood of an academic career as listed in Table 1. Biographical data included gender, age at the time of application, other advanced degrees in addition to medical doctor, or a prior career and were extracted directly from archived application forms. Other advanced degrees include a master's degree, or PhD, and did not have to be from a scientific field. Prior career was defined as any previous position lasting longer than one year that was not designed to get clinical or research experience for a career in medicine, or any job position that lasted for longer than five years.

We extracted undergraduate research experience from self-reported data on each archived application, and then confirmed publications via searches on PubMed and Google Scholar. Manuscripts published after graduation from research done while an undergraduate were still marked as an undergraduate publication. Research and manuscripts done after undergraduate graduation but before medical school were also counted in the undergraduate category.

Medical school data included research experience, manuscript publications, membership in Alpha Omega Alpha (AOA) honor society, USMLE Step 1 and Step 2 scores, a personal statement with references to a career in academics, and attendance at a "research-heavy" medical school, classified as appearing in the top 10 list of "Research Medical Schools" in

Table 1. Variables studied.

Age
Gender
Previous career (yes/no)
Advanced degree (yes/no)
Undergraduate research (yes/no)
Number of undergraduate publications
Research heavy medical school (yes/no)
Medical school research (yes/no)
Number of medical school publications
Personal statement mentioning academics
USMLE step 1 score
USMLE step 2 score
AOA membership

USMLE, United States Medical Licensing Exam; *AOA*, Alpha Omega Alpha.

Table 2. *US News and World Report's* top 10 research medical schools (2000-2010).

Columbia University
Duke University
Harvard University
Johns Hopkins University
Stanford University
University of California at Los Angeles
University of California at San Francisco
University of Chicago
University of Michigan
University of Pennsylvania
University of Washington
Washington University in St. Louis
Yale University

Please note that there are a total of 13 schools that ranked in the top 10 research schools during this time period.

the *US News and World Report* rankings during the years of the study.[11] This list of research-heavy schools during this time period is shown in Table 2. A personal statement considered positive for a reference to an academic career was one in which the resident applicant specifically stated that he or she wished to pursue a career in academic medicine or at an academic institution. During data collection, we resolved any discrepancies with scoring the subjective variable "personal statement mentioning academics" after consensus discussion.

We classified residency graduates into academic and non-academic categories depending on their initial job following residency or fellowship graduation. An academic position was defined as a job in which the graduate would directly work with and supervise residents rotating through the ED affiliated with an accredited graduate medical education program. Of note, this did not include only EM residents. This definition was chosen to be consistent to be inclusive for all physicians who would consider themselves an academic clinician and an educator even though they may not be employed directly by a medical school or university. The location of where the graduates initially practiced was acquired from their residency archive file, which is continuously updated by our administrative staff.

We used a binary logistic regression to evaluate the importance of each predictor. Statistical analyses were conducted using SPSS (v. 24; Armonk, New York).

RESULTS

We included a total of 211 EM graduates in the analyses. As shown in Table 3, 79 graduates (37%) chose an initial position in academics while 132 (63%) initially took a community position. As shown in Table 4, the statistically significant factors associated with an academic position were younger age, undergraduate publications, and medical school publications. In terms of age, the correlation was inversely related to each increasing year of age (odds ratio [OR] [0.79] per year, 95% confidence interval [CI] [0.67-0.93], p=0.01). Other factors, such as gender, previous career, advanced degrees, conducting research in undergraduate and medical school, a research-heavy medical school, USMLE scores, and AOA membership, showed no statistical association with an initial academic position. Furthermore, mention of pursuing a career in academics in a personal statement was not associated with an initial academic position (p=0.41).

DISCUSSION

This study sought to determine the factors that would predict an initial position in academic EM. To our knowledge, this is the first study in EM that looks at individual factors associated with academics, and the correlation of an applicant's undergraduate publications and medical school publications is consistent with findings reported in other fields.[3-5,7] A unique finding is an inverse relationship with increasing age and a position in academics, which has not been shown in studies from other fields.[13-14] It is unclear why age is a specific predictor in this study compared to other fields as most academic tenure tracks have similar promotion processes; however, a potential reason may be that EM is unique in that shift-work allows for more schedule flexibility, and older physicians who would potentially have more personal responsibilities such as families would prefer the increased flexibility, and potentially greater pay at community sites.

The correlation of publishing with an initial academic position was something hypothesized to be a predictor as it has

Table 3. Baseline demographics of graduates of Emory University's emergency medicine residency program.

Characteristic	% or M	95% CI or IQR
Female (%)	46.92	40.19; 53.65
Age (M)	27	3
Advanced degree (%)	17.54	12.4; 22.67
Prior career (%)	15.64	10.74; 20.54
Undergraduate research (%)	69.19	62.96; 75.42
Medical school research (%)	63.51	57.01; 70.0
Undergraduate publications (%)		
0	76.3	70.57; 82.04
1	10.9	6.7; 15.11
2	8.53	4.76; 12.3
3	2.37	0.32; 4.42
4	0.95	0.0; 2.26
7	0.47	0.0; 1.4
17	0.47	0.0; 1.4
Medical school publications (%)		
0	82.46	77.33; 87.6
1	12.32	7.89; 16.76
2	3.79	1.21; 6.37
3	0.47	0.0; 1.4
4	0.47	0.0; 1.4
6	0.47	0.0; 1.4
USMLE 1 (M)	222	24.6
USMLE 2 (M)	230.03	26.1
Academic personal statement (%)	16.78	11.74; 21.82
AOA (%)	10.43	6.3; 14.55
Academic career (%)	37.44	30.91; 43.97

USMLE, United States Medical Licensing Exam; *AOA*, Alpha Omega Alpha; *M*, median value; *CI*, confidence interval; *IQR*, interquartile range.

been consistent with studies in other fields. The act of publishing in a peer-reviewed journal shows a level of interest and dedication to conducting research, especially in EM as it is not as research intensive as other specialties. We suspected that individuals arriving into residency with an interest in research would likely take an initial academic position where there are potentially more research opportunities and protected time than with a community position.

Other factors such as gender, a prior career, undergraduate, or medical school research experience showed no significant correlation to an academic position. Unlike studies in other fields, neither an advanced degree, a research-intensive medical school, nor USMLE scores predicted an academic position.[4,6,7] The lack of an association with USMLE scores and AOA membership with respect to academics is more likely specific to the field of EM, which usually evaluates these factors in the context of a whole application as opposed to a threshold or screening criteria. Furthermore, the lack of an association between an academic career and *US News and World Report* rankings of a research-heavy medical school is likely attributable to EM's greater emphasis on clinical and population-based research, which is not as well reflected as basic science in these rankings.

Although 39 (18.5%) of the graduates stated in their personal statement that they wished to pursue an academic career, only 17 of those graduates took an initial job in academics, which demonstrated no statistical significance. The reasons behind this discrepancy are beyond the scope of our study but could potentially be the result of changing life priorities as a resident goes through training, and the colloquial belief that when applying at academic centers they must express a desire to pursue academics to be considered for a spot in the program.

LIMITATIONS

The major limitations of this study are those associated with a single-institutional study and whether the results are generalizable to other programs. The rates of residents who pursue an initial academic, fellowship, or community career are similar to rates previously described in the literature.[2] The finding that pre-residency publications are associated with an academic career is consistent with findings in a variety of other fields. In addition, the review was retrospective and historical; graduating residents' career decisions might change with the clinical landscape. Furthermore, the use of *US News and World Report* rankings as a measure of research productivity is controversial; however, this method has been used by previous authors and the methodology is well described.[4,12] Lastly, although our study was similarly powered to studies in other fields, the presence of 13 variables and 79 total applicants who went into academics lends itself to the risk of overfitting, and a large-scale multi-institutional study would be beneficial to validate these findings. It is also important to note that this study looks at an initial position in academic medicine; however, many individuals may spend a year or more at an academic institution while they are deciding on a career choice. This may lead to an overestimation of how many graduates ultimately pursue a career in academics.

CONCLUSION

In summary, this was a pilot study that looked for individual residency-application factors that would predict a graduate's initial career choice to pursue academic EM. Among the 13 variables analyzed over this 10-year period, we found an association between an initial academic position and having peer-reviewed publications during undergraduate and medical school, as well as with younger age. The act of publishing itself was statistically significant, but research experience itself was unrelated. Other EM studies are needed to validate these results.

Table 4. Predictors of an initial academic position.

Predictor	Odds ratio	95% CI	P value
Gender	1.42	0.72; 2.78	0.31
Age	0.79	0.67; 0.93	0.01
Prior career	2.05	0.65; 6.41	0.22
Undergraduate research	1.57	0.74; 3.33	0.24
Undergraduate publications	1.41	1.08; 1.83	0.01
Advanced degree	1.76	0.69; 4.52	0.24
Research focused medical school	0.38	0.08; 1.88	0.23
Medical school research	0.71	0.35; 1.43	0.34
Medical school publications	3.39	1.66; 6.94	<.001
Academic personal statement	1.43	0.61; 3.35	0.41
USMLE 1	0.99	0.96; 1.02	0.55
USMLE 2	1.01	0.98; 1.04	0.65
AOA	0.78	0.25; 2.45	0.67

USMLE, United States Medical Licensing Exam; *AOA*, Alpha Omega Alpha; *CI*, confidence interval.
P values refer to the results of binary logistic regression analysis for academics versus non-academics.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Assessing Residency Applicants' Communication and Professionalism: Standardized Video Interview Scores Compared to Faculty Gestalt

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Section Editor: Sally A. Santen, MD, PhD
Submission history: Submitted July 11, 2018; Revision received October 8, 2018; Accepted October 19, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39709

Introduction: The Association of American Medical Colleges has introduced the Standardized Video Interview (SVI) to assess the communication and professionalism skills of residency applicants to allow a more holistic view of applicants beyond academic performance. Initial data suggests scores are not correlated with academic performance and provide a new measure of applicant attributes. It is not currently known how the SVI compares to existing metrics for assessing communication and professionalism during the interview process.

Methods: Applicants to the University of Wisconsin Emergency Medicine Residency program were invited and interviewed without use of the SVI scores or videos. All faculty interviewers were blinded to applicants' SVI information and asked to rate each applicant on their communication and professionalism on a scale from 1-25 (faculty gestalt score), analogous to the 6-30 scoring used by the SVI. We transformed SVI scores to our 1-25 system (transformed SVI score) for ease of comparison and compared them to faculty gestalt scores as well as applicants' overall score for all components of their interview day (interview score).

Results: We collected data for 125 residency candidates. Each applicant received a faculty gestalt score from up to four faculty interviewers. There was no significant correlation of SVI scores with faculty gestalt scores (Spearman's rank correlation coefficient [r_s] (123)=0.09, p=0.30) and no correlation with the overall interview score (r_s(123)=0.01, p=0.93). Faculty gestalt scores were correlated positively with interview scores (r_s(123)=0.65, p<0.01).

Conclusion: SVI scores show no significant correlation with faculty gestalt scores of communication and professionalism. This could relate to bias introduced by knowledge of an applicant's academic performance, different types of questions being asked by faculty interviewers, or lack of uniform criteria by which faculty assess these competencies. Further research is needed to determine whether SVI scores or faculty gestalt correlate with performance during residency. [West J Emerg Med. 2019;20(1)132–137.]

INTRODUCTION

Emergency medicine (EM) residency programs receive hundreds of applications each year for just a handful of residency positions. Residency applicants to Accreditation Council for Graduate Medical Education (ACGME)-accredited EM residencies submitted an average of 48.2 applications each to programs in 2017, a 50% increase from 32.2 applications each five years ago.[1] The Association of American Medical

Colleges (AAMC) has noted this trend across specialties and has encouraged students to apply to fewer programs, citing diminishing returns with an increased number of applications.[2] Residency programs continue to search for methods of managing this increased volume of applicants, from the Standardized Letter of Evaluation (SLOE) aimed at allowing programs to rank applicants more effectively[3] to coordinated interview days by institutions in the same geographic area, allowing applicants to curb the significant costs associated with travel to an increasing number of programs.[4]

Starting in the 2017-2018 application cycle, the AAMC implemented the Standardized Video Interview (SVI) as a pilot component of the Electronic Residency Application Service (ERAS®) for all applicants to EM residency programs. The SVI is intended to provide program directors (PDs) with standardized, reliable, and comparable information about applicants' interpersonal communication skills and professionalism, allowing residency programs an additional data point by which to sort applicants, with a secondary goal of boosting the applications of applicants who might not otherwise have been considered.[5] In past years, these characteristics could only be rated during in-person interviews. Questions were reviewed by subject matter experts in EM and graduate medical education and linked to ACGME competencies to ensure maximum validity.[6] Following the 2017 pilot, it was demonstrated that there was no correlation between the SVI score and United States Medical Licensing Examination Step 1 exam scores, validating one of the objectives of the SVI: that it measure characteristics separate from academic knowledge.[5] It has yet to be determined, however, the level of correlation that exists between SVI score and how applicants are currently evaluated by faculty during in-person interviews. The goal of this study was to determine the correlation of the AAMC's SVI score to interview faculty gestalt of professionalism and communication skills during in-person interviews at the University of Wisconsin Emergency Medicine Residency program during the 2017-2018 application cycle. Our hypothesis was that the SVI scores should correlate with our faculty's gestalt of communication skills and professionalism.

Population Health Research Capsule

What do we already know about this issue?
Communication and professionalism are essential aspects of competent physicians and could previously only be evaluated by residencies during the in-person interview. The Association of American Medical Colleges (AAMC) introduced the Standardized Video Interview (SVI) to assess applicants' competency in these domains.

What was the research question?
How do SVI scores compare to faculty evaluations of applicants' communication and professionalism?

What was the major finding of the study?
There was no correlation between SVI scores and faculty communication and professionalism scores.

How does this improve population health?
SVI scores appear to provide novel data to the residency application process which could aid in the selection of physicians with strong professionalism and communication skills. More research is needed to determine how SVI scores correlate with residency performance.

METHODS

SVI

When taking the SVI, the applicant receives a total of six questions, one at a time, presented on a personal computer. They are allowed up to 30 seconds to prepare their answer, and then up to three minutes to record their response. Questions are not provided prior to the start of the interview. Questions were first vetted by a group of residency PDs for potential bias and relevance to ACGME competencies.[7] Each of the applicant's answers are then graded by six different trained evaluators who use a standardized rating scale developed by PDs and have an opportunity to practice and receive feedback using the rating scale. Raters also receive training in unconscious bias. Each question is rated on a five-point scale with total scores falling between 6-30 (pilot mean: 19.1, standard deviation [SD] 3.1). Applicants are unable to retake the SVI or void their score. An applicant's video and score are available for viewing by EM residency program leadership within the applicant's ERAS application during the current pilot.

Setting

The University of Wisconsin Emergency Medicine Residency is a three-year residency program with 12 residents per year, based at a tertiary-care hospital located in Madison, Wisconsin.

Applicant Screening

During the applicant screening process, the program director (PD) and the two assistant program directors (APD) reviewed each applicant's entire file with the exception of the SVI information, which was not examined in any way. Applicants were assigned a composite score based on academic and clinical achievement, which was used to generate a list of applicants invited to interview. The screening and invitation process was identical to what had been used in prior years before the SVI information was available.

Applicants

All applicants who attended an interview at the University of Wisconsin Emergency Medicine Residency program during the 2017-2018 interview season were eligible for inclusion; there were 11 interview days in total. We excluded internal applicants (from the University of Wisconsin School of Medicine and Public Health) since faculty may have had previously formed opinions about their communication skills and professionalism.

Interview Day

Prior to each interview day, all faculty members who were interviewing applicants received the ERAS file for each applicant. At the start of each day, one of the investigators gave faculty a standard set of instructions. Interviewers were asked to conduct their interview in their usual fashion (unstructured—ranging from casual conversation to behavioral interview questions depending on individual faculty preference), but to use applicants' responses to these questions to rate their competence in the areas of communication and professionalism alone, with a score of 1 representing the least effective professionalism and communication skills an applicant could demonstrate and a 25 representing the most advanced professionalism and communication skills an applicant could demonstrate. This score was dubbed the "faculty gestalt score." A 1-25 scale was chosen to mirror the SVI's 6-30 scoring scale as closely as possible, removing the additional complexity of a nonstandard starting integer. While the SVI scores applicants from 1-5 across six individual domains to generate a composite final score, this was deemed unfeasible for faculty to complete for each applicant during the brief duration of a standard residency interview; hence, a single gestalt score was used instead.

Immediately after each interview, each interviewer recorded the score for the applicant's communication and professionalism based on the interview alone along with their overall interview day score for each applicant (the "interview score"), which was based on a much broader range of factors (e.g., personal statement, research experience, academic interests) and was identical to the system used in previous years to evaluate and rank applicants.

Every applicant interviewed with four faculty members during their interview day: the PD and one of the APDs interviewed all applicants, while the other APD was present for every interview day but did not interview every applicant, and the remainder of the interviews were performed by other members of the faculty group. A total of 19 different faculty members participated in the interview season. All interviewers were core faculty members who use the ACGME EM Milestones to help assess residents after each shift, including the Interpersonal and Communication Skills (ICS) and Professionalism (PROF) milestones.

After each interview day, the professionalism and communication faculty gestalt scores were recorded by the residency coordinators in a confidential, secure spreadsheet along with the overall interview scores, which only the residency leadership team had access to. Other than the addition of the professionalism and communication faculty gestalt score, the process was identical to the previous year's interview process for applicants.

Analysis

All of the SVI scores for applicants were transformed to our 1-25 rating scale by subtracting five from each score for ease of comparison and interpretation. This new score became the "transformed SVI score." With an alpha = .05 and power = 0.80, the projected sample size needed to detect a medium correlation (r_s=0.30) is approximately n = 85. For each applicant, a mean of all available faculty gestalt scores was calculated. We used Microsoft Excel to compute ranges, medians and means and SPSS was used to calculate Spearman's rank correlation coefficient ($r_{s)}$ for the transformed SVI score, the professionalism and communication faculty gestalt score, and the overall interview score. Krippendorf's alpha (similar to Cohen's kappa with similar standards for acceptable agreement[8] but allows for missing data) for faculty gestalt scores was calculated using ReCal OIR, available at http://dfreelon.org/utils/recalfront/recal-oir/.

This study was deemed to be exempt from full institutional review board (IRB) review by the The University of Wisconsin Health Sciences IRB. This study also received approval from the AAMC to use SVI pilot data.

RESULTS

A total of 125 applicants were included in the analysis, with 423 faculty gestalt scores total out of a possible 500 generated over the interview season. Means and SDs for the transformed SVI score and the faculty gestalt score are listed below in the Table. The mean transformed SVI score was 14.6 (+/- 2.6), the mean faculty gestalt score was 17.9 (+/- 3.0), and the mean interview score was 6.7 (+/- 1.7).

There was no significant correlation ($r_s(123)$=0.09, p=0.30) between transformed SVI scores and faculty gestalt scores (Figure 1). Additionally, there was no correlation ($r_s(123)$=0.01,

Table. Range, median and mean transformed Standardized Video Interview (SVI), faculty gestalt, and interview scores, with standard deviations (SD).

	Transformed SVI score	Faculty gestalt score	Overall interview Score
Range	9-21	2-25	1-10
Median	15	19	7
Mean	14.6	17.9	6.7
SD	2.6	3.0	1.7

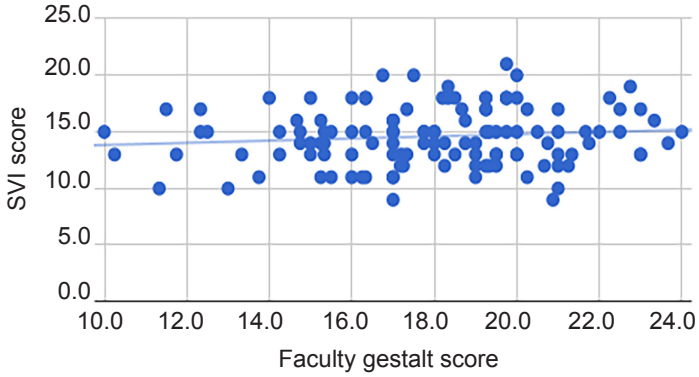

Figure 1. Scatter plot of transformed Standardized Video Interview (SVI) score vs. faculty gestalt score ($r_s(123)=0.09$, p=0.30), with line of best fit.

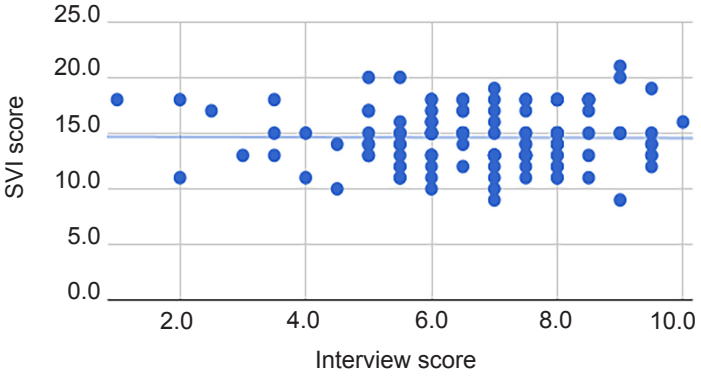

Figure 2. Scatter plot of transformed Standardized Video Interview (SVI) score vs. interview score ($r_s(123)=0.01$, p=0.93), with line of best fit.

p=0.93) between overall interview scores and transformed SVI scores (Figure 2). There was, however, a significant correlation with a medium effect ($r_s(123)=0.65$, $p<0.01$) between the faculty gestalt score and the overall interview score (Figure 3).

We calculated Krippendorff's alpha to determine the agreement between faculty raters of communication and professionalism and found it to be 0.26, suggesting low inter-rater reliability.

DISCUSSION

Our results showed no significant correlation between SVI scores and faculty gestalt. For our residency program, the SVI appears to provide new and unique applicant data that differs from any data currently generated during the interview process. The challenge for programs centers on whether and how to use this information during the recruitment season.

According to the AAMC, EM programs should consider adding the SVI score to the composite score during the initial applicant screening process to determine which applicants are invited to interview.[9] This stage of the application process generally includes data such as USMLE step scores and SLOE performance. Incorporation of the SVI at this early stage would allow for consideration of non-academic factors into the screening process; however, it could also give it an impact beyond that of many other available ERAS data points not frequently used in the composite score, such as leadership or research experience. Determining the ideal weight of the SVI score at this early stage compared with other composite score elements poses a particular challenge when the link between SVI scores and residency performance has not been firmly established.[7] Our research further suggests that using SVI scores during this stage as a surrogate for how faculty would feel about an applicant's professionalism and communication would not be effective, since the two scores were not correlated.

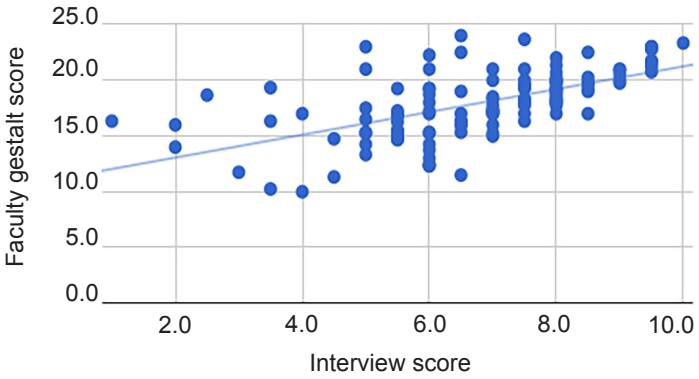

Figure 3. Scatter plot of faculty gestalt score vs. interview score ($r_s(123)=0.65$, $p<0.01$), with line of best fit.

It is not surprising that faculty gestalt and overall interview scores are highly correlated, as they are based on observation of the same interview. One potential explanation for the disparity between SVI and faculty gestalt scores, however, lies in what is being assessed by faculty gestalt. While faculty were instructed to score professionalism and communication skills as objectively as possible when generating a faculty gestalt score, an applicant's "fit" or similarity to existing residents and faculty can color assessments when evaluating potential trainees and future colleagues. This sense of how an applicant will fit within the culture of a program and institution inevitably invokes implicit bias, which can have significant long-term consequences for diversity, inclusion, and overall program identity. It can also vary greatly between individuals, as seen in the low inter-rater reliability of our faculty gestalt scores, consistent with prior literature on the unreliability of unstructured interviews.[10] Despite knowledge of this variability, residencies continue to put great faith in interviewers' aggregate impression of applicants' skills and potential for success.[11]

Perhaps, then, an objective SVI score is a welcome addition to our interview process, introducing a more objective measure of interpersonal skills than has previously been possible.

Alternatively, a more concerning possibility raised by this study is that the SVI score does not measure the professionalism and communication skills that it purports to measure, instead measuring other variables such as applicants' performance and improvisation skills, an objection that has been raised before.[12] Accurately assessing interpersonal skills via a one-way interaction with technology may be inherently problematic and does not have the same base of validity evidence for assessing resident competency in the literature as techniques such as the Mini-Clinical Evaluation Exercise and 360-degree evaluations.[13] Similarly, while professionalism assessments around ethics and moral reasoning (such as the SVI) have been shown to be reliable and valid,[14] there is concern that these may not translate well to observed behaviors.[15] Finally, while the SVI currently does not cost students money during the pilot phase,[5] the significant resources required to execute this project suggest that it is unlikely to remain free to students. As the cost of applying and interviewing for residency is already estimated at ≈ $8,000 per student,[16] there should be significant caution with burdening students with a further source of stress and cost when the value it provides is currently unclear.

LIMITATIONS

Our study has several important limitations. The sample size was small, and it was drawn from a single year of data collected at one institution. Some of the faculty gestalt scores were missing, likely due to interviewers forgetting to record a score or running out of time. However, missing scores represented a relatively small portion of the data. To create similarity with the SVI's 6-30 scoring, we used a 1-25 scoring system; however, it may have been difficult for faculty to differentiate between scores with this many items in the rating scale (e.g., between a 20 and a 21).

Although interviewers received standardized instruction at the beginning of each interview day, we did not formally train them, provide formalized feedback, or define how they should rate an applicant's professionalism and communication, raising the possibility that interviewers assessed and rated these qualities differently. Interviewers also had access to applicant's application files when assigning faculty gestalt scores, raising the possibility that factors other than interview performance affected their scores. While our core faculty are familiar with the EM Milestones and use them frequently to assess residents, we did not specifically review the content of the interpersonal communication skills and Professionalism milestones with faculty as a part of this study. Interviewer implicit bias is an additional concern that was not assessed by this study. We believe that overall, however, our methods are likely representative of how other institutions currently assess applicant communication and professionalism skills during the interview process.

CONCLUSION

SVI scores for our cohort of 2017-2018 applicants showed no correlation with our faculty's gestalt rating of applicants' communication and professionalism during their interviews. It is unclear at this time if either metric is correlated with future applicant success. The uncertainty about the current value of the SVI score represents an opportunity for future research prior to a broader roll-out, which might explore the potential correlations between SVI scores and success in the match, professionalism citations, clinical performance, and Press-Ganey ratings.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Does Implementation of a Corporate Wellness Initiative Improve Burnout?

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Section Editor: Chris Merritt, MD, MPH
Submission history: Submitted July 11, 2018; Revision received October 4, 2018; Accepted October 15, 2018
Electronically published November 13, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39677

Introduction: Burnout affects over 50% of all physicians. Nearly 70% of emergency physicians are affected, and it has been found to be as high as 76% in resident physicians overall. Previous wellness initiatives have yielded variable results; therefore, we looked for interventions that could potentially be effective at reversing this trend. We explored effective wellness programs originating from other industries. Our objective was to implement a corporate wellness program with previous evidence of success in other healthcare provider populations. We aimed to investigate whether this program would be effective in decreasing burnout in emergency medicine (EM) residents.

Methods: This program was conducted during required EM resident conference hours from 2016-2017. The Maslach Burnout Inventory was completed before and after the series of sessions, and we collected reactions-level data following completion of the six sessions.

Results: Post-intervention scores revealed a small trend toward increased emotional exhaustion and depersonalization scores, and with increased personal accomplishment scores. The overall satisfaction rating for this program was low, at 1.5 on a 5-point scale. Forty-three percent of residents stated that this intervention subjectively worsened their overall burnout, with another 39% stating it did not improve their burnout at all. A similar trend was seen for effects on wellness.

Conclusion: We found that a corporate wellness intervention that had previously been shown to be successful with other types of healthcare providers did not objectively improve burnout and was subjectively perceived as paradoxically worsening burnout for many residents. This result may be related to the type of intervention chosen (individual vs. systems-focused), the design of the intervention itself, or the unique stressors faced by the resident population. [West J Emerg Med.2019;20(1)138–144.]

INTRODUCTION

Burnout affects over 50% of all physicians. It is nearing 70% in emergency physicians (EP) and has been found to be as high as 76% in resident physicians.[1–4] Between 2011 and 2014, burnout rates have trended upwards, reaching what has been described as "epidemic proportions."[1,5] Burnout has been defined as "a syndrome of emotional exhaustion, depersonalization, and a sense of low personal accomplishment that leads to decreased effectiveness at work," while wellness is an even broader, multidimensional concept.[5,6] Burnout has been shown to have a negative impact on patient safety and quality of care, patient satisfaction, and healthcare costs, as well as having negative effects on the individual such as job dissatisfaction, intent to leave, decreased productivity, and increased incidence of alcohol abuse, depression and suicidal ideation.[7] Various types of wellness, resilience and stress management interventions have been implemented in the past among various populations of

healthcare providers, revealing inconsistent results.[8–19]

Similar inconsistent results have been seen with corporate wellness programs across a wide variety of industries, with an overall positive impact reported via meta-analysis.[20] While many corporate programs focus on absenteeism and job satisfaction as the main outcomes, one program called "The Happiness Practice" (THP) has shown success for non-physician, emergency medicine (EM)-based healthcare providers (predominantly nurses) in decreasing burnout, increasing wellness, and even increasing patient satisfaction.[20,21] This program has also been shown to decrease burnout in hospital-based executive leadership teams, while increasing individual happiness, resilience, innovation and sustainability [Personal communication, Nancy O'Brien]. THP is focused on methods to increase each individual's happiness and resilience through helping them develop "new ways of thinking, feeling and behaving that positively impact their life, their work and their environment."[22]

Additional studies are needed to investigate which types of interventions are effective for certain groups of healthcare providers.[15] There is evidence that both systems-based and individual-based wellness initiatives can have benefits.[23] Since previous, individual-focused interventions such as mindfulness and mindful communication have shown improvements in healthcare-provider burnout, we aimed to investigate whether the corporate THP program would be effective to decrease burnout in EM residents.[24–28]

Population Health Research Capsule

What do we already know about this issue?
Burnout has become prevalent in the medical field, including graduate medical education. Nearly 70% of emergency physicians meet criteria for burnout.

What was the research question?
Would a corporate wellness program "The Happiness Practice" be effective in decreasing burnout in emergency medicine (EM) residents?

What was the major finding of the study?
This program was not effective in improving EM resident burnout, despite its prior efficacy with EM nurses and hospital leadership.

How does this improve population health?
Specific, individual-focused burnout interventions may not be equally effective among different healthcare provider types. Systems-focused interventions may be beneficial.

METHODS

We implemented THP for EM residents at an urban training program during regularly scheduled conference hours in 2016-2017. This program included six, monthly, one-hour didactic sessions from September through February, each focusing on a different core principle following an introductory session. These included the following: 1) Be conscious; 2) Honor feelings; 3) Release control in favor for empowerment; 4) Co-create what works now; and 5) Learn life lessons. Sessions were developed and led by two former business executives who co-founded THP. Their company was contracted by our hospital system, and provided this program to any interested groups or units during the period of that contract. Optional, small-group, evening social discussions called "Happy Chats" between sessions were also held at local restaurants between the first three sessions, led by the two co-founders. These included time for building interpersonal relationships and reflecting on the content that was delivered during the conference sessions through facilitated discussion. Following the introductory session, many residents provided feedback that the conference session was too long for the amount of information provided and was not structured in a high-yield format. Therefore, subsequent sessions were adjusted to become 15-minute sessions delivered in a more high-yield fashion. The Maslach Burnout Inventory (MBI) was completed before and after the series of six sessions. Following the completion of all six sessions, residents were also surveyed for reactions-level data using an anonymous electronic platform.[29] Descriptive data are presented, and we conducted thematic analysis using a data-driven inductive approach to code comments.[30] All comments were coded by two independent researchers. The institutional review board determined this study to be exempt.

RESULTS

The response rate for MBI completion was 34 of 46 (74%) residents prior to the training and 24 of 46 (52%) residents after the training. There was a slight trend toward increased overall burnout scores in areas of emotional exhaustion (EE) and depersonalization (DP), with improved mean personal accomplishment (PA) scores following this intervention (Table 1). These trends were also seen in the post-graduate year (PGY)-1 and PGY-2 classes, all with overlapping standard deviations. In the PGY-3+ class, only four respondents completed the post-intervention MBI; thus, these results should be interpreted with caution (Table 1, Figure). The response rate for the reactions-level data post-survey was 23 of 46 residents (50%). Results of the survey questions are in Table 2. The overall satisfaction rating was 1.5 on a 5-point scale (Table 2). An average of 27 residents attended each conference session.

Nineteen individuals provided free-text comments on the

Table 1. Maslach Burnout Inventory scores of emergency medicine residents before and after participation in a corporate wellness program.

	Pre-EE mean (SD)	Post-EE mean (SD)	Pre-DP mean (SD)	Post-DP mean (SD)	Pre-PA mean (SD)	Post-PA mean (SD)
All classes combined (n=34 pre-intervention, n=24 post-intervention)						
MBI score	24.3 (9.8)	26.2 (9.7)	14.2 (5.4)	15.8 (6.6)	33.1 (5.0)	37.9 (5.3)
PGY-1 class (n=13 pre-intervention, n=9 post-intervention)						
MBI score	20.9 (9.7)	24.2 (8.2)	11.9 (4.7)	14.6 (6.3)	33.5 (3.8)	39.0 (3.9)
PGY-2 class (n=9 pre-intervention, n=7 post-intervention)						
MBI score	22.6 (7.8)	28 (12.2)	13.4 (5.2)	17.1 (8.2)	36.0 (4.7)	38.6 (6.0)
PGY-3+ class (n=9 pre-intervention, n=4 post-intervention)						
MBI score	31.6 (8.3)	22.5 (7.8)	19.2 (3.4)	15.8 (7.1)	30.1 (4.7)	34.25 (7.1)

PGY-3+ also includes EM/IM combined residents in their third, fourth, and fifth years. There are 46 total residents in this training program, 14 per year, and two per class in the fourth and fifth years of EM/IM.
Pre = prior to implementation of the happiness practice sessions, Post = after completion of these 6 sessions.
Three learners did not identify their learner level on the pre-intervention MBI, and four did not identify their learner level on the post-intervention MBI.
Scoring for EE (per MBI scoring guidelines): High = 27 or greater, Moderate = 17-27, Low = 0-16.
Scoring for DP (per MBI scoring guidelines): High = 13 or greater, Moderate = 7-12, Low = 0-6.
Scoring for PA (per MBI scoring guidelines): High burnout = 0-31, Moderate burnout = 32-38, Low burnout = 39 or greater. Lower personal accomplishment raw scores are an indication of higher burnout, so this item is reverse scored.
PGY, post graduate year; *EM*, emergency medicine; *IM*, internal medicine; *MBI*, Maslach Burnout Inventory; *EE*, emotional exhaustion; *DP*, depersonalization; *PA*, personal accomplishment.

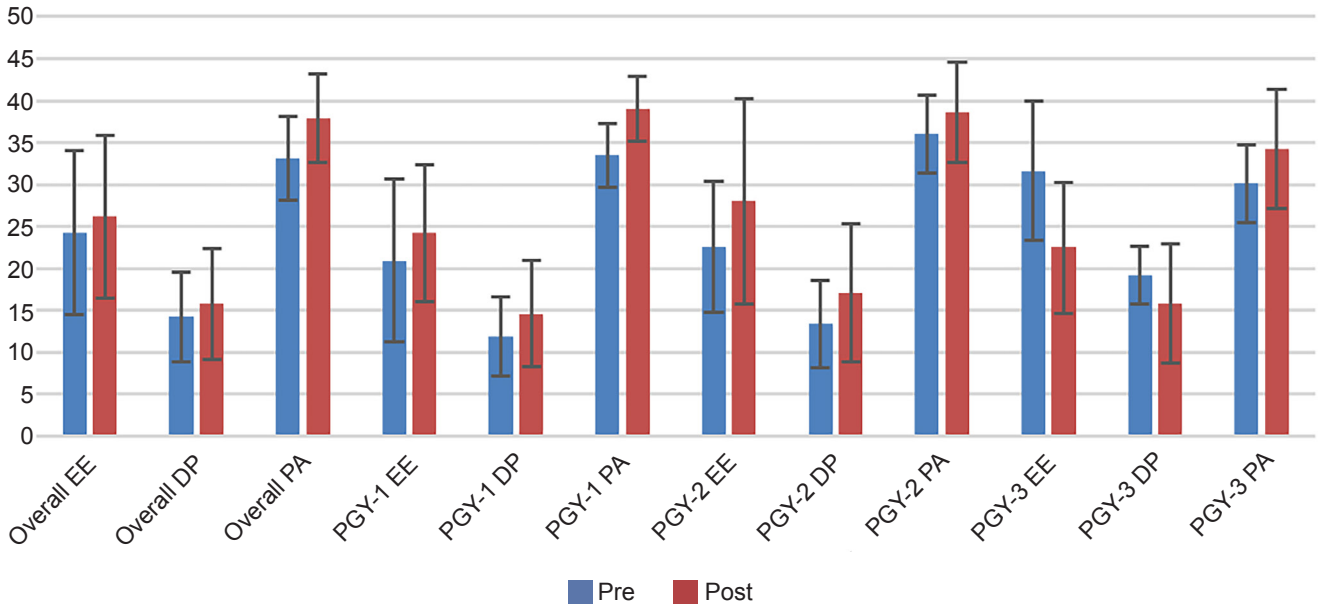

Figure. Maslach Burnout Inventory scores of EM residents before and after "The Happiness Practice."
PGY-3+ also includes EM/IM combined residents in their third fourth and fifth years.
Pre = prior to implementation of "The Happiness Practice" sessions, Post = after completion of these six sessions.
The PGY-3 class only had four respondents post-intervention; so, these results should be interpreted with caution.
PGY, post-graduate year; *EM,* emergency medicine; *MBI*, Maslach Burnout Inventory; *EE*, emotional exhaustion; *DP*, depersonalization; *PA*, personal accomplishment.

survey. There were only two positively coded responses and 17 negatively coded responses, with 100% rater agreement on these categorizations. One positively coded comment revolved around sound philosophy and the other reflected enthusiastic delivery. Thematic analysis of negatively coded comments initially had 84% agreement between raters, with 100% agreement after discussion. Some responses included multiple comments touching on various themes. The following themes emerged: a) The instructors had a poor understanding of residency stressors, resulting in lack of relevance (3); b) the instructors had a poor understanding of EM work, resulting in a lack of relevance (4); c) the sessions needed to be tailored better to healthcare professionals overall (4); d) the sessions were generally unhelpful (11); and e) residents would prefer to be learning topics related to medicine during conference hours (3).

One resident commented, "*A medicine topic lecture would have been more helpful because part of my sensation of burnout is that I do not have enough time to study and learn things, and the anxiety that produces leads to more burnout.*"

Table 2. Survey questions and residents' responses.

Likert scale rating	% of residents
Question #1: Please rate your overall satisfaction with "The Happiness Practice."	
1 = low satisfaction	70%
2	13%
3 = average satisfaction	17%
4	0%
5 = high satisfaction	0%
Question #2: How much do you feel this series improved (lessened) your overall burnout?	
0 = "it made my burnout worse"	43%
1 = not at all	39%
2	9%
3 = moderately	9%
4	0%
5 = significantly	0%
Question #3: How much do you feel this series improved your overall wellness?	
0 = "it made my wellness worse"	17%
1 = not at all	57%
2	17%
3 = moderately	9%
4	0%
5 = significantly	0%

Resident survey responses after implementation of "The Happiness Practice."

Another commented, "*The situations they brought up as things that were stressful (e.g., mild workplace disagreements) didn't seem relevant to emergency physicians/residents. I remember sitting in the session and thinking, "I'm not stressed because some co-worker said something mildly bothersome. I'm stressed because I'm overworked and trying to prevent people from dying every day at work.*"

DISCUSSION

This corporate-based wellness intervention, which has been successful for other types of healthcare providers, did not appear to have much of an effect on overall burnout levels on the MBI and was quite negatively perceived by EM residents.[21] PGY-1s and PGY-2s had a trend towards worsening EE and DP levels during the course of the study. Previous studies have found that burnout and depression, including EE and DP scores, increase significantly throughout intern year, and empathetic concern decreases, likely due to challenging clinical experiences and workloads, long work hours and increased sleep deprivation, limited time to nurture personal lives, and other factors.[31–35] Although an increase in burnout has been found from the start of intern year to mid-year or end of year, further worsening of burnout has not been found between mid-year and end of year in interns or in subsequent years of training.[31,32,34,35] Our post-EE, DP and PA scores, collected nine months into intern year, were similar to end-of-year intern EE and PA scores in pediatric residents and DP scores in internal medicine residents from prior studies.[32,35]

It is unknown whether our intervention had any effect on this trend towards worsening EE and DP, or was just not powerful enough to reverse it. It is possible that any positive impacts of this intervention on burnout could be masked by the expected increase in burnout during intern year, with sustained burnout in subsequent years of training. However, the fact that 82% of residents subjectively felt that the intervention either did not improve or worsened their burnout makes a masked positive effect seem less likely, as does the trend towards worsening burnout scores in our PGY-2 cohort.

The PGY-1 class did experience an improvement in their PA. It is again unknown how much of this stemmed from this intervention vs. other factors such as the increase in confidence and competence that often occurs during PGY-1 year. Since the PGY-3+ class only had four individuals (<25%) complete the post-intervention MBI, the results for this subgroup must be interpreted with caution, as a large potential for bias exists. While some benefit has been seen with individual-focused initiatives to improve burnout (such as mindfulness and small-group activities focusing on meaning and interconnectedness), recent literature has begun to focus more on the importance of systems-based initiatives to decrease burnout and improve wellness.[7,15,23,36–40] It seems that interventions in both of these areas may be helpful to

move the needle in a meaningful way on the burnout and wellness spectrum.

When considering why this intervention was successful in other groups of healthcare workers (ED nurses and hospital leadership) but not EM residents, it is possible that individuals in residency training represent a unique population because 1) residents have longer work hours than other healthcare provider groups, often working 60-80 hours per week; 2) a contributing factor to lack of resident and physician wellness is not having enough time away from work to nurture aspects of one's personal life and spend time with family and friends, and therefore they want to perceive time spent at work as high yield and well spent;[11,41,42] 3) residents are learners, trying to develop competence in a medical specialty and so have an increased focus on developing individual competence with less of a focus in other areas; 4) residents could be living in more of a moment-to-moment mindset and may not see the long-term benefit of such sessions; and 5) burnout has been shown to increase over the first year of residency.[31-35, 42] Their perceptions of this wellness intervention worsening burnout could be related to these factors.

Additionally, THP has a proprietary "Return on Happiness" system that is used to track and report participant progress. That system reportedly "measures and reports qualitative and quantitative improvements at individual, group and organizational levels" (http://www.experiencehappiness.biz/thp/). In this study, we elected not to use this proprietary evaluation tool and instead used the MBI in conjunction with a newly developed reactions-level survey. Our use of a different evaluation tool may also have contributed to the discrepancy between the previously reported success of this intervention and our results.

Our results suggest that wellness initiatives for residents may be perceived as more beneficial if they were more focused on specific EP-related stressors and coping techniques and taught by individuals such as EPs (with expertise in burnout and wellness) who understand EM challenges well. Since residents did not seem to perceive this information to be important, a more explicit explanation of how wellness relates to the residents' general underlying goal of becoming a competent and satisfied physician, and how burnout impacts patient quality of care and safety, patient satisfaction and healthcare costs, may be required.[7]

Positioning this wellness intervention during mandatory educational time was also negatively received. While we feel that education on "non-medicine" topics such as communication, professionalism, wellness/ burnout/ depression, and other topics are important, it is possible that certain types of wellness activities may work better in optional settings, allowing residents autonomy to choose whether they would like to participate.[11,43] Optional sessions could, however, result in individuals with high levels of burnout or low levels of wellness who could benefit from the sessions choosing not to attend.

Since EM has the highest rate of burnout of any medical specialty, nearing 70%, we feel that efforts to elucidate effective interventions for EM providers and residents are important.[3] Conducting a needs assessment within individual residency programs to elicit what that program's residents feel would truly help their wellness would likely also be of benefit, allowing this information to guide the content of future interventions.[23] Exploring system-based frustrations and inefficiencies and having the EM residents partner with departmental leadership to identify systems issues that could be improved may also be of benefit.[37,38]

LIMITATIONS

This study examined THP at only a single residency program over a one-year period. The response rates for the post-intervention MBI and survey were 50%-52%, which could be a source of bias. The lower number of PGY-3+ residents completing the post-intervention measures could also significantly bias these subgroup results. Even though conference time is "protected," due to logistics with resident schedules and off-service rotations not all residents were able to attend each session. It is possible that the results would have been different if every person could attend each session. These sessions were also integrated into our required, resident conference hours; it is unclear if prior successes of the THP program included voluntary or mandatory participation.

Based on resident feedback, the length of each session was decreased from 60 minutes to 15 minutes; therefore, the implemented program was different than that initially described by O'Brien et al.[21] This could have affected the effectiveness of this intervention. Additional demographics were not collected outside of PGY, not allowing further investigation using these variables. Finally, there was no control group for this study, and as far as we are aware, there is no literature describing expected trends in burnout throughout EM residency specifically. Therefore, while THP was not powerful enough to reverse this natural trend towards increased burnout seen in intern year, it is impossible to know if it had any smaller positive or negative effects on the rate of burnout progression.

CONCLUSION

We found that a corporate wellness intervention that had previously been shown to be successful with other types of healthcare providers did not objectively improve burnout and was subjectively perceived as paradoxically worsening burnout for many residents. This may be related to the type of intervention chosen (individual vs. systems focused), the design of the intervention itself, or unique stressors faced by the resident population.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Simulation-based Remediation in Emergency Medicine Residency Training: A Consensus Study

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Section Editor: Jeffrey N. Love, MD, MSc, MHPE
Submission history: Submitted July 13, 2018; Revision received October 19, 2018; Accepted October 26, 2018
Electronically published November 20, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39781

Introduction: Resident remediation is a pressing topic in emergency medicine (EM) training programs. Simulation has become a prominent educational tool in EM training and been recommended for identification of learning gaps and resident remediation. Despite the ubiquitous need for formalized remediation, there is a dearth of literature regarding best practices for simulation-based remediation (SBR).

Methods: We conducted a literature search on SBR practices using the terms "simulation," "remediation," and "simulation based remediation." We identified relevant themes and used them to develop an open-ended questionnaire that was distributed to EM programs with experience in SBR. Thematic analysis was performed on all subsequent responses and used to develop survey instruments, which were then used in a modified two-round Delphi panel to derive a set of consensus statements on the use of SBR from an aggregate of 41 experts in simulation and remediation in EM.

Results: Faculty representing 30 programs across North America composed the consensus group with 66% of participants identifying themselves as simulation faculty, 32% as program directors, and 2% as core faculty. The results from our study highlight a strong agreement across many areas of SBR in EM training. SBR is appropriate for a range of deficits, including procedural, medical knowledge application, clinical reasoning/decision-making, communication, teamwork, and crisis resource management. Simulation can be used both diagnostically and therapeutically in remediation, although SBR should be part of a larger remediation plan constructed by the residency leadership team or a faculty expert in remediation, and not the only component. Although summative assessment can have a role in SBR, it needs to be very clearly delineated and transparent to everyone involved.

Conclusion: Simulation may be used for remediation purposes for certain specific kinds of competencies as long as it is carried out in a transparent manner to all those involved. [West J Emerg Med. 2018;20(1)145-156.]

INTRODUCTION

With the Accreditation Council of Graduate Medical Education's (ACGME) adoption of a competency-based (CB) educational framework, and the majority of emergency medicine (EM) residencies reporting at least one resident on probationary status, remediation has become a pressing topic in EM resident education.[1,2] Some residency training programs struggle with the paradox between the foundational premise of CB training (i.e., a time-independent path to competence for all learners) and the ACGME's prescribed length of residency training (three or four years for EM residency training).[3,4] The fact that not all learners achieve competence at the same time or rates[2] further compounds the matter, necessitating remediation plans for learners falling outside the competency bell curve.[5,6]

"Remediation" can be used to describe the status of a resident within a program (such as "probation") or the "effort spent to improve a resident's knowledge, skills, or attitudes."[7] In this project, remediation is defined as any additional training, instruction, or practice provided to residents found to be deficient in one of the six core competencies in EM.[5,7] Note that remediation is not necessarily equivalent to probation, which implies a formal notation on a resident's academic file; remediation may occur informally without an annotation or the resident being formally under probation.[5]

The last two decades have seen an increase in the use of simulation pedagogies, such as simulation-based mastery learning (SBML) in EM resident education,[8-11] and there are reports of SBML successfully being used for procedural education.[9,12] SBML lends itself particularly to the CB approach in that it is time-independent, allowing learners to achieve mastery over time.[9,10,13] There are also anecdotal reports of success with other kinds of simulation models in EM. Simulation modalities such as high-fidelity patient simulators (mannequins), standardized patients, partial task trainers, computer screen-based simulation, virtual reality environments, and tabletop role-playing exercises such as oral board exam-style simulations have been used to create opportunities and safe environments for clinical training[14] and anecdotally for remediation. While over 90% of EM residency programs use some form of simulation,[11,15] how exactly it is being used and the principles guiding its use vary widely. Current recommendations, in general, support the incorporation of simulation into curricula for instruction, identification of knowledge gaps, evaluation and remediation.[8,16-24]

The successful use of simulation-based remediation (SBR) in other specialties and fields such as anesthesia, internal medicine, and nursing have been described, but the concept in general is under-reported.[17,18,20,25-27] Evidence supporting the use of SBR within EM training is somewhat contradictory. In 2007 a Society of Academic Emergency Medicine (SAEM) task force on simulation research in EM cautioned against the use of SBR, contending that the term "remediation" could not be reliably applied, given differences in faculty perception of resident performance.[28] In 2012, the ACGME published 23 EM sub-competencies to be used in the assessment of EM residents. They suggest using simulation as one method to evaluate sub-competencies 1-11 and 16-23.[29] Some authorities have posited that since simulation could be used for specific sub-competency assessment, it could also be used for remediation within those same sub-competencies.[17,18] In 2016, the Council Of Residency Directors (CORD)-EM Remediation Task Force (RTF) recommended simulation for remediating multiple competencies, including patient-centered communication, teamwork and leadership.[16,30]

Interestingly, many of the recommendations on the use of SBR arose from experts in EM residency leadership and remediation. Simulationists were possibly under-represented among the stakeholders making the aforementioned recommendations. This is relevant because some simulationists view the experience as formative and eschew the use of simulation for remediation purposes, arguing that remediation implies summative assessment, which intrinsically threatens the principle of "learner safety" integral to simulation-based education.[31-34] There are also concerns that simulation for high-stakes assessment requires consensus on case design standards and setting of minimum performance levels to ensure that the testing is valid.[35]

With the exception of SBML and procedural remediation,[9] there remains no clear consensus on when and how to appropriately use simulation for remediation in EM for other

Population Health Research Capsule

What do we already know about this issue?
With the Accreditation Council of Graduate Medical Education's transition towards a competency-based framework, simulation-based remediation (SBR) has become a pressing topic; however, few guidelines exist to direct its use.

What was the research question?
Authors sought to develop consensus on the appropriate use of SBR in emergency medicine residency training programs.

What was the major finding of the study?
SBR can be used for remediating specific competencies provided there is process and outcome transparency.

How does this improve population health?
SBR can assist in remediating learners so as to produce clinically competent physicians, thereby promoting patient safety and quality of care.

sub-competencies. The lack of specific recommendations and guidelines makes SBR planning difficult for both residency program and simulation leadership. To answer this need, the CORD-EM Simulation Community of Practice (COP), CORD-EM RTF and the SAEM Simulation Academy formed a joint collaboration, the Simulation Based Remediation Collaborative (SBRC), to clarify the role of SBR. This study was based on their work, and its objective was to build consensus on the appropriate use of SBR in EM.

METHODS

This study was deemed exempt by the local institutional review board. Using previously described methodology, we employed a modified Delphi approach to derive a set of consensus statements on using simulation for remediation in EM.[36-40] The study design is depicted in Figure 1. We conducted a literature search on simulation remediation practices using terms "simulation," "remediation," and "simulation based remediation," and identified commonly occurring themes. Using these themes, we created an open-ended questionnaire. From May through June 2017, the CORD-EM listserv was queried for all programs with experience in SBR. The questionnaire was subsequently sent to the 18 programs that indicated experience in SBR. Responses to the questionnaire were assessed using thematic analysis[41] by two EM simulation remediation experts (NN, GP) and an EM remediation expert (SK). We used the commonly occurring themes to create an initial survey, which was then piloted among a group of six EM simulation and remediation experts (NN, CS, MK, DH, JN, TM) and further refined based on their input.

We circulated the final primary survey to 52 experts with experience using simulation for remediation purposes, who had been identified a priori through their involvement in the CORD-EM Simulation COP, the RTF, and SAEM Simulation Academy and any publications or presentations on SBR. Experts were requested to rank each statement according to the following categories: "agree," "modify," or "disagree;" and survey program

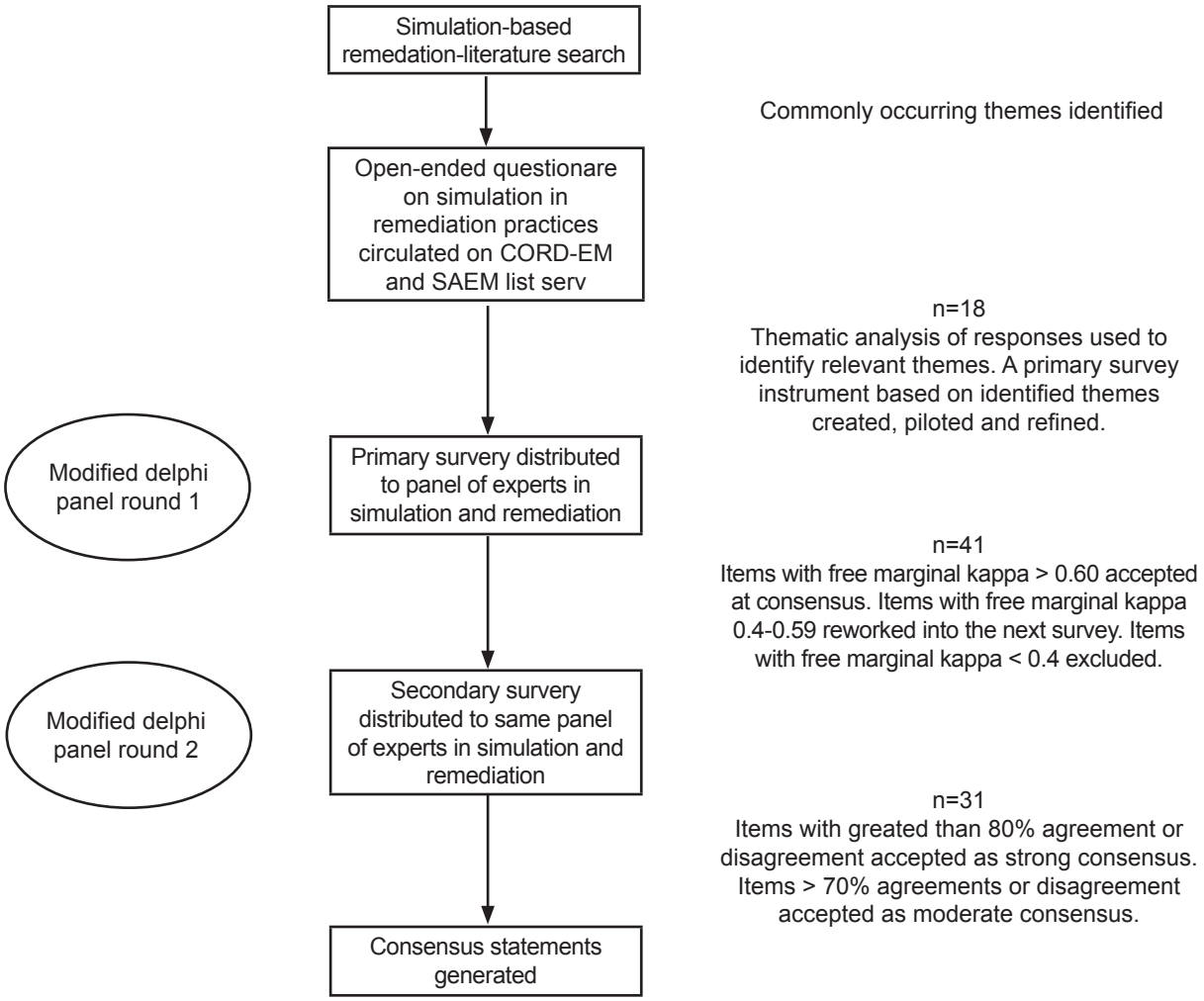

Figure 1. Study design.
CORD-EM, Council of Emergency Medicine Residency Directors; *SAEM,* Society for Academic Emergency Medicine.

parameters were set to completion of all survey items. The study group analyzed the results of the primary survey, and Randolph's free marginal kappa was calculated to gauge agreement for each statement. Randolph's free kappa is a chance-adjusted measure of agreement for any number of cases, categories, or raters[42] and has been used to measure agreement in studies with large numbers of raters (experts).[39,40]

A free marginal kappa ≥ 0.6 was used to indicate good agreement.[42,43] We removed items without consensus (free marginal kappa < 0.4). Items with moderate agreement (free marginal kappa 0.4-0.59) were reworked into a second survey. We also analyzed narrative comments from the initial survey and comments pertaining to "modifying" statements through thematic analysis, and any newly emerging themes were incorporated into the second survey. The second survey was distributed to the same panel of experts who had responded to the initial survey. On the secondary survey we used a cut off of 80% to indicate strong agreement and we deemed 70% moderate agreement with respect to consensus.

RESULTS

41 of 52 invited individuals completed Round 1 of the survey for a response rate of 78%, and 31 out of the initial 41 participants completed Round 2 for a response rate of 76%. Sixty-six percent of participants identified themselves primarily as simulation faculty, 32% identified themselves primarily as program directors (PDs) or assistant/associate program directors (APDs), and 2% identified themselves primarily as core faculty. Four of those identifying themselves as PDs/APDs also had simulation training. Experts represented 30 programs from across North America (Table 1). The modified Delphi process yielded 38 statements with strong agreement, eight with moderate agreement and nine with no agreement within six themes: 1) role of simulation in remediation; 2) decision to use simulation in remediation; 3) SBR process; 4) debriefing SBR; 5) assessing and reporting SBR; and 6) defining and determining SBR success. The modified Delphi process yielded 11 statements with strong agreement, one with moderate agreement and five with no agreement within the theme "deficiencies best addressed by SBR." The modified Delphi process yielded 10 statements with strong agreement, two with moderate agreement and 11 with no agreement for "sub-competencies best addressed by SBR" (Table 2). Consensus in the alignment of simulation modalities to competency being remediated was also achieved (Figure 2).

Table 1. Emergency medicine residency programs represented in the Delphi panel.

1.	Zucker School of Medicine-Hofstra/Northwell, New York
2.	Zucker School of Medicine-Hofstra/Northwell-Staten Island University Hospital, New York
3.	Yale New Haven Medical Center, Connecticut
4.	Icahn School of Medicine at Mt. Sinai, New York
5.	University of Connecticut, Connecticut
6.	Stanford University/Kaiser Permanente Medical Center, California
7.	Washington University/B-JH/SLCH Consortium, Missouri
8.	St. John's Riverside Hospital, New York
9.	SUNY Health Science Center-Brooklyn, New York
10.	University of Missouri-Columbia, Missouri
11.	Icahn School of Medicine at Mount Sinai/St Luke's-Roosevelt, New York
12.	Brown University, Rhode Island
13.	University of California-Davis, California
14.	Cook County Health and Hospitals Systems, Illinois
15.	University of Chicago, Illinois
16.	University of Florida College of Medicine-Jacksonville, Florida
17.	University of Arizona, College of Medicine-Tucson, Arizona
18.	University of California (UCLA) David Geffen School of Medicine/UCLA Medical Center/Olive View, California
19.	University of Illinois College of Medicine at Peoria, Illinois
20.	McGaw Medical Center of Northwestern University, Illinois
21.	University of Texas Southwestern, Texas
22.	Maimonides Medical Center, New York
23.	Boston University Medical Center, Massachusetts
24.	Virginia Commonwealth University, Virginia
25.	Indiana University School of Medicine, Indiana
26.	New York Presbyterian-University Hospitals of Columbia and Cornell University, New York
27.	Hennepin County Medical Center, Minnesota
28.	University of Pennsylvania, Pennsylvania
29.	New York Presbyterian Queens, New York
30.	Lehigh Valley Health Network, Pennsylvania

DISCUSSION

The results of our study show that there is strong agreement in many areas regarding SBR, including the belief that simulation can play a role in remediation. SBR should be part of a multifaceted remediation plan and not the *sole* remediation strategy. The residency leadership and the remediation faculty committee (or equivalent) should still be responsible for the overall remediation plan, with specific goals for the SBR components. These goals should be transparent to the learner and the faculty conducting the SBR. The methods used to assess the learner's performance should be transparent and communicated to all stakeholders: the learner; the residency leadership; the remediation team; the clinical competency committee (CCC); and all other faculty involved in summative decisions regarding advancement. Although formative assessment is ideal, summative assessment may be employed, provided the process is clearly defined and transparent.

Table 2. Simulation-based remediation consensus statements.

Agreement strength*	Item
The role of simulation in remediation	
Strong agreement	Simulation can play a role in emergency medicine resident remediation.
	Simulation can be used as a diagnostic strategy for identifying specific learning deficits that may require remediation.
	Simulation can be used as a therapeutic strategy for addressing specific learning deficits.
	Simulation-based remediation (SBR) should be flexible with respect to topics and competencies to accommodate a wide variety of learner deficits.
	Various simulation modalities can be used to accommodate a variety of learner deficits. (For example, oral board-style tabletop simulations for medical knowledge remediation/clinical reasoning, partial task training for procedural remediation, high fidelity mannequin, and standardized patient simulation for communication/teamwork/situation awareness remediation/medical knowledge application/clinical skills).
The decision to use simulation for remediation	
Strong agreement	National organizations have recommended using simulations for teaching specific deficiencies and competencies; therefore, simulation can also be used to remediate the same deficiencies and competencies.
	SBR should be suggested by faculty or program leadership after learner assessments identify specific problems. (For example, specific learner deficits are realized at monthly evaluations or end of shift evaluations and discussed at faculty meeting or clinical competency committee [CCC] meetings or poor patient outcome).
	Learners should be informed of need for SBR by program leadership.
	SBR should be a part of a larger remediation process or plan.
	SBR should be conducted transparently such that the process of and performance during SBR are transparent not only to the learner, but also to the residency leadership and faculty involved in the resident's remediation (i.e., CCC).
	The number of sessions and duration of SBR should be dependent on the issue being remediated and the resident's performance and progress during each session.
Moderate agreement	SBR may be conducted by the program director/assistant program director (those ultimately involved in making progression decisions), as long as they have training in simulation.
	It is possible for procedure-based SBR to occur with only one session if competence is demonstrated at the end of the session.
The simulation-based remediation process	
Strong agreement	Ideally, SBR should be conducted by faculty who have formal simulation training/experience.
	SBR should occur one on one with the learner, unless the remediation concerns center around teamwork.
	If available, SBR cases should be pulled from a pool of cases with some validity evidence, provided the case objectives and goals apply to the specific situation (need/deficit) being remediated.
	If necessary, scenarios for SBR can be created de novo or pre-existing cases modified to address specific learner deficits or needs.
	SBR scenarios should be developed by faculty with simulation training and experience.
	Ideally, SBR should occur through multiple sessions.
Moderate disagreement**	The format of SBR should follow a standardized template or protocol.

*Strong agreement refers to free marginal kappa > 0.6 in the first round or total percent agreement, agreement >80% in the second round of the Delphi. Moderate agreement is defined as total percentage >70% in the second round.
**Strong disagreements refers to statements where total disagreement percent > 80% for strong and 70% for moderate levels of disagreement in first and second rounds of Delphi panel.

Table 2. Continued.

Agreement strength*	Item
Debriefing simulation-based remediation	
Strong agreement	SBR scenarios should always be followed by learner debriefing.
	The ideal debriefing method for SBR depends on the specific learner and the specific learning need and can be variable.
	The ideal debriefing method for SBR should be a blended approach such as PEARLS framework, which can include multiple debriefing modalities such as plus-delta and advocacy-inquiry.
Strong disagreement	The ideal debriefing method for SBR is blind debriefing by a third-party faculty based on a checklist/rubric filled out by simulation faculty.
Assessing and reporting simulation-based remediation	
Strong agreement	The format of SBR should be fluid and tailored to learner need or a specific deficiency identified.
	If available, learner assessment should be guided by checklists or rubrics with some validity evidence.
	Learner assessment may be guided by general critical action checklists that need not be "validated" but generally accepted per specialty guidelines.
	The length of SBR debriefing sessions can vary depending on the length of the simulation case, session objectives, and learner needs.
	If SBR occurs in a group setting with multiple learners, then the confidentiality of the learner requiring remediation must be maintained from other learners.
	SBR cases should be assessed formatively.
	Summative assessment may have a role in SBR, provided the cases have been specifically designed for it.
	If summative assessment is being used for SBR, learners should be informed ahead of time.
Strong disagreement	No report should be generated after SBR sessions, as this violates the "safe space" requirement for successful simulations.
Moderate disagreement	In SBR, learner assessment should be strictly scored per validated checklists or rubrics.
	SBR sessions should be confidential between the SBR faculty and the learner, and any report that is generated should remain confidential between the learner and SBR faculty.
	If a report is generated at the end of an SBR session, it should include definite statements like “credentialed” or “safe for independent practice.”
Defining and determining simulation-based remediation success	
Strong agreement	The definition of SBR success for a specific deficit must be clear, objective, measurable, and transparent.
	The definition of SBR success for a specific deficit must be set a priori, in collaboration with the learner, simulation faculty, and residency leadership collaboratively.
	Although checklists and global rating scales are a part of SBR assessment, they do not exclusively define SBR success, as they are focused on the simulation component and not the debriefing (where majority of learning occurs).
	One component of SBR success includes the learner developing insight into or awareness of his or her particular deficiencies as gauged through debriefing.
	Initial unsuccessful attempts at procedural SBR should require repeating the simulation session and successfully demonstrating that procedure.

PEARLS, Promoting Excellence and Reflective Learning in Simulation debriefing approach.
*Strong agreement refers to free marginal kappa > 0.6 in the first round or total percent agreement, agreement >80% in the second round of the Delphi. Moderate agreement is defined as total percentage >70% in the second round.

Table 2. Continued.

Agreement strength*	Item
	Initial unsuccessful attempts at non-procedure-based SBR should require completing another simulation session and successfully managing a different case with the same learning objectives.
	SBR success is defined by the learner appropriately addressing deficiencies in real-time clinical practice post simulation, as gauged by supervising clinical faculty. (For example, learner is demonstrating improved multi-tasking and patient dispositions in real time after sessions of SBR).
Moderate agreement	When SBR is being used as a diagnostic strategy to better identify/clarify learner deficits that require remediation, the ability of the faculty to identify or clarify one or more of these issues is what defines success.
Moderate disagreement	Successful SBR is defined exclusively by minimum passing scores on a critical action checklist and/or specific ratings on a global rating scale.
Deficiencies best addressed by simulation-based remediation	
Strong agreement	Application of medical knowledge
	Decision-making
	Clinical reasoning for high-acuity cases
	Procedural competencies
	Communication
	Teamwork
	Team-based resuscitations such as trauma/cardiac/pediatric codes
	Leadership in resuscitations
	Crisis resource management
	Multitasking (managing multiple patients simultaneously)
	Cognitive overload management for high-acuity cases
Moderate disagreement	Foundational medical knowledge
Sub-competencies best addressed by simulation-based remediation	
Strong agreement	1. Emergency Stabilization (patient care [PC]1) Prioritizes critical initial stabilization action and mobilizes hospital support services in the resuscitation of a critically ill or injured patient and reassesses after stabilizing intervention.
	2. Performance of Focused History and Physical Exam (PC2) Abstracts current findings in a patient with multiple chronic medical problems and, when appropriate, compares with a prior medical record and identifies significant differences between the current presentation and past presentations.
	4. Diagnosis (PC4) Based on all of the available data, narrows and prioritizes the list of weighted differential diagnoses to determine appropriate management.
	5. Pharmacotherapy (PC5) Selects and prescribes appropriate pharmaceutical agents based upon relevant considerations such as mechanism of action, intended effect, financial considerations, possible adverse effects, patient preferences, allergies, potential drug-food and drug-drug interactions, institutional policies, and clinical guidelines. Effectively combines agents and monitors and intervenes in the advent of adverse effects in the emergency department (ED).
	8. Multi-tasking (Task-switching) (PC8) Employs task switching in an efficient and timely manner in order to manage the ED.

*Strong agreement refers to free marginal kappa > 0.6 in the first round or total percent agreement, agreement >80% in the second round of the Delphi. Moderate agreement is defined as total percentage >70% in the second round.

Table 2. Continued.

Agreement strength*	Item
	9. General Approach to Procedures (PC9) Performs the indicated procedure on all appropriate patients (including those who are uncooperative, at the extremes of age, hemodynamically unstable and those who have multiple comorbidities, poorly defined anatomy, high risk for pain or procedural complications, and sedation requirement), takes steps to avoid potential complications, and recognizes the outcome and/or complications resulting from the procedure.
	10. Airway Management (PC10) Performs airway management on all appropriate patients (including those who are uncooperative, at the extremes of age, hemodynamically unstable and those who have multiple comorbidities, poorly defined anatomy, high risk for pain or procedural complications, and sedation requirement), takes steps to avoid potential complications, and recognize the outcome and/or complications resulting from the procedure.
	14. Other Diagnostic and Therapeutic Procedures: Vascular Access. Successfully obtains vascular access in patients of all ages regardless of the clinical situation.
	22. Patient-centered Communication (ICS1) Demonstrates interpersonal and communication skills that result in the effective exchange of information and collaboration with patients and their families.
	23. Team Management (ICS2) Leads patient-centered care teams, ensuring effective communication and mutual respect among members of the team.
Moderate disagreement	17. Systems-based Management (SBP2) Participates in strategies to improve healthcare delivery and flow. Demonstrates an awareness of and responsiveness to the larger context and system of healthcare.
	19. Practice-based Performance Improvement (PBLI) Participates in performance improvement to optimize ED function, self-learning, and patient care.

*Strong agreement refers to free marginal kappa > 0.6 in the first round or total percent agreement, agreement >80% in the second round of the Delphi. Moderate agreement is defined as total percentage >70% in the second round.

SBR may be used "diagnostically" and "therapeutically" to benefit the remediating learner. Diagnostic SBR provides a protected, standardized, and contextualized environment in which a learner's performance gaps may be more precisely studied. In contrast to remediation where the struggling learner is situated within the clinical environment (under direct observation), the classroom, or an equivalent didactic setting, diagnostic SBR provides the conditions under which faculty and learners may safely and accurately explore the learners' frames responsible for observed deviations from ideal performance. We posit that faculty are more likely to accurately identify the true reasons for performance gaps in the laboratory environment where SBR occurs (than in the clinical environment). While most faculty are likely able to directly observe their learners while contemporaneously working alongside them and identifying performance gaps, they are likely unable to learn *why* these gaps exist. In the challenging clinical milieu of today's academic emergency department, where cognitively-loaded faculty and learners must balance the demands, expectations, and temporal pressures of patient care, there is no time, space, and privacy to support the reflection necessary for uncovering causes for performance gaps, which frequently tend to be multifactorial.[6,44] As many residents struggle in multiple domains,[19,21] diagnostic SBR may provide the best opportunity to identify one or more domains requiring attention. Diagnostic SBR, with a low resident-to-faculty ratio, may provide the best data to inform the development of an individualized remediation plan.

Modalities chosen for therapeutic SBR should be aligned with the learner's needs. There is strong agreement that SBR is appropriate for areas such as application of medical knowledge, clinical reasoning, decision-making, communication, teamwork, leadership, crisis resource management (CRM), and cognitive overload/multitasking in high acuity situations. There is moderate agreement that SBR is not the best modality for developing foundational medical knowledge, as this may be best acquired through other means.

SBR seems most appropriate for the following sub-competencies: emergency stabilization, performance of a history and physical exam, diagnosis, pharmacotherapy, multitasking, and the procedural and communication milestones. Outside of CRM, simulation may not be the best modality for improving sub-competencies linked to the general competencies of systems-based practice (SBP) or problem-based learning and improvement (PBLI). While some aspects of PBLI could potentially be addressed in the debriefing portion of SBR (e.g., improving a learner's insight through self-reflection following SBR, informing the development of an individualized development plan), this seems to be a small component of a

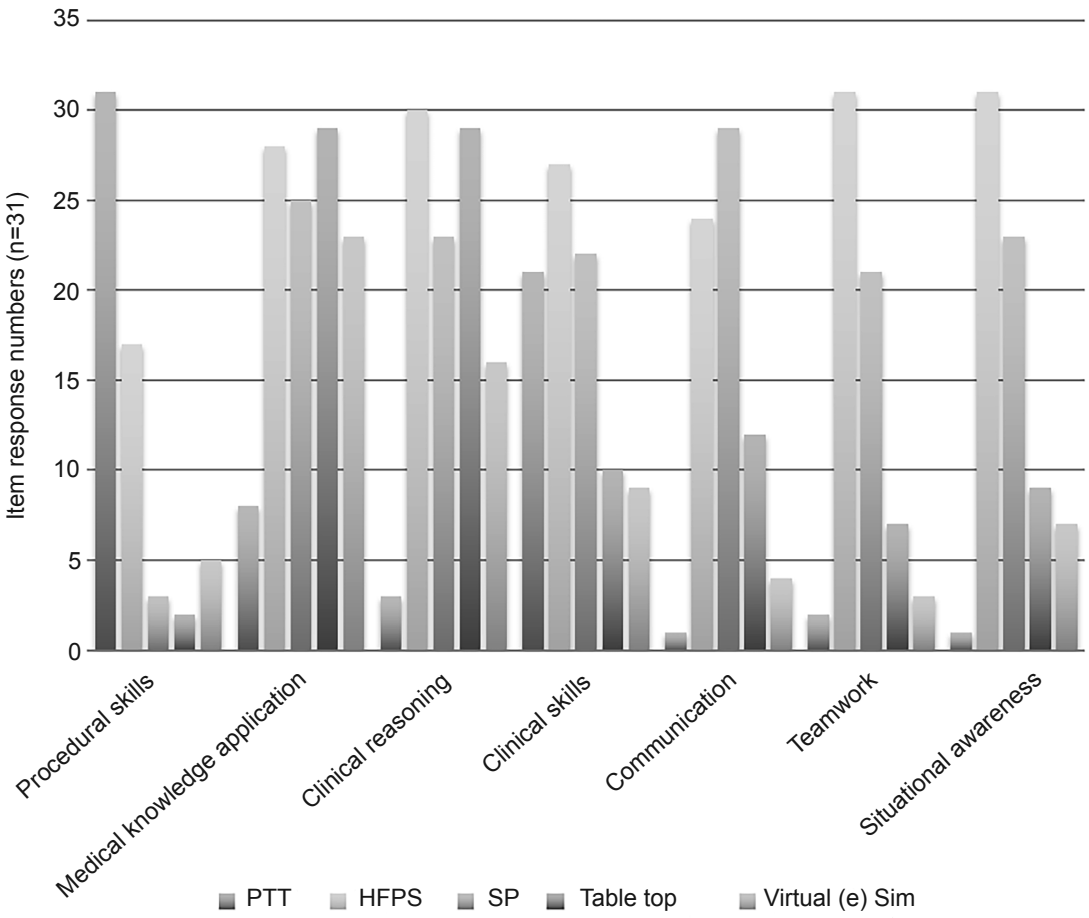

Figure 2. Simulation modalities best suited to specific deficiencies.
PTT, partial task trainers; *HFPS*, high fidelity patient simulators (mannequins); *SP*, standardized patients.
Tabletop: oral board-style simulations; Virtual (e) Sims Online web-based virtual simulations.

larger PBLI remediation plan. While SBR for SBP may provide some opportunities for learners to practice mobilizing institutional or system resources to optimize patient care, the other aspects of this competency requiring remediation may necessitate the use of other strategies. Professionalism represents another domain more effectively addressed through means other than SBR. The Hawthorne effect could bias the assessment of a learner's performance in a SBR conducted for professionalism concerns. While some learners may have difficulty with professionalism competencies in any circumstance, others may only display professionalism lapses when they are overly stressed, busy, frustrated, or not being directly observed.

The optimal number of SBR sessions required is difficult to define at the outset of a remediation plan and is dependent upon the focus of remediation and the learner's progress. SBR focused on one domain requiring improvement has the potential to unmask another, which may necessitate a different simulation or non-simulation-based intervention. Learner improvement during each SBR session, therefore, informs the next steps to be taken. SBR for procedures incorporates the mastery learning approach,[9,10,45,46] where the learner deliberately practices a procedure under facilitation until it is completed safely and competently in the simulated environment.[47] For non-procedural SBR, learners should experience multiple simulation sessions of comparable cases with similar learning objectives in contrast to repeating the same exact simulation case (a practice that did not achieve agreement in our study) until those objectives are met.

Ideally, SBR would be conducted by faculty with formal simulation training or experience. However, only moderate agreement was obtained for the item "SBR may be conducted by the PD/APD (those ultimately involved in making progression decisions), as long as they have training in simulation." One possible explanation for this moderate level of agreement is that residency leadership's (PD/APD) direct involvement in SBR may be perceived as a threat to the principle of "learner safety." While it may be optimal to have non-residency leadership faculty conduct SBR, we recognize the feasibility of this approach is dependent on the resources at the program; in some programs,

the simulationist is part of the residency leadership. Programs should use the resources they have to optimize the learning and outcomes of SBR for their trainees.

With respect to assessment, our results, based on the final round of the Delphi panel, support the use of assessment tools with some validity evidence, similar to the work described by Blum et al.[25] While procedural assessment tools with validity evidence exist,[48,49] there are few simulation cases with validity evidence beyond content validity (i.e., internal structure, response process, relations to other variables, or consequential validity).[50,51] Various assessment tools for non-technical skills also have been found to have some validity evidence, but without a co-existing recommended simulation case for EM resident learners. If assessment tools with validity evidence are available for the domain requiring remediation, these tools should be used to promote best practice. However, to maintain the validity of judgments made by using such an assessment tool, the tool must be applied to a similar population of learners, implemented under similar conditions, using similarly trained raters.

Tools with demonstrated validity evidence in one circumstance do not automatically demonstrate the same characteristics when applied to other circumstances. Unless validity evidence is re-demonstrated in the new contexts, there may not be current validity evidence for the tools chosen. Therefore, in agreement with previously published works by Blum et al.,[25] we also recommend that summative ("high-stakes") SBR should not be used as the *solitary* measure of a learner's attainment of competency in a given domain. Summative SBR should be used as part of a comprehensive remediation plan providing multiple data points to be evaluated when assessing a resident's progression. A single checklist or global rating scale should not be the *only* measure defining SBR success. The ultimate success of any remediation plan should be improvement in the learner's performance in the clinical environment.

Given the challenges of residency length constraints and learner variability in achieving competence, SBR can provide extra time and opportunities for struggling learners to train contemporaneously to routine simulations in order to achieve mastery within the CB framework. Although similar to non-remediation simulations in principle, what differentiates SBR from the former is the absolute need for confidentiality for ensuring a psychologically safe learning environment, low resident to faculty ratios, and the need for absolute transparency between the learner and the program leadership regarding the process (goals, objectives, results) of SBR. Also included in the latter is clear delineation of assessment methods and how their results will be used, especially as pertaining to high-stakes decisions such as "promotion" or "probationary" status. Unlike routine simulations, where to preserve psychological safety and safe-space principles, learner performance is not discussed outside of the debriefing room,[32,33] in SBR learner performance is frequently discussed with residency leadership; the learners should be informed of this significant difference a priori.

LIMITATIONS

The main limitations of this study are that it only represents EM residency programs from the United States. Caution should be used in applying these results to nursing and medical students and to other specialties and geographical locations. Although we met the stated guidelines for the size of the Delphi panel,[52] the panel may have missed experienced simulationists. Our expert selection was dependent on available publications and presentations on SBR, of which there is a significant dearth. Although some of our experts have published or presented on this topic, most were identified through their actual experience in SBR, which in itself may not make them "experts" per se. Given the obvious lack of data on the subject, this approach seems reasonable. Additionally, although our survey instruments were developed using an iterative process, the length of the initial instrument could have contributed to survey fatigue and potential bias. Finally, a lack of face-to-face discussions to resolve disagreements may have limited some of our findings.

CONCLUSION

This Delphi-based study, based on input from 30 ACGME-accredited EM programs across the United States, found agreement on many aspects of SBR. Simulation can be used diagnostically as well as therapeutically in remediation processes. Once a deficit is identified, simulation can be a helpful remediation tool for certain competencies and milestones, but simulation is not a one-size-fits-all approach that can be applied to every EM skill or competency. Simulation is best suited for remediation of procedural, patient care and communication milestones and less suited for remediation of systems-based practice and problem-based learning milestones. SBR can be one aspect, but should not be the sole component of a remediation plan. Similarly, SBR performance should only be one component of how remediation success is assessed by program leadership

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and the CCC, using tools with validity evidence when possible. These SBR assessments should be transparent between the simulation faculty, the learner, the program leadership and the CCC.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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July Phenomenon Impacts Efficiency of Emergency Care

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Section Editor: Douglas S. Ander, MD
Submission history: Submitted July 17, 2018; Revision received August 29, 2018; Accepted October 3, 2018
Electronically published November 19, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39885

Introduction: The "July effect" describes the period in which new interns begin learning patient care while senior residents take on additional responsibility in an academic hospital setting. The annual change in staffing creates inefficiencies in patient care, which may negatively impact quality of care. Our objective was to evaluate the impact of the annual resident turnover on emergency department (ED) efficiency in a teaching hospital.

Methods: This was an institutional review board-approved retrospective chart review spanning two academic years analyzing 79,921 records. We grouped July and August into the period of least experience (PLE) and May and June into the period of most experience (PME). Outcomes included faculty and resident productivity, ED door-to-doctor time, and time to disposition.

Results: Patients were evaluated by 117 emergency residents and 73 emergency faculty. We excluded patient records for 35 off-service residents. Residents saw 15.8% more patients in the PME compared to the PLE ($p<0.0001$). The residents' average door-to-doctor time during the PLE was 45.63 minutes (standard deviation [SD] 33.01, median 36) compared to 34.69 minutes (SD 25.22, median 28) during the PME, with a decrease in time by 21.3% ($p=0.0203$). The residents' average time to disposition during the PLE was 304.6 minutes (SD 308, median 217) compared to 269.0 minutes (SD 282, median 194) during the PME, decreasing by 12.4% ($p=0.0001$). Residents had an average ED length of stay for discharged patients of 358.5 minutes (SD 374.6, median 238) during the PLE compared to 309.9 minutes (SD 346.4, median 209) during the PME, decreasing 13.7% for discharged patients ($p=0.0017$).

Conclusion: Annual turnover of resident staffing has a significant impact on common ED efficiency metrics. EDs should consider interventions to mitigate the impact of these expected inefficiencies. [West J Emerg Med. 2019;20(1)157-162.]

INTRODUCTION

Resident training is an enormous component of our healthcare system, made up of a tiered structure of roles and responsibilities as learners pursue the profession of medicine. The "July effect" describes the period in which new interns begin learning patient care while senior residents take on additional responsibility and autonomy at teaching hospitals across the country.[1] Within the medical community it has long been assumed that the yearly influx of new resident physicians temporarily decreases hospital efficiency, and may contribute to hospital crowding, medical errors and increased wait times for patients.[1-8] Despite these concerning findings, some studies have argued against the "July effect" as a clinically significant entity. Several studies found no change in morbidity and mortality during resident turnover in the fields of surgery and obstetrics.[9,10] At times the media, e.g, an essay "It's July, the Greenest Month in Hospitals, No Need to Panic" published in the *New York Times,* have attempted to overtly refute the July phenomenon and reassure the community.[1]

The "July effect," though, may have particular significance in the emergency department (ED). According to the National Hospital Ambulatory Medical Care Survey, there were over

21 million ED visits at teaching hospitals in the United States (U.S.) during 2010.[11] Annual turnover of resident physicians may temporarily decrease efficiency in the ED during months in which residents have limited experience. Despite this significance, few studies have been done on this topic in the ED setting. Riguzzi and colleagues identified no difference in overall length of stay (LOS) in the ED when comparing months of the academic year.[12] However, this study evaluated only one parameter, which was likely influenced by multiple contributing factors. Additional variables that may contribute to quality of care in the ED are more closely tied to physician work. These factors include faculty and resident productivity, door-to-doctor time, and time to disposition. The objective of this study was to evaluate the impact of annual resident turnover on these efficiency parameters within the ED in a teaching hospital. We aimed to further clarify the influence of the "July effect" on ED efficiency, and potentially highlight staffing adjustments that may be necessary to improve quality of care in this time period.

Population Health Research Capsule

What do we already know about this issue?
Within the medical community, it has long been assumed that the yearly influx of new resident physicians temporarily decreases hospital efficiency, and may contribute to hospital crowding, medical errors, and increased wait times for patients.

What was the research question?
The purpose of this study was to evaluate the impact of annual resident turnover on efficiency parameters within the emergency department (ED) in a teaching hospital.

What was the major finding of the study?
The annual resident turnover impacts physician productivity, door-to-doctor time, and time-to-disposition in the ED with inefficiencies highlighted during the early segment of the academic year.

How does this improve population health?
Resident training is an enormous component of our healthcare system. The annual resident turnover appears to be a clinically relevant factor in the quality and efficiency of patient care. Teaching facilities should consider interventions to mitigate the impact of these expected inefficiencies.

MATERIALS AND METHODS

Study Design

This was an institutional review board-approved retrospective chart review. We extracted data from the electronic health record (EHR) that spanned two academic years (July 2011 - June 2012, and July 2012 - June 2013), with specific attention to charts from May-August in both years. We defined house staff experience by the month of academic year during which the patient received care. July and August were grouped into the period of least experience (PLE) for each year, while May and June were grouped into the period of most experience (PME) for each year. We analyzed and compared data from the PLE and PME intervals.

Study Setting and Population

The study included patients evaluated by ED residents who were in post-graduate years (PGY) 1-3 and ED attending physicians at a suburban academic Level I trauma ED with annual volumes of approximately 120,000 visits. Only the initial event for each visit was selected for inclusion. We excluded patients seen by residents in other specialties. Table 1 illustrates the staffing comparing PLE with PME for PGY 1-3 ED residents, ED faculty, and rotating residents represented by number of full-time equivalents (FTE).

Measurements

Outcomes assessed included the following: door-to-doctor time, as measured by the time from ED presentation until the first recorded assignment of a doctor (attending or resident) to the patient; time to disposition as measured by the time from ED presentation until the first recorded disposition time; and physician productivity as defined by average number of patients per month by faculty and resident personnel. Statistics for each variable of interest were provided for combined year 1 (from July 2011-June 2012) and year 2 (from July 2012-June 2013), for all physicians collectively, resident physician groups only, and attending physician groups only.

Data Analysis

We calculated means, standard deviations (SD) and medians for each outcome variable. Percent change from the PLE to PME was provided for the total number of patients seen and all time variables deemed statistically significant. We constructed mixed-effects models treating "time of year" as a fixed effect and "resident" as a random effect. We performed standard model diagnostics and conducted F-tests of significance for the fixed effects, using the Satterthwaite approximation for denominator degrees of freedom. We performed analysis using R software version 3.1.0. A p-value of less than 0.05 was deemed significant.

Table 1. Staffing comparison from period of least experience (PLE) to period of most experience (PME) represented as average full-time equivalents per month.

	PLE (July/August)	PME (May/June)
PGY 1	6.13	6.43
PGY 2	6.43	5.44
PGY 3	11.25	10.5
Rotating resident	3.5	5.0
Attending physician	34.74	35.17
Mid level provider	4.4	4.4
Overall	66.45	62.94

PGY, postgraduate year.

RESULTS

Between July 2011 and June 2013, 79,921 patient records were reviewed. Compared to 40,399 patients in the PME, 39,522 patients were seen in the PLE. Each patient in the study was assigned to one of 190 doctors: 73 attending physicians and 117 emergency medicine residents out of 152 total residents (77%). Patients seen by 35 residents from other specialties were excluded. The number of ED visits by time of year is displayed in Table 2.

There is a slight increase in total patient volume throughout the two-year study. We were unable to detect a significant difference in patient volume between the beginning and end of the academic year (p=0.45). Table 2 illustrates the number of patients seen by type of doctor – resident or attending – during each period of interest. Patients were evaluated by attending physicians alone or in resident/attending combination. For those patients who were evaluated by a resident, it is assumed that the resident was the first doctor to see the patient. There was no difference in mortality between groups (p=0.7652).

Physician Productivity

Attending physicians saw 10.3% fewer cases primarily at the end of the year than at the beginning of the year (p<0.001). Resident physicians saw 15.8% more patients toward the end of the year compared to the beginning (p<0.0001). Table 3 illustrates these results.

Door-to-doctor Time

The average door-to-doctor time during the PLE was 44.18 minutes (SD 32.89, median 35) compared to 34.17 minutes (SD 24.9, median 27) during the PME for all practitioners. The residents' average door-to-doctor time during the PLE was 45.63 minutes (SD 33.01, median 36) compared to 34.69 minutes (SD 25.22, median 28) during the PME, with a significant decrease in time by 21.3% (p=0.0203). The attendings' average door-to- doctor time during the PLE was 42.57 minutes (SD 32.67, median 34) compared to 33.48 minutes (SD 24.64, median 27) during the PME, with a significant decrease in time by 14% (p<0.0001). Figure 1 graphically illustrates the average door-to-doctor time for providers during the PLE and PME.

Time to Disposition

The average time to disposition during the PLE was 293.1 minutes (SD 319.5, median 204) compared to 268.5 minutes (SD 326.5, median 186) during the PME for all physicians. The residents' average time to disposition during the PLE was 304.6 minutes (SD 308, median 217) compared to 269.0 minutes (SD 282, median 194) during the PME, decreasing the time throughout the year by 12.4% (p=0.0001) (95% confidence interval [2.5% to 23.0%]) The attendings' average time to disposition during the PLE was 279.9 minutes (SD 331.5,

Table 2. Number of emergency department patient visits by time of year.

	Number of patient visits	PME (May/June)	Number of patient visits
Year 1 (July 2011 - June 2012) n= 39,268			
PLE (July/August)			
July 2011	9,678	May 2012	10,193
August 2011	9,748	June 2012	9,649
Total	19,426		19,842
Year 2 (July 2012 - June 2013) n= 40,653			
PLE (July/August)			
July 2012	9,974	May 2013	10,599
August 2012	10,122	June 2013	9,958
Total	20,096		20,557

PLE, period of least experience; *PME,* period of most experience.

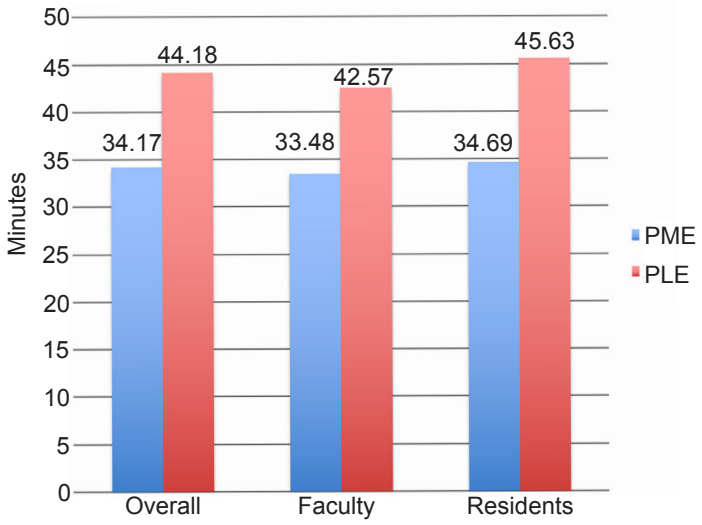

Figure 1. Door to doctor interval for residents, faculty, and all physicians.
PLE, period of least experience (July/August); *PME,* period of most experience (May/June).

median 186) compared to 267.8 minutes (SD 378.9, median 175) during the PME, which was not a significant change between the beginning and end of the year (p=0.3713). Figure 2 graphically illustrates the average time to disposition for providers during the PLE and PME.

DISCUSSION

Teaching hospitals are the training grounds for more than 100,000 new practitioners in the U.S. each year and provide care to millions of patients.[13] As new interns begin learning patient care and senior residents take on additional responsibility and autonomy at teaching hospitals across the country each July, the question remains whether this progression impacts efficiency and patient care. The topic has come to the forefront in mainstream media, and is on patients' minds as they perceive the healthcare quality they receive.[1] While there are limited publications in terms of the efficiency impact of the "July effect" across medical specialties, this topic is very relevant to emergency care at teaching facilities and requires further inquiry.

Tracking efficiency metrics is relevant as there is a strong link between quality of care and efficiency. Specifically, early patient contact with an emergency provider is linked to improved quality. In a very large analysis of emergency visits in Australia with nearly six million patients, researchers found that a rapid assessment and triage improved ED length of stay (LOS), ED mortality, and elective-inpatient mortality.[14] Although we did not find a difference in mortality in our study, it is likely that the sample size was underpowered for this outcome. In another evaluation of 2,619 hospitals, it was evident that each additional hour of ED LOS was associated with a 0.7% decrease in top satisfaction rating and reduction in "definitely recommend the hospital." A one-hour increase in ED LOS was associated with a 44% increase in the odds that the patient would leave without being seen (LWBS).

Applying overall ED LOS as an efficiency metric has some limitations. Riguzzi et al. found that ED LOS does not differ by month of the academic year in a teaching hospital; rather, it is steadily slower throughout the year when compared to non-teaching hospitals. We found that other parameters of efficiency do in fact differ. We specifically did not use ED LOS as an outcome measure since this outcome is heavily influenced by many variables outside the control of the physician such as hospital occupancy, ED admissions, and number of elective surgical cases.[15] Instead, the time intervals chosen for this study included door-to-doctor time and time to disposition – two time intervals that the physician more directly influences. While it is intuitive and expected that increasing experience over the course of the academic year improves efficiency metrics, there is minimal existing literature that quantifies this change in efficiency. Our goal was to fill this void and provide baseline guidance.

We found that residents had a longer door-to-doctor time and time to disposition at the beginning of the academic year. Further, resident-physician productivity increased substantially over the course of the academic year. While the results are statistically significant, the clinical impact is more difficult to measure. On average, the door-to-doctor time and time to disposition improved from the PLE to PME by 10 minutes and 35 minutes, respectively. Further elucidation is necessary to determine whether these time parameters make a tangible impact on quality of care and patient satisfaction. One study evaluating door-to-room times and the impact on LWBS rates found a goal rate of less than 1% could be met in patients

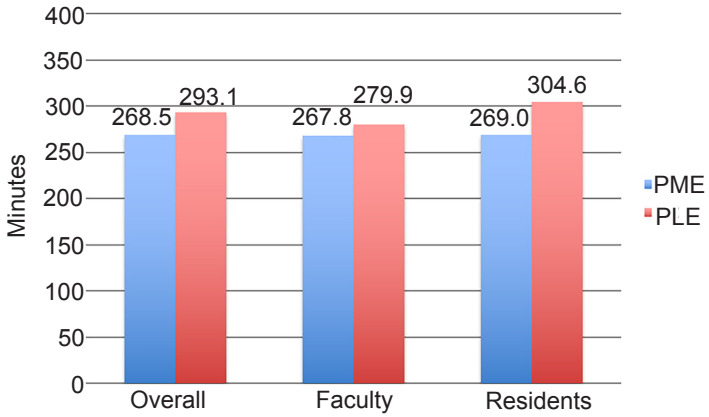

Figure 2. Time to disposition interval for residents, faculty, and all physicians.
PLE, period of least experience (July/August); *PME,* period of most experience (May/June).

Table 3. Number of patients seen per month stratified into attending alone and resident/attending combination.

	Time of year	Mean	SD	Median
Year 1 (July 2011-June 2012)				
Doctor				
Attending	PLE	150.1	83.55	149
Attending	PME	136.1	68.84	129
Resident	PLE	188.2	107.88	167
Resident	PME	201.2	96.59	168
Year 2 (July 2012-June 2013)				
Doctor				
Attending	PLE	149.8	77.24	147
Attending	PME	136.9	72.22	123
Resident	PLE	203.9	96.21	187
Resident	PME	209.4	103.17	192

PLE, period of least experience; *PME,* period of most experience; *SD,* standard deviation.

waiting less than 20 minutes. When patients waited between 21 and 35 minutes, the likelihood of meeting the LWBS goal dropped by 74%. Small changes in efficiency metrics can have a meaningful impact on patient care.[16]

Furthermore, efficiency metrics are inherently intertwined with modification of one variable potentially impacting other variables. Applying these trends may support the introduction of additional interventions to improve efficiency metrics during transition periods. Successful interventions could target provider staffing, ancillary staffing, or other diagnostic testing. Further prospective studies are needed to evaluate this notion because staffing EDs can be complex and costly.

LIMITATIONS

This study had some limitations, including its retrospective nature. Additional factors may have influenced the outcomes measures. We considered potential covariates in our analysis and made points to account for these. For instance, we confirmed that there was no additional staffing at this hospital during the resident entry month of July. By comparing attending and resident physicians jointly and independently, we considered resident performance separately and resident influence on attending's patient care performance throughout the academic year. However, there are a number of variables impacting LOS that cannot be quantified. These variables include transport delays, equipment malfunction, information technology upgrades and mishaps, and patient flow within the hospital.

The use of the electronic health record to capture relevant time intervals has some inherent margin of error. For instance, the time-to-disposition interval represents the time from when the patient is evaluated by the provider until a, disposition decision has been made. It is possible that the time stamp when the physician signed up to see the patient is not when the patient was actually evaluated. Finally, although the volume of patients was similar between the PLE and PME, we did not specifically evaluate for differences in overall acuity. It is possible that patients seen at the beginning of the year had a higher acuity that those patients at the end of the year and the complexity of the cases created inefficiencies. Further, while staffing was similar between the PLE and PME, minor differences in FTE per level of training may have impacted the efficiency parameters.

CONCLUSION

This study shows that resident training impacts several efficiency metrics for patient care with increasing experience related to better performance. The annual resident turnover appears to be a clinically relevant factor in the quality and efficiency of patient care at this teaching hospital. EDs should consider interventions to mitigate the impact of these expected inefficiencies. Further investigations are needed to evaluate any targeted intervention.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Randomized Evaluation of Videoconference Meetings for Medical Students' Mid-clerkship Feedback Sessions

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Section Editor: Eric Shappell, MD, MHPE
Submission history: Submitted July 10, 2018; Revision received October 10, 2018; Accepted October 31, 2018
Electronically published November 26, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39641

Introduction: Videoconferencing has been employed in numerous medical education settings ranging from remote supervision of medical trainees to conducting residency interviews. However, no studies have yet documented the utility of and student response to videoconference meetings for mid-clerkship feedback (MCF) sessions required by the Liaison Committee on Medical Education (LCME).

Methods: From March 2017 to June 2018, third-year medical students rotating through the mandatory, four-week emergency medicine (EM) clerkship at a single medical school were randomly assigned either to a web-based videoconference meeting via Google Hangouts, or to a traditional in-person meeting for their MCF session. To compare students' MCF experiences we sent out an electronic survey afterward to assess the following using a 0-100 sliding scale: overall satisfaction with the meeting; the effectiveness of communication; the helpfulness of the meeting; their stress levels, and the convenience of their meeting location. The survey also collected data on these demographic variables: the name of the faculty member with whom the student met; student gender, age, and interest in EM; location prior to meeting; meeting-method preference; and number of EM shifts completed.

Results: During the study period, 133 third-year medical students responded to the survey. When comparing survey responses between individuals who met online and in person, we did not detect a difference in demographics with the exception of preferred meeting method ($p=0.0225$). We found no significant differences in the overall experience, helpfulness of the meeting, or stress levels of the meeting between those who met via videoconference vs. in-person ($p=0.9909$; $p=0.8420$; $p=0.2352$, respectively). However, individuals who met in-person with a faculty member rated effectiveness of communication higher than those who met via videoconference ($p=0.0002$), while those who met online rated convenience higher than those who met in-person ($p<0.0001$). Both effects remained significant after controlling for preferred meeting method ($p<0.0001$ and $p=0.0003$, respectively) and among EM-bound students ($p=.0423$ and $p<0.0110$, respectively).

Conclusion: Our results suggest that LCME-required MCF sessions can be successfully conducted via web-based programs such as Google Hangouts without jeopardizing overall meeting experience. While the convenience of the meetings was improved, it is also important for clerkship directors to note the perceived deficit in the effectiveness of communication with videoconferencing. [West J Emerg Med. 2019;20(1)163–169.]

INTRODUCTION

Mid-clerkship feedback (MCF) sessions are formal, one-on-one meetings between medical students and faculty members to assess student progress and address any remediation needs. It is a Liaison Committee on Medical Education (LCME) requirement for all medical school clerkships of four weeks or more in duration.[1] These meetings are traditionally completed in-person; however, it is not uncommon for scheduling difficulties to arise for rotations with varying schedules such as emergency medicine (EM). With advancements in technology, videoconferencing has become widely available and could potentially provide a solution to this problem.

Videoconferencing has been shown to be beneficial in various medical education[2,3] and inpatient care settings.[4-6] Cameron et al.[5] and Xavier et al.[6] assessed the use of videoconferencing for the supervision and training of medical professionals, and both studies found that the majority of participants rated use of technology as "positive." Bertsch et al.[2] and Stain et al.[3] found that material delivered via online lectures was as effective as traditional in-person lectures. Other studies have also reported improved convenience with online interviews for conducting residency[7] and fellowship interviews.[8] While videoconference use has been described in these medical or educational settings, the use of videoconferencing for MCF meetings has not yet been investigated. We conducted a prospective, randomized controlled study to examine the utility of and student response to using videoconference for MCF sessions. Based on previously documented, successful utilization of videoconferencing, we hypothesized that videoconferencing could be as effective as in-person meetings for MCF sessions.

Population Health Research Capsule

What do we already know about this issue?
Videoconferencing is utilized successfully in various medical education settings, though its use for medical student Mid-Clerkship Feedback (MCF) sessions has not yet been investigated.

What was the research question?
We investigated student perceptions on the use of videoconferencing for mandatory MCF meetings between third-year medical students and our emergency medicine faculty.

What was the major finding of the study?
MCF via videoconference can be successful without jeopardizing overall experience. However, perceived communication was rated lower and convenience higher than those that met in-person.

How does this improve population health?
Our finding provides evidence that clerkship directors can potentially incorporate videoconferencing for MCF meetings as an option depending on students' needs.

METHODS

All third-year medical students who rotated through our EM clerkship between March 2017 and June 2018 were invited to participate in the study. During each four-week rotation, 8-12 students participated in the EM clerkship. Individuals who consented to participate in the study were randomly assigned to either a web-based videoconference meeting or a traditional in-person meeting for their EM mid-clerkship feedback session by block randomization. The MCF sessions were conducted by one of three EM faculty members. Each student was assigned to a meeting time with a faculty member based on the faculty member's availability. All meetings were scheduled for 30 minutes during standard business hours. If their meeting time coincided with a shift, the students were excused from their shift for the duration of the meeting. The meeting involved a case presentation by the student, a review of current clinical grades, and a discussion of the student's strengths and weaknesses. In-person meetings were held in the EM faculty member's office. For videoconference meetings, faculty remained in their offices, whereas students were informed they could access their meeting from anywhere with reliable Internet access. Google Hangouts (Mountain View, California) was used as the videoconference platform.

After their meeting, the participants were invited via university email to complete an anonymous electronic survey (Supplemental Figure) to assess their meeting experience. The survey asked students to rate five aspects of their meeting – overall experience, effectiveness of communication, helpfulness of meeting for their learning, stress levels during their meeting, and convenience of the meeting location, on a sliding scale from 0-100. We designed the first question to assess the student's overall satisfaction with their meeting experience (overall experience). The following four questions were designed to help understand the factors that may have influenced their overall experience (communication, helpfulness, stress levels, and convenience). These four factors were identified by faculty and medical students as important determinants for a successful meeting in the setting of mid-clerkship formative feedback.

We used a 0-100 scale since it provided students with greater flexibility, and it would result in greater statistical power compared to an ordinal scale. The directionality of the

scale was indicated on the survey as seen in Supplemental Figure. The survey question, "How was your overall experience with Mid-Clerkship Feedback session?" will be henceforth referred to as "overall experience." The survey question, "How effective was the communication using your meeting modality?" will be referred to as "communication." The survey question, "How was your stress level during the meeting?" will be referred to as "stress levels." The survey question, "How convenient was the meeting location for you?" will be referred to as "convenience."

The survey also included questions regarding the following factors: faculty with whom they met, student's gender and age, shifts completed prior to meeting, interest in EM, location prior to meeting, and meeting-method preference. To maintain confidentiality, the names of the faculty members from the survey have been removed in Supplemental Figure. Doctors "X," "Y," and "Z" have been used in place of their names. Answers to all survey questions were required except for the free-text answer to "Additional suggestions for how to improve mid-clerkship feedback sessions?" A reminder email was sent every two days up to a maximum of five times, or until completion of the survey. We collected and managed the survey data using the Research Electronic Data Capture (REDCap)[9] tool hosted at our home institution. The study was reviewed and approved by our local institutional review board.

Statistical Analysis

Student variables were stratified by meeting method for analysis. For categorical variables, frequencies and column percentages were reported. We calculated p-values using chi-square and Fisher's exact tests, as appropriate to determine statistical significance. For normally distributed continuous variables, we reported means and standard deviations, and we calculated p-values using t-tests; otherwise, medians and $25^{th}/75^{th}$ percentiles were reported, and p-values were calculated using Mann-Whitney U tests. We used multivariable linear regression models to adjust for potential confounding variables in the relationship between student ratings and group assignment. All analyses were done in R programming language, version 3.5.0 (R Foundation for Statistical Computing, Vienna, Austria). Statistical significance was set to a $p<0.05$.

RESULTS

Of the 163 third-year medical students who rotated through EM during the research period, 141 consented to participate in the study (86.5%). Eight of the 141 students (5.6%) were excluded from the study prior to the completion of their survey. Five of the eight were excluded due to scheduling conflicts that resulted in a change in their assigned meeting method; one student withdrew from the study due to a personal preference for the alternative meeting method; one was unable to meet online due to technical difficulties; and one was excluded from the study due to a leave of absence from medical school. Of the 133 remaining participants, the survey completion rate was 100%. Sixty-seven participants were randomized to the videoconference group and 66 participants were randomized to the in-person group.

Demographic variables are detailed in Table 1. Dr. X met with the largest portion of students for their MCF meetings (57.1%). The majority of the participants (56.4%) were between 25-29 years old, male (54.1%), expressed that they did not have any interest in EM as a future career choice (57.9%), and listed their location prior to meeting as "home" (55.6%). The participants had completed an average of seven shifts prior to their mid-clerkship meetings. When comparing those who met online vs. in-person, the only demographic variable that significantly differed between the two groups was their preferred meeting method ($p=0.0225$). Of those students who did meet online, a significantly higher proportion of them reported a preference to meeting online (46.3% videoconference group vs 24.2% in-person group). Among those who met in-person, a greater proportion of students reported preferring to meet in-person (56.1% in-person group vs. 35.8% videoconference group). In the response to the survey question, "Additional suggestions for how to improve MCF sessions," we identified several common themes. Seven of the 67 individuals who met via videoconference reported some degree of technical difficulty, three of the 67 suggested allowing students to choose their meeting method, and two students commented on the difficulty of finding an appropriate location for a videoconference while on campus. Of those students who met in-person, one of the 66 also suggested allowing students to self-select the meeting method.

To determine if there were differences in experience between those who met online vs. in-person, we compared participants' sliding scale ratings of overall experience, communication, helpfulness, stress levels and convenience of meeting location between the two groups (Figure, Table 2). We found no significant differences in the scores between videoconference and in-person meetings in overall experience, helpfulness of meeting, stress levels, or convenience. (Median overall experience score: 90.0 for videoconference, 91.5 for in-person, $p=0.9909$; median helpfulness score: 80.0 for videoconference, 85.0 for in-person, $p=0.8420$; median stress level score: 20.0 for videoconference, 22.5 for in-person, $p=0.2352$.) However, individuals meeting in-person rated effectiveness of communication higher than those meeting via videoconference (median score: 85.0 for videoconference, 100 for in-person, $p=0.0002$), but with significantly lower convenience (median score: 100 for videoconference, 75.0 for in-person, $p<0.0001$).

Since preferred meeting method was found to differ significantly between the two groups, we used multivariable linear regression models to control for its

Table 1. Analyses of study participants' demographic variables comparing individuals meeting via videoconference vs. in-person for their mid-clerkship feedback sessions.

Variable	Overall	Videoconference	In-person	P value*
Number of students	133	67	66	
Faculty member, N (%)				
Dr. X	76 (57.1%)	35 (52.2%)	41 (62.1%)	0.5227
Dr. Y	47 (35.3%)	27 (40.3%)	20 (30.3%)	0.5227
Dr. Z	10 (7.5%)	5 (7.5%)	5 (7.6%)	0.5227
Student gender, N (%)				
Female	61 (45.9%)	32 (47.8%)	29 (43.9%)	0.7885
Male	72 (54.1%)	35 (52.2%)	37 (56.1%)	0.7885
Student age, years, N (%)				
20 – 24	42 (31.6%)	20 (29.9%)	22 (33.3%)	0.8390
25 – 29	75 (56.4%)	38 (56.7%)	37 (56.1%)	0.8390
30 +	16 (12.0%)	9 (13.4%)	7 (10.6%)	0.8390
Student interest in EM career, N (%)				
No	77 (57.9%)	40 (59.7%)	37 (56.1%)	0.4966
Undecided	25 (18.8%)	10 (14.9%)	15 (22.7%)	0.4966
Yes	31 (23.3%)	17 (25.4%)	14 (21.2%)	0.4966
Location immediately prior to meeting, N (%)				
Home	74 (55.6%)	41 (61.2%)	33 (50.0%)	0.3770
Campus	23 (17.3%)	10 (14.9%)	13 (19.7%)	0.3770
ED shift	35 (26.3%)	15 (22.4%)	20 (30.3%)	0.3770
Other	1 (0.8%)	1 (1.5%)	0 (0.0%)	0.3770
Preferred meeting method, N (%)				
In-person	61 (45.9%)	24 (35.8%)	37 (56.1%)	0.0225
Online	47 (35.3%)	31 (46.3%)	16 (24.2%)	0.0225
No preference	25 (18.8%)	12 (17.9%)	13 (19.7%)	0.0225
EM shifts completed, median (25th – 75th percentile)	7.0 (6.0 – 8.0)	7.0 (6.0 – 8.0)	7.0 (6.0 – 8.0)	0.5317

EM, emergency medicine; *ED*, emergency department.
*Video conference versus in-person.

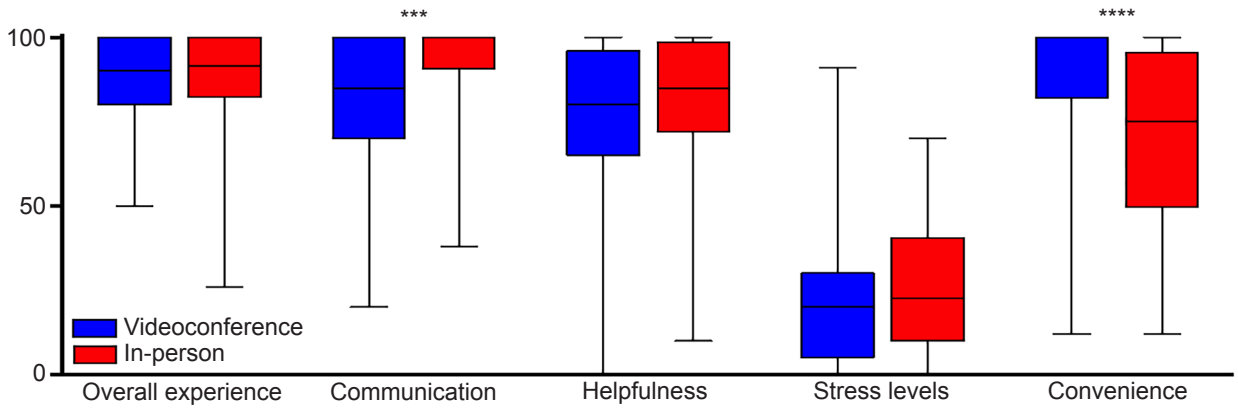

Figure. Box and whiskers plot comparing participant ratings. Statistical analysis conducted using t-test or Mann-Whitney U as appropriate. Displayed is median, interquartile range and minimum to maximum.
***p<0.001.
****p<0.0001.

Table 2. Comparison of participant ratings in individuals randomized to videoconference compared to in-person meetings for their mid-clerkship feedback sessions.

Variable	Videoconference median (25th – 75th percentiles)	In-person median (25th – 75th percentiles)	P-value videoconference versus in-person
Number of students	67	66	
Overall experience	90.0 (80.0 – 100.0)	91.5 (83.3 – 100.0)	0.9909
Communication	85.0 (72.5 – 100.0)	100.0 (91.3 – 100.0)	0.0002
Helpfulness	80.0 (67.0 – 96.0)	85.0 (72.3 – 97.5)	0.8420
Stress levels	20.0 (7.0 – 29.5)	22.5 (10.0 – 40.0)	0.2352
Convenience	100.0 (83.5 – 100.0)	75.0 (50.0 – 95.0)	<0.0001

effect on the relationship between study group and the rating score (Supplemental Table 1). Overall, the results did not change after controlling for preferred meeting method. Overall meeting satisfaction, helpfulness of the meeting, and stress levels during the meeting still did not differ significantly between the groups (p=0.9680, p=0.8650, and p=0.6615, respectively). Effectiveness of communication and convenience of meeting location were still found to differ significantly between the study groups; participants who met in-person rated communication higher than those who met online. (Mean difference [MD]: 13.9, 95% confidence interval [CI] [7.724-20.108], p<0.0001) and videoconference group rated convenience higher than those who met in-person (MD [-16.817], 95% CI [-25.802 - -7.833]), p=0.0003).

To assess the impact of videoconferencing on students interested in a career in EM, we completed a subgroup analysis on the 31 participants who selected "Yes" to the question, "Do you have an interest in EM career?" Among the demographic variables, no significant difference was identified between individuals meeting via videoconference compared to in-person in any of the variables including preferred meeting method (p=0.0688, Supplemental Table 2). Since these results were borderline significant, we hypothesize that with a larger sample size, significance may also have been achieved. The results of the rating scales in students interested in EM were the same as the overall results. Effectiveness of communication and convenience of meeting remained significantly different (p=0.0423 and p=.0110, respectively), whereas no significant differences were observed in student ratings for overall experience, helpfulness, and stress levels (p=0.7102, p=0.1520, and p=0.8731, respectively) (Supplemental Table 3).

DISCUSSION

Our study assessed the use of videoconference for medical students' MCF sessions using a prospective, randomized controlled study. We found no difference in overall experience, stress levels and helpfulness of the meeting between students who met via videoconference compared to those who met in-person. However, we did identify significant differences in convenience and communication between the two groups. The non-significant, equally high ratings of overall experience in all participants support our hypothesis that the videoconference can be as effective as in-person meetings for MCF sessions. Our randomized controlled study design provides solid evidence for the non-inferiority of videoconference, indicating that the use of videoconference is a viable option for MCF meetings. However, it is important for faculty and students to note that, while videoconferencing improved convenience, as it can be conducted from any location with Internet access, students felt it jeopardized their communication capabilities. Hence, our study has helped faculty and students identify these as important factors to consider when selecting a meeting method. Additionally, as suggested in students' qualitative comments, providing them a choice of preferred meeting method may be the optimal solution. Students may have personal preferences regarding which qualities they valued more. Additional studies are needed to confirm whether using meeting methods consistent with student preference has additional benefits on meeting satisfaction as, outside the context of a research study, it is unlikely that students would be randomized to a meeting method.

We suspect that the lack of improved overall experience despite higher convenience may be due to the hindrances in communication experienced by the participants. In addition to the lower communication ratings in the videoconference group, seven videoconference participants indicated in the free-text response section that they experienced some level of technical difficulty during their meetings, and one student was unable to complete a meeting due to technological issues. We did not include a question on our survey that specifically asked about technical challenges, as we wanted to keep the survey

identical between the two groups. Therefore, it may be possible that additional students experienced technical difficulties but did not mention them in the "additional suggestions" section. In this regard, further investigation of the quality of communication problems would lend insight to future implementation of videoconferencing for MCFs. As technology continues to advance, we expect the audiovisual quality and Internet speeds to concurrently improve and lead to globally enhanced communication capabilities. Lastly, several other studies have used multiple platforms for online medical education, such as FaceTime and Skype.[10,11] Assessing multiple videoconferencing platform options would also be beneficial for future studies to identify the characteristics of the electronic platform that are best suited to the study population.

As expected based on previous literature,[7,8] convenience was improved with online meetings. Although not statistically significant, more people were at home immediately before their meetings (61.2%) in the videoconference group than the in-person group (50.0%). We can most likely attribute the difference in improved convenience to people not having to leave the comforts of home for their meetings. Of the five students who were dropped from the study due to a change in meeting method, three switched from meeting in-person to meeting online due to unexpected weather conditions that resulted in the closure of the university. Although survey data were not obtained from those three individuals, convenience may have been improved for these individuals as well. While our study does not include multiple campuses, we anticipate that not having to travel would further improve meeting satisfaction and convenience for students at satellite locations who need to complete their MCFs.

We are pleased to show that there was no difference in student ratings of their stress levels and perceived helpfulness of their MCF meetings. These results provide additional evidence for the non-inferiority of using videoconference for MCF meetings. It is important to note that stress levels were equally low in both groups of students, indicating MCF meetings at our institution are carried out under low-intensity conditions.

Faculty experience was not formally assessed in this study; however, the general feedback from all three attending physicians who participated in the study was positive. The faculty reported that the videoconference format allowed the concurrent completion of the institution's electronic evaluation forms, which improved the efficiency of the meetings and the perceived accuracy of the evaluation forms. A drawback to videoconferences reported by the faculty was that several students required extra time to obtain video and audio function or to download plug-ins. However, similar delays also occurred with the in-person meetings due to tardiness. The exact number of individuals and the exact durations of the delays were not formally documented in our study. Formal assessments of faculty experience are encouraged in future studies.

LIMITATIONS

There are several limitations to our study. First, eight students were excluded from the study after randomization because they elected to meet via the alternative meeting method. We are aware that this may have eliminated several undesirable or desirable ratings of the particular meeting method. Similarly, there was also a minority of students that rescheduled their meeting times based on the meeting method they were randomized into. For instance, if a student had been randomized to do an in-person meeting on a day after an overnight shift, the student may have elected to email the faculty member to ask if they could meet on an alternative day to avoid having to come to campus on post-call day. The faculty members made alternative arrangements whenever possible. Rescheduling for a more convenient time may also have affected survey ratings.

Additionally, there may have been biases in the population that consented to participate in the study. It is highly likely that those individuals with strong preferences on particular meeting method deferred the study and self-selected the preferred meeting method; therefore, their experiences are not captured. However, the highly significant differences in meeting convenience and communication despite controlling for the preferred meeting method suggest that a student's preference for a particular meeting method did not affect the overall results of our study.

Lastly, with regard to the study's methodology the survey instrument has not been previously validated. Although the survey questions do not satisfy any of the "common pitfalls of survey design" detailed by Artino et al.[12], the wording of the questions, directionality of sliding scale, and the layout of the electronic survey could have influenced our results. We also note that this was a single-center study, which may limit the generalizability of our results.

CONCLUSION

Our study provides preliminary evidence for the efficacy of videoconferences for routine meetings between faculty and medical students during MCF sessions. The survey data showed no differences in the overall experience of individuals meeting via videoconference compared to in-person. Given the improved convenience of videoconferencing, it may be beneficial for clerkship directors to provide it as a meeting option to provide more flexibility for students. However, it is also important for faculty to be aware of the perceived decrease in communication effectiveness related to videoconferencing along with the possibility of technical difficulties. Additional studies in multiple academic locations and using better-validated study tools are needed to confirm the results of our study.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Emergency Physicians' Familiarity with the Safe Handling of Firearms

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Section Editor: Andrew W. Phillips, MD, MEd
Submission history: Submitted July 14, 2018; Revision received October 31, 2018; Accepted November 7, 2018
Electronically published November 30, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.11.39822

Introduction: Emergency physicians (EP) experience high rates of workplace violence, the risks of which increase with the presence of weapons. Up to 25% of trauma patients brought to the emergency department (ED) have been found to carry weapons. Given these risks, we conducted an educational needs assessment to characterize EPs' knowledge of firearms, frequency of encountering firearms in the ED, and level of confidence with safely removing firearms from patient care settings.

Methods: This was a survey study of attending and resident EPs at two academic and four community hospitals in the Midwest and Northeast. A 26-item questionnaire was emailed to all EPs at the six institutions. Questions pertained to EPs' knowledge of firearms, experience with handling firearms, and exposure to firearms while at work. We calculated response proportions and p-values.

Results: Of 243 recipients who received the survey, 149 (61.3%) completed it. Thirty-three respondents (22.0%) reported encountering firearms in the workplace, 91 (60.7%) reported never handling firearms, and 25 (16.7%) reported handling firearms at least once per year. Thirty-six respondents (24.0%) reported formal firearms training, and 63 (42.3%) reported no firearms training. There were no significant regional differences regarding firearms training or exposure. Residents from the Northeast were more likely to be moderately confident that they could safely handle a firearm prior to law enforcement involvement (p=0.043), while residents from the Midwest were more likely to be not at all confident (p=0.018).

Conclusion: The majority of surveyed attending and resident EPs reported little experience with handling firearms. Among resident EPs, there was a regional difference in confidence in handling firearms prior to law enforcement involvement. Given the realities of workplace violence and the frequency with which firearms are encountered in the ED, further investigation is needed to evaluate provider competence in safely handling them. EPs may benefit from training on this topic. [West J Emerg Med. 2019;20(1)170–176.]

INTRODUCTION

Violence in the emergency department (ED) is a well-known occurrence, with 75% of emergency physicians (EP) experiencing at least one violent incident in the workplace every year.[1] Of particular concern in this context is the possibility for the introduction of weapons into the ED. Aspects of EDs designed to improve patients' access to care, specifically open walk-in entry areas and waiting rooms,

inadvertently allow for easier entry of weapons.[2] One study estimates that 20% of EDs in the United States have guns or knives brought in on a daily or weekly basis.[3] While the majority of ED workplace violence consists of verbal threats and physical assaults without the use of weapons,[4] the potential threat of firearms in particular is of ongoing concern.

Analysis of hospital-based shootings reveals that one third occur in the ED or in the immediate surrounding areas (ambulance ramp, ED parking lot, waiting room).[5] EDs in southern states, hospitals with more than 400 beds, EDs seeing more than 60,000 patients per year, and Level I trauma centers are at particular risk.[4–6] One retrospective study found that 26% of major trauma patients were armed with lethal weapons, and guns comprised 16.3% of the weapons confiscated from these patients.[6] Moreover, guns brought into the ED by patients represent only a part of the problem; among safety incidents involving firearms, 50% involved a security personnel member's firearm. These findings suggest that the presence of any firearm in this high-stress environment can be a threat to patient and staff safety.[5]

Clearly, EPs are at risk for exposure to guns while at work in the ED. While we are not aware of any published data on the likelihood that EPs will be required to handle firearms at work (e.g., removing a firearm from a patient's person or belongings during a trauma assessment), the risk for such an event is concerning. There is also a paucity of published data on accidental firearms discharges in the ED, however these events represent a real risk for injury. Epidemiologic data from the community show that a large number of injuries due to accidental firearms discharge result from routine activities such as carrying, showing, or looking at a gun, with one study estimating the incidence of these mechanisms at 23.9%.[7] A more recent study showed that 35.3% of patients presenting to the ED with firearm injuries sustained unintentional injuries.[8] These findings highlight the risks associated with merely handling firearms, particularly among those inexperienced with doing so.[9] To our knowledge, no studies have specifically assessed the exposure of EPs to firearms or EPs' confidence in handling them. Given the unpredictable nature of the ED and the potential for entry of firearms, it is evident that data is lacking regarding the risks of EP encounters with firearms in the workplace.

The purpose of this study was to determine the frequency with which EPs encounter firearms while at work in the ED, characterize EPs' experience with handling firearms, and describe EPs' level of confidence with safely handling a firearm should one be encountered in the ED.

Population Health Research Capsule

What do we already know about this issue?
The emergency department is at risk for the entry of guns. Guns represent a safety risk for patients and staff. A large proportion of gun injuries are due to accidental discharges during handling.

What was the research question?
How often do emergency physicians (EPs) encounter guns? What experience and level of confidence do EPs have with handling guns?

What was the major finding of the study?
The surveyed EPs report encountering guns at a low but measurable rate. Respondents have little experience with handling guns.

How does this improve population health?
Our findings demonstrate a knowledge gap among the surveyed EPs that has implications for workplace safety. EPs may benefit from training on the topic of firearms safety.

METHODS

Study Design

This was a survey study of resident and attending EPs at two academic and four community hospitals in the Midwest and Northeast. Our survey tool was developed using an iterative process in keeping with published best practices in survey design.[10,11] We conducted a literature review to identify relevant variables in EPs' exposure to firearms. After developing survey items in keeping with the terminology and data present in the relevant literature, we assessed for content validity of the survey items using local content expert review. Content experts included academic emergency medicine (EM) faculty with experience in survey design methodology and EM faculty with training in firearms handling, defined as having undergone a formal gun safety course such as concealed-carry training, tactical firearms training, etc. Experts reviewed the wording of each item for clarity, content, and utility, and their comments were integrated into the survey. After assessment for content validity the survey was administered to EM faculty to assess for response process validity using immediate retrospective probing.[10] Their impressions of each item were recorded and integrated into the final version of the survey.[12] After finalizing survey items, the survey was electronically delivered to the study population.

Study Population

The study population included resident and attending EPs at two academic hospitals and their community affiliate hospitals in the Midwest and Northeast. As EDs have been found to be at higher risk for firearms encounters,[5] these two populations represent the most likely physicians to be exposed to firearms in the hospital setting.

Study Protocol

A questionnaire was emailed to EPs whose primary clinical duties were at the included institutions (Appendix). All survey responses were anonymous. A total of three reminders were sent to all respondents. We conducted the survey questionnaire using Google Forms, and stored all data in a password-protected online file. This study was considered exempt by the institutional review board of Northwestern University.

Key Outcome Measures

We sought to characterize multiple facets of EPs' exposure, confidence, and experience with handling firearms, and the frequency with which they encounter firearms while on duty in the ED.

Data Analysis

We analyzed survey results using Stata (14.2). Response rates were calculated using the calculator tool provided by the American Association for Public Opinion Research.[13] We calculated response proportions for each question, and p values were calculated using chi^2 and Fisher's exact test.

RESULTS

Of 243 recipients who were sent the survey, 149 (61.3%) completed it. Demographic data of respondents can be found in Table 1. Respondents from the Midwest included 40 of 58 resident EPs (70.0%) and 21 of 44 attending EPs (47.7%), while respondents from the Northeast included 24 of 36 resident EPs (66.7%) and 64 of 115 attending EPs (55.7%). There were no significant regional differences in response rates of attending or resident EPs, nor were there significant regional differences in response rates of men vs. women.

Twenty-five percent of resident EPs and 20% of attending EPs reported encountering firearms in the ED or its immediate environment. Of these, few respondents reported encountering firearms in the workplace on a daily, weekly, or monthly basis, with the majority reporting encountering firearms on a yearly or less-often basis. We observed no significant differences in level of training or geographic region regarding rates of firearms exposure in the workplace (Table 2).

Personal experience with handling firearms was similarly low, with 90 respondents (60.4%) reporting never

Table 1. Demographics of emergency physicians who responded to survey regarding familiarity with handling firearms.

	Midwest (n=61)	Northeast (n=88)
Attending [n(%)]	21 (34.4)	64 (72.3)
Resident [n(%)]	40 (65.6)	24 (27.3)
Male [n(%)]	41 (67.2)	62 (70.5)
Practice site – Urban [n(%)]	59 (96.7)	76 (86.4)
Practice site – Suburban [n(%)]	2 (3.3)	10 (11.4)
Practice site – Rural [n(%)]	0 (0.0)	2 (2.3)
Practice site – Level 1 Trauma Center [n(%)]	59 (96.7)	57 (64.8)
Practice site – Trauma Center, not Level 1 [n(%)]	2 (3.3)	2 (2.3)
Practice site – not a Trauma Center [n(%)]	0 (0.0)	29 (33.0)

Table 2. Reported frequency of encountering firearms in the emergency department or its immediate surrounding areas.

How often do you personally encounter firearms in your primary emergency department or its immediate environment (waiting room, parking lot, ambulance bay, etc.)? (n=149)	Attending Midwest (n=21)	Attending Northeast (n=64)	P value	Resident Midwest (n=40)	Resident Northeast (n=24)	P value
Never or blank	18 (86)	50 (78)	0.545	31 (78)	17 (71)	0.565
Less frequently, but I do personally encounter firearms in/ around the emergency department	2 (10)	5 (8)	0.805	4 (10)	3 (13)	0.756
Yearly	1 (5)	4 (6)	0.801	3 (8)	2 (8)	0.904
Monthly	0 (0)	1 (2)	0.565	1 (3)	2 (8)	0.285
Weekly	0 (0)	1 (2)	0.565	1 (3)	0 (0)	0.435
Daily	0 (0)	3 (5)	0.312	0 (0)	0 (0)	n/a

handling a firearm in their daily lives. Attending EPs were significantly more likely than resident EPs to report never handling firearms in their daily lives (p=0.003), with no significant regional differences found within either group. Of those who reported handling firearms, there was a trend toward resident EPs being more likely than attending EPs to report having undergone formal or informal firearms training (p=0.06). Attending EPs were significantly more likely than resident EPs to report having no firearms training (p=0.018). No significant regional differences in firearms training were found among either resident or attending EPs (Table 3).

Confidence in handling a firearm found in a patient's possession until it could be safely turned over to law enforcement was varied, but each confidence level was fairly evenly distributed when comparing resident EPs to attendings (Table 4). No significant differences in level of confidence were found between resident and attending EPs, nor were there significant regional differences among attending EPs. Resident EPs from the Northeast were significantly more likely to be "moderately" confident that they could safely handle a firearm found in a patient's possession (p=0.043), while resident EPs from the Midwest were significantly more likely to be "not at all" confident that they could do so (p=0.018). Attending EPs were significantly more likely than resident EPs to report knowing whether their hospital had a protocol regarding the handling and management of firearms found in a patient's possession, while residents were significantly more likely to be unsure whether their hospital had a protocol (p=0.001) (Table 5). No significant regional differences were found regarding knowledge of such hospital protocols.

Table 3. Resident and attending emergency physicians' reported degree of personal experience with handling firearms.

	Attending (n=85)	Resident (n=64)	P value
How often do you handle firearms in your daily life? (n=149)			
Never	60 (71)	30 (47)	*0.003
How often do you personally encounter firearms in your primary emergency department or its immediate environment (waiting room, parking lot, ambulance bay, etc.)? (n=149)			
Never or blank	68 (80)	48 (75)	0.444
To what extent have you had firearms training? (n=149)			
Formal	18 (21)	18 (28)	0.060
Informal	24 (28)	26 (41)	0.060
None	43 (51)	20 (31)	*0.018
If you were to encounter a firearm in a patient's possession, how confidently do you feel you could safely handle it until it can safely be turned in to law enforcement? (n=149)			
Extremely	14 (16)	9 (14)	0.895
Moderately	20 (24)	12 (19)	0.895
Somewhat	10 (12)	9 (14)	0.895
Slightly	18 (21)	17 (27)	0.895
Not at all	23 (27)	17 (27)	0.895

Table 4. Resident and attending emergency physicians' reported degree of confidence in handling firearms encountered in a patient's possession.

If you were to encounter a firearm in a patient's possession, how confidently do you feel you could safely handle it until it can safely be turned in to law enforcement? (n=149)	Attending Midwest (n=21)	Attending Northeast (n=64)	P value	Resident Midwest (n=40)	Resident Northeast (n=24)	P value
Extremely	1 (5)	13 (20)	0.172	4 (10)	5 (21)	0.228
Moderately	5 (24)	15 (23)	0.972	4 (10)	8 (33)	*0.043
Somewhat	3 (14)	7 (11)	0.679	6 (15)	3 (13)	0.781
Slightly	4 (19)	14 (22)	0.783	11 (28)	6 (25)	0.827
Not at all	8 (38)	15 (23)	0.190	15 (38)	2 (8)	*0.018

Table 5. Resident and attending emergency physicians' reported degree of knowledge of hospital protocols regarding management of firearms discovered in patients' possession.

Are you aware of a hospital protocol regarding handling and management of firearms discovered in the possession of patients within your primary emergency department? (n=149)	Attending (n=85)	Resident (n=64)	P value
Yes it does	29 (34)	6 (9)	*0.001
No it doesn't	1 (1)	0 (0)	*0.001
Unsure	55 (65)	58 (91)	*0.001

DISCUSSION

We found that the majority of EPs at the surveyed institutions reported little experience with safely handling firearms. At the same time, a cumulative 20% of responding attendings and 25% of responding residents reported encountering firearms while at work in the ED. In some ways this "low frequency high risk" encounter is analogous to other unique scenarios in EM such as performing an ED thoracotomy or peri-mortem caesarean section. These rare but crucial procedures receive high levels of educational attention, as EPs must be able to perform them in the event they are needed. The majority of our respondents reported little or no experience with handling firearms, showing a knowledge gap. Further investigation is needed to assess the prevalence of this knowledge gap among resident and attending EPs generally. A national knowledge gap in this area would suggest a general need for firearms education that may have implications for workplace safety, as accidental firearms discharge in the ED should be considered a "never event." Although such education may not translate to confidence in handling firearms, just as with other "low frequency high risk" procedures, EPs may benefit from subject matter familiarity in the event that they are required to remove a firearm from the clinical care environment.

The surveyed population had heterogeneous levels of experience with handling firearms, with resident EPs being more likely to have handled firearms in their daily lives. This coincides with the fact that the surveyed residents were more likely to have had formal or informal firearms training than the surveyed attendings. The survey was not calibrated to investigate the nature of this training; for example, it is possible that a higher percentage of the surveyed residents served in the military. Nevertheless, this difference suggests variability among EPs in firearms training and personal familiarity with firearms. Further investigation may be needed to assess the generalizability of these findings and could help elucidate the exact education and exposures that lead to the intergroup differences we found in this study.

Resident respondents in the Northeast were significantly more likely than those in the Midwest to report confidence that they could safely handle firearms encountered in the clinical environment. The driver for this difference is unclear, as very few other regional differences existed in the surveyed populations. The likelihood of encountering firearms in the clinical environment was not significantly different between respondents from the Midwest and respondents from the Northeast. Similarly, these groups were not significantly different in the extent to which they have received firearms training or the frequency with which they handle firearms in their daily lives. Comparison of resident respondents in the Midwest vs. the Northeast and attending respondents in the Midwest vs. the Northeast also yielded no significant differences. A performance-based needs assessment could help evaluate the actual baseline level of ability residents have in safely handling firearms found in the clinical environment.

Finally, attending respondents were significantly more likely than resident respondents to report knowledge of hospital protocols regarding the handling and management of firearms found in patient possession. This may be driven by the greater involvement of attending EPs with departmental and hospital administration, leading to greater familiarity with hospital protocols in general. However, despite their comparatively greater familiarity with the presence or absence of a hospital protocol, the majority of attending respondents were unsure of whether or not their hospital had a protocol regarding patients' firearms. These findings, therefore, highlight a knowledge gap among both residents and attendings that suggests a need for additional education for workplace safety training. Particularly given that resident and attending EPs may be called upon to remove firearms from the clinical setting, familiarity with hospital protocols surrounding this action may be critical.

LIMITATIONS

This study has several important limitations. Respondent level of training differed between the Midwest and Northeast, with significantly more residents than attendings responding from the Midwest and vice versa from the Northeast ($p<0.001$). This makes interpretation of these two geographic regions problematic, as the average level of training differs between these two respondent populations. This effect is

mitigated by analyzing the data within groups defined by resident- and attending-level of training. An additional limitation is the lack of pilot administration during survey design, potentially limiting its internal validity. This was due to the relatively small size of some of our sub-populations (e.g., 36 residents in the Northeast). Administration of a pilot would have rendered those respondents ineligible for analysis in the final survey, as participation in both would potentially have created an exposure bias. Decreasing the number of potential respondents eligible for analysis would effectively decrease our maximum response rate and thereby reduce the study's power to detect differences between groups. Given this risk and in light of our otherwise-rigorous development of the survey tool, we elected to proceed with the survey in lieu of a pilot study. The similar response rates to all questions except as noted above suggest that our survey tool is very likely to have a high degree of internal validity.

A final limitation is the fact that this study was conducted at only two academic centers and their community affiliates. While our response rate is likely to be representative of the surveyed population,[14] this population represents only a small portion of the total number of resident and attending EPs in the surveyed regions. Furthermore, some regions not represented in our study are at higher risk for hospital-based firearms violence. These factors greatly limit this study's generalizability to the country as a whole. A multi-center investigation including hospital systems in the American South, Southeast, and West could help elucidate whether EP experience and confidence in handling firearms is related to the regional variability seen in firearms ownership[15] and firearms violence.[4,5] With this in mind, geographic differences and differences between levels of training were found in the surveyed populations, which may suggest even greater heterogeneity among EPs nationally. Further investigation may be needed to better characterize the degree of variability among EPs.

CONCLUSION

The majority of EPs at the surveyed institutions report little experience with handling firearms. While our survey shows that firearms are infrequently encountered in the clinical environment, a low level of exposure is nevertheless apparent among our surveyed population. Given the high risks associated with handling firearms and the fact that accidental firearms could discharge during removal from the patient bedside should be considered a "never event," it may be beneficial for EPs to receive training in safely handling firearms. Finally, respondents were largely unaware of the presence or absence of protocols at their home institutions regarding handling of firearms found in a patient's possession. EPs may benefit from dedicated training on these topics.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of Dr. David Salzman, Dr. Seth Trueger, and Dr. James Adams in survey development and content revision.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. No author has professional or financial relationships with any companies that are relevant to this study. There are no conflicts of interest or sources of funding to declare.

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Accuracy Screening for ST Elevation Myocardial Infarction in a Task-switching Simulation

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Section Editor: Andrew W. Phillips, MD, MEd
Submission history: Submitted July 22, 2018; Revision received November 4, 2018; Accepted October 30, 2018
Electronically published November 30, 2018
Full text available through open access at http://escholarship.org/uc/uciem_westjem
DOI: 10.5811/westjem.2018.10.39962

Introduction: Interruptions in the emergency department (ED) are associated with clinical errors, yet are important when providing care to multiple patients. Screening triage electrocardiograms (ECG) for ST-segment elevation myocardial infarction (STEMI) represent a critical interrupting task that emergency physicians (EP) frequently encounter. To address interruptions such as ECG interpretation, many EPs engage in task switching, pausing their primary task to address an interrupting task. The impact of task switching on clinical errors in interpreting screening ECGs for STEMI remains unknown.

Methods: Resident and attending EPs were invited to participate in a crossover simulation trial. Physicians first completed a task-switching simulation in which they viewed patient presentations interrupted by clinical tasks, including screening ECGs requiring immediate interpretation before resuming the patient presentation. Participants then completed an uninterrupted simulation in which patient presentations and clinical tasks were completed sequentially without interruption. The primary outcome was accuracy of ECG interpretation for STEMI during task switching and uninterrupted simulations.

Results: Thirty-five participants completed the study. We found no significant difference in accuracy of ECG interpretation for STEMI (task switching 0.89, uninterrupted 0.91, paired t-test p=0.21). Attending physician status (odds ratio [OR] [2.56], confidence interval [CI] [1.66-3.94], p<0.01) and inferior STEMI (OR [0.08], CI [0.04-0.14], p<0.01) were associated with increased and decreased odds of correct interpretation, respectively. Low self-reported confidence in interpretation was associated with decreased odds of correct interpretation in the task-switching simulation, but not in the uninterrupted simulation (interaction p=0.02).

Conclusion: In our simulation, task switching was not associated with overall accuracy of ECG interpretation for STEMI. However, odds of correct interpretation decreased with inferior STEMI ECGs and when participants self-reported low confidence when interrupted. Our study highlights opportunities to improve through focused ECG training, as well as self-identification of "high-risk" screening ECGs prone to error during interrupted clinical workflow. [West J Emerg Med.2019;20(1)177–184.]

INTRODUCTION

Interruptions, defined as activities that briefly disrupt a primary task, are frequent in the emergency department (ED). Emergency physicians (EP) are interrupted 5-15 times per hour.[1,2] Interruptions have been associated with increased rates of error in psychology,[3] aviation,[4] and tactical decision-making,[5] and have been implicated as a cause of preventable medical errors.[6] However, interruptions are also important when caring for multiple patients in the busy environment of the ED. Screening triage electrocardiograms (ECG) for ST-segment elevation myocardial infarction (STEMI) represents a time-sensitive, critical interrupting task that EPs frequently encounter. STEMI is regarded as a medical emergency; delays in diagnosis increase patient morbidity and mortality.[7,8] Guidelines recommend that patients presenting to the ED with chest pain have a screening ECG performed and interpreted by a physician within 10 minutes of arrival, resulting in multiple interruptions every shift devoted to ECG interpretation from often-unknown triage patients.[9,10]

To manage the multiple interrupting ECGs per shift, along with other clinical interruptions, physicians often engage in a cognitive process known as task switching.[11] Task switching involves briefly shifting away from a primary task to address a secondary, or interrupting, task. Once the interruption is addressed, attention is returned to the primary task. According to cognitive theory, task switching exacts a mental cost; each switch places an increased workload on short-term memory, subsequently increasing the likelihood of error. That said, not all task switching incurs the same mental cost. Factors related to the physician (experience, ability to use cognitive shortcuts), the task (difficulty, similarity to other tasks), and the environment alter the mental cost and subsequent probability of error.[12]

Given the complex cognitive processes involved in task switching, research evaluating interrupted clinical workflow and medical errors remains difficult to interpret.[13] Observational studies involving EP workflow,[14] order entry,[15] and pharmacy dispensing[16] all support associations between interruptions and errors. However, experimental trials in medication ordering,[17] surgical procedures,[18] and clinical decision-making[19] have failed to find an association between interruptions and clinical errors. Further, previous studies have focused only on detecting errors in completing the primary task, ignoring the accuracy of the interrupting stimuli. There is a paucity of literature applicable to the unique environment of the ED, where correct interpretation of the interrupting task may be more important than primary task completion. Our study explores physicians' accuracy screening triage ECGs for STEMI in an interrupted, task-switching simulation compared to an uninterrupted simulation. We hypothesized that accuracy interpreting ECGs for STEMI would be lower in the task-switching simulation compared to the uninterrupted simulation.

Population Health Research Capsule

What do we already know about this issue?
While interruptions have been associated with medical errors, they also impart critical information, such as screening electrocardiograms (ECGs) in emergency department (ED) patients.

What was the research question?
Evaluate physician accuracy interpreting simulated interrupting triage ECGs compared to uninterrupted.

What was the major finding of the study?
We found no significant difference in accuracy interpreting interrupting ECGs for ST elevation myocardial infarction compared to uninterrupted.

How does this improve population health?
Not all clinical interruptions are associated with medical errors. Addressing specific, high-risk task factors that promote errors may improve care in the busy ED.

METHODS

Participants

Intern, resident and attending physicians from the three-year emergency medicine residency program at Baystate Medical Center (BMC) were invited to participate. BMC is a tertiary care hospital and regional STEMI receiving center in Springfield, Massachusetts, with 115,000 annual visits. There were no exclusion criteria. The BMC's institutional review board approved this study.

Design

We created a 2x2 factorial crossover design in which each participant completed two simulations during the study: a task-switching simulation and an uninterrupted simulation. To limit priming bias and discovery of the primary outcome, all participants completed the task-switching simulation first and the uninterrupted simulation second. During each simulation, participants viewed a series of patient presentation videos (primary task) and interpreted a series of screening ECGs for STEMI (secondary task). Participants were randomized to which of two patient presentation videos (A or B) and which group of screening ECGs (1 or

2) they completed in the task-switching and uninterrupted simulations, respectively. We used randomization to control for unmeasured differences in difficulty in each of the tasks following applicable Consolidated Standards of Reporting Trials guidelines.[20]

Primary Task: Patient Presentation Videos

The primary task assignment was to view patient presentation videos. We created patient presentation videos to mimic listening to a formal oral presentation of a complex ED patient from a medical student. Two patient presentation videos (A and B) were created and reviewed for content and clarity by clinical experts WS and TJM. Each video included four, four-minute fictitious ED patient presentations, each with multiple possible medical diagnoses. To ensure similar difficulty, patient presentation videos were matched by the type of patient (adult, elderly, pediatric, trauma), number of items in the history of present illness, past medical history, medications, allergies, and physical exam.

Secondary Interrupting Task*:* Screening ECGs for STEMI

The secondary interrupting task was screening ECGs for STEMI. Two clinical stimuli packets (1 and 2) were created, each containing 13 unique ECGs, (five STEMI, four normal ECGs and four ECGs with non-critical findings). ECGs were obtained with permission from the WaveMaven ECG website.[21] WaveMaven is a database of 473 de-identified, online ECGs with difficulty ratings and diagnoses assigned by board-certified cardiologists using corresponding patient level data, such as coronary catheterization results. ECGs in each clinical stimuli packet were matched on diagnosis and difficulty rating, as provided by WaveMaven. We then piloted the ECG stimuli packets in a cohort of 12 EPs not affiliated with the study to evaluate for concordance of difficulty between tests (Supplemental material). To conceal the primary outcome of interest, we included chest radiographs (CXR) and laboratory values in clinical stimuli packets, resulting in a total of 20 interrupting stimuli in each clinical stimuli packet.

Simulation

Prior to the start of the simulation, participants were randomized in blocks of four using sequentially numbered, opaque envelopes to which primary task (patient presentation video A or B), and which interrupting task (clinical stimuli 1 or 2) would be completed in the task switching and uninterrupted simulations, respectively. Researchers who led the simulation (WS, BP, ET) were not involved in the creation of randomization envelopes and were blinded to group allocation until the simulation began.

Participants were instructed that the task-switching simulation was meant to mirror ED workflow. Their assignment was to remember details and form a differential diagnosis for each of four medical-student patient presentations. Participants were advised they would be interrupted every minute with a clinical stimulus: live paper copies of ECGs, CXRs, and laboratory values from unknown patients waiting in triage. They were asked to quickly evaluate the interruption for any actionable finding (YES/NO), write their diagnosis, and rate their confidence in interpreting the interruption (Likert: 1=uncertain; 5=certain.) An actionable finding was defined as a discovery that would require the patient to be brought into the ED from triage for further evaluation. If participants asked about additional information regarding the triage patient, they were told it was not known. Video patient presentations temporarily paused during interruptions, allowing 15 seconds for participants to interpret the interruption and record answers.

After the task-switching simulation, participants completed the uninterrupted simulation in which the patient presentation videos were viewed uninterrupted. Immediately following the videos, participants completed the second set of clinical tasks without interruption or time limit.

At the conclusion of each simulation, participants completed a written exam testing their memory of the patient presentation videos. The assessment included questions regarding details from the chief complaint, past medical history, medications and physical exam of each patient, as well as a final question that asked for a ranked differential diagnoses list for each patient (Figure 1).

Statistical Analysis

The primary outcome for this study was accuracy interpreting ECGs for STEMI. We defined accuracy as the sum of true positive and true negative interpretations divided by the total number of ECGs. A true positive interpretation was coded if participants correctly identified an actionable finding on the STEMI ECG with a corresponding written diagnosis of STEMI. A true negative interpretation was coded if participants correctly indicated no actionable findings on non-STEMI ECGs, or if participants indicated a finding unrelated to STEMI. We calculated sensitivity and specificity for each participant during each module; we then used means across participants in the final analysis. Paired t-tests were used to evaluate differences in overall ECG accuracy, mean sensitivity and mean specificity in the task-switching and uninterrupted simulations.

To explore associations of accuracy of ECG interpretation for STEMI with clinically relevant covariates, we performed repeated-measures logistic regression using the odds of correct interpretation of each individual ECG as a binary outcome (correct/incorrect). With 26 ECGs for each of the 35 participants, this allowed for up to 910 outcomes. Generalized estimating equations grouped ECGs by participant to account for non-independence of outcomes. Clinically relevant variables defined *a priori* that were incorporated in the model included the following: simulation

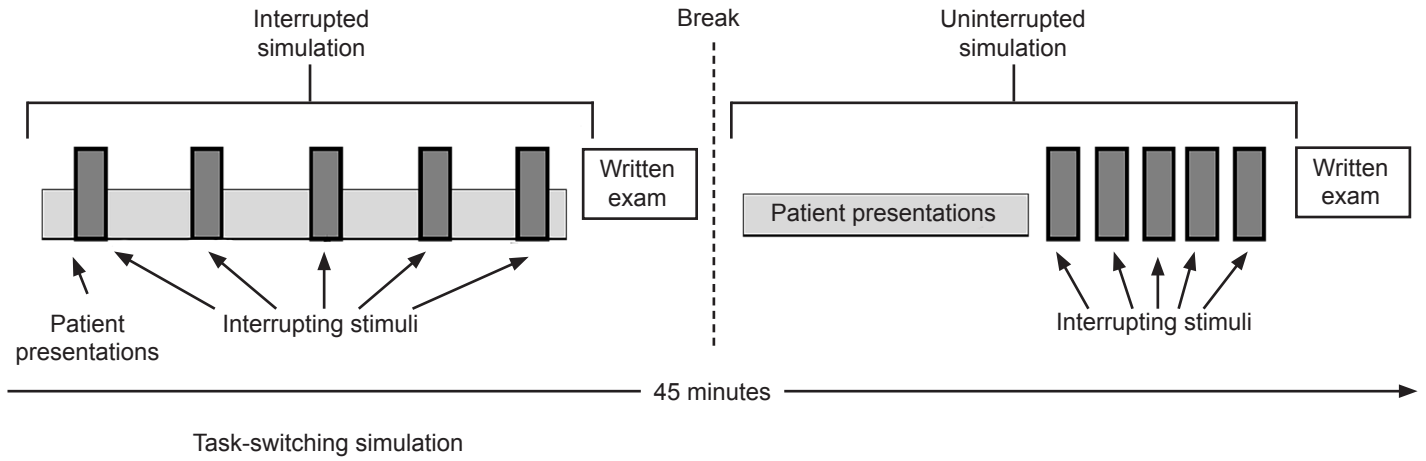

Figure 1. Participant flow through the crossover simulation trial evaluating accuracy of screening electrocardiogram interpretation for ST-elevation myocardial infarction. Participants first completed the task-switching simulation, viewing patient presentations interrupted by clinical stimuli. Then, after completing a written exam and a short break, participants completed the uninterrupted simulation, viewing patient presentations and interpreting clinical stimuli independently and uninterrupted.

(task switching, uninterrupted); physician experience (intern, resident, attending); type of ECG (non-STEMI, anterior-lateral STEMI, inferior-posterior STEMI; performance on the primary task (measured by scores on the corresponding written examinations); and confidence in interpretation of interrupting stimuli (dichotomized into low confidence 1-3, high confidence 4-5). To evaluate for effect modification, the interaction of simulation (task switching, uninterrupted) with physician experience, type of ECG and self-reported confidence, were selected a priori for analysis.

Power

Using paired t-test, with a two-tailed alpha of 0.05, power analysis estimated that 33 participants would allow a power of 0.9 to demonstrate a 0.1 difference in accuracy, or an approximate difference of two ECGs in 26 presented for interpretation, with a standard deviation of 0.20. We performed all statistical analyses using SAS software 9.4 (SAS Institute, Inc., Cary, NC)) and R statistical software (2014. R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Thirty-five EPs completed the study and were included in the analysis, including eight of 13 eligible interns, 12 of 24 senior residents and 15 of 28 attending physicians. Years of experience for participants ranged from less than one year to 47 years (median three years, 25th,75th percentile= 2,10), whereas nonparticipants ranged from less than one year to 39 years (median three years, 25th,75th percentile= 2,19). One participant, a senior resident, completed the simulation but was not included in analysis because his paper data file was lost upon transfer from the simulation center to the secure site.

Participants' mean accuracy on identification of STEMI by ECG was not significantly different during task switching and uninterrupted simulations (task switching =0.89, standard deviation [SD] = 0.08, uninterrupted=0.91, SD = 0.08, p=0.21). Mean sensitivity of ECG interpretation for STEMI in the task-switching simulation was 0.82 (SD=0.13) compared with mean sensitivity in the uninterrupted simulation of 0.81 (SD = 0.18, p=0.84). Specificity of ECG interpretation for STEMI in the task- switching scenario was 0.90 (SD = 0.19) compared to the uninterrupted scenario of 0.97 (SD=0.07, p=0.07). Stratified by physician experience, there were no significant differences in mean sensitivity or specificity between simulations (Table 1).

Odds of correct ECG interpretation for STEMI were not significantly different between task-switching and uninterrupted groups (odds ratio [OR] [0.81], confidence interval [CI] [0.58-1.12], p=0.32). Covariates related to correct interpretation of ECG included attending physician (OR [2.56], CI [1.66-3.94], p<0.01) and self-reported confidence in ECG interpretation (OR [3.10], CI [2.14-4.50], p<0.01). Presence of an inferior STEMI was associated with decreased odds of correct ECG interpretation (OR [0.08], CI [0.04-0.14], p<0.01). Performance on written exams evaluating memory of the patient presentations were not associated with significant changes in accuracy of ECG interpretation (OR [1.01], CI [0.96-1.05], p=0.82) (Table 2).

In the task-switching simulation, low self-reported confidence in correct ECG interpretation was associated with lower accuracy of ECG interpretation for STEMI, compared to the uninterrupted simulation (Interaction p=0.02) (Figure 2). Physician experience and ECG-type demonstrated no significant interaction in predicting accuracy of ECG interpretation for STEMI.

Table 1. Mean accuracy (standard deviation) in interrupted and uninterrupted simulations, overall and stratified by position. Hypothesis testing performed using paired t-tests.

Variable	Task switching	Uninterrupted	P value
All participants (n=35)	0.89 (0.08)	0.91 (0.08)	0.21
Interns (n=8)	0.82 (0.08)	0.88 (0.09)	0.17
Residents (n=12)	0.88 (0.09)	0.88 (0.08)	0.81
Attending physicians (n=15)	0.93 (0.05)	0.94 (0.05)	0.38

Table 2. Generalized estimating equations logistic regression (univariate and full model) for factors associated with correct ECG interpretation for STEMI. Low confidence was defined as a self-reported Likert score of 1-3, and high confidence was defined as a self-reported Likert score of 4-5.

	Univariate model			Full model		
Variable	OR	CI	P value	OR	CI	P value
Simulation						
Uninterrupted (base)	1.00			1.00		
Task-switching	0.81	0.58-1.12	0.32	0.80	0.51-1.24	0.31
Physician experience						
Intern (base)	1.00			1.00		
Resident	1.30	0.80-2.13	0.26	1.29	0.68-2.47	0.44
Attending*	*2.56	*1.66-3.94	*<0.01	*2.40	*1.42-4.05	*<0.01
Type of ECG						
Normal (base)	1.00			1.00		
Anterior STEMI	1.17	0.44-3.13	0.67	0.78	0.30-2.03	0.61
Inferior STEMI*	*0.08	*0.04-0.14	*<0.01	*0.06	*0.03-0.11	*<0.01
Written exam	1.01	0.96-1.05	0.83	1.01	0.96-1.06	0.62
Confidence						
Low (1-3) (base)	1.00			1.00		
High (4-5)*	*3.10	*2.14-4.50	*<0.01	*3.68	*2.26-6.01	*<0.01

ECG, electrocardiogram; *STEMI*, ST-elevation myocardial infarction; *OR*, odds ratio; *CI*, confidence interval.
*p<0.05.

DISCUSSION

The Institute of Medicine's landmark 1999 report, *To Err Is Human,* highlighted interruptions as a modifiable source of preventable medical errors.[6] Recommendations have since focused on removing interruptions from clinical workflow.[22,23] However, EPs practice in an environment where interruptions may impart critical information, such as an ECG revealing a STEMI in a triage patient with chest pain. Because we cannot simply remove interruptions from the ED, we must identify and understand modifiable variables that increase the incidence of clinical errors when interrupted.

The aim of the current study was to create a commonly experienced, interrupted-workflow simulation to explore the impact of task switching on accuracy interpreting screening ECGs for STEMI, as well as the variables that influence the likelihood of error. Our study was unique in that it created a scenario that many EPs experience – listening to a medical student's patient presentation while being interrupted with a clinical task. Further, rather than disregarding the interruption, our study focused on correct interpretation of the clinical interrupting task, a factor uniquely applicable to the EP.

Contrary to our hypothesis, task switching was not associated with accuracy of ECG interpretation for STEMI. There are many reasons why our study may have found no significant difference in accuracy of ECG interpretation for STEMI. First, it is possible that our task-switching simulation was not challenging enough to cause error compared to an uninterrupted simulation. Factors intrinsic to the simulation

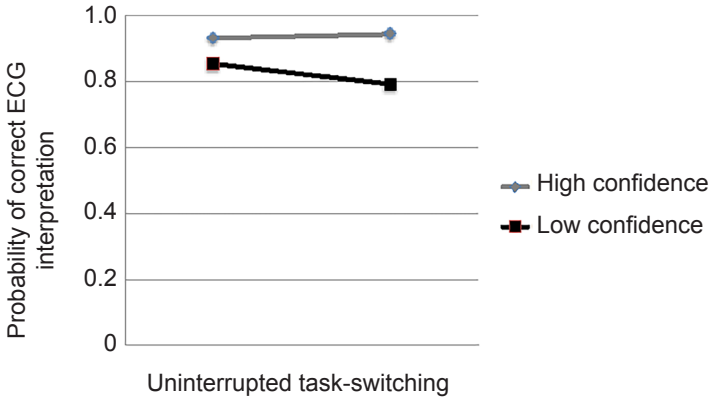

Figure 2. Interaction effect of confidence and scenario on the estimated probability of correct electrocardiogram (ECG) interpretation for ST-elevation myocardial infarction. Low confidence (black) refers to Likert scores of 1-3, whereas high confidence (gray) refers to Likert scores of 4-5. The p value for the interaction was 0.02.

such as ECG difficulty and time allotted to complete interpretation may have produced less strain on working memory, allowing physicians to switch between tasks without significant differences in measured accuracy.

Yet overall accuracy on ECG interpretation for STEMI was only moderate, with physicians incorrectly identifying between 2-5 of 26 total ECGs. Further, consistent with prior literature we found that physician experience, location of STEMI, and self-reported confidence in ECG interpretation were each associated with improved accuracy, suggesting our ECGs were of comparable difficulty to previous studies.[24-30] Finally, most participants appeared to experience time pressure to complete tasks, as many used all 15 seconds to interpret interrupting stimuli, with some continuing to interpret as the video patient presentations resumed, although this was not formally measured. [31]

A theory-based explanation is that task switching has a variable association with errors, changing depending on the mental cost experienced, which is dependent on factors intrinsic to the individual physician and the environment. Previous research suggests that different types of interruptions have different error rates. Interruptions that take more time, use similar cognitive resources, and occur in the middle of the primary task often lead to worse performance.[32-34] Further, physician experience and task difficulty appear to attenuate the mental costs associated with task switching.[35] Our interrupted-workflow simulation involved EPs evaluating short, clinically relevant, visually based clinical tasks in the setting of visual and auditory patient presentations. It is possible that EPs' experience and training, both in ECG interpretation and with task switching, resulted in minimal mental costs when engaged in a frequently encountered scenario – screening ECG interpretation for STEMI – leading to no significant differences in accuracy.

This theory is supported by the interaction of simulation with confidence. ECGs that participants reported higher confidence in interpretating demonstrated similar mean accuracies across simulations. Put another way, when interpreting self-reported "easier" ECGs, trained EPs may have experienced minimal mental costs with task switching, resulting in no significant differences. However, for ECG interpretation self-identified as more difficult to interpret, error rates in the task-switching simulation were significantly increased, suggesting increased mental cost for more difficult tasks that may predispose to increased clinical errors when interrupted.

Future Directions

Our results suggest opportunities for improvement in interpreting screening ECGs for STEMI in a task-switching environment through education in STEMI identification as well as in self-awareness of more difficult-to-complete interrupting tasks. With regard to ECG identification, physicians were significantly less likely to correctly identify inferior and posterior STEMI ECGs in both simulations. Previous literature had demonstrated multiple, subtle STEMI patterns that EPs have higher odds of misclassifying, including posterior STEMI.[36] Focused training and education on identification of more difficult-to-interpret STEMI ECG patterns may help avoid future errors when physicians are interrupted.

Additionally, although physicians may be poor at global self-assessment,[37] they may be able to correctly interpret their odds of successful performance on specific clinical tasks. Using complex patient presentations, Friedman et al.[38] found modest but significant associations of correct diagnoses and level of confidence in students, residents, and attending physicians. Similarly, Eva et al.[39] demonstrated that psychology students were able to discern trivia questions they were more likely to answer incorrectly, with the study concluding that self-assessment on specific items may be more accurate than global assessments. The ability to apply metacognition and self-assessment in the interruption-driven work environment may have particular relevance to reducing cognitive errors. [40] Future research should focus on evaluating EPs' ability to self-identify difficult tasks that could increase error in an interrupted environment.

LIMITATIONS

Our study has many limitations. Most importantly, our results are from a controlled simulation study and should not be over-generalized. Due to standardization and patient safety concerns, prospective simulations could not be performed during actual clinical practice. While we attempted to create an accurate representation of an interrupted, time-pressured ED scenario, many factors cannot be replicated in a simulation. Therefore, our results should be viewed as exploratory and used to highlight factors that can be modified to improve accuracy when interpreting clinical interruptions in the ED.

Additionally, participants were not randomized to the order of the simulation, which may have introduced bias. We chose to standardize simulation order to avoid any effect of task priming, in which participants would have completed multiple ECGs in the uninterrupted simulation immediately prior to the task switching simulation, thus artificially improving their performance. Additionally, because analysis of the primary outcome required that we have a higher proportion of ECGs with STEMI in the simulation, we were concerned that the participants who were randomized to the uninterrupted simulation first would notice the high proportion of STEMI ECGs and subsequently devote unequal attention to the task-switching ECGs, invalidating results. Given that the uninterrupted simulation was completed without task switching or time restraint, we felt that knowledge of the outcome during the uninterrupted simulation would have less of an impact on study validity.

CONCLUSION

In our simulation, task switching was not associated with accuracy of ECG interpretation for STEMI. However, odds of correct interpretation decreased with inferior STEMI ECGs and when participants self-reported low confidence when interrupted. Our study highlights opportunities to improve through focused ECG training as well as self-identification of "high-risk" screening ECGs prone to error during interrupted clinical workflow.

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Conflicts of Interest: By the *West*JEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. The project described was supported by the National Center for Advancing Translational Sciences, National Institutes of Health, Award Numbers UL1TR000073 and UL1TR001064. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Dr. William Soares is supported by a NIH 1K08DA045933-01 grant.

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