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# **Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health**

### **Title**

CDEM/CORD Special Education Issue 23.1

### **Permalink**

<https://escholarship.org/uc/item/3gp1658n>

### **Journal**

Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health, 23(1)

### **ISSN**

1936-900X

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### **Publication Date**

2022

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Peer reviewed



Volume 23, Number 1, January 2022

Open Access at [www.westjem.com](http://www.westjem.com)

ISSN 1936-900X

# *Western Journal of Emergency Medicine:* Integrating Emergency Care with Population Health Indexed in MEDLINE



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Emergency medicine is a specialty which closely reflects societal challenges and consequences of public policy decisions. The emergency department specifically deals with social injustice, health and economic disparities, violence, substance abuse, and disaster preparedness and response. This journal focuses on how emergency care affects the health of the community and population, and conversely, how these societal challenges affect the composition of the patient population who seek care in the emergency department. The development of better systems to provide emergency care, including technology solutions, is critical to enhancing population health.

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The *WestJEM* Special Issue in Educational Research & Practice 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.

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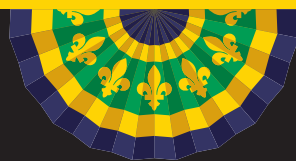
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## Metrics of Resident Achievement for Defining Program Aims

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Section Editor: Jeffrey Love, MD and Sara Krzyzaniak, MD

Submission history: Submitted June 7, 2021; Revision received December 8, 2021; Accepted December 6, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.12.53554

**Introduction:** Resident achievement data is a powerful but underutilized means of program evaluation, allowing programs to empirically measure whether they are meeting their program aims, facilitate refinement of curricula and improve resident recruitment efforts. The goal was to provide an overview of available metrics of resident achievement and how these metrics can be used to inform program aims.

**Methods:** A literature search was performed using PubMed and Google Scholar between May and November of 2020. Publications were eligible for inclusion if they discussed or assessed “excellence” or “success” during residency training. A narrative review structure was chosen due to the intention to provide an examination of the literature on available resident achievement metrics.

**Results:** 57 publications met inclusion criteria and were included in the review. Metrics of excellence were grouped into larger categories, including success defined by program factors, academics, national competencies, employer factors, and possible new metrics.

**Conclusions:** Programs can best evaluate whether they are meeting their program aims by creating a list of important resident-level metrics based on their stated goals and values using one or more of the published definitions as a foundation. Each program must define which metrics align best with their individual program aims and mission. [West J Emerg Med. 2022;23(1)1–8.]

### INTRODUCTION

Every residency program desires to offer truly excellent training to their learners. However, excellence represents different things to different physicians, institutions, communities, and patients.

The Accreditation Council of Graduate Medical Education (ACGME) requires programs to develop aims that are reflections of the program’s mission statement as part of their Self-Study.<sup>1</sup> When creating these aims, programs may benefit from “beginning with the end in mind” and considering the desired outcomes for their graduates. The identification of measurable and achievable aims targeted to an individual

residency program’s unique context represents an important means of effective program evaluation and accountability. Clearly defining trainee-level aims also allows for effective program evaluation and evaluation of resident selection processes.<sup>2,3</sup> The goal of this review is to discuss available metrics for programs to use in the creation of program aims to fit its mission.

### METHODS

#### Author Group

The author group is made up of practicing U.S. emergency medicine physicians from multiple academic

institutions and includes four members of the residency leadership team and two Medical Education Fellows.

## Design

A narrative design was chosen in order to examine the literature regarding possible metrics of assessing resident achievement. The scope of the review was designed to focus on actionable ideas for programs.

## Data Sources and Study Selection

Individual searches were conducted by the authors using the Google Scholar and PubMed databases for relevant keywords, including “achievement,” “success,” “resident,” “physician,” “training,” and “graduate medical education”. From the list of articles generated, a list of 17 potential metrics was generated through virtual discussion between experienced scholars using the telecommunications software Zoom (Zoom Telecommunications, Inc., San Jose) (Table 1). Other

**Table 1.** Metrics of resident success.

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Assessments:
ACGME Milestones
Faculty assessment
Peer assessment
Self assessment
Academics:
Fellowship training
Academic leadership
Scholarship and Research Examination
Performance remediation
Clinical:
Clinical performance metrics
Patient satisfaction
Procedural competence
Adaptability
Social:
Community service
Empathy
Social justice/advocacy
Wellness

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*ACGME*, Accreditation Council for Graduate Medical Education.

metrics of resident achievement that were less amenable to being used to create actionable program-level aims, such as being selected as chief resident, were ultimately excluded as they did not align with the purpose of this review. The 17 included metrics were used as keywords for further searches specific to each metric. Searches included articles outside the EM literature to inform program leaders of potentially underutilized metrics within the specialty. Publications were eligible for inclusion if they attempted to provide commentary on the assessment of resident performance, directly assessed resident performance, or could be potentially modified to assess resident performance during residency training using

one or more of the 17 metrics. Targeted searches in the Google search engine (Mountain View, CA) using these keywords as well as review of the references section of other included manuscripts also revealed additional articles that met the inclusion criteria.

## RESULTS

Our literature search revealed 57 unique papers that met inclusion criteria for the review.

### Assessments

#### *ACGME Milestones/EPAs*

The ACGME outlines Milestones that provide a framework for assessing resident performance.<sup>4</sup> These Milestones, along with the ACGME competencies, typically refer to abilities of the trainee. Many specialties have also created a set of Entrustable Professional Activities (EPAs) that can be used to determine the appropriate level of supervision by faculty.<sup>5</sup> Resident achievement of certain Milestone levels (e.g., Level 4) could be used to ensure that a program is meeting its goals. Programs must consider what level is most appropriate to use as their standard (as achievement of particular Milestone levels is not an ACGME graduation requirement), as well as how the Milestones are assigned to ensure accuracy. Alternatively, they could determine individual Milestones they consider to be of the greatest importance and define levels for these individual areas alone.

#### *Faculty Assessments*

The use of faculty assessment data has been demonstrated previously to predict future success in residency.<sup>6</sup> Programs could determine a certain percentage of residents achieving high aggregate numerical scores on faculty clinical assessments to be an aim suggestive of excellent clinical acumen. This approach has several advantages, including that residents are evaluated on skills that map closely to independent practice, such as creating treatment plans and working in interdisciplinary teams. However, faculty assessments can be vulnerable to bias,<sup>7,8</sup> and faculty may not be entirely reliable evaluators of clinical performance.<sup>9</sup> Further, skills such as independent learning and timely completion of administrative tasks are not well-assessed by this model, since faculty have few opportunities to observe and assess these skills. Programs could also ask for faculty gestalt of resident performance instead of using aggregate clinical assessments.<sup>6,10-15</sup> While these assessments encompass all aspects of trainee performance, gestalt is ill-defined in terms of what exactly is being evaluated and concerns remain about bias.

#### *Peer Assessment*

Peer assessments can be another source of important feedback on resident performance. Faculty members were shown in one study to score residents higher than their peers in several sub-competency categories,<sup>16</sup> including interactions that occur mainly with peers, such as transitions of care, teamwork, and communication. Creating an environment



where residents are highly regarded by their peers could be an important metric to consider if a program wishes to emphasize strong personal connections between residents, professionalism, and interprofessional communication.

#### *Self-Assessment*

While resident self-assessment data can be useful for program evaluation, historically, learners have difficulty determining the areas in which they are deficient.<sup>17</sup> However, the use of anchoring data or a framework, such as the ACGME Core Competencies and Milestones for feedback, may improve the accuracy of this self-assessment and therefore make it more useful to measure for determining success at the program level.<sup>4,18-20</sup>

A portfolio assembled by the resident, highlighting key examples where the resident believes they have demonstrated strength as well as weaknesses that they are working on could be used by programs in conjunction with other more traditional forms of assessment, with faculty assessing the resident's portfolio.<sup>21</sup> This may engage resident learners to reflect more extensively on their performance more than a simple self-assessment, and could be timed to align with other key interactions, such as in preparation for semi-annual or summative assessments.

### **Academics**

#### *Fellowship Training*

Fellowship training results in the attainment of specialized knowledge and skills beyond those of graduates pursuing general practice. The number of residents deciding to pursue fellowship could be a benchmark of success for programs, particularly those affiliated with academic institutions where training future leaders in the specialty is valued. This has been used previously as a means of evaluating general surgery programs.<sup>22</sup>

#### *Academic/Administrative Leadership*

The number of residents serving in leadership roles within residency programs, medical schools, or healthcare administration near the beginning of their post-residency career could represent an important focus for program evaluation.<sup>22</sup> These positions represent the opportunity to create systems-level change and affect the care or education of a large number of patients or learners. However, this may be difficult to measure as these positions may not be attainable for most until several years into the postgraduate period.

#### *Scholarship and Research*

Residency programs have considered the number and/or quality of scholarly works produced over the course of training as a marker of excellence given that this represents one of academia's most widely accepted currencies.<sup>23</sup> Participation in research may be useful for programs attempting to boost their profile nationally or develop a more robust infrastructure for scholarship within their own department. Studies outside EM

have shown that residents who participate in research during training are more likely to hold future academic positions in their field of interest than those who do not engage in research, which may be useful to programs trying to augment their profile nationally.<sup>24,25</sup> Programs interested in this type of aim may wish to emphasize the quantity of publications, for example, or other aspects of scholarship such as presentations at regional or national conferences.

#### *Examination Performance*

Objective measures, such as the in-training exam (ITE) or USMLE Step 3, have been shown to correlate well with future passage of specialty board exams.<sup>26-29</sup> However, current standardized assessments have not been shown to correlate with important markers of clinical performance, such as care provided to patients, professionalism and interpersonal communication skills.<sup>22,30</sup> Board certification is expected by the American Board of Medical Specialties (ABMS) and is highly regarded by institutions and the general population. Passing the initial certifying exam is an important measure of excellence for continued accreditation of training programs, and a data point tracked by the ACGME.<sup>29</sup> This may be most useful for programs whose residents are struggling academically or with first-time boards pass rate, who could use a score threshold as a metric for defining excellence.

#### *Remediation*

The need for remediation implies a deficiency in one or more ACGME core competencies, most commonly medical knowledge, patient care, and professionalism.<sup>31</sup> Low or non-existent need for remediation therefore represents a potentially attractive aim to define program success. However, considering the need for remediation as a failure of the program may misinterpret residents who remediate without issue, or residents who start behind their peers but make extraordinary progress due to the appropriation of program resources as a failure rather than a success. The decision to undergo remediation is also often at the discretion of program leadership, and informal remediation typically does not involve the creation of a permanent record. Rate of remediation in EM has been measured at 4.4%, but this varies widely between specialties (<2% to >10%), suggesting this may be an unreliable metric.<sup>31-34</sup> Tracking remediation rates could be potentially attractive to a program that has had multiple residents undergo remediation in a given year.

### **Clinical**

#### *Performance Metrics*

While clinical performance metrics hold promise as an objective measure of excellence for a residency program, it can be challenging to generate meaningful performance metrics for resident physicians that are free from significant confounders. Markers of efficient care delivery (e.g., patients per hour or number of relative value units (RVUs) generated), as well as

measures of care quality (e.g., number of Emergency Department (ED) rapid return visits (i.e., “bouncebacks”) or ICU upgrades, are attractive metrics that could be defined by each program or institution. Higher resident case volumes correlated with better performance in diagnostic radiology,<sup>35</sup> but no similar study exists in EM. One study showed that resident sensitive quality measures, such as the correct ordering of medications in asthma care, can be used successfully as a part of resident assessment.<sup>36</sup> On the other hand, the clinical performance of resident physicians across a program is often affected by factors outside of their control, such as variance in patient acuity or their attending physicians, and may point to a need for administrative improvements or faculty development rather than any particular excellence or failure on the part of the residency program.<sup>37</sup>

#### *Patient Satisfaction*

Resident patient satisfaction scores may be another useful tool by which to benchmark program excellence. While this metric is similar to what attending physicians are measured on, it is controversial whether patient satisfaction scores are appropriate markers for quality of care received and physician performance,<sup>38-40</sup> and it may be difficult to separate scores about the residents from perceptions of their attendings.<sup>37</sup> Despite these significant limitations, training programs have begun to experiment with collecting data on resident-specific patient satisfaction scores and these could be used as one metric for defining excellence for a program.<sup>37</sup>

#### *Procedural Competence*

The successful completion of the procedures without complications is necessary for independent physician practice and is patient-centered, making this a potentially attractive target as a program aim. This is often measured by the absolute number of procedures completed through a portfolio or logbook,<sup>41</sup> though the manner in which performance is assessed is variable, from direct observation gestalt to mastery learning checklists. There is some evidence, however, that the number of cases logged does not by itself demonstrate procedural competence in surgical residents, casting some doubt on its appropriateness as a program level metric.<sup>42</sup>

#### *Adaptability*

A more recent potential measure of residency program success is adaptability. With change accelerated by the COVID-19 pandemic, adaptability in an ever-changing clinical environment has become a focus, as new facets of care, such as virtual healthcare visits, are being implemented rapidly.<sup>43,44</sup> A Master Adaptive Learner model has been proposed, suggesting that residents who develop the metacognitive skills to self-assess, self-regulate and implement new knowledge and experience may be deemed the most successful.<sup>45</sup> While no data currently exists on residency programs using these skills as a measure of success, programs have been shown to play a critical role in creating a learning

environment that is supportive of adaptive learning and assesses these skills.<sup>46</sup>

### **Social**

#### *Community Service*

The number of graduates choosing to practice in a local community may be critically important for certain residency programs. Success in this regard could encompass not only practicing medicine in these communities, but also serving in other ways, such as health literacy training.<sup>47</sup> Increasing the interest of residents in serving these communities has been the subject of targeted interventions.<sup>48</sup> Establishing programmatic goals and benchmarks for community service in emergency medicine may be an important way to prioritize this metric for certain programs, such as those that have poor retention of physicians in their community post-graduation.

#### *Empathy*

While interpersonal skills, communication, and professionalism are measured by the Core Competencies and Milestones, empathy has not previously been a target of significant performance assessment. Empathy has been rated as critically important to successful physicians and has been demonstrated to increase patient satisfaction and improve treatment outcomes.<sup>49</sup> Targeted interventions at cultivating empathy have been shown to increase this quality in residents.<sup>50</sup> Different instruments for measuring empathy in trainees exist and assess qualities related to empathy such as cognitive empathy (i.e. ability to recognize and understand another’s experience) and affective empathy (i.e. ability to form a bond with patients).<sup>49-51</sup> Empathy has also been shown to decline during medical training.<sup>52</sup> Therefore, the maintenance or improvement of empathy in residency as measured by these instruments despite the emotional intensity of graduate medical training could be a target for program evaluation.

#### *Social Justice/Advocacy*

With multiple public health crises ongoing in the U.S., such as racism, COVID-19 and gun violence, some residency training programs may consider advocacy work to be an important measure of success in their graduates. While well-studied metrics to measure the impact of these programs are currently lacking, curricula for residents have been introduced successfully into training programs.<sup>53,54</sup> In order for EM programs to prioritize these initiatives in social justice and advocacy, potential aims could look at the number of residents involved with advocacy work, the number of successful projects introduced by trainees, or impact on the surrounding community.

#### *Well-being*

Well-being is an important component of success as a physician, as physician burnout has been associated with increased medical errors and decreased adherence to best practices.<sup>55</sup> Programs can impact the culture of wellness

among their trainees, making this an appropriate metric to consider when defining program aims. Many residency programs have implemented comprehensive curricula aimed at teaching career-long skills for maintaining well-being, as well as monitoring resident well-being throughout training.<sup>56,57</sup> Reducing physician work hours and implementing a resident wellbeing program have been successful in reducing factors that negatively impact well-being such as emotional exhaustion.<sup>58,59</sup> Continued measurement of wellness on a programmatic level will be important for developing wellness as a metric for residency success and could be particularly useful for programs who have undergone recent crises.

**DISCUSSION**

Given the wide array of potential metrics for residency programs to define excellence, each program should thoughtfully determine which metrics are most meaningful in their environment and for the trainees that they want to produce.

Key departmental stakeholders should be included in the selection of appropriate metrics for program aims. Defining new metrics will often cause a change in how resources are deployed, so buy-in from the department chair, as well as the residents that will be directly affected by any changes, will be especially

crucial. Benchmark performance levels should be set based on historical performance in the chosen area; if a residency program has never sent a graduate to fellowship, it may be unrealistic to achieve a goal of 80% of graduates choosing this option in the next few years. As the program grows and changes, the excellence metrics may need to evolve also. A program with an interest in developing a track record of resident scholarly publications for example, may want to turn its attention to academic leadership positions after several years of success.

Programs may also wish to carefully consider how their definition of excellence is used during the selection of residents to ensure they are meeting their goals while also seeking out residents who can push the program in new directions.<sup>60</sup> While programs may impact the likelihood that a resident pursues scholarship or advocacy, selecting students who already have a track record of success in these areas may mean they are likely to continue to excel in this area during residency. Table 2 shows how four example residencies might use the definitions described in this manuscript to define measurable aims for themselves, using vastly different metrics depending on their local goals. It is also important to note that developed program aims can, and should, evolve over time to meet the current needs of the program and its graduates. For example, a program previously focusing

**Table 2.** Examples of incorporating metrics of resident achievement into the creation of program aims.

	Aim	Metrics	Explanation
Residency A	Train physicians with expertise in population health and an interest in serving the medically underserved.	<ol style="list-style-type: none"> <li>70% of residents complete an advocacy project during residency.</li> <li>50% residents continue to practice in a medically underserved area.</li> <li>100% of residents are rated by faculty as “good” or “excellent” clinicians on end of 3rd year evaluations.</li> </ol>	Residency A is committed to providing high quality care while also demonstrating a deep commitment to its social mission. By choosing metrics which reflect both, the program holds itself accountable to ensuring that neither mission is neglected.
Residency B	Train leaders in academic EM and increase the national profile of the residency program.	<ol style="list-style-type: none"> <li>At least 20% of residents publish a peer reviewed manuscript during residency.</li> <li>10% of residents achieve an academic leadership position within 3 years of graduation.</li> <li>40% of residents choose to pursue fellowship training after graduation.</li> </ol>	Residency B is focused on scholarly productivity and leadership development to highlight the achievements of their residents as part of a plan to develop a national reputation for their program.
Residency C	Successfully maintain accreditation.	<ol style="list-style-type: none"> <li>100% of residents placed in remediation successfully complete their remediation plan.</li> <li>100% of residents score in the top 50% on the In Training Exam.</li> <li>100% of residents achieve at least a Level 3 across all EM Milestones.</li> </ol>	Residency C has recently been placed on Warning status by the ACGME, so excellence in their context involves successfully preparing all residents for independent practice without incurring additional citations.
Residency D	Create a mutually supportive culture of resident wellness.	<ol style="list-style-type: none"> <li>0% of residents report high levels of burnout as measured by the Maslach Burnout Inventory.</li> <li>90% of residents are rated highly on teamwork by peers.</li> <li>80% of residents assess themselves as “good” or “excellent” clinicians.</li> </ol>	Residency D is interested in ensuring residents have a safe and healthy learning environment in which to grow and have prioritized metrics that focus on wellness as well as self and peer perception.

on metrics associated with resident scholarship may require shifting focus to the creation of aims surrounding metrics of resident wellness in response to the COVID-19 pandemic and the emotional burden it placed on trainees.

## LIMITATIONS

This review does have limitations, many of which are inherent to the narrative design of the review. First, some relevant studies may have been missed. Given the broad range of metrics included and the lack of standardized terminology, it is difficult to ensure that all the related literature was assessed for inclusion. However, this was not designed to be an exhaustive search from its conception. Second, it is possible that there was bias in the inclusion or exclusion of certain studies given the non-systematic nature of the review. We attempted to ensure quality studies were included based on assessment by the authors who are experienced medical educators. Finally, more rigorous consensus methodology could have been employed to enhance the content validity of the review rather than the more informal discussion between the author group.

Further work will also be required to determine if the introduction of novel metrics, such as wellness or empathy scores, can be effectively used to improve outcomes via program evaluation. Additionally, future work could focus on the long-term impact of program-level metrics; for example, do physicians who initially start in an underserved community stay there, or are patient satisfaction gains sustained even after the program begins to focus in other areas.

## CONCLUSIONS

There are a variety of possible resident-level metrics which can be used for program evaluation, many of which target different aspects of performance beyond clinical skills. Each program should assess the available metrics and decide collectively on those that they consider most aligned with their program's mission statement, aims and individual and institutional goals and use those to create measurable targets for program evaluation.

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*Conflicts of Interest:* By the WestJEM 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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# A Virtual Escape Room versus Lecture on Infectious Disease Content: Effect on Resident Knowledge and Motivation

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Section Editor: Jeffrey Love, MD and Sara Krzyzaniak, MD

Submission history: Submitted July 1, 2021; Revision received December 7, 2021; Accepted December 9, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.12.54010

**Introduction:** Medical educators are constantly seeking methods to increase engagement in the era of coronavirus disease 2019 (COVID-19) where virtual and blended learning formats are increasingly common. Educational escape rooms have previously been used to motivate learners, enhance communication skills, and cultivate teamwork. However, it is not known whether escape rooms increase learner knowledge as compared to a lecture format.

**Methods:** This quasi-experimental study included 30 emergency medicine residents at two programs who participated in both a virtual escape room and a lecture on infectious disease content. Learners completed a pre- and post-quiz and a tool to gauge resident motivation for each activity (the Intrinsic Motivation Inventory [IMI]). The primary objective was to determine a change in knowledge as a result of the activities, and a secondary objective was to determine resident motivation for each format.

**Results:** At both programs learners demonstrated a significant improvement in their pre- vs. post-quiz scores for the escape rooms (University of California Irvine [UCI]: 77.8% to 88.9%,  $p = 0.028$ , Prisma: 73.81% to 89.68%,  $p = 0.002$ ), whereas the lectures did not impact a statistical improvement (UCI: 73.8% to 78.6%,  $p = 0.460$ , Prisma: 85.71% to 91.27%,  $p = 0.236$ ). Learners at UCI noted equivalent results on the IMI for both formats, while residents at Prisma noted they were more motivated by the escape room.

**Conclusion:** Emergency medicine residents at two programs participating in a virtual escape room demonstrated a statistical increase in knowledge on infectious disease content as compared to a lecture format and reported positive motivation ratings for both formats, with one program preferring the escape room. [West J Emerg Med. 2022;23(1)9–14.]

## INTRODUCTION

Medical educators are constantly seeking methods to increase learner engagement, particularly in the era of coronavirus disease 2019 (COVID-19) where blended and virtual learning formats are increasingly common. One innovative modality of teaching used by educators is escape rooms. As described by Nicholson,<sup>1</sup> escape rooms are defined as “live-action team-based games where

players discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal (usually escaping from the room) in a limited amount of time”. Over the past five years, escape rooms have been implemented in medical education for various purposes, including recruitment to nursing programs,<sup>2</sup> promoting active learning and engagement,<sup>3,4,5</sup> developing teamwork and communication skills,<sup>6</sup> teaching specific

skills or knowledge,<sup>7,8,9</sup> and fostering interprofessional development.<sup>10,11,12</sup> In a systematic review by Veldkamp et al.,<sup>13</sup> the vast majority of studies reported the escape room created an active learning environment with engaged learners and were highly rated by participants. Virtual escape rooms are adaptations of in-person escape rooms where the content is delivered synchronously online using tools such as Zoom (Zoom Video Communications, San Jose, CA) breakout rooms and Google Forms (Google, LLC, Mountain View, CA) to allow learners to solve a series of puzzles.

Few experimental studies have shown an increase in knowledge in a pre- vs post-test fashion,<sup>5,14,15</sup> and others have demonstrated either no change<sup>16</sup> or a decline in pre- to post-test scores.<sup>17</sup> None of the studies had a control group. There are also no known studies to date comparing lecture formats to escape rooms. Didactic lectures remain the primary means of disseminating information to learners, with many educators using synchronous tools such as Zoom to deliver content due to the COVID-19 pandemic.<sup>18</sup> Recent research has indicated that residents may be less engaged and distracted by non-conference activities during synchronous virtual didactic learning.<sup>19</sup>

Escape rooms have a theoretical basis to motivate learners as described by self-determination theory. The theory states that motivation comprises three psychological needs: competence; autonomy; and social relatedness. As stated by Guckian et al,<sup>20</sup> “a good escape room...sets achievable goals for participants (competence), facilitates freedom of choice for learners (autonomy) and features effective teamwork and facilitation (relatedness).” Self-determination theory (Figure 1) describes a continuum of motivation from a complete lack of motivation to extrinsic motivation (the provision of external rewards such as a prize or penalty) to the ultimate goal, which is intrinsic motivation or internal interest, enjoyment, and satisfaction from completion of the activity.<sup>21</sup> Ideally, an escape room will fulfill learners’ needs as described by self-motivation theory.

As learning environments transform, innovative modalities of teaching that motivate learners must be urgently explored and researched in an experimental fashion. Therefore, in this study we sought to understand whether a virtual escape room on infectious disease topics would increase learner knowledge as compared to a didactic lecture, as assessed by a pre- and post-quiz. A secondary objective was to assess learners’ self-rated interest and enjoyment with the activities as determined by the Intrinsic Motivation Inventory (IMI) held after the escape room.

### Population Health Research Capsule

What do we already know about this issue?  
*Educational escape rooms have previously been shown to motivate learners, however it is not known if they positively impact knowledge compared to a lecture format.*

What was the research question?  
*Does a virtual escape room on infectious disease topics increase knowledge compared to a lecture format?*

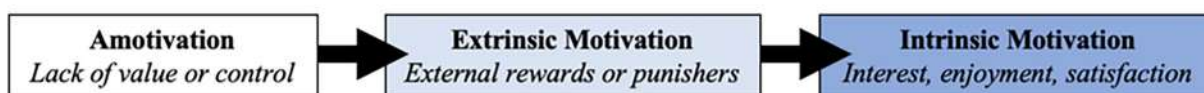
What was the major finding of the study?  
*Learners improved their pre vs. post-quiz scores on escape room content, but not the lecture content.*

How does this improve population health?  
*A virtual educational escape room may be a unique method to engage learners in an online synchronous format without sacrificing knowledge acquisition.*

## METHODS

We surveyed 30 emergency medicine (EM) resident learners at two different postgraduate year (PGY) 1-3 EM programs, the University of California-Irvine (UCI) in Orange, California, and Prisma Health-Upstate in Greenville, South Carolina, in March 2021. Residents at both programs were selected by convenience sample as attendees at a weekly didactic conference during their infectious disease block in March–April 2021. Study participation was voluntary. This study was determined to be exempt after review by the Prisma Health-Upstate Institutional Review Board.

Prior to study implementation, three faculty with fellowships in medical education developed six learning objectives related to infectious disease topics guided by the Model of the Clinical Practice of Emergency Medicine Practice<sup>22</sup> as the basis for the lectures and escape rooms. These objectives were divided into objectives 1-3 (opportunistic infections, vector-borne illnesses, and sexually transmitted infections) and objectives 4-6 (infectious rashes, foodborne illnesses, and infectious causes of neuromuscular blockade).



**Figure 1.** Self-determination theory continuum model.

We crosschecked to ensure that the objectives were maintained at the same level on Bloom's taxonomy ("remember" and "understand"). We then created and reviewed multiple-choice questions relevant to the objectives comprising the pre- and post-quizzes. The entire activity took approximately 30 hours to create, and there was no associated cost.

On the study dates, participating residents completed a survey that included basic demographics, including their PGY year, identified gender, identified generation based on birth year, and previous experience with educational escape rooms. Then they completed a nine-item, multiple-choice pre-quiz relevant to objectives 1-3. After the pre-quiz, residents from UCI participated in the escape room format, whereas residents from Prisma received the same content in a lecture format. During the second half of the session, both programs completed another nine-item, multiple-choice pre-quiz, this time covering objectives 4-6. Residents from UCI this time received the lecture format, whereas residents from Prisma instead participated in an escape room activity (Figure 2). Directly after completion of all activities, learners were given the same quiz content as the pre-quizzes presented as an 18-question, multiple-choice post-quiz that covered all objectives 1-6. They also completed items from the IMI, a validated tool containing an interest/enjoyment subscale that is considered effective to assess learners' self-reported intrinsic motivation based on self-determination theory and has been found to be adaptable to multiple research settings.<sup>23,24</sup> (See Appendix B.)

The entire session lasted 90 minutes total, including 25 minutes for each activity followed by 5-10 minutes for debrief and questions. All content was delivered virtually via Zoom. The lecture format was delivered using Google Slides. To maintain the highest quality of lecture we used best practices in multimedia design based on Mayer's principles of multimedia learning,<sup>25</sup> including limiting the amount of text on slides and using non-distracting and enhancing graphics, as well as using color and bolding to

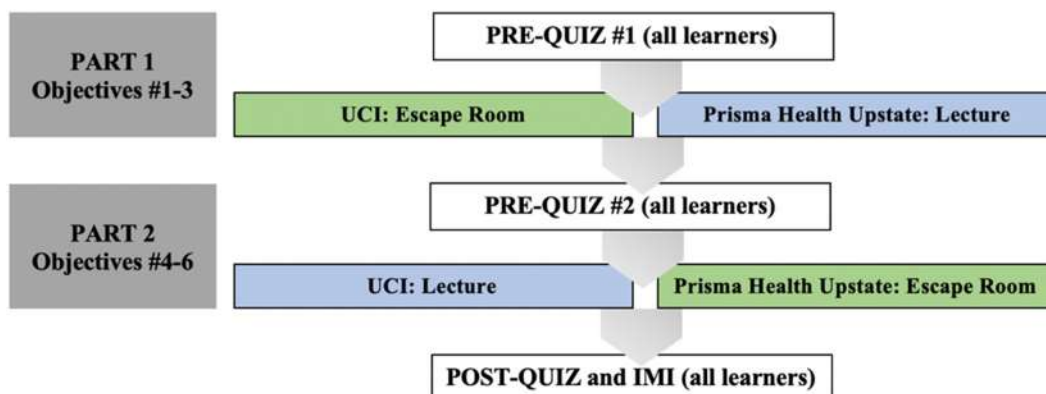
highlight key information. A video detailing the instructions for the escape room, logistics of play, and the game rules was delivered prior to the activity.

The residents were randomly divided into teams of 4-5 participants that included a mix of PGY levels. They were split into breakout rooms and provided with a quick response code linking to a Google Form, which guided them through four escape room puzzles with a 25-minute time limit. They were allowed to use any source for information and up to two hints provided at the study authors' discretion. The first team that completed all the puzzles correctly was recognized as the winner. See Appendix A for puzzle examples. A short debrief was held after the activity to review the escape room answers. Time was recorded by a timekeeper to ensure equal time was provided to the lecture and escape room activity.

Survey data was stored in a secure Research Electronic Data Capture survey tool (REDCap, Vanderbilt University, Nashville, TN). We calculated mean aggregated scores on the pre- and post-quizzes for the escape room and the lectures using the two proportions z-test, as well as IMI results for each program using the paired t-test for normally distributed data and the Wilcoxon signed-rank test paired for non-normally distributed data (where the Shapiro Wilks test was used to determine normality). Data analysis was conducted using the software program R version 4.0.4 (The R Foundation for Statistical Computing, Vienna, Austria).

## RESULTS

A total of 30 EM residents participated in this quasi-experimental study, 14 from UCI and 16 from Prisma. The demographics were similar at both programs, with >90% of the residents self-identifying as being born in the millennial generation (see Table 1). There were more self-identified male than female participants at both programs, with three females and 11 males from UCI, whereas there were five female



**Figure 2.** Research study design.

UCI, University of California, Irvine; IMI, Intrinsic Motivation Inventory

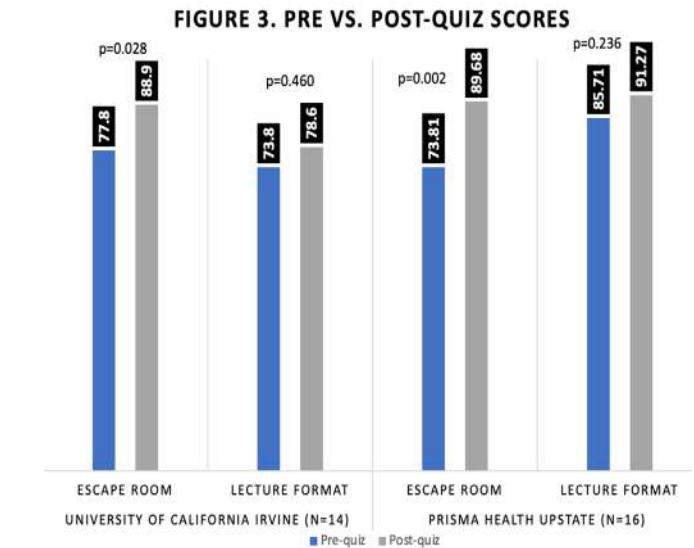
and 11 males from Prisma. There was good representation across all PGY levels at both programs, with all residents being PGY1-PGY3. Most residents had only participated in 1-2 escape rooms for educational purposes in the past, with some residents at UCI having participated in more than five educational escape rooms.

Residents at both programs improved their pre- vs post-quiz scores on the content related to the escape room; however, there was no significant improvement in the pre- vs post-quiz scores pertaining to the lecture activities at either program (see Figure 3).

The IMI interest/enjoyment subscale results are listed in Table 2. Learners at UCI responded to the question “I enjoyed the activity very much” with a median score of 5 for both the escape room and lecture formats ( $p = 0.1434$ ), whereas Prisma reported a significant difference in the median score of 6 for the escape room format vs 3.5 for the lecture format ( $p = 0.0145$ ). Learners at UCI responded to the question “The activity did not hold my attention at all” with a median score of 2 for both the escape and lecture formats ( $p = 0.4606$ ), whereas learners at Prisma reported a significant difference of 0 for the escape room format vs 3 for the lecture format ( $p = 0.0259$ ).

**DISCUSSION**

This study demonstrated a statistically significant increase in knowledge as a result of participation in an escape room at two EM residency programs compared to a lecture format, where there was no statistical increase



**Figure 3.** Comparison of pre- and post-quiz scores for escape room and lecture format by institution.

in knowledge. The IMI results demonstrate that residents enjoyed the escape room and found it interesting at both programs, although the learners at Prisma noted a statistical difference in their enjoyment vs the learners at UCI. While no qualitative data was collected to learn why this distinction existed, residents at UCI reported slightly more experience with educational escape rooms. Also, in our experience UCI includes more educational games as part of its didactics as compared to Prisma. A novelty effect, or a waning

**Table 1.** Participant demographic information: University of California Irvine and Prisma Health-Upstate.

Question	UCI (n=14)	Prisma (n=16)
Generation, n (%)		
Gen X	1 (7.14)	0 (0)
Millennial	13 (92.9)	15 (93.8)
Gen Z	0 (0)	1 (6.3)
Gender, n (%)		
Female	3 (21.4)	5 (31.3)
Male	11 (78.6)	11 (68.8)
PGY Year, n (%)		
PGY1	4 (28.6)	8 (50)
PGY2	5 (35.7)	3 (18.8)
PGY3	5 (35.7)	5 (31.3)
Experience, n (%)		
I have never participated in an escape room for educational purposes	4 (28.6)	4 (25)
I have participated in a few (1-2) escape rooms for educational purposes	5 (35.7)	9 (56.3)
I have participated in multiple (3-4) escape rooms for educational purposes	3 (21.4)	3 (18.8)
I have participated in a lot of (5+) escape rooms for educational purposes	2 (14.3)	0 (0)

Gen X, Generation X (birth years mid-1960s to early 1980s); Gen Z, Generation Z (birth years mid-1990s to early 2010s); PGY, postgraduate year.



**Table 2.** Intrinsic motivation inventory interest/enjoyment subscale results by program.

IMI Item	UCI (n = 14)			Prisma (n = 16)		
	Escape Room	Lecture	p-value	Escape Room	Lecture	p-value
I enjoyed the activity very much. (Mean ± SD)	5.18 ± 1.17	4.44 ± 1.01	0.12	5.50 ± 1.41	4.00 ± 2.13	0.00
Median (IQR)	5 (5, 5.5)	5 (4, 5)	0.14	6 (5, 6.25)	3.5 (2, 6)	0.01
The activity was fun to do. (Mean ± SD)	4.69 ± 1.49	3.50 ± 1.09	0.03	5.44 ± 1.55	3.38 ± 2.29	0.00
Median (IQR)	5 (4, 5)	4 (2.75, 4)	0.02	6 (5, 6.25)	3 (1, 5)	0.01
I would describe the activity as very interesting (Mean ± SD)	4.50 ± 1.78	3.80 ± 1.14	0.28	5.13 ± 1.85	3.58 ± 2.19	0.00
Median (IQR)	4 (3.75, 5.5)	4 (3.25, 4.75)	0.29	6 (4, 6.5)	3.5 (2, 5)	0.01
I thought the activity was quite enjoyable. (Mean ± SD)	4.43 ± 1.83	4.25 ± 0.71	0.87	5.56 ± 1.71	3.31 ± 2.10	0.00
Median (IQR)	5 (3.25, 5)	4 (4, 5)	0.92	6 (5, 7)	3 (2, 5)	0.01
While I was doing the activity, I was thinking about how much I enjoyed it. (Mean ± SD)	3.00 ± 2.04	3.29 ± 1.25	0.84	4.67 ± 1.88	2.23 ± 2.65	0.00
Median (IQR)	3.5 (1, 4)	4 (2, 4)	1.00	5 (4, 5.5)	1 (0, 4)	0.01
I thought the activity was boring. (Mean ± SD)	2.00 ± 1.60	3.15 ± 1.14	0.12	1.06 ± 1.06	3.08 ± 2.43	0.01
Median (IQR)	2 (0.75, 3.25)	3 (2, 4)	0.16	1 (0, 2)	3 (1, 5)	0.02
The activity did not hold my attention at all. (Mean ± SD)	2.00 ± 1.71	2.70 ± 1.64	0.37	0.81 ± 1.22	3.23 ± 2.45	0.02
Median (IQR)	2 (0.75, 3.25)	2 (2, 3)	0.46	0 (0, 1)	3 (1, 5)	0.03

UCI, University of California, Irvine; IMI, Intrinsic Motivation Inventory; SD, standard deviation; IQR, interquartile range.

motivation level, has been described in previous gamification literature and could explain this difference.<sup>26</sup> Despite these results, based on our observations, the use of multimedia and interactive puzzles to solve a challenge did seem to engage the learners at both programs.

## LIMITATIONS

There are many potential limitations of this study. Firstly, it was a limited convenience sample of residents attending their weekly didactic conference at two programs. There may be baseline differences in the participants that were not identified, such as their enjoyment of gamification techniques, an inherent variation in resident baseline knowledge on infectious disease topics due to different curricula at different programs, and varying familiarity with escape rooms, and in particular virtual escape rooms. The pre- and post-quizzes were the same for a given activity; therefore, recall of the questions may have affected the results (although there was still only a significant increase in the escape room groups). Competition and the increased cognitive load of the game itself could have negatively affected some learners.

It is not clear whether learners will retain the knowledge they gained through the escape room as opposed to a lecture format as we did not assess for this. While every attempt was made to ensure consistency across the content delivered, there is a possibility that the content was not presented in a

similar manner, as it was delivered on two different days and the learning objectives were delivered in opposite formats to the program. The faculty did train together prior to the sessions to rehearse the teaching scripts and used similar templates for both the escape room and lecture content despite it covering different objectives. Regarding the IMI results, despite it being a validated tool this was a limited sample size and therefore may not have accurately reflected learners' motivation.

## CONCLUSION

As a result of the COVID-19 pandemic, it has become apparent that educators must be able to adapt to virtual settings to reach their learners. Delivering a virtual escape room may be a feasible way to do this. This study helps establish the utility of using escape rooms to enhance learning as compared to a lecture format. While didactic lectures remain an efficient way for medical educators to disseminate information to learners, virtual escape rooms may be an equally if not a more effective way to provide knowledge to learners while creating a fun, motivating, and interactive environment for learning with minimal to no cost. Future research comparing traditional teaching methods to in-person escape rooms may be helpful, as well as testing long-term retention of knowledge as a result of the activities.

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**Conflicts of Interest:** By the WestJEM 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 Medicine Program Directors' Perspectives on Changes to Step 1 Scoring: Does It Help or Hurt Applicants?

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Section Editor: Douglas Ander, MD

Submission history: Submitted December 9, 2020; Revision received March 2, 2021; Accepted March 25, 2021

Electronically published December 20, 2021

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.3.50897

**Introduction:** The United States Medical Licensing Examination (USMLE) Step 1 score is one of the few standardized metrics used to objectively review applicants for residency. In February 2020 the USMLE program announced that the numerical Step 1 scoring would be changed to a binary (Pass/Fail) system. In this study we sought to characterize how this change in score reporting will impact the application review process for emergency medicine (EM) program directors (PD).

**Methods:** In March 2020 we electronically distributed a validated anonymous survey to EM PDs at 236 US EM residency programs accredited by the Accreditation Council for Graduate Medical Education.

**Results:** Of 236 EM PDs, 121 responded (51.3% response rate). Overall, 72.7% believed binary Step 1 scoring would make the process of objectively comparing applicants more difficult. A minority (19.8%) believed it was a good idea, and 33.1% felt it would improve medical student well-being. The majority (88.4%) reported that they will increase their emphasis on Step 2 Clinical Knowledge (CK) for resident selection, and 85% plan to require Step 2 CK scores at application submission time.

**Conclusion:** Our study suggests most EM PDs disapprove of the new Step 1 scoring. As more objective data is peeled away from the residency application, EM PDs will be left to rely more heavily on the few remaining measures, including Step 2 CK and standardized letters of evaluation. Further changes are needed to promote equity and improve the overall quality of the application process for students and PDs. [West J Emerg Med. 2022;23(1)15–19.]

## INTRODUCTION

The United States Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge (CK) have served as assessments of medical licensure eligibility.<sup>1</sup> Over time, Step 1 has unintentionally guided undergraduate medical education curriculum and become a primary screening tool for objectively selecting applicants for residency interviews in many specialties.<sup>2-4</sup> In an attempt to “reduce the adverse impact of the current overemphasis on USMLE performance in residency screening and selection,” the USMLE program announced in

February 2020 that numerical Step 1 scoring would change to a binary system (Pass/Fail) no sooner than 2022.<sup>1</sup>

Every year US residency program directors (PD) are inundated with numerous applications for few positions.<sup>5-7</sup> Emergency medicine (EM) is ranked as one of the top five specialties to which most US doctor of medicine (MD) and doctor of osteopathic medicine (DO) seniors match. In 2020, 9.5% and 11.4% of all matched US MD and DO seniors matched into EM, respectively.<sup>6</sup> During the 2019-2020 application cycle, 3323 applicants applied for 2665 available

EM postgraduate year-1 positions, and on average each EM PD reviewed 953 applications.<sup>6,7</sup> Most programs receive far more applications than positions available, and program directors are forced to use metrics (eg, USMLE Step 1) to help filter and select applicants, even if those metrics are being used in an unintended manner.<sup>2</sup>

To address some of the shortcomings surrounding the review process, EM residency programs have deliberately implemented additional objective measures to standardize the review process. These measures include a standardized letter of evaluation (SLOE) and the previously piloted standardized video interviews (SVI). Overall, EM PDs have reported that Step 1 and Step 2 CK scores, SLOEs, and EM rotation grades are among the most critical determinants used to select applicants to interview.<sup>5-8</sup> Altering Step 1 scoring could dramatically change the review process for residency programs. In fact, aggregate data from a recent national survey demonstrated resounding frustration from PDs in multiple specialties.<sup>9</sup> This study applies additional scrutiny to the perspectives of EM PDs who, on average, review approximately 1000 applications per cycle.<sup>7</sup>

## METHODS

After institutional review board exemption was granted, we invited PDs from Accreditation Council for Graduate Medical Education (ACGME)-accredited residency programs to participate in an anonymous, validated survey using Research Electronic Data Capture (REDCap, Vanderbilt University, Nashville, TN). The survey instrument underwent pre-pilot testing and was piloted with a group of 27 academic physicians. We assessed internal validity by computation of Cronbach's alpha (0.87). No modifications were made after pilot testing was performed. The 19-item survey was electronically distributed to all PDs of ACGME-accredited residency programs in 30 specialties, including EM. In disseminating the survey to EM PDs we used the email addresses of 236 EM PDs (92.2% of all EM PDs), which we obtained from a publicly available ACGME listing of accredited programs during the academic year 2019-2020. Each unique email represented an EM PD from a separate EM residency program. We sent three subsequent survey requests to non-responders before the analysis was completed in an effort to generate greater participation.

The anonymous REDCap survey consisted of an optional demographic collection segment, a required series of three-point Likert scale questions (ie, disagree, neutral, agree), and an optional free-response comment box at the conclusion of the section. Survey items were designed in such a way that disallowed submission if required data collection fields were absent or incomplete. For this study's purpose, the response rate was determined by the overall number of submitted surveys received (partial or completed) compared to the initial number of survey requests sent. We calculated descriptive statistics using Microsoft Excel (Microsoft Corporation, Redmond, WA).

### *Population Health Research Capsule*

What do we already know about this issue?  
*In 2020, the United States Medicine Licensing Examination changed its Step 1 from a numerical to binary scoring system. Most residency program directors (PD) disapprove of this change.*

What was the research question?  
*Do Emergency Medicine residency PDs approve of the change to Step 1 scoring?*

What was the major finding of the study?  
*Most Emergency Medicine PDs disapprove of the pass/fail Step 1 scoring system. As a result, more PDs will increase their emphasis of Step 2 Clinical Knowledge scores.*

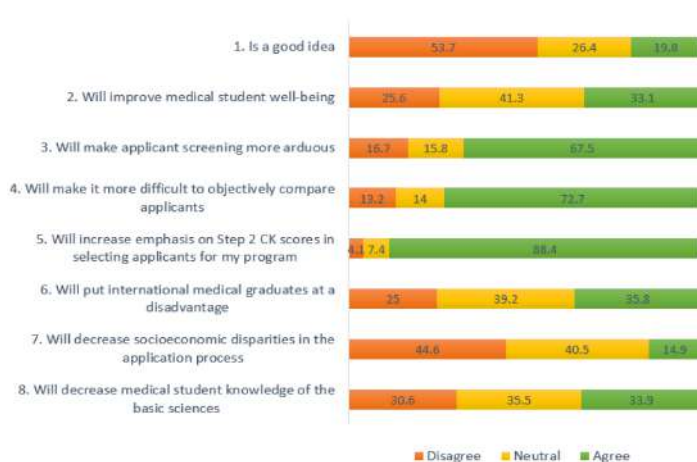
How does this improve population health?  
*More standardized metrics are needed in the residency application process to increase equity.*

## RESULTS

In March 2020, 121 of 236 EM PDs responded to a REDCap survey (51.3% response rate). The majority (67%) of respondents were male, with a mean tenure as PD of  $5.8 \pm 5.4$  years ( $n = 105$ ). Over half (61.9%) of the responding PDs had one to five years of experience while 37.1% had greater than five years of experience. In total 13.3% had held their positions for 10 or more years. Only one response (0.01%) came from a PD with less than one year of experience. Among those who responded, 26.7% were from programs in the Northeast (47.8% of respondents from that region); 35.8% in the South including Puerto Rico (58.1% of respondents from that region); 24.2% in the Midwest (45.3% of respondents from that region); and 13.3% in the West (51.6% of respondents from that region).

Of all the survey responses received, 19.8% of PDs agreed that the scoring change was a good idea and 33.1% believed it would improve medical student well-being. Additionally, 67.5% anticipated the change would make applicant screening "more arduous," and 72.7% felt it would be more difficult to compare applicants objectively. Most PDs (88.4%) reported that binary Step 1 scoring would increase their emphasis on USMLE Step 2 CK scores. Furthermore, 35.8% believe this change will disadvantage international medical graduates applying to EM. Only 14.9% felt this change would decrease socioeconomic disparities among applicants (Figure 1).

As a result of changing USMLE Step 1 to Pass/Fail, the majority (85%) of EM PDs indicated that they plan to



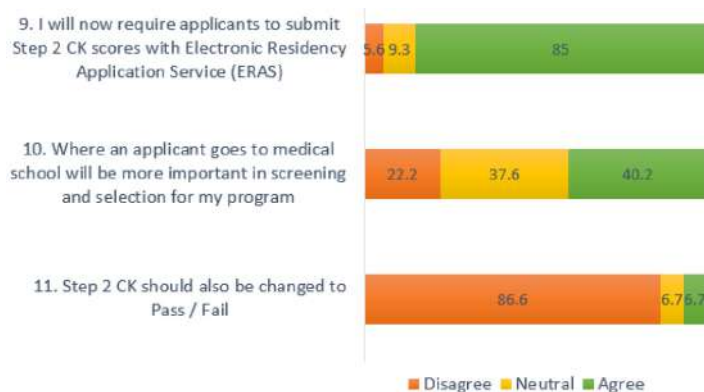
**Figure 1.** Program directors' responses to the planned use of binary scoring for USMLE\* Step 1.

\*United States Medical Licensing Exam.  
CK, clinical knowledge.

require Step 2 CK scores to be submitted at the time of application. Additionally, 40.2% of the PDs reported that medical school reputation would become more critical for the selection process. Only 6.7% of PDs recommended changing Step 2 CK to Pass/Fail (Figure 2).

Of the 121 surveys we received 33 had free-text responses. Two authors (GEG and JB) reviewed and subjectively ranked these responses based on positivity, neutrality, or negativity. Of these responses, four expressed a favorable opinion of the change (12.1%), seven remained neutral (21.2%), and 22 were negative (66.7%).

The positive comments from PDs in favor of the change mostly focused on the long misuse of Step 1 scores to filter students and the potential for bias against students from under-represented groups. All four comments indicated that the use of Step 1 scores to compare students was not an ideal method and favored a preference for continued reforms to student evaluation. As stated by one PD, "A single exam score does



**Figure 2.** How program directors plan to adjust their applicant screening process. CK, clinical knowledge.

not accurately depict the student's qualifications as a whole. Too much emphasis is placed on this score. We ought to utilize additional measures on equal footing as the muscle score. For example, a letter of recommendation, Dean's letter, transcript, interview, etc." Another PD wrote, "... I also think it was discriminatory toward certain socioeconomic groups. The same may be true for [S]tep 2 though I think it predicts more for emergency medicine."

Neutral remarks often focused on other potential screening methods. As one PD reported, "While we had Step 1 scores listed as part of the criteria, our other factors have always carried much more weight." Other comments shared a desire for a different ranking system other than Pass/Fail scoring, such as "strict class ranking systems or transitioning Step 1 to measuring quartiles or thirds."

Given the higher percentage of negative responses, there was a more significant variation in responses. In one PD's words, "this is a bad idea and hampers residency programs' ability to objectively compare applicants from different medical schools." Most commentaries indicated the PD's plan to transition to using Step 2 as a new marker for granting student interviews and away rotations. Eight commenters described the change as a "bad idea," with two calling it "ridiculous" or "not logical." Two even requested to reverse the change. Another PD wrote, "I see overinflated grades at medical schools, which makes a standardized test important. This is a step back. Students must learn medicine as they are taking care of people's lives. A few exams require preparation and acquisition of knowledge; it doesn't lead to burnout. The thought process behind it is understood, but the conclusion and plan are wrong."

## DISCUSSION

In this study we found that most EM PDs disagree with the newly established binary Step 1 scoring system. The rationale supporting the new format released in the USMLE Summary Report defined five specific areas that would be enhanced by the change. According to these guiding principles, the adoption of a Pass-Fail system is intended to "address flaws in the transition from undergraduate to graduate medical education systems, improve reliability of assessments in medical education, promote holistic review of residency applicants, maintain quality and integrity in the US medical licensure system for both domestic and international graduates, and ultimately, improve examinee and physician well-being."<sup>7</sup> Unfortunately, among those EM PDs who responded to our survey, only 33.1% of PDs believed that medical student well-being would improve. Furthermore, 88.4% of respondents indicated they were planning to increase emphasis on USMLE Step 2 CK scores as a countermeasure, compared to the 48% of programs requiring USMLE Step 2 CK scores in a 2018 report.<sup>5</sup> This represents a significant shift in focus and suggests that the current emphasis on standardized testing will merely be moved from Step 1 to Step 2 CK, rather than be mitigated as was initially intended.



While this survey reflects the current opinions of EM PDs and the actual determinants for interview invitations may vary, the impact on future applicants cannot be ignored. Many US MD and DO seniors currently delay taking the Step 2 CK exam to prioritize away or audition rotations. This shift in focus from Step 1 to Step 2 CK could dramatically change a medical student's curriculum, particularly during their third and fourth years.

Numeric Step 1 scores have anecdotally been used to compare Step 2 CK performance and gauge a student's improvement over time. Without a numerical Step 1 score, Step 2 CK scores are reduced to a single data point, rather than a trend. In 2018, Negaard et al found only 10% of EM residency educators required a USMLE Step 1 score greater than 220, and that most required a minimum score of 200-210 or a passing grade.<sup>11</sup> Despite the small percentage of programs that required a target score of 220 for screening, now 72.7% of PDs believe the absence of the Step 1 score will make it more difficult to compare students' academic achievements objectively. This may imply that even though a target score was not required, the objective metric provided by a standardized test was still a valuable component of the evaluation process.

In the last 25 years, EM residencies have recognized the need for objective data in the applicant review process. The Council of Emergency Medicine Residency Directors implemented a template for standardized letters of recommendation in 1997, now referred to as the SLOE. This metric has been shown to increase efficiency, eliminate the potential for inflated student evaluations, and to have a higher degree of inter-rater reliability than traditional narrative letters of recommendation.<sup>12</sup> Before the COVID-19 pandemic and subsequent travel restrictions, 80% of EM programs required at least one SLOE to be considered for an interview.<sup>11</sup> To acquire a SLOE, a medical student must rotate at a designated SLOE-approved institution. Restrictions on the number of away rotations performed during the COVID-19 pandemic meant there were subsequently fewer metrics for comparison included in the applications.

In addition to the SLOE, the Association of American Medical Colleges launched a pilot for the SVI in 2017 as another tool to provide additional standardized data to EM PDs. Although this pilot has concluded, it does highlight the need for more standardized data to aid EM PDs in the review of residency applications. The removal of numerical Step 1 scores would mean that EM PDs have even less objective data to base their decisions for interview invitations. This unfortunately comes in an era where the push to create more objective measures, such as the SLOE and SVI, has clearly been sought and created within the field of EM.

## LIMITATIONS

This survey was distributed to PDs only and may not reflect all the EM graduate medical education community.

Further, while email addresses were collected from publicly available documents, not all PDs' emails were available. Therefore, we were unable to query all active EM PDs. Our study's response rate was 27.5% greater than the ACGME's PD survey of the 2019-2020 application cycle.<sup>7</sup> We cannot reasonably perform a non-response bias analysis; however, it remains possible that PDs interested in the topic were more inclined to respond. More responses were obtained from male PDs; this was expected as the EM field is predominately male with women comprising only 27.6% of active US emergency physicians in 2017.<sup>13</sup> Moreover, in 2011 Long et al found that 18.8% of PD positions were held by female physicians.<sup>14</sup> This indicates that our pool of mostly male respondents is roughly similar to the overall population of EM PDs in relation to gender. The free-response comments section was completed by only 27% (33/121) of the survey respondents. Lastly, this survey did not investigate the PDs' backgrounds or their level of involvement in undergraduate medical education. This may present a potential confounder.

## CONCLUSION

We found that most EM program directors do not favor the move to binary USMLE Step 1 scoring. Our study suggests that the proposed change in USMLE score reporting may not achieve its intended goal of reducing overall emphasis on USMLE performance. Program directors may merely shift their focus from one standardized exam to another. The present study suggests that changes to Step 1 scoring may not decrease disparities, and further research will be needed to assess the true effects.

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*Conflicts of Interest:* By the WestJEM 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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# Learning Outcomes of High-fidelity versus Table-Top Simulation in Undergraduate Emergency Medicine Education: Prospective, Randomized, Crossover-Controlled Study

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Submission history: Submitted July 7, 2021; Revision received December 21, 2021; Accepted December 4, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.12.53926

**Introduction:** Over the last several decades simulation, in both graduate and undergraduate emergency medicine education, has continued to develop as a leading and highly effective teaching modality. Limited research exists to evaluate the efficacy of low-fidelity (table-top) simulation, as compared to high-fidelity standards, as it relates to medical knowledge learning outcomes. We sought to assess the efficacy of a low-fidelity simulation modality in undergraduate emergency medicine education, based on quantitative medical knowledge learning outcomes.

**Methods:** A prospective, randomized, crossover-control study comparing objective medical knowledge learning outcomes between simulation modalities. Analysis was designed to evaluate for the statistical equivalence of learning outcomes between the two cohorts. This was done by comparing a calculated 95% confidence interval (CI) around the mean difference in post-test scores, between experimental and control modalities, to a pre-established equivalence margin.

**Results:** Primary outcomes evaluating student performance on post-test examinations demonstrated a total cohort CI (95% CI, -0.22 and 0.68). Additional course-subject subgroup analysis demonstrated non-inferior CIs with: Shortness of Breath (95% CI, -0.35 and 1.27); Chest Pain (95% CI, -0.53 and .94); Abdominal Pain (95% CI, -0.88 and 1.17); Cardiovascular Shock (95% CI, -0.04 and 1.29). Secondary outcome analysis was done to evaluate medical knowledge acquisition by comparing the difference in pre and post-test examination between the cohorts. CI of the full cohort ranged from (95% CI, -0.14 and 0.96).

**Conclusion:** The student's performance on quantitative medical-knowledge assessment was equivalent between the high-fidelity control and low-fidelity experimental simulation groups. Analysis of knowledge acquisition between the two groups also demonstrated statistical equivalence. [West J Emerg Med. 2022;23(1)20–25.]

## INTRODUCTION

Over the last several decades simulation has continued to develop as a highly effective teaching modality used in a wide range of settings.<sup>1,2</sup> In emergency medicine education the rapid evolution of simulation has relied heavily on cutting-edge technology, with increased levels of fidelity, as well as advanced modality-specific training programs such as post graduate fellowships.<sup>3</sup> Increased recognition of the potential impact of simulation in emergency medicine education has grown in the wake of the academic challenges that followed the SARS-COV-2 (COVID-19) pandemic.<sup>4</sup>

In spite of the increasing utilization of simulation in emergency medicine education, significant challenges have persisted.<sup>5</sup> These include the need for technically skilled operators, simulation trained educators, and substantial material resources.<sup>6-8</sup> To date, the limited existing data has focused heavily on high-fidelity simulation for teaching both medical knowledge and clinical skills.<sup>9-12</sup> Consequently, the integration of simulation into emergency medicine clerkship programs has remained selective, representing a secondary didactic adjunct at the undergraduate level.<sup>13</sup> In response to these challenges, undergraduate emergency medicine educators have expressed significant interest in the use of low-fidelity (table-top) simulation experiences, despite the lack of outcomes-based research.<sup>14,15</sup>

During the 2019 academic year we looked to assess the efficacy of low-fidelity simulation modalities in undergraduate emergency medicine education, and conducted a randomized crossover study comparing a low-fidelity experimental model to a high-fidelity simulation control group.<sup>16</sup> The primary outcome was medical knowledge acquisition measured by standardized multiple-choice examinations at the end of the one-month clerkship. As the efficacy of high-fidelity simulation control has been well established, our study was designed to assess for statistical equivalence of the experimental low-fidelity modality.

## METHODS

### Setting

The study was conducted in a large urban medical college, where emergency medicine holds full departmental status, with robust undergraduate (UGME) and residency (GME) training programs. Medical students and residents rotate through a Level 1 urban trauma center and referral teaching hospitals. The department offers a four-week clerkship featuring low-fidelity case-based simulation clerkship curriculum inaugurated during the 2018 academic year. Its medical knowledge content is in line with generally accepted national standards set forth by Council of Residency Directors in Emergency Medicine (CORD) and Clerkship Directors in Emergency Medicine (CDEM) guidelines and includes the subjects of: chest pain (CP), shortness of breath (SB), abdominal pain (AP) and cardiovascular shock (CS).

The experimental, low-fidelity, simulation sessions

### *Population Health Research Capsule*

What do we already know about this issue?  
*Although emergency medicine has long embraced simulation, the challenges associated with offering high-fidelity experiences remains a significant barrier to widespread implementation.*

What was the research question?  
*What is the efficacy of low-fidelity simulation in undergraduate emergency medicine education?*

What was the major finding of the study?  
*Low and high fidelity simulation modalities are equivalent when comparing medical-knowledge learning outcomes.*

How does this improve population health?  
*Our study provides some of the first data to support low-fidelity simulation as an equivalent modality, to high-fidelity models, as it pertains to medical-knowledge learning outcomes.*

utilized teddy bears as patient models through which participating students interacted with cases. The control high-fidelity simulation was conducted in, the on-campus, Health and Hospitals Institute for Medical Simulation and Advanced Learning (IMSAL) on a Laerdal SimMan®3G mannequin, with residency simulation faculty and additional technical support staff on site, in one of the center's high-fidelity resuscitation rooms.

Case-based teaching points for each of the four topics, as well as teaching formats, remained unchanged for the entire 2019 academic year regardless of study assignment and included an initial oral board style case simulation, a clinical knowledge debrief discussion and a summative simulation exercise. As such session structure remained consistent between control and experimental modalities. Other than intrinsic differences of the two modalities, efforts were made to control for all other variables including session duration, identical learning points regardless of learning modality and consistency amongst a small group of educators. Over the course of each clerkship cohort period, all participating students were randomly assigned to participate in two experimental and two control didactic sessions. All students were exposed to all teaching points through either the experimental or control simulation modality.

### Study Design and Population

We used a randomized, crossover design to control for confounders related to the course subject content and

individual participants. The 2019 academic year consisted of six clerkship cohorts, designated as either ‘A’ or ‘B,’ totaling fifty-five students. The randomization to determine assignment was performed in May, 2019 and consisted of a coin toss. We randomized the first topic of the first cohort to either experimental or control modality and determined that subsequent topic and subsequent cohorts would alternate topics. (Table 1)

**Table 1.** Cohort configurations.

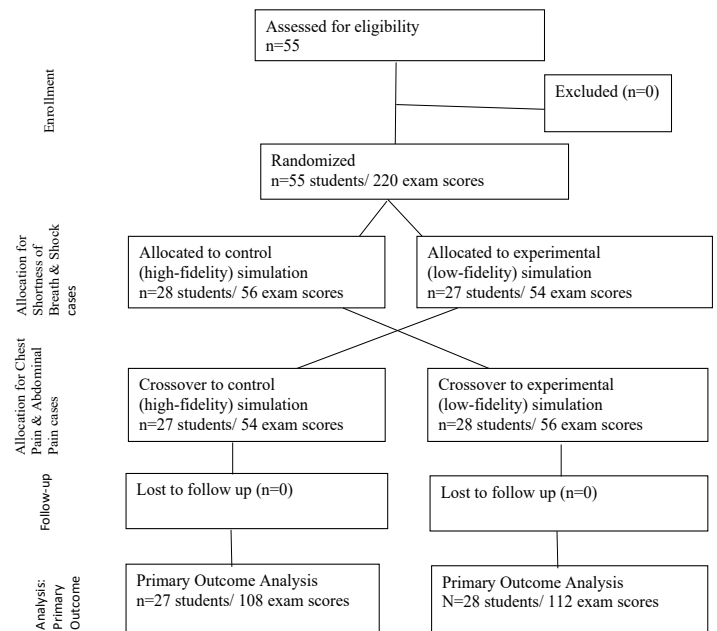
Cohort #	1	2	3	4	5	6
Number of students	8	10	12	9	8	8
Configuration*	A**	B	A	B	A	B
Subjects via experimental modality	CP/ AP	SB/ CS	CP/ AP	SB/ CS	CP/ AP	SB/ CS
Subjects via control						
Modality	SB/ CS	CP/ AP	SB/ CS	CP/ AP	SB/ CS	CP/ AP

\* Configuration ‘A’ cohorts participated in the Chest Pain (CP) and Abdominal Pain (AP) content sessions using the experimental learning modality, and the Shortness of Breath (SB) and Cardiovascular Shock (CS) content sessions via the control modality. Configuration ‘B’ cohorts participated in the CP and AP content sessions using the control learning modality, and the SB and CS content sessions via the experimental modality. \*\*Prior to the start of the academic year, cohort number on 1 was randomized (via a non-biased coin toss) to the ‘A’ configuration. Following the initial randomization of the first cohort, all subsequent cohorts strictly adhered to a pre-established rotational configuration. CP, chest pain; AP, abdominal pain; SB, shortness of breath; CS, cardiovascular shock.

Ultimately, each student participated in two topics taught via the experimental and two topics taught via the control modalities. This crossover design allowed each student to serve as their own control while also controlling for variability related to the specific content of each subject being taught. (Figure 1) Over the course of the study, each topic was taught by each modality an equal number of times. The study was designed for all students, in a given cohort, to experience each of the four areas of content via the same learning modality, with all participating students having the same number of exposures to the control and experimental learning modalities.

All fourth-year medical students in the department’s emergency medicine clerkship were eligible for inclusion in the research study. All students signed a formal consent for participation in research, but were blinded to the study’s objectives and hypothesis. The study had no formal exclusion criteria other than each student’s ability to decide not to participate in the research study.

Although the program’s simulation experience was mandatory for all clerkship participants, their participation in the study was optional. Students were informed, prior to the



**Figure 1.** A flowchart of the study design for randomized crossover study of high- versus low-fidelity simulation.

start of their participation in the course’s educational activities, that their clerkship evaluation would not be affected by their participation in the research study and that their performance on the research study’s activities had no impact on their clerkship evaluation. The university’s institutional review board (IRB) granted the study an educational exemption.

## Outcome Measures

We chose student performance on a summative multiple choice question exam as the study’s primary outcome due to the important role of medical student clerkships in transmitting foundational medical knowledge.<sup>17</sup> This represents an intermediate level on the Kirkpatrick hierarchy.<sup>18</sup> We created a collection of forty multiple choice questions, which evaluated the student’s knowledge of the curriculum’s forty discrete teaching points. The forty teaching points and corresponding questions were evenly distributed among the four didactic topics. A ten-question pre-test was given prior to each of the four didactic sessions (totaling 40 test questions per student). All forty questions, which were incorporated into the student’s final course exam, served as the study’s post-test. Student examination performance was defined as the number and percentage of correct responses out of the total number of examination questions.

The primary outcome compared the students’ performance on post-test examinations between the control and experimental cohorts. We performed this analysis for the entire forty question test as well as sub-group analysis for each of the four specific subject topics. The secondary outcome was knowledge acquisition, defined as the magnitude of changes in score between pre and post-test examinations.

For this analysis, only post-test data that had a completed corresponding pretest was eligible for inclusion.

We calculated the sample size via the Rollin Brant calculator (<https://www.stat.ubc.ca/~rollin/stats/ssize/n2.html>) based on the following assumptions: a Standard of Deviation of 5.8; Mean of Group 1=85.9; Mean of Group 2=92.0, an alpha of 0.05 and a beta of 0.2. Assumptions were based on examination scores from prior years. The calculation showed a needed sample size of at least 15 participants in each study arm. The study was thus sufficiently powered to analyze both the primary and secondary outcomes.

**Data Analysis**

We used an equivalency analysis.<sup>19</sup> We assessed equivalence by determining whether the between-group difference and the associated 95% confidence interval (CI) fell entirely within a pre-established *equivalence margin* ( $\Delta$ ).<sup>20,21,22,23</sup>

The data from the results of the pre and post-tests were analyzed with Microsoft Excel 365 (Version 1905; Microsoft Office, Redmond, Washington), <https://www.socscistatistics.com> and R-Studio (Version 1.1.414 – © 2009-2018). Each exam consisted of ten questions with a total value of ten points reflecting a single point earned for each correct question. As such, we established the equivalence margin to be +/- one point (- 1 to 1).

To evaluate the study’s primary outcome, we sought to determine if there was equivalence on post-test performance between the control and experimental groups. First, we calculated the 95% CI around the mean difference in post-test scores between experimental and control for each student. Second, we examined if the 95% CI of this mean difference fell within our pre-established *equivalence margin*. If the 95% CI of the mean difference between the control and experimental groups fell within the equivalence margin, we rejected the null hypothesis that there was a difference between the control and experimental modalities.

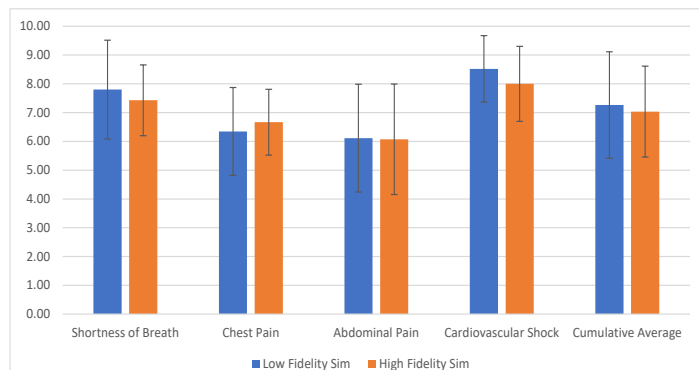
Our secondary outcome was to determine if there was a difference between the magnitude of improvement, from pre to post-test examinations, between the two study groups. Differences between pre and post-test performance was calculated by subtracting paired pre-scores and post-scores for each participant in the experimental and control groups respectively. We again calculated the 95% CI around the difference of means for each group pair. As with the primary outcome findings, confidence intervals falling within the equivalence margin demonstrated equivalence between the control and experimental modalities.

**RESULTS**

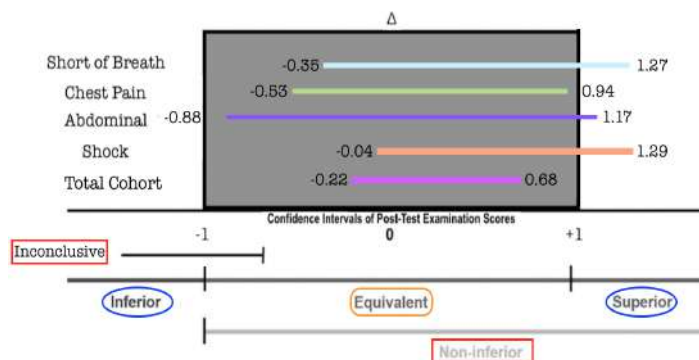
All fifty-five (n=55) students completed the post-test examination and were included in the primary analysis. Two participants were excluded from the secondary analysis due to missing all four pretests. Four additional discrete paired test scores were excluded because four participants missed a single

corresponding pretest. In total, 208 scores from fifty-three participants were included in the secondary analysis.

The mean post-test scores for the low-fidelity experimental cohort were: SB- 7.9/10; CP-6.4/10; AP-6.2/10; CS-8.6/10. Across all subjects, the mean post test score for the low-fidelity cohort was 7.3/10. The mean post-test scores for the high-fidelity control cohort were: SB- 7.4/10; CP-6.7/10; AP-6.1/10; CS-7.9/10. Across all subjects, the mean post test score for the high-fidelity cohort was 7.0/10. (Figure 2) Calculated the 95% CI around the difference of means for the cohort’s total score was (95% CI, -0.22 and 0.68). Subject specific CIs were as follows: SB (95% CI, -0.35 and 1.27); CP (95% CI, -0.53 and 0.94); AP (95% CI, -0.88 and 1.17); CS (95% CI, -0.04 and 1.29). (Figure 3) The secondary outcome, considering the difference between groups in magnitude of improvement from pre to post-test examination, was (95% CI, -0.14 and 0.96). (Figure 4)

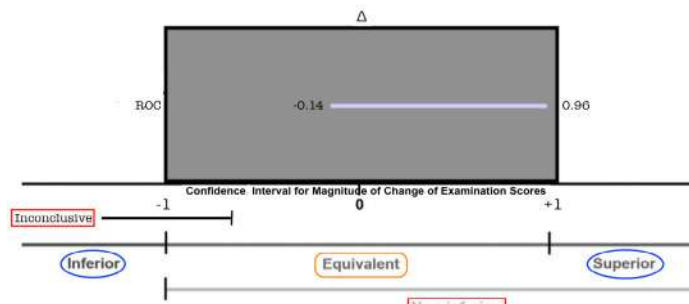


**Figure 2.** Post-test examination scores of high- versus low-fidelity simulation.



**Figure 3.** Analysis of post-test examination scores. X-axis depicts confidence intervals (CI) of post-test examination scores with an equivalence margin ( $\Delta$ ) ranging from -1 to 1. Y-axis depicts individual course subject subgroup analysis for, shortness of breath (SB), chest pain (CP), abdominal pain (AP), cardiovascular shock (CS) and mean outcome of the total cohort (TC). Boxed term in orange indicates margins of Statistical Equivalence (representing the study’s primary outcome measure). Boxed terms in red represent graph legend of possible statistical data outcomes including Non-inferiority and Inconclusive. Boxed terms in blue represent graph legend of possible statistical data outcomes including superiority and inferiority.





**Figure 4.** Analysis of magnitude of change of pre- and post-test exam scores.

X-axis depicts confidence intervals (CI) of magnitude of change between pretest and post test scores falling within the pre-set equivalence margin ( $\Delta$ ), ranging from -1 to 1. Y-axis depicts category of magnitude of change between pretest and post test scores of the entire cohort. Boxed term in orange indicates margins of Statistical Equivalence (representing the study's primary outcome measure). Boxed terms in red represent graph legend of possible statistical data outcomes including Non-inferiority and Inconclusive. Boxed terms in blue represent graph legend of possible statistical data outcomes including superiority and inferiority.

## DISCUSSION

Our study sought to assess the efficacy of a low-fidelity simulation modality in undergraduate emergency medicine education, based on quantitative medical knowledge learning outcomes.<sup>24,25</sup> These data demonstrated that medical education learning outcomes were equivalent between high-fidelity and low-fidelity cohorts across all topics and within specific topics. Similarly, knowledge gain between the study arms was equivalent.

Although emergency medicine has long embraced simulation the challenges associated with offering high-fidelity experiences remains a significant barrier to widespread implementation. More recently, educators have looked to overcome these challenges in order to integrate simulation into their educational offerings especially in the context of academic challenges related to the SARS-COV-2 pandemic.<sup>26,27</sup> Emergency medicine education, in particular, has faced significant challenges as a result of the high personal risks of infection and illnesses in the emergency department, the heavy emphasis on the medical student clerkship in evaluating prospective applicants, and the central role of clinical training for both GME and UGME emergency medicine training.<sup>28,29</sup>

Our study provides some of the first randomized, controlled data to support low-fidelity simulation as an equivalent modality to more traditionally accepted high-fidelity models, as it pertains to medical-knowledge learning outcomes. These findings support existing evidence on the efficacy of simulation as a learning modality, while at the same time challenging the notion that level of fidelity correlates to improved learning outcomes. Our data suggests that simulation programming can be an effective learning

modality even when resources for higher levels of fidelity are not available. Future research studies would help to better characterize these findings and extend them to other learning sectors targeted by simulation, such as their impact on clinical outcomes.

## LIMITATIONS

Our study was conducted in a single academic center over the course of a single academic year. Both the control and interventional sessions were taught by members of the research team who were not blinded to the study or its objectives. Although pre-test data was incorporated into secondary outcome analysis, baseline knowledge characteristics of the participating cohorts may have been variable. Despite controlling for this variable, subgroup analysis was not conducted to evaluate learning outcomes as a reflection of time, such that it is not clear how participating in cohorts later in the academic year impacted outcomes. The study was only designed to address medical knowledge learning outcomes. It cannot comment on the relative efficacy of the two modalities with regard to clinical outcomes.

## CONCLUSIONS

We conducted a randomized, crossover-controlled study assessing the equivalence in learning outcomes of high-fidelity and low-fidelity simulation modalities in undergraduate emergency medicine education. Findings showed that the student's performance on quantitative medical-knowledge assessment was equivalent between the control and experimental groups. Furthermore, analysis of knowledge acquisition between the two groups also demonstrated statistical equivalence.

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*Conflicts of Interest:* By the WestJEM 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 Longitudinal Research Curriculum for Pediatric Emergency Medicine Fellowship

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Section Editor: Jeffrey Love, MD and Chris Merritt, MD

Submission history: Submitted April 19, 2021; Revision received September 27, 2021; Accepted October 4, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.52854

[West J Emerg Med. 2022;23(1)26–29.]

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## BACKGROUND

The Accreditation Council for Graduate Medical Education (ACGME) requires programs to develop research curricula regarding how research is “conducted, evaluated, explained to patients, and applied to patient care.”<sup>1</sup> Specific to fellowship, the ACGME requires fellows to participate in and complete scholarly work aligned with their subspecialty requirements.<sup>2</sup> The American Board of Pediatrics (ABP) subspecialty in pediatric emergency medicine (PEM) further requires that each PEM fellow have a strong core knowledge in scholarly activities and complete meaningful scholarly work; the ABP tests research knowledge as part of the in-training exam (ITE), board certification exam, and maintenance of certification. The ITE and board exams’ proportion of research questions is not trivial (7% of questions overall).<sup>2,3</sup>

However, how to optimally merge research education with individual fellowship research projects is unknown. Further to this, individual trainees’ level of research education varies widely.<sup>4</sup> For fellowship where research is of higher emphasis, traditional research “blocks” are not well suited to completing a substantive project given unpredictable and variable time periods to obtain institutional review board (IRB) approval and acquire/analyze data. Therefore, fellows need a structured research curriculum to perform well on the ITE and board exams and finish their research project,<sup>5,6</sup> while also fulfilling clinical duties and maintaining wellness. Additionally, a MedEdPortal search at the commencement of this project revealed no PEM fellowship research curricula. At our institution, the previous approach for addressing those areas was a monthly PEM journal club, individual dedicated research blocks, and the completion of a scholarly project by

each fellow. However, a program needs assessment revealed that scholarly activity questions on the ITE exam was the section where fellows scored lowest.

## OBJECTIVES

We developed a longitudinal research curriculum for PEM fellows using Kern’s six-step approach. Our goals were to 1) impart research knowledge; 2) ensure completion of individual research projects; and 3) adequately prepare fellows for board exams. We present preliminary data regarding the third goal using fellow ITE scores before and after the curriculum’s implementation.

## CURRICULAR DESIGN

Our ACGME-accredited PEM fellowship contains seven fellows in a three-year program, housed within the emergency department of a large academic hospital/university. The previous curriculum used fixed research “blocks.” We implemented the new research curriculum at the beginning of academic year 2018-2019. This educational initiative was exempt from IRB approval. We used Kern’s six-step approach to assist in developing a longitudinal curriculum (Table 1).<sup>4,7</sup> As stated above, we recognized the general need by reviewing previous fellow research performance on the ITE exam. We assembled a multidisciplinary group comprised of the PEM fellowship director, a second-year PEM fellow, the PEM fellowship’s new research rotation director, and our campus-wide Office of Educational Affairs’ Director of Educational Development and Research to complete a targeted needs assessment. Decisions were made by consensus of individuals’ opinions related to their subject matter expertise using a Robert’s Rules of Order approach.

The group conducted a search for disseminated/published research curricula and reviewed the ABP's four core-knowledge content areas. Building upon those four areas, we structured six key topic areas to follow a longitudinal semester-type format over the three years of fellowship: Ethics in Research; Principles of Epidemiology

and Clinical Research Design; Principles of Biostatistics in Research; Statistical Testing; Measurement of Association and Effect; and Cost Benefit, Cost Effectiveness, and Outcomes. We then developed learning objectives within each of the topic areas (Table 1). To provide content for each of those objectives, we performed a search of formal

**Table 1.** Pediatric emergency medicine research curriculum learning objectives and milestones by postgraduate year.

Semester	Learning objectives	Learning content	Milestones for scholarly project
Semester 1 July - Dec PGY 4	Understand the principles of ethical conduct of human subjects research Acquire a familiarity with univariate statistical testing techniques	Ethics in research 1. Professionalism and misconduct in research 2. Principles of research with human subjects 3. Principles of consent and assent 4. Diagnostic tests 5. Including "gold standard" in testing, sensitivity, specificity	Institutional IRB training Identify mentor / topic / hypothesis
Semester 2 Jan - June PGY 4	Understand the importance of study design and pros and cons to different types of study designs	Principles of Epidemiology and Clinical Research Design 1. Assessment of study design, performance and analysis (internal validity) 2. Assessment of generalizability (external validity) 3. Bias and confounding 4. Causation a. Understand the difference between association and causation 5. Incidence and prevalence a. Distinguish disease incidence from disease prevalence	IRB approval for project Introduction to manuscript written and approved by mentors and research rotation director
Semester 3 July - Dec PGY 5	Learn to formulate a proper hypothesis Understand and recognize different types of common data distributions	Principles of Use of Biostatistics in Research 1. Types of variables 2. Distribution of data 3. Hypothesis testing	Data abstraction completed
Semester 4 Jan - June PGY 5	Apply knowledge learned to date to interpretation of results for scholarly research project	Statistical Tests	Data analysis completed Submission of abstract to national conference
Semester 5 July - Dec PGY 6	Understand the rationale for and be able to interpret results of advanced statistical tests including multivariate tests	Measurement of Association and Effect 1. Relative risk, risk ratio, odds ratio 2. Regression analysis	Initial draft of entire scholarly manuscript due to research rotation director
Semester 6 Jan- June PGY6	Become familiar with the vocabulary and variables used for economic evaluation of health services and outcomes	Cost Benefit, Cost Effectiveness, and Outcomes	Submission of scholarly manuscript for publication in a peer-reviewed journal

PGY, postgraduate year; IRB, institutional review board.



gray literature, followed by vetting selected online learning modules, videos, and written materials that could serve as independent learning content. We used the online learning management system Canvas (Instructure Inc., Salt Lake City, UT) to organize the materials and for easy access for the fellows. Additionally, each semester contained milestones for fellows to complete work toward their scholarly projects, and those milestones were tied to the other educational research content. The PEM fellowship's research rotation director formatted the monthly literature review to tie articles to key semester content.

### IMPACT/EFFECTIVENESS

This project produced a longitudinal structured research curriculum for pediatric EM. Our preliminary evaluations include fellow reviews and ITE scores. Fellow reviews of the new curriculum were universally positive, particularly commenting on the benefit of greater time to develop and complete their research projects, including comments such as "have enough time getting my research project done," "EXCELLENT" resources and materials, and "exposure to research, time to work on research project." We compared de-identified fellows' ITE scores from the year before and after curriculum implementation, specifically questions on core knowledge in research. Overall, the seven fellows' median score rose from 37.5% to 75% correct (score range pre-curriculum 25-75% and post-curriculum 37.5-87.% correct). Small sample size precluded further statistical testing for this preliminary, short-term data of effectiveness.

We also believe the core content of research curriculum is transferrable to other fellowship programs regardless of specialty. A major advantage of our curriculum is its longitudinal structure, which accounts for and is resilient to the unpredictable vagaries in completing scholarly projects (eg, waiting for IRB approval, data analysis, etc.). Longitudinal curricula have been shown to provide learners with an innovative, practical educational vehicle to achieve their educational goals.<sup>8</sup> Longitudinal curricula also emphasize patient- and learner-centered education and are better suited to prepare trainees for lifelong learning.<sup>9,10</sup>

This curriculum was also strengthened by its multidisciplinary inception and active involvement of a PEM fellow in its construction. We feel the multidisciplinary approach and trainee involvement contributed to the semester structure and balance of topics toward better feasibility and sustainability, although more longitudinal follow-up is required to draw conclusions in that regard. Our curriculum was also designed to follow the natural progress of a scholarly project over the three years, as the first modules focus on ethical research conduct, epidemiology principles, and study design to aid in formulating a hypothesis. This was followed by biostatistics content for the third and fourth semesters when

fellows would be expected to engage in data analysis for their individual projects. Additionally, given that there is a plethora of open-source online educational material on this topic, we found the program relatively easy to implement and at minimal cost.

### LIMITATIONS

Our curriculum and this project have limitations. The improvement in ITE scores is over one year and needs further monitoring as more fellows complete and progress through the program. Differences pre- and post-curriculum could be due to fellowship level, more experience with scholarship, or other non-curriculum related gains in knowledge. While ITE scores in some cases correlate with future board exam performance, that finding too requires future evaluation.<sup>11</sup> Future evaluations of the curriculum should include the quality of fellows' individual research projects, including conference presentations and peer-reviewed publications. The curriculum is designed to meet the ABP's content specifications for PEM, and while very broad and likely generalizable to other specialties/subspecialties, may not be completely transferrable. Lastly, we tested the curriculum at one program; thus, more generalizable evidence from other institutions is needed.

### CONCLUSION

We constructed and implemented a longitudinal PEM fellowship research curriculum. Future work remains to measure our curriculum's impact on individual fellow research projects, long-term board exam performance, and adaptability to other institutions and programs.

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*Conflicts of Interest:* By the *WestJEM* 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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# A Brief Coaching Pilot Enhances Professional Identity Formation and Clinical Skills Acquisition During Emergency Medicine Clerkships Shortened by COVID-19

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Submission history: Submitted June 29, 2021; Revision received December 20, 2021; Accepted December 8, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.12.53917

**Introduction:** The Covid-19 pandemic limited educational and career development opportunities for medical students, requiring innovative programs to accelerate professional identity formation and clinical skills acquisition.

**Methods:** We developed a brief coaching intervention that took place over the advanced (sub-internship) emergency medicine rotation at our institution. We trained coaches using a newly developed workshop, who met with students for an average of 4.5 hours over 3 weeks.

**Impact/effectiveness:** We showed that this coaching program was both feasible and impactful for faculty coaches and medical students. [West J Emerg Med. 2022;23(1)30–32.]

## BACKGROUND

The COVID-19 pandemic has been disruptive to medical education, curtailing clinical experiences vital for training and professional identity formation. At our institution, multiple student clerkships were delayed while safety measures were instated. “Away” audition rotations were cancelled. Clerkships such as our advanced emergency medicine (EM) rotation were shortened to three weeks, further limiting potential preparation for residency.

As clerkship directors and advisors, we were concerned that students would have diminished opportunities to acquire clinical skills within the speciality and have difficulty developing their professional identity. Professional identity formation is a key outcome of undergraduate medical education (UME). Medical students take their personal identity and values, combine inputs from role models and clinical experiences, and determine if their professional identity is the right “fit” in a chosen speciality.<sup>1,2</sup>

To address these challenges, we looked to foster meaningful and authentic partnerships between medical students and EM faculty through the development and implementation of a brief coaching intervention. Coaching can enhance skills training and performance, motivation, and well-being.<sup>3,4,5,6</sup>

However, coaching interventions often take place over months.<sup>7</sup> Effectiveness regarding skill acquisition and professional identity formation in coaching for medical education has not been shown over such a brief period as three weeks.

## OBJECTIVES

We aimed to implement an impactful coaching pilot over our 3-week advanced EM clerkship shortened by COVID. Our objectives were to enhance clinical skills acquisition and provide a trusted relationship for conscious reflection around professional identity formation.

## CURRICULAR DESIGN

The two most relevant conceptual frameworks related to our coaching intervention are professional identity formation<sup>1,2</sup> and Kolb’s experiential learning cycle.<sup>8</sup> A crucial outcome of advanced clerkships is to transcend clinical knowledge acquisition and place the student in an experiential environment with direct responsibility for clinical decision making and patient care.<sup>2</sup> Coaching facilitates professional identity formation via experiential learning, allowing students to take a concrete experience and participate in reflective observation,

subsequent abstract conceptualization, and then plan for active experimentation for their next shift.<sup>8,9</sup> Our curriculum development process was informed by Kern et al.<sup>10</sup> This project was reviewed and cleared by the IRB/Research Compliance office at Stanford University. We recruited a coach cohort of five faculty with an interest in medical education. To protect psychological safety, we identified junior faculty who were *not* part of residency or clerkship leadership to limit student concern for bias in the subsequent application cycle and encourage candid discussions. We created a virtual two-hour coach training workshop ([addendum](#)), reflective of Deiorio and Hammoud's coaching approach, which included a coaching toolkit.<sup>11</sup> We invited all advanced EM clerkship students from 6/29/2020 through 8/30/2020 to participate. Eight students accepted, reflecting all students from our home institution applying in EM during the 2020-2021 recruitment cycle.

Students completed a coaching worksheet centered on clerkship and career goals, and identified areas of strength, growth, and specific objectives. Students and coaches met 3-5 times during the 3-week clerkship, facilitating experiential learning. Sessions included goal formation, strength assessments, check-ins, revisiting action plans, and reflective practice on clinical challenges.

## IMPACT/EFFECTIVENESS

Our coaching intervention was rapidly deployed to all EM advanced clerkship students over 3 rotations despite the limitations presented by COVID-19. Impact was measured through an anonymous survey tool with Likert and open-ended items. 15/16 (93.75%) of surveys were completed: 7 student and 8 coach experiences. Our intervention was successful in multiple domains, including:

- Psychological safety: all students were comfortable that coaching discussions would not be used as part of their assessment. All felt they could be candid with their coach in discussing areas of clinical growth.
- Professional identity formation: all students indicated that the coaching program increased their understanding of the field of EM, separately from the clerkship itself. 71.4% indicated improvement of their understanding of whether EM fits with their strengths and values.
- Clinical skills: all students reported that coaching improved their clinical abilities (e.g. development of differential, determination of assessment and plan) during their rotation. All felt more prepared to enter residency.
- All faculty noted that being a coach contributed to their own professional fulfillment and felt prepared to be coaches despite the short training period. Please see the Figure for our results summary.

One example quote from a student: *“My coach helped me immensely during my sub-I. S/he listened to my concerns, validated my experience, provided a different perspective,*



Survey completion:  
93.75 % (15/16): 7/8 students, 8/8 coaches

### Respondents indicated success in several areas:



#### Psychological safety:

- All student respondents were comfortable that coaching discussions would not be part of their assessment.
- All felt they could be candid in discussing clinical growth.



#### Professional identity formation:

- All students indicated the coaching program increased their understanding of the field of EM, separately from the clerkship itself.
- 71.4% indicated improvement of their understanding of whether EM fits their strengths and values.



#### Clinical skills:

All students reported that coaching improved their clinical abilities (e.g. development of differential, determination of assessment and plan) during their rotation.



All faculty noted that being a coach contributed to their professional fulfillment.

**Figure 1.** Summary of brief coaching pilot results. EM, emergency medicine.

*gave great professional and personal advice, and overall made my experience 1000% better! It was so beneficial to have an “insider” to speak to and bounce ideas off of. S/he helped me gain confidence and enjoy each shift to the fullest.”*

In summary, this was a feasible and impactful intervention. Each coach had a maximum of 2 students. Coaching time averaged 4.5 coaching hours for each student over three weeks. Coaches were volunteer faculty, limiting costs and allowing representation of different subspecialties within the field of EM. Our just-in-time coach training workshop and materials helped position our program to have this impact despite none of our junior faculty coaches having prior coaching experience. Our subjects found the intervention acceptable and impactful. There is significant potential for replication in other specialties or other EM clerkships.

**This research was presented at CORD Virtual Conference 2021 and Virtual SAEM 2021 where it received a “Best of the Best Abstracts” Award.**

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*Conflicts of Interest:* By the WestJEM 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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## An Emergency Medicine Virtual Clerkship: Made for COVID, Here to Stay

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Section Editor: Douglas Ander, MD and Andrew Phillips, MD, MEd

Submission history: Submitted July 14, 2021; Revision received September 30, 2021; Accepted November 4, 2021

Electronically published December 17, 2021

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.54118

**Introduction:** Safety concerns surrounding the coronavirus 2019 pandemic led to the prohibition of student rotations outside their home institutions. This resulted in emergency medicine (EM)-bound students having less specialty experience and exposure to outside programs and practice environments, and fewer opportunities to gain additional Standardized Letters of Evaluation, a cornerstone of the EM residency application. We filled this void by implementing a virtual clerkship.

**Methods:** We created a two-week virtual, fourth-year visiting clerkship focused on advanced medical knowledge topics, social determinants of health, professional development, and professional identity formation. Students completed asynchronous assignments and participated in small group-facilitated didactic sessions. We evaluated the virtual clerkship with pre- and post-medical knowledge tests and evaluative surveys.

**Results:** We hosted 26 senior medical students over two administrations of the same two-week virtual clerkship. Students had a statistically significant improvement on the medical knowledge post-tests compared to pre-tests (71.7% [21.5/30] to 76.3% [22.9/30]). Students reported being exposed to social determinants of health concepts they had not previously been exposed to. Students appreciated the interactive nature of the sessions; networking with other students, residents, and faculty; introduction to novel content regarding social determinants of health; and exposure to future career opportunities. Screen time, technological issues, and mismatch between volume of content and time allotted were identified as potential challenges and areas for improvement.

**Conclusion:** We demonstrate that a virtual EM visiting clerkship is feasible to implement, supports knowledge acquisition, and is perceived as valuable by participants. The benefits seen and challenges faced in the development and implementation of our clerkship can serve to inform future virtual clerkships, which we feel is a complement to traditional visiting clerkships even though in-person clerkships have been re-established. [West J Emerg Med. 2022;23(1)33–39.]

### BACKGROUND

The coronavirus 2019 (COVID-19) pandemic drastically altered educational and residency application landscapes

for emergency medicine (EM)-bound medical students by restricting in-person visiting clerkships.<sup>1-5</sup> Visiting clerkships traditionally have been critical for EM-bound students.<sup>6</sup>

Medical students who are EM bound typically complete at least two EM clerkships to gain additional experience and explore varied training environments. Visiting clerkships also provide Standardized Letters of Evaluation (SLOE) – crucial to the residency application – and allow for reciprocal exposure between the student and program.<sup>6-8</sup> In response to COVID-19 restrictions, many medical schools and residencies pivoted to online education and cancelled visiting rotations.<sup>9,10</sup> With the loss of in-person visiting clerkships, a novel virtual curriculum was urgently needed to fill this void.

As an alternative to traditional in-person visiting clerkships, we created, implemented, and evaluated a virtual “visiting” clerkship with a focus on advanced and less commonly taught topics (ie, social EM and professional development). Based on the most recent recommendations, many institutions have removed restrictions on in-person rotations but continue to limit visiting rotations to one per student.<sup>11</sup> Looking forward, the virtual environment creates a unique opportunity for programs to continue to meet their applicants more in depth, in addition to circumventing geographic and socioeconomic barriers often faced by students participating in traditional visiting rotations.

## CURRICULUM DESIGN

Rather than replicating a traditional clerkship virtually, we designed our curriculum to focus on advanced medical topics: social determinants of health; structural competency; and professional identity formation<sup>12,13</sup> by employing Kern’s method for curriculum development.<sup>14</sup> We identified educational needs as institutional COVID-19 restrictions were released. We performed a needs assessment including data from our postgraduate year one class as near peers. Our topic list was further refined by consensus among the author group, which included a clerkship director, associate program directors, medical education fellow, and senior EM residents. We developed goals and objectives informed by the topic list and the additional goals of exposing students to our residency program and social EM, as well as advancing professional identity formation. Our traditional in-person sub-internship experience typically covers medical knowledge topics commonly seen in the emergency department as well as skills to help learners thrive while rotating in person. In addition to being vastly different from a traditional experience given that it would be delivered virtually, we felt that this rotation could possibly serve as an ideal environment to cover social EM and professional identity formation, topics that would benefit from minimal interruptions or competing pressures.

## OBJECTIVES

Curriculum goals included teaching advanced EM clinical knowledge, introducing social EM and professional identity formation, and providing exposure to our residency program. See Table 1 for course goals and objectives.

When choosing educational methods, we used the conceptual framework developed by Brown et al to

maximize online learning and engagement. This framework encourages expectation management, learner engagement, and “nudging.”<sup>15</sup> Our orientation outlined expectations, including asynchronous assignments and recommended norms for small group. We prioritized interactive teaching modalities and active learning to maximize engagement such as small-group learning among as well as our “Virtual Escape Room” (Appendix A) and simulation. Our small group, case-based discussions used a flipped classroom model, an effective and recommended modality for virtual instruction.<sup>16-22</sup> All small-group facilitators were reminded of the best practices for online, small group teaching,<sup>23</sup> which included use of introductions, learner-directed questioning to encourage equal participation, and “nudging” – reminders for learners to actively participate (See Appendix B).

Each virtual clerkship session was held on weekdays over two weeks for a total of 10 instruction days. The students were expected to complete various asynchronous learning assignments (estimated two hours daily) and attend four hours of Zoom (Zoom Video Communications, Inc, San Jose, CA) sessions daily. (See Appendix C for example schedule and specific content.) Cases from “Foundations of EM,” a national free, open-access online resource, were used to teach medical knowledge.<sup>24</sup> Social medicine instruction was done using modules from the International and Domestic Health Equity and Leadership (IDHEAL) Section from the University of California, Los Angeles.<sup>25</sup> Chosen modules included Language, Incarceration, Gender Identity, Race, and Homelessness, and assigned readings from those modules were delivered to learners via email. The Virtual Escape Room consisted of a tricyclic antidepressant overdose case, created by authors AV and TJ (Appendix A) with inspiration from another published escape room.<sup>26</sup> The virtual simulation was carried out over Zoom, and cases from our traditional clerkship were used, which cover pediatric anaphylaxis, motorcycle trauma, hypothermia, and abdominal aortic aneurysm. The “Communities of Practice Panel” consisted of a panel of faculty/attendings who practice in different EM environments (ie, tertiary referral center, county, community, Veterans Administration, and critical access community). Many of these modalities have previously been highlighted as effective teaching modalities.<sup>27,28</sup> Within the professional identity formation theme, learners read Carol Dweck’s “Mindset” to prepare for a book club-type discussion – a modality previously well-received by other learners.<sup>29</sup> Finally, students were introduced to basic pedagogical techniques and practiced non-medical teaching sessions for their peers and faculty; feedback was provided.

Asynchronous assignments consisted of *Emergency Medicine Reviews and Perspective* C3 podcasts, free open-access medicine (FOAM) curated by the Academic Life in EM (ALiEM) AIR series, Foundations of EM “Frameworks,” and articles introducing topics of social EM.<sup>24,25,30,31</sup> Asynchronous content was designed to correspond to daily synchronous

**Table 1.** Course goals and objectives of a virtual emergency medicine clerkship.

Goals	Objectives
1. To build upon existing EM knowledge through less commonly taught core EM chief complaints	By the conclusion of this rotation, the students should be able to: Medical Knowledge
2. To expose students to the broad variety of ED practice environments and patient populations they will care for through panels and case-based discussions	1. Describe an approach to several commonly seen chief complaints in EM.
3. To improve the knowledge base, and importance of justice in healthcare in caring for ED patients of diverse socioeconomic statuses, race, ethnicities, gender, and sexual orientations.	Social EM
4. To introduce students to clinical and non-clinical niches in EM including toxicology, critical care, ultrasound, EMS, medical education, research, healthcare administration, and social determinants of health	2. Compare how different practice environments, associated healthcare systems, and access to care affect care plans.
5. To expose students to a variety of learning modalities including practicing their own teaching skills	3. Discuss areas within medicine, including within EM, how biases may affect patient care and create strategies to overcome one's own bias.
6. To introduce the concept of professional skill-set development and how growth mindset may impact clinical encounters	4. Describe how language, race, gender, homelessness, and addiction affect patient care.
	Professional Identity Formation
	5. Describe clinical and non-clinical practice environments as well as niches within EM.
	6. Understand the importance of a growth mindset over a fixed mindset and develop strategies to incorporate a growth mindset.
	7. Apply principles of growth mindset to commonly experienced scenarios in the clinical setting.
	8. Describe challenges of interviewing virtually.
	9. Outline effective strategies for identifying medical content, learning, and organizing medical knowledge in the 21st century.
	10. Describe challenges and opportunities of teaching in the 21st century.
	11. Demonstrate ability to teach peers on pre-selected topic.

EM, emergency medicine; ED, emergency department; EMS, emergency medical services.

content; specifics can be found on Appendix C. We made our virtual clerkship available to all fourth-year medical students applying into EM via the Visiting Student Application Service (VSAS) website and offered it twice during the 2020-2021 academic year.<sup>33</sup> Given our predicted teaching resources, we estimated an ideal class size of less than 25 students per session. Ultimately, 26 students enrolled (nine in the first session, 17 in the second session). Attendance at all sessions was mandatory.

We recruited a group of residents and faculty to teach for a total of 24 lecturers and 26 small-group facilitators across both sessions. Facilitating the clerkship during the two-week session required one of three clerkship directors to be present on Zoom four hours per day, in addition to administrative tasks related to that day's activities.

We assessed medical knowledge with a 30-item, peer-reviewed, multiple-choice test consisting of questions donated by RoshReview (Rosh Review LLC, Huntington Woods, MI), a commercial question bank company. RoshReview validates questions against real-world exam performance such as the in-training exam for EM residents.<sup>32</sup> Questions were chosen by the course directors by a systems-based approach (ie, neurology, cardiovascular, etc) with the goal of choosing questions that were reflective of clerkship's curriculum. Students did not have the ability to see the

answers to the questions after taking the pre-test. Because the test was conducted at home, students theoretically could access open-access content in real time. Students completed the same medical knowledge test on the first and last days of the clerkship.<sup>34</sup> We calculated mean scores and compared pre- and post-tests using a paired t-test, analyzed with the software statistical package Stata 16.1 (StataCorp, College Station, TX). Test scores had no bearing on final grades.

Each two-week clerkship contained five social EM sessions, which were assessed by an anonymous survey exploring previous experience with the topic and comfort with applying content learned to the clinical environment (Appendix D). This tool had been previously used in residency education by the IDHEAL group. It was developed by content experts after literature review to maximize content validity. We analyzed questions relevant to this clerkship. Participants were sent an online anonymous survey after each of the five sessions. In total, we sent a total of 130 surveys (five surveys per participant) and analyzed the data descriptively.

We assessed students' overall attitude toward the course with a 16-item evaluative survey consisting of 11 multiple-choice, one slider scale, and four free-response items. The survey was created by SV, who has a Master's in Education, had advanced training in survey design and experience in qualitative research, and was the course director, all providing content validity



evidence. We read survey items aloud among the author group and piloted the survey with a small reference population to optimize response process validity. The survey was distributed on the last day of class (Appendix E). We calculated and reported descriptive statistics for survey questions with discrete answer choices. For free-response data within the survey, two authors (SV and AV) performed a thematic analysis. SV trained AV, a senior resident, to perform a thematic qualitative analysis. The analysts independently reviewed the data and later met to establish a final coding scheme, which they then independently applied to all data. After applying the final coding scheme, they identified discrepancies and finalized themes. The simple percent agreement between the two analysts was 80.3%. Discrepancies were resolved via in-depth discussion and negotiated consensus.

This study was deemed exempt by the University of California, Los Angeles Internal Review Board (IRB #20-002014) approved on November 19, 2020.

### IMPACT/ EFFECTIVENESS

Twenty-six students participated in the virtual clerkship representing 22 medical schools and all regions of the US. All students completed the medical knowledge pre- and post-test. Mean test scores improved from 21.5 (standard deviation [SD] +/-2.6) to 22.9 (SD +/- 1.24) ( $P = 0.006$ ), effect size 0.68, 95% confidence interval, 0.12-1.24.

Of the 130 IDHEAL post-module surveys administered, 98 (75%) were completed. Of the modules chosen,

incarceration was least likely to have been previously covered with only 6% (1/18) of respondents having prior instruction. Eighty-nine percent (87/98) of respondents “strongly agreed” that these topics were important for patient care in the ED, and 66% (65/98) felt more confident after completing the modules. See Table 2 for full results.

Almost all (25/26, 96%) students completed the end-of-rotation evaluative survey. Of all respondents, 95% “strongly agreed” or “agreed” that the rotation should be repeated in the future, and all “strongly agreed” or “agreed” that the rotation would impact the way they ranked our program. Major themes from the qualitative analysis are described in Table 3.

Prior literature has demonstrated knowledge acquisition and retention from virtual curricula, and we saw similar results, albeit our study demonstrated only a modest improvement.<sup>35,36</sup> One explanation for the lack of larger change is that our assessment items may not have been perfectly aligned with our curriculum as the questions were pulled from a standard question bank. For future versions, we would strongly consider constructing and validating our own internal assessment of medical knowledge to be better aligned with our objectives. Additionally, students rated themselves as more confident in discussing and managing social medicine topics. Ideally, we would be able to conduct a repeat assessment at a predetermined timepoint to assess whether the social EM content had modified their practice as residents. While we emphasized our program’s strong social EM vision, other programs may replicate this

**Table 2.** International and Domestic Health Equity and Leadership sessions survey.

Question/statement	Yes	No			
Have you ever had formal instruction on social determinants of health? (n = 98)	81 (83%)	17 (17%)			
Have you ever had formal instruction on social determinants of health during an emergency medicine rotation or departmental education conference? (n = 98)	42 (43%)	56 (57%)			
Have you ever had formal instruction on topic discussed					
Topic (n = 98)	Yes	No			
Language (n = 23)	8 (35%)	15 (65%)			
Incarceration (n = 18)	1 (6%)	17 (94%)			
Gender (n = 16)	9 (56%)	7 (44%)			
Homelessness (n = 15)	6 (40%)	9 (60%)			
Race (n = 16)	11 (69%)	5 (31%)			
Unknown (n = 10)	7 (70%)	3 (30%)			
Please rate your agreement with the following statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I learned about how this topic affects the health of my patients.	79 (80%)	18 (18%)	0 (0%)	0 (0%)	1 (1%)
I feel more confident about how to address this topic when seeing patients in the ED.	65 (66%)	28 (29%)	4 (4%)	0 (0%)	1 (1%)
This topic is important for the care of patients in the ED.	87 (89%)	10 (10%)	0 (0%)	0 (0%)	1 (1%)

ED, emergency department.

Table 3. Themes identified from the end-of-rotation survey.

Domain	Themes	Exemplar quotes
<b>Favorites</b>		
Course design	Interactive education	Respondent 11: "Some of my favorite sessions were the teaching sessions, the escape room, and the simulation"
		Respondent 12: "board style cases from foundations"
		Respondent 23: "Enhancing my medical knowledge/clinical skills by participating in numerous simulations and mock oral board-style, small group exercises"
	Topic variety	Respondent 9: "Incredible mix of content and social EM"
		Respondent 10: "Having this diversity of sessions made it easier to engage fully for the two hours that each topic was covered every day. It would've been tough to stay focused for 4 hours of medical knowledge didactics or 4 hours of social EM/career topics, so mixing it up was great"
		Respondent 20: "I like the mix of medical content with professional development and social issues."
	Social determinants of health focus	Respondent 6: "The social EM aspect of this course was incredibly powerful and important"
		Respondent 11: "Social discussions are incredibly valuable and vital to the work providers (particularly in EM) do. The medical knowledge will always be hammered into us whether it's in medical school or residency, but the social determinants of health are truly vital in understanding the populations we serve."
		Respondent 12: "Learning about social aspects of EM from experts and listening to their experiences and perspectives"
Professional identity formation	Networking with other students, residents, faculty	Respondent 10: "it was a great way to get to know more about my peers and build a bond."
		Respondent 11: "I loved meeting other students from across the country."
		Respondent 12: "I absolutely loved how many attendings, residents, and fellows I was able to meet. If I came there in person. I do not think I would have met even an eighth as many."
	Exposure to future career opportunities	Respondent 4: "it was great to get to know people who specialize in different areas and options for fellowship"
		Respondent 18: "information about the program, fellowships and culture"
<b>Least favorite/barriers</b>		
Technology related	Screen time	Respondent 1: "long zoom hours"
		Respondent 7: "Towards the end of the last week I was feeling the zoom fatigue"
	Technical issues	Respondent 3: "Zoom challenges can be rough audio and freezing"
		Respondent 5: "only issue were the brief problems with Wi-Fi connectivity"
Course design	Too much content for time allotted	Respondent 14: "I wish we had a bit more time on the foundations cases or had a follow up 10-15 minute review of the topics"
		Respondent 15: "I wish there was a little more small group time!"
	Instructor orientation	Respondent 4: "Whenever you split people into small groups, ALL proctors should implement the round-robin approach for participation AND the proctor should tell the students when their turn is over. Most proctors did this, and I really appreciate it. When it didn't happen, the sessions felt less fluid"
	Alignment of asynchronous and synchronous content	Respondent 9: "Some of the asynchronous resources were not too connected to the sessions that day."

EM, emergency medicine.

curriculum to focus on their own strengths. In the past, visiting clerkships have acted as a recruiting tool for residencies,<sup>8</sup> and virtual clerkships may also allow residencies to highlight strengths and successfully recruit.

Students from 22 institutions participated in our clerkship at minimal cost to them (only the cost to apply via VSAS). In contrast, EM applicants averaged 1.9 visiting rotations costing almost \$1000 per rotation in 2019.<sup>37-39</sup> While many institutions have implemented scholarships for under-represented in medicine students, virtual clerkships remove financial barriers for all students and may be an invaluable option for students with familial or other obligations.<sup>40</sup> Virtual clerkships represent an additional strategy to help mitigate the socioeconomic barriers of visiting rotations.

While students perceived our virtual experience to be valuable, several challenges were encountered. The clerkship required significant administrative efforts and a large number of facilitators to create the intimate small-group experiences critical to its success. There was no protected time or funding for the instructors. Overall, at least 40 hours per clerkship among NW and SV were required, which did not account for planning and time from all instructors who volunteered their time. These requirements may be adjusted by limiting the number of students enrolled. Furthermore, as we look to the future, simultaneously administering a virtual clerkship and in-person clerkship will likely require significant additional administrative support.

While this rotation ultimately served 25 students, we considered this rotation to be a success as we were fortunate to match three interns of our current class from the Virtual Clerkship. If we were to repeat this clerkship again, we would expand our evaluation efforts as it was limited, mainly only allowing for assessment in small groups. One other addition would be to encourage asynchronous communication among students and faculty. Examples of communication would be continued improvement of the environment and incorporation of daily questions expanding on the day's content to further enhance spaced repetition. Lastly, interest in our virtual clerkship was likely increased due to COVID-19 restrictions on in-person opportunities. Future versions will require more advertisement and may not bolster as much interest.

We envision we will offer both versions of each clerkship separately moving forward. However, we likely would not offer a formal SLOE to students who pursue the Virtual Clerkship given we cannot comment on their clinical skills in the virtual format. However, we would gladly write a letter of recommendation as, in some ways, program leadership may get to know these students in a more personal way, especially with certain aspects of the SLOE such as "commitment to EM." Finally, we may incorporate some of the social EM content and other teaching modalities into the traditional clerkship.

## CONCLUSION

This virtual clerkship was created in response to an acute educational need created by the COVID-19 pandemic.

However, our experience suggests that virtual learning experiences may be valuable in the future as an adjunct to traditional in-person rotations. Virtual rotations provide flexibility allowing for the incorporation of topics not traditionally taught (eg, social EM), allow residencies and students increased access to one another, and may eliminate socioeconomic barriers advancing educational equity.

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*Conflicts of Interest:* By the WestJEM 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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# An Effective COVID-19 Medical Student Elective

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Section Editor: Douglas Ander, MD and Andrew Phillips, MD, MEd

Submission history: Submitted June 14, 2021; Revision received June 14, 2021; Accepted November 18, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.53656

**Background:** The COVID-19 pandemic has revealed the importance of teaching medical students pandemic preparedness and COVID-19 related clinical knowledge. To fill the gap of COVID-19 instruction backed by evaluation data, we present a comprehensive COVID-19 pilot curriculum with multiple levels of evaluation data.

**Methods:** In the spring of 2020, the University of California, Irvine (UCI) School of Medicine piloted a two-week, primarily asynchronous COVID-19 elective course for medical students. The goal of the course is to provide a foundation in clinical care for COVID-19 while introducing students to emerging issues of a modern pandemic. Objectives align with institutional objectives, and instruction is delivered in thematic modules. Our curriculum utilizes numerous instructional strategies effective in distance learning including independent learning modules (ILM), reading, video lectures, discussion board debates, simulation and evidence-based argument writing. We designed a three-level, blended evaluation plan grounded in the Kirkpatrick and Kirkpatrick evaluation model that assessed student satisfaction, relevance, confidence, knowledge and behavior.

**Results:** Our end of course survey revealed that students had high levels of satisfaction with the curriculum, and felt the course was relevant to their clinical education. Various assessment tools showed excellent levels of knowledge attainment. All respondents rated themselves as highly confident with the use of personal protective equipment, though fewer were confident with ventilator management.

**Conclusion:** Overall our pilot showed that we were able to deliver relevant, satisfying COVID-19 instruction while allowing students to demonstrate knowledge and desired behaviors in COVID-19 patient care. [West J Emerg Med. 2022;23(1)40–46.]

## BACKGROUND

The COVID-19 pandemic has created unprecedented changes to healthcare and medical education systems. As case numbers in the United States rose exponentially in March 2020, many medical schools developed COVID-based electives to give students relevant clinical experiences while responding to the Association of American Medical Colleges recommendation to “[pause] all student clinical rotations.”<sup>1</sup> Despite this pause being lifted, the current pandemic reveals the importance of teaching medical students pandemic preparedness along with the tenets of COVID-19 patient care. A recent meta-analysis by Ashcroft et al. showed that implementing disaster training into undergraduate medical education improved student knowledge, skills, and preparedness during times of a pandemic.<sup>2</sup> Therefore, pandemic preparedness education provides training

that is relevant through the current pandemic, as well as for future practice.

While some medical schools developed COVID-19 related courses, a thorough literature review found no medical student course that has undergone a formal evaluation process. To bridge this unmet need, we present a comprehensive, multidisciplinary, COVID-19, medical student pilot curriculum with multiple levels of evaluation data. To our knowledge, this novel course is the first to combine formats of virtual learning, simulation, independent learning modules, moderated discussions, and service learning to meet course goals and objectives.

In the spring of 2020, the University of California, Irvine (UCI) School of Medicine developed and implemented a primarily asynchronous, two-week COVID-19 elective course for medical students. The course was designed within the

Kern framework of curricular development.<sup>3</sup> Based on a needs assessment consisting of focus groups with course leadership, medical school curricular affairs leadership (associate dean for clinical science and vice dean of medical education) and medical students at various levels, we developed the instructional goal to provide a foundation in clinical care for COVID-19 patients while introducing students to emerging issues of a modern pandemic including ethical dilemmas, palliative care, tele-health, personal mental/physical health strategies, and community service.

## OBJECTIVES

Using frameworks from Dick, Carey and Carey in *The Systemic Design of Instruction*, we created thematic modules matching the instructional goals of our needs assessment, wrote terminal objectives for each thematic module, and mapped these objectives to the School of Medicine's program objectives and competencies (see Appendix 1).<sup>4</sup> Within each module, we also created subordinate objectives to guide the selection of instructional strategies and materials (Table 1).

## CURRICULAR DESIGN

### Educational Strategies

The course employs a wide range of educational strategies that align with the various domains of Bloom's taxonomy.<sup>5</sup> These include independent reading, videos, podcasts, team-

based learning, discussion board forums, standardized patient encounters, debate, and simulation. Instructional material was curated by analyzing and validating existing content developed by outside educational institutions. This included complete review from the UCI School of Medicine Curriculum and Educational Policy Committee. A full accounting of instructional strategies and materials aligned with learning objectives can be seen in Table 1.

### Implementation

A pilot course was run in April 2020 with 51 medical students at the School of Medicine through the Canvas learning management system (Instructure, Inc., Salt Lake City, UT). Of the 51 medical students, 67% (n = 34) had just completed their second year of medical school; 24% (n = 12) had just completed their third year, and 10% (n = 5) of students were in the final month of their fourth year of medical school. The course was held in a hybrid format with most sessions held virtually and/or asynchronously. Students did attend an in-person, socially distanced, simulation and personal protective equipment sessions during the course.

### Assessment and Evaluation Tools

We used the Kirkpatrick and Kirkpatrick model of evaluation, with a focus on Levels 1-3, to design our various

**Table 1.** Detailed learning module themes, module terminal objectives, subordinate objectives, instructional strategies, and activities.

Module theme and terminal objective	Subordinate objectives	Instructional strategies	Activity and materials
<b>Clinical care</b> The student will be able to recognize the clinical presentation of a COVID-19 patient, select and interpret diagnostic tests, and explain interventions for effective treatment of COVID-19 patients.	<ul style="list-style-type: none"> <li>- Describe incubation period.</li> <li>- Describe typical clinical course.</li> <li>- Recognize risk factors for severe disease.</li> <li>- List imaging modalities used in the COVID-19 workup.</li> <li>- Describe lab abnormalities associated with disease.</li> <li>- Describe lab abnormalities related to increased mortality.</li> <li>- Synthesize the practical approach to patient management.</li> </ul>	<ul style="list-style-type: none"> <li>Independent learning module (ILM)</li> <li>Video lectures</li> <li>Simulation</li> </ul>	<ul style="list-style-type: none"> <li>Harvard Medical School (HMS) Course- Module 1</li> <li>Osmosis- COVID-19 Disease video</li> <li>Lecturio COVID Overview videos</li> <li>COVID-19 simulated patient encounter</li> </ul>
<b>Virology and epidemiology</b> The student will be able to explain general and specific mechanisms by which the SARS-CoV-2 virus causes disease and be able to describe its epidemiology.	<ul style="list-style-type: none"> <li>- Identify the virus class.</li> <li>- Describe mechanism of infection.</li> <li>- Explain significance of R<sub>0</sub> in viral infections.</li> <li>- Compare/contrast COVID-19 infection to annual influenza infection.</li> <li>- Define the epidemiology variables E, p and Nd.</li> <li>- Label a case growth curve with the following terms: inflection point, growth factor.</li> <li>- Describe why COVID-19 infections follow a logistic curve.</li> <li>- Create a logistic curve for a given country's infection data.</li> <li>- Create a visualization of Orange County, CA, infections, mortality, and testing rates.</li> <li>- Compare the US policy response to COVID-19 to other countries around the globe.</li> </ul>	<ul style="list-style-type: none"> <li>ILM</li> <li>Video lectures</li> </ul>	<ul style="list-style-type: none"> <li>HMS Course- Module 2</li> <li>UCI COVID-19 Virology Video Lecture</li> <li>UCI Town Hall Video - "What you need to know."</li> <li>Epidemiology Video- Exponential Growth</li> <li>Epidemiology Video- Simulating a Pandemic</li> </ul>

COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome-coronavirus-2; UCI, University of California, Irvine; CT, computed tomography.

**Table 1.** Continued.

Module theme and terminal objective	Subordinate objectives	Instructional strategies	Activity and materials
<p><b>Radiology</b></p> <p>The student will be able to describe indications for various COVID-19 imaging and recognize common imaging findings.</p>	<ul style="list-style-type: none"> <li>- List common radiograph findings of COVID-19 on chest radiograph (CXR).</li> <li>- List common CT chest findings of COVID-19.</li> <li>- Describe the sensitivity and specificity of CT and CXR in the diagnosis of COVID-19.</li> <li>- Synthesize a position statement of the use of CT imaging in diagnosis of COVID-19.</li> <li>- Describe the implications of radiology suite disinfection practices on resource utilization and patient care.</li> </ul>	<p>Video lectures</p> <p>Reading</p> <p>Evidence-based argument writing</p>	<p>Osmosis radiology video</p> <p>Reading international radiology position statements</p> <p>Radiology position statements</p>
<p><b>Ventilator management</b></p> <p>The student will be able to apply knowledge of COVID-19 pathophysiology to ventilator setting selection and troubleshooting.</p>	<ul style="list-style-type: none"> <li>- Describe the basic mechanics of a ventilator.</li> <li>- Interpret ventilator pressure and flow curves for common pathology.</li> <li>- Choose appropriate ventilator settings for lung injury.</li> <li>- Troubleshoot an alarming ventilator.</li> <li>- Describe the ARDSnet ventilation protocol.</li> <li>- Explain why ARDSnet ventilation protocol is the ideal ventilation strategy in COVID-19 patients.</li> <li>- Order the approach of escalating ventilator interventions for the decompensating COVID-19 patient.</li> <li>- Discuss emerging technologies to bridge resource needs in ventilator shortages.</li> </ul>	<p>Podcasts</p> <p>Team-based learning (TBL) Activity</p> <p>ILM</p>	<p>Emergency Medicine Reviews and Perspectives Podcast - Vents 101</p> <p>Ventilator Management TBL</p> <p>HMS Course - Module 5</p>
<p><b>Telehealth</b></p> <p>The student will be able to demonstrate compassionate patient care through a telehealth delivery system.</p>	<ul style="list-style-type: none"> <li>- Define the term “telehealth.”</li> <li>- Describe the role of telehealth interventions in the COVID-19 crisis.</li> <li>- Compare telehealth patient care with traditional in-person patient care.</li> <li>- Demonstrate key telehealth interview skills.</li> </ul>	<p>Video lecture</p> <p>Simulation</p>	<p>Video: Panel Discussion from Telehealth Experts</p> <p>Standardized Patient Telehealth Small Groups</p>
<p><b>Ethics, palliative care, and communication</b></p> <p>Students will be able to analyze various ethical dilemmas related to the emergence of the COVID-19 pandemic.</p>	<ul style="list-style-type: none"> <li>- Identify various ethical dilemmas in patient care associated with the COVID-19 crisis.</li> <li>- Appraise the ethical dilemma of medical resource management during surge patient care during the COVID-19 crisis.</li> <li>- Prepare scripts for discussing end-of-life care of COVID-19 patients.</li> </ul>	<p>ILM</p> <p>Video Lecture</p> <p>Group Discussion Board</p>	<p>HMS Course - Module 4</p> <p>Video Lecture: Ethics in a Pandemic</p> <p>Video Lecture: Interview with a Palliative Care Expert</p> <p>Discussion Board Activity: Initiating Palliative Care Discussions</p>
<p><b>Evaluation of emerging literature</b></p> <p>The student will be able to appraise and evaluate emerging COVID-19 literature.</p>	<ul style="list-style-type: none"> <li>- Appraise emerging literature related to the COVID-19 pandemic.</li> <li>- Collect evidence for/against the use of various PPE for healthcare professionals caring for COVID-19 patients.</li> <li>- Collect evidence for/against the use of hydroxychloroquine/azithromycin in COVID-19 treatment.</li> <li>- Justify the use/prohibition of NSAIDs in COVID-19 patients.</li> </ul>	<p>Debates</p>	<p>Discussion Board Debates: Controversies in COVID-19 Care.</p>
<p><b>Patient and personal safety</b></p> <p>The student will be able to demonstrate proper use of personal protective equipment.</p>	<ul style="list-style-type: none"> <li>- Differentiate between the various precautions (airborne, contact, droplet).</li> <li>- List the various respiratory PPE equipment and summarize the protections afforded by each piece of equipment.</li> <li>- Demonstrate the proper donning/doffing techniques for PPE used in COVID-19 patients.</li> <li>- Summarize the use of homemade PPE for healthcare providers.</li> </ul>	<p>Video lectures</p> <p>ILM</p> <p>Simulation</p>	<p>Video Lecture: Proper PPE Donning and Doffing at UCI</p> <p>Video Lecture: Osmosis N95 Video</p> <p>HMS Course - Module 5</p> <p>COVID-19 simulated patient encounter</p>

*ARDSnet*, acute respiratory distress syndrome network; *PPE*, personal protective equipment; *NSAID*, non-steroidal anti-inflammatory drug.

Table 1. Continued.

Module theme and terminal objective	Subordinate objectives	Instructional strategies	Activity and materials
<b>Mental health and wellness</b>	- List potential effect of quarantine during a pandemic on the mental health of patients. - Describe the various mental health tolls on providers caring for COVID-19 patients. - Employ various coping tools when working under the stressors of COVID-19 patient care.	Video lecture  Group Discussion Board	HMS Course - Module 6  Video Lecture: Reflections from the Frontline - Panel Discussion with NYC Providers  Discussion Board Activity: Mental Health in the Time of a Pandemic
The student will be able to describe the stressors related to COVID-19 patient care and employ various mental health coping tools.			
<b>Service</b>	- Provide administrative, educational, and appropriate clinical support to the UCI health system in the face of the COVID-19 crisis.	Service Learning	Various community service activities arranged by students
The student will be able to show commitment to the Orange County, CA, community through COVID-19 related service efforts.			

COVID-19, coronavirus disease 2019; CA, California.

measurement instruments.<sup>6</sup> Due to the pause on clinical rotations, Level 4 evaluation of clinical outcomes was not pursued. This study qualified as exempt by the UCI Institutional Review Board.

### Level 1: Reaction

At the conclusion of the elective, students completed a course evaluation that was administered through the Qualtrics survey platform (Qualtrics, Provo, UT) and distributed via email. The evaluation tool contained 27 questions asking students to rate the course (on a four-point Likert scale) in domains of satisfaction, teaching quality, objectives, instructional materials, confidence, and relevance of the instructional content. The complete course evaluation is available in Appendix 2.

### Level 2: Knowledge

To assess knowledge, students were assessed with four multiple-choice quizzes ranging from 10-20 questions in length. These quizzes were developed using assessment items that align with content objectives and were piloted with this learning group. We used two additional assignments to assess Level 2 outcomes and higher orders of thought:

- **Epidemiology Visualization Assignment:** Students created a novel graphic/visualization of COVID-19 epidemiologic data. A five-point grading rubric was used to assess the student's ability to apply epidemiology principles to real-life data.
- **Policy Position Statement:** Students created a short position statement for the reopening of schools in their local county. A five-point rubric was created to assess their ability to integrate evidence-based principles into an effective written argument.

### Level 3: Behavior

We assessed behavioral outcome data through various assignments, discussions, and simulation sessions throughout the course:

- **Appraisal of Emerging Literature Assignment:** Students were asked to create an infographic or written report of the evidence backing a certain side of a controversial debate related to COVID-19 care. A five-point grading rubric was created to assess student work in the domains of medical evidence, effective written/visual communication, and professionalism.
- **Simulation Session:** Students participated in a simulation session that focused on the care of a critically ill COVID-19 patient. Simulation instructors used a 15-point, critical action checklist to assess student competence in patient care. The simulation case and critical actions checklist were implemented from a peer-reviewed, published case scenario.<sup>7</sup>
- **Standardized Patient Encounter:** Students participated in two virtual standardized patient encounters. Students were evaluated with an eight-point critical action checklist.
- **Discussion Board Participation:** Five discussion board activities were required of students participating in our elective. A participation rubric was created to ensure timely, meaningful conversation between students. Discussion boards were graded by the course director throughout the two-week course.

All assignments and grading rubrics are available in Appendix 3.

### IMPACT/EFFECTIVENESS

#### Results

We collated all evaluation data and analyzed student scoring through simple percentage comparisons of various



scoring categories. All student scores for various assignments were compiled, and the mean and standard deviation of scores were calculated to analyze the data. We categorized results based on the Kirkpatrick and Kirkpatrick hierarchy.<sup>6</sup>

**Level 1 Results**

Seventy-one percent (n = 36) of students completed the post-course evaluation. Virtually all respondents in the post-course evaluation rated their satisfaction in various aspects of the course as “satisfied” or “very satisfied” (Figure 1). Notably, 92% (n = 33) of students rated their satisfaction with the quality of instructional materials as “very satisfied;” and 100% (n = 36) of students rated their satisfaction with the overall growth of clinical competence and knowledge as “very satisfied” or “satisfied.”

When asked to rate agreement with the statement “this course has prepared me to better understand the complex information related to emerging pandemics,” 86% of students (n = 31) “strongly agreed” with the statement while 14% (n = 5) of students “agreed” with the statement. Similar levels of agreement were shown with students’ ability to implement tools from this course into future work, and the value of this course as a clinician overall.

**Level 2 Results**

**Knowledge:** The mean score of knowledge quizzes was 90.5% (n = 51, standard deviation [SD] 0.89) showing excellent knowledge attainment. Students scored equally well in topics of clinical care, epidemiology, radiology, and PPE use.

**Confidence:** Our survey evaluated confidence in various domains of pandemic patient care. When surveyed about confidence in donning and doffing personal protective equipment, 100% (n = 36) of students rated “high” or “moderate” confidence in this task. Students also exhibited similar confidence in describing the epidemiology of

COVID-19, critically evaluating literature, and discussing mental health issues/resources (Figure 2). In contrast, only 47% (n = 17) of students rated “high” or “moderate” confidence in ventilator management, and only 72% (n = 26) students rated “high” or “moderate” confidence in medical management of COVID-19 patients.

**Level 3 Results:**

**Literature Appraisal**

All students submitted the literature appraisal assignment on time. Of the five points in the assignment, the average score was 4.99 (n = 51, SD 0.07).

**Simulation Session**

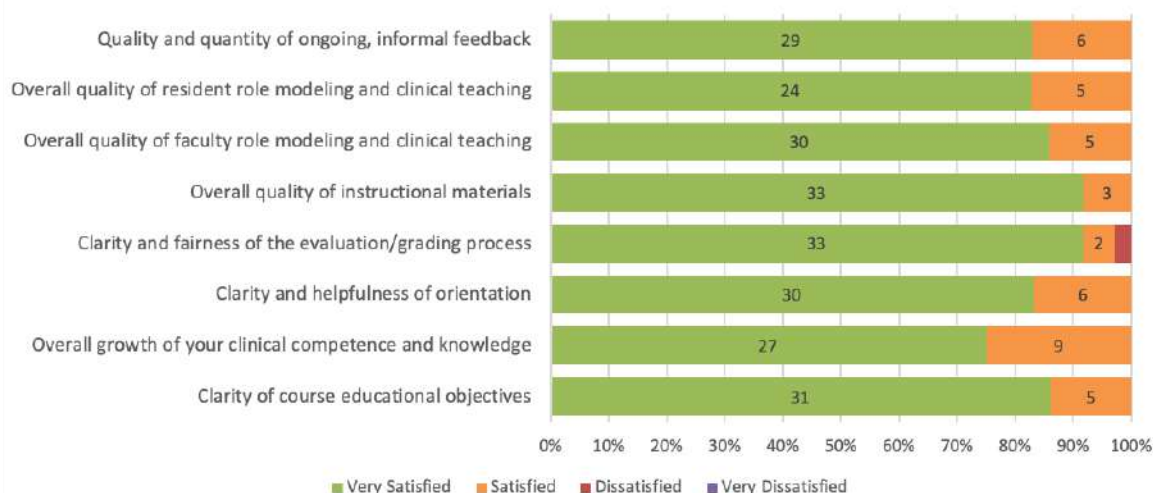
All 51 students participated in the COVID-19 patient simulation session. Due to various constraints, students participated in the session in groups of five. Because the simulation facilitator could not individually evaluate students, the critical actions checklist was applied at the group level. All groups either completed all critical actions or took time to debrief on the missed critical actions in the checklist.

**Standardized Patient Encounters**

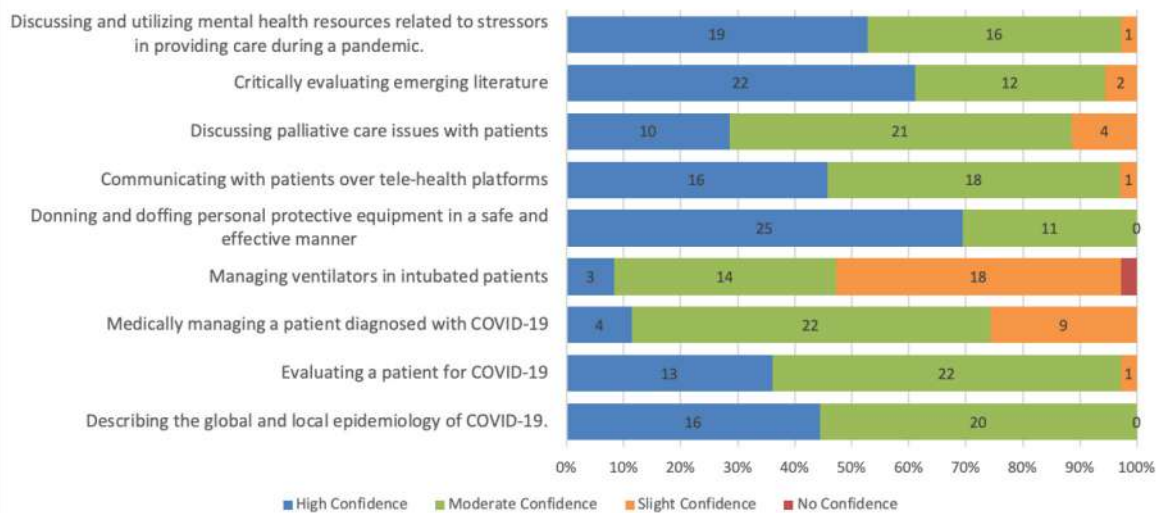
In groups of three to four, all students (n = 51) had the opportunity to interview standardized patients in mock telehealth Zoom encounters (Zoom Video Communications, San Jose, CA). Small-group facilitators applied the critical action checklist to the group interview and reported that groups either completed all critical actions, or missed items were debriefed after interviews.

**Discussion Board Participation**

All 51 students actively participated in various discussion board topics. To receive full credit, students were required to contribute meaningful comments to each discussion. The



**Figure 1.** Post-course survey responses related to student satisfaction in various instructional categories (n=36).



**Figure 2.** Post-course survey responses related to student confidence (n=36).

average score for all discussion board assignments was 4.97 (n = 51, SD 0.04). Based on review of these discussions, students were able to demonstrate the following behavior:

- Appraise ethical dilemmas in COVID-19 patient care
- Prepare scripts for discussing end-of-life care with patients
- Appraise emerging literature related to COVID-19
- Share various coping tools related to mental well-being of COVID-19 providers
- Serve Orange County, CA, through community service opportunities.

### Successes

Throughout the COVID-19 pandemic, medical students have expressed the desire “to be prepared to provide care,” while schools have struggled with “finding the best way to educate in the current climate.”<sup>8</sup> Our course provides a highly rated framework for addressing this vital need. Our results show that students were able to gain key knowledge in COVID-19 patient care, exhibit behaviors necessary to work effectively in the time of a pandemic, and were overall satisfied with the learning experience. To our knowledge, our course is the first to show positive outcomes in knowledge acquisition, student confidence, and behavior.

By designing an experience with a breadth of educational strategies, we were able to ensure continued engagement throughout our elective, which was delivered almost exclusively over remote platforms. Course discussion boards required social negotiation and collaboration to discuss complex problems. Because students were processing and synthesizing emerging COVID-19 data in real time with the medical community, our course leveraged educational strategies grounded in constructivist learning theory, which states that “knowledge is constructed by learners as they attempt to make sense of experiences.”<sup>9</sup>

This course provides a generalizable framework for the delivery of future COVID-19 related and pandemic preparedness curricula. While the various curriculum objectives can be easily modified to introduce emerging topics such as social media disinformation and vaccine hesitancy, our hybrid delivery method and education strategies have proven to be successful in helping learners from various levels explore topics in pandemic preparedness and care. This curriculum is also generalizable to future outbreaks of infectious disease on the local or international level. While this curriculum focuses on COVID-19 patient care, topics in epidemiology, telehealth delivery, ethics, palliative care, PPE, and appraisal of emerging literature are easily applicable to other pandemic preparedness situations.

### Challenges

Our evaluation did reveal some limitations in our curriculum. As described in our outcomes, students did rate lower levels of confidence in COVID-19 medical and ventilator management. This could be explained by the lack of clinical experience of most students in the class. The majority of students in the class were newly risen third-year medical students who had limited experience clinically in the hospital. General medical and respiratory management are skills learned after years on the medical ward.

Our pilot course also revealed weaknesses in some of our assessment tools. The average score of our literature and discussion board assignments were very high in our pilot cohort. While this can suggest very high engagement in our course activities, it also reveals that our assessment tools may have less validity in assessing academic attainment in the domain areas they were addressing.

## Next Steps

The UCI School of Medicine COVID-19 medical student elective was an effective and satisfying asynchronous experience for medical students at our institution. Next steps in full implementation include further integration of immersive experiences in COVID-19 patient care, including augmented and virtual reality, task trainers and hands-on work with ventilators. We also plan to evaluate our assessment tools in various reliability and validity measures to better assess knowledge and behavior in our cohorts.

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*Conflicts of Interest:* By the WestJEM 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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# Rethinking Radiology: An Active Learning Curriculum for Head Computed Tomography Interpretation

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Submission history: Submitted June 14, 2021; Revision received October 13, 2021; Accepted October 12, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.53665

**Introduction:** Head computed tomography (CT) interpretation is a vital skill for emergency physicians. Existing literature shows poor concordance between emergency physicians and radiologists in head CT interpretation. Prior studies have used passive learning methods to address this knowledge gap. We created an active learning curriculum for teaching head CT interpretation to emergency medicine (EM) residents and compared its effectiveness to a passive learning strategy.

**Methods:** We conducted a prospective, randomized controlled study of EM residents at a single institution. Three educational sessions were delivered over a three-month period via video conference. The active learning cohort (ALC) scrolled through head CT teaching cases we designed on Pacsbin, a web-based radiology picture archiving and communication system. The passive learning cohort (PLC) watched instructional videos that scrolled through the same cases. Both cohorts were given equal time to review the cases and ask an instructor questions. Residents took pre-intervention and post-intervention tests on head CT interpretation. We analyzed scores using paired and unpaired t-tests.

**Results:** Forty-two residents took the pre-intervention test. Mean pre- and post-test scores for the ALC were 43.8% and 59.0% ( $P < 0.001$ ), and for the PLC were 41.7% and 45.3% ( $P = 0.29$ ). The difference in ALC and PLC post-test scores was statistically significant ( $P = 0.009$ ) with a large effect size (Cohen's  $d = 1.34$ ).

**Conclusion:** Our active learning head CT curriculum using Pacsbin showed superior learning outcomes when compared to a passive learning strategy and required no additional time or resources. This intervention offers a more effective and learner-centric method for implementing radiology curricula in EM residency programs. [West J Emerg Med. 2022;23(1)47–51.]

## INTRODUCTION

Emergency physicians (EPs) must be able to identify life-threatening and time-sensitive findings on head computed tomography (CT) that require immediate action, often before a radiologist's report is available.<sup>1,2</sup> Learning to accurately interpret head CTs requires detailed instruction and repeated exposure to both normal studies and diverse pathologic findings, elements that are difficult to achieve in a time-restricted setting such as emergency medicine (EM) residency didactic conference. Perhaps unsurprisingly, head CT interpretation concordance between EPs and radiologists has been shown to be poor across a variety of practice settings.<sup>1-7</sup>

Prior studies addressed this knowledge gap using one-time didactic lectures or instructional videos.<sup>8-12</sup> However, demonstrating CT findings on single images poorly represents the cognitive work of identifying these findings in clinical practice.<sup>13</sup> Even if a lecturer "scrolls" through a CT, learners are unable to actively engage with the images. While we know that passive learning methods lead to poorer retention,<sup>14</sup> active learning curricula for radiographic interpretation have remained elusive. Despite a body of evidence supporting the benefits of active learning,<sup>15-22</sup> time and resource barriers exist to implementing these methods into residency didactic curricula.<sup>18-24</sup>



Pacsbin (Orion Medical Technologies, Baltimore, MD) is a web-based radiology picture archiving and communication system (PACS) that provides learners with a familiar platform to scroll through CTs, simulating the way they engage with imaging studies in clinical practice and providing a potential vehicle for active learning ([www.pacsbin.com](http://www.pacsbin.com)).<sup>25-29</sup> While practice cases on various PACS platforms have supplemented existing curricula,<sup>27-29</sup> no prior study has used this technology to directly compare active and passive learning strategies.

To evaluate this approach, we created an active learning-based curriculum using Pacsbin for teaching head CT interpretation to EM residents. Our objective was to compare the effectiveness of this active learning approach to a passive learning strategy within our didactic conference while maintaining resource neutrality in terms of time and access to instruction. We hypothesized that EM residents who learned head CT interpretation using our active learning curriculum would demonstrate greater diagnostic accuracy on a head CT interpretation test.

## METHODS

### Study Population and Design

This study was conducted at the University of California, Davis EM residency program and approved by our institutional review board. We used a convenience sample of first-, second-, and third-year residents at our institution. As this was a pilot study, we did not perform an *a priori* power calculation. After consent, residents took a pre-test of head CT interpretation and were subsequently randomized to an active learning cohort (ALC) or passive learning cohort (PLC). Three educational sessions (on intracranial hemorrhage, acute ischemic stroke, and increased intracranial pressure) were delivered monthly over a three-month period via Zoom conference (Zoom Video Communications, Inc., San Jose, CA). The ALC convened in a virtual breakout room where residents accessed head CT teaching cases on Pacsbin using their individual computers (cases in Supplement). Pacsbin simulates a radiology PACS, allowing learners to scroll through CTs (including axial/coronal/sagittal views), annotate images, adjust brightness and contrast, and access built-in links to instructional diagrams. Residents scrolled through head CTs guided by teaching points built into each case. After finishing the cases the ALC had a 10-minute, live question-and-answer (Q&A) session led by one of the investigators.

The PLC watched pre-recorded instructional videos in a live, synchronous fashion via video conference which was immediately followed by a 10-minute, live Q&A session. These videos scrolled through the same cases and explained the same teaching points the ALC received through Pacsbin. We controlled the length of these educational sessions using virtual breakout rooms with a pre-set time limit of 60 minutes. Residents took a post-test one month after the last session using the same questions on the pre-test. We tested the

data for normality and analyzed pre- and post-test scores using paired and unpaired t-tests.

### Head Computed Tomography Test and Active Learning Cases

We created a head CT interpretation test on Pacsbin and pilot tested it with three EM education and simulation faculty to collect content and response process validity evidence for the instrument. All faculty agreed the test cases represented critical knowledge and skills needed in EM and noted there was an appropriate range of difficulty. Faculty agreed the image quality was essentially identical to what we would encounter on our institution's radiology PACS. Feedback from faculty was used to revise the test. We reviewed and modified answer choices across all the questions to reduce potential construct-irrelevant variance from learners inferring correct/incorrect choices based on where they appeared.

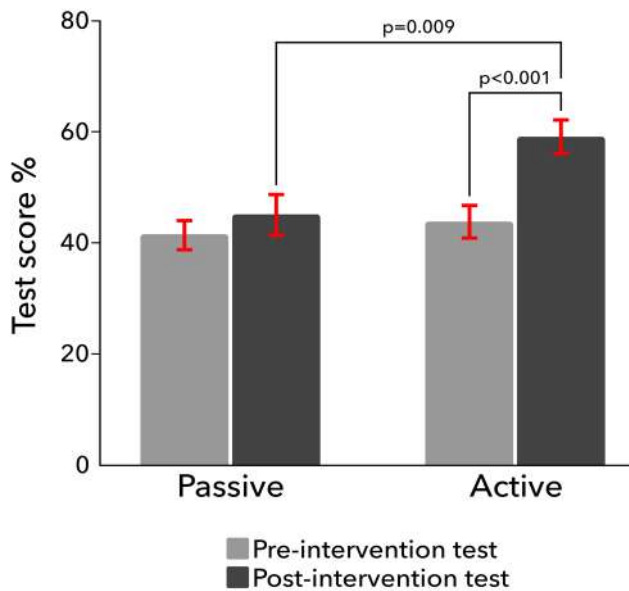
The test included cases with obvious pathologic findings as positive controls (e.g., classic "star" pattern of acute subarachnoid hemorrhage filling the basal cisterns, large acute subdural hematoma) and normal studies as negative controls. We built active learning modules on Pacsbin. Each module consisted of six to eight cases illustrating critical findings relevant to EM practice and normal comparisons. The modules guided the learner to incorporate predefined heuristics for identifying critical findings. The videos watched by the PLC presented the same heuristics and cases (test, modules, and videos in Supplement). The primary author completed four years of neurosurgery residency before switching to EM and used his expertise in head CT interpretation to develop the learning modules and heuristics.

## RESULTS

Forty-two residents took the pre-test. Twelve residents in the ALC and eight residents in the PLC completed all three educational sessions and took the post-test. Test score distributions passed the Shapiro-Wilk normality test. Mean pre-test scores and 95% confidence intervals (CI) were as follows: for the ALC 43.8% (CI: 38.0-49.5), and for the PLC 41.7% (CI: 36.5-46.8) ( $P = 0.62$ ). Mean post-test scores and 95% CI were as follows: for the ALC 59.0% (CI: 53.3-64.8), and for the PLC 45.3% (CI: 38.2-52.5) ( $P = 0.009$ ) (Figure). The score increase for the ALC was statistically significant using a paired t-test ( $P < 0.001$ ); however, it was not for the PLC ( $P = 0.29$ ). The effect size was large when comparing the ALC and PLC post-test scores (Cohen's  $d = 1.34$ ).

## DISCUSSION

While EPs do not need the same level of mastery in head CT interpretation as radiologists, they must be able to identify critical and time-sensitive findings, often before a radiologist's report is available.<sup>1,2</sup> This is particularly true in practice settings that do not have attending radiologists in house at all times.<sup>10,30,31</sup> Nonetheless, the skill of head CT interpretation



**Figure.** Pre- and post-intervention test scores for passive and active learning cohorts.

exists in a border region of knowledge domains between clinical specialties. As educators, this forces us to consider the complex issue that teaching one topic to sufficient depth can come at the expense of time for other topics in residency education. In this study, we designed an evidence-based and learner-centered solution for teaching head CT interpretation and found this was achievable within the time and resource constraints of our residency's didactic conference curriculum.

Active learning is rooted in constructivist learning theory and posits that learners build knowledge frameworks through active engagement with learning material.<sup>32</sup> Despite extensive evidence supporting active learning approaches, passive learning remains the dominant modality in most educational settings.<sup>14,19,21,22</sup>

Avoidance of active learning may be related to the perception that it requires extra time or resources; however, our intervention fit into an existing residency didactic conference schedule without requiring extra time either during or outside the session.

Our novel curriculum created active engagement by making learners scroll through head CT images themselves, setting the conditions for active learning and accurately reproducing the cognitive work used to identify these findings in clinical practice. This intervention embedded the didactic content into a Pacsbin and incorporated all the skills needed to correctly interpret a non-contrast head CT (e.g., manipulating window presets, brightness and contrast, and identifying pathologic findings in relation to key anatomic structures). This forced learners to interact with the didactic content in a way that is lost with lectures or videos. This approach to teaching head CT interpretation has not been previously described in the literature and represents an important step forward from the historical reliance on passive learning strategies to address this key content area.

We designed this study to specifically isolate the influence of passive vs active engagement with the learning material. Both the ALC and PLC were exposed to identical cases, embedded prompts, and questions. The two groups received identical amounts of time to review the material using Zoom breakout rooms to control length of exposure, and both received the same amount of time to ask clarifying questions. The crucial difference between the two groups was how they engaged with the learning material. The PLC watched videos where an instructor scrolled through cases whereas the ALC had to scroll through cases themselves. Given that all other learning conditions were controlled for, we hypothesize that making residents in the ALC search for and identify key findings on their own may have facilitated deeper knowledge encoding and greater improvement in diagnostic accuracy.

It is notable that the PLC did not significantly improve despite receiving the same content, teaching points, and heuristics. The videos watched by the PLC were made to be engaging, clear, and easy to follow. It is possible the videos' cognitive fluency produced an illusion of learning and robbed the viewers of effortful learning, leading to poorer retention.<sup>16,33-35</sup> In contrast, the ALC had to scroll through images and search for findings, which likely contributed to some degree of effortful learning. We realize that the three 60-minute Pacsbin sessions given to the ALC were insufficient to ensure complete understanding of all this content, despite showing improved performance compared to the PLC. However, this work serves as a proof of concept and a potential springboard for spaced repetition. After residents complete the initial modules, single cases can be delivered synchronously or asynchronously and completed in a shorter time frame. We suspect these subsequent cases might serve as booster inoculations, strengthening knowledge encoding and potentially improving scores on future tests.

## LIMITATIONS

This pilot study is not without limitations. We collected content and response process validity evidence for our head CT interpretation test; however, this evidence relied on expert (i.e., attending-level) opinion and might have been strengthened by incorporating junior learners. The intervention was conducted without an *a priori* power calculation and used a convenience sample of residents at a single EM residency program, limiting its generalizability. We used pre-recorded instructional videos as our passive learning control, which differ from traditional lectures and limit our results' generalizability. However, the videos allowed us to standardize the control intervention while providing some resemblance to lectures by being shown in live, synchronous fashion followed by a Q&A session. Our study also suffered from attrition, with 22 residents missing one or more educational sessions due to schedule conflicts. We nonetheless found a large effect size despite a relatively small sample, highlighting the potential impact of our intervention.

## CONCLUSION

Our active learning head CT curriculum using Pascbin led to greater diagnostic accuracy when compared to a typical passive learning strategy. We achieved this superior outcome while maintaining resource neutrality in terms of time and access to instruction. We believe this study adds to the landscape of active learning literature by demonstrating an effective way to strengthen radiology curricula in EM residency programs.

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**Conflicts of Interest:** By the WestJEM 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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# AAEM'S Response to the Yale PA "Residency Program"

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Submission history: Submitted May 8, 2021; Revision received May 8, 2021; Accepted June 22, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.6.53137

[West J Emerg Med. 2022;23(1)52–53.]

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Dear Editor:

We believe the letter to the editor by Tsyruunik et al<sup>1</sup> clarifying the initial manuscript "Implementation of a Physician Assistant Emergency Medicine Residency Within a Physician Residency" from December 2020 is an important marker and acknowledgment of a deep-rooted workforce issue that will plague emergency medicine (EM) for the entirety of its future. It also only scratches the surface. Indeed, in the aftermath of the EM workforce reports by the American Academy of Emergency Medicine (AAEM), and more recently the American College of Emergency Physicians, the AAEM Resident and Student Association is now advocating for an end to all postgraduate training programs for non-physician practitioners (NPP).<sup>2</sup>

There is currently a logic paradox that threatens the quality of patient care in the United States. More than 25 states now allow nurse practitioners (NP) to care for patients without any physician involvement.<sup>3</sup> This trend has now started for physician assistants (PA) as well and is rapidly gathering momentum in many state legislatures this year, coming on the heels of a global pandemic that saw many states relax supervision or collaboration regulations for both NPs and PAs.<sup>4</sup>

Both NPs and PAs have a fraction of the graduate medical education and training required for physicians to become independently licensed.<sup>5</sup> Already, many patients with Emergency Severity Index scores 1 and 2 are seen independently by a PA or NP, and this is an important context in which the Yale PA graduate program is situated.<sup>6</sup>

Whether or not the authors intended any political inferences to be drawn from their study, *WestJEM* readers and emergency physicians should be aware that they most certainly will be. The pressure on healthcare systems to do "more with less" is very real and a matter of survival for many. This will inevitably lead to consideration of replacing emergency physicians with NPPs, especially if they have

postgraduate education that is inferred to be equivalent. To describe physician assistants as "independent providers of patient care," as in the original manuscript, fuels the erroneous position that physicians and nonphysician practitioners are equivalent, and it was crucially important for the authors to clarify in their reply.

It is not fair to PAs and NPs to put them in the position of responsibility as independent practitioners because they do not have equivalent education and training to that of emergency physicians. The AAEM firmly believes that patients should have timely and unencumbered access to the most appropriate care led by a board-certified emergency physician.<sup>7</sup>

Additionally, words are of striking importance, and the language of a "Physician Assistant Emergency Medicine Residency" conflates a true residency for emergency physicians with that of additional, specific training for PAs who want to work in the EM environment. The AAEM, alongside multiple EM specialty organizations, opposes this language.<sup>8</sup> Moreover, we do not support a PA or NP taking part in procedures that would take away from a physician resident's education, nor do we support NPPs being trained in procedures that exceed the scope of their practice, such as procedural sedation, cricothyrotomy, and others.

The silver lining in the presumably unintentional ambiguous language of the original manuscript is that these issues have come to the forefront of conversation, and we appreciate the authors returning to the conversation to clarify that additional education and training short of the full, accredited education and training undertaken by physicians is insufficient for independent practice. The knowledge, skill sets, and hours of training for physicians are vastly different from those of NPs and PAs.<sup>9</sup> Physician resident education must be the highest priority for any graduate training program to ensure the highest quality team leaders in the evolving EM work force.

We hope that academic and non-academic emergency departments alike take note of these issues and recognize

the importance of physician-led patient care, as well as the threat to this care model that is being promulgated by the ongoing movement of NPPs to acquire independent practice in many states.

The safety of our patients is at stake.

Sincerely,

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*Conflicts of Interest:* By the *WestJEM* 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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# Response to AAEM's "Response to the Yale PA Residency Program"

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Submission history: Submitted June 23, 2021; Revision received June 23, 2021; Accepted June 23, 2021

Electronically published January 1, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.6.53820

[West J Emerg Med. 2022;23(1)54–55.]

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Dear Editor:

We appreciate the opportunity to respond to the letter to the editor in reference to our prior publications<sup>1,2</sup> and to clarify the concerns raised. It seems that we, the authors of the original article, and the author(s) of the most recent letter to the editor have common ground on many of the issues presented. We believe that all emergency patients should be cared for by emergency physician-led teams. We agree that the training of our physician residents cannot be compromised.

First and foremost, we are proud of all our trainees and of the collaborative educational programs we have developed. As we noted previously, our original publication<sup>1</sup> was “a brief innovation report,” meant to describe an educational innovation, and not intended to be interpreted as a comment on workforce challenges facing our specialty. In our original manuscript, we did not try to equate the graduating physician resident with a graduating physician assistant (PA) from our program but to make a comparison of milestone achievements after a year of postgraduate training. This point is made more explicit in the response to our original article: “We do not seek to equate the two programs or the skills of their respective graduates.”

The author(s) of the most recent letter to the editor claim that we promote PAs as “independent providers of patient care” in our manuscript. In fact, this language is from the background section of the paper and is quoting references<sup>3,4</sup> to establish the importance of postgraduate training for PAs. Our clarifying letter to the editor explicitly states the following: “1. Advanced practice providers (APP) in emergency medicine should work with the supervision of an emergency medicine (EM) specialty-trained physician. 2. Patients should be cared for by emergency physician-led teams in the emergency department.”<sup>2</sup>

The author(s) of the letter to the editor state that “More than 25 states now allow nurse practitioners (NP) to care

for patients without any physician involvement. This trend has now started for physician assistants (PA)...” While this deserves discussion and attention by relevant professional organizations and legislators, we do not see it as a mandate to halt educational programs. As educators, we believe that continuing medical education of all team members is essential to the safe care of patients regardless of professional degree.

The author(s) of the letter to the editor claim that the American Academy of Emergency Medicine (AAEM) and the American College of Emergency Physicians (ACEP) advocate an end to all postgraduate training programs for non-physicians. They cite an open letter published by a single author.<sup>5</sup> In fact, the ACEP “Workforce of the Future”<sup>6</sup> presentation lists “Support Standardized Training and Certification for APPs Working in the ED” as one of the ways to move forward in addressing the workforce issue facing EM. The Society of Academic Emergency Medicine (SAEM) and the American Board of Emergency Medicine (ABEM) are the lead organizations for this proposal.

An important detail we would like to address is the name of our program. Our original manuscript was submitted on July 13, 2020. Several organizations including ACEP and AAEM later called for the use of the term “resident” to be used strictly in reference to MD trainees. We have complied with this recommendation and our program has been renamed the “Yale Emergency Medicine APP Post-Graduate Training Program.”

As physician educators, we agree that the training of our EM residents should not be compromised. As is pointed out in our response publication, “due to our high ED patient volume, including multiple training sites, our physician trainees have not had a decrease in patient or procedure exposure.”<sup>2</sup> Caseloads and procedure logs are monitored carefully to ensure ample exposure and opportunity for our EM residents on a continuous basis.

The author(s) of the letter to the editor accurately note that many critically ill patients are seen by PAs and NPs in the ED. While we agree with the AAEM position that emergency patients should be cared for by board-certified emergency physician-led teams,<sup>7</sup> this does not negate the fact that all team members benefit from further training. The letter concludes this way: "the safety of our patients is at stake." In that spirit, we hope we can all agree that a patient-centered approach to healthcare delivery is aided by comprehensive instead of minimal training of all members of a physician-led team.

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*Conflicts of Interest:* By the *WestJEM* 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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# Punctuated Equilibrium: COVID and the Duty to Teach for Adaptive Expertise

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Section Editor: Jeffrey Love, MD

Submission history: Submitted November 1, 2021; Revision received November 1, 2021; Accepted November 26, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.55268

[West J Emerg Med. 2022;23(1)56–58.]

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Learning is critical to developing and maintaining competence. Learning is slow at the beginning, accelerates rapidly as we gain skills and knowledge, and then slows again as we achieve competence and approach expertise. Rapid periods of expansion of ability and understanding alternate with stages of relative inertia. We may at times focus on routinization, the repetitive effort by which we standardize aspects of our practice, producing a steady practice state that is efficient and systematic. At other times, however, patients and systems demand a more dynamic approach to learning.

This notion of dynamic expertise requires emergency medicine (EM) practitioners to continually adapt; the very nature of EM requires it. If a practitioner does not exert at least some adaptive effort in response to pressures, expertise erodes and, in extreme situations, a competency threshold may be breached.<sup>1</sup> In practice, maintenance of competency looks similar to evolution – periods of static equilibrium where little adaptive energy is required punctuated by intense periods of exploration or expansion of skills. At no time has this become more evident than during the COVID-19 pandemic.

COVID-19 has disrupted our equilibrium, dictating rapid evolutionary advances in our EM knowledge and skills. The fault lines in our expertise have been laid bare and our individual and organizational adaptability tested to the point of near breaking.<sup>2–5</sup> Systems and individuals alike have had to flex their adaptive expertise in the face of this strain. Emergency physicians rapidly developed new methods of patient assessment, intubation, ventilation, and critical care to name but a few.<sup>6–9</sup> There has been rapid dissemination of innovation, with the worldwide medical community quickly

sharing, learning, and adapting to address the crisis on the patient and system levels.<sup>10</sup> We have developed, out of necessity, a type of expertise in which the EM expert is newly facile with innovation, flexibility, and adaptability.<sup>11–13</sup>

Emergency physicians know intuitively that one size does not fit all. Every day brings novelty and complexity. COVID-19 taught us new lessons in adaptive expertise, yet as EM educators we may not think intentionally about training our learners and ourselves in becoming adaptive experts able to maintain competence in the face of disruptive pressures.

To promote the type of adaptive expertise that allows emergency physicians to be innovators and lifelong learners, it is important to teach not just EM facts, skills, and procedures. We also need to provide our EM learners with the mindset and ability to be adaptive.<sup>14</sup> In other words, our learners should be encouraged to develop “the ability to learn new information, make effective use of resources, and invent new procedures in order to support learning and problem solving in practice.”<sup>15</sup> The adaptive lens emphasizes learning that occurs with awareness of the complexity of context, and encourages learners to become aware of new features as well as recognizing old features (Table 1).<sup>16</sup>

A number of learning conditions or contexts facilitate a trainee’s preparation for adaptation. Many of these will be familiar to the emergency physician (Table 2). For example, learning from a *wide range of examples* allows for the recognition that although illness scripts may represent the typical case of a given condition, no illness or condition is without variability. “If you’ve seen one case, you’ve seen one case” often rings true. By experiencing not just repetition but

**Table 1.** A comparison of traditional teaching methodology with teaching for adaptive expertise. Teaching for adaptive expertise may not replace more traditional teaching methods in all cases but ought to be built into emergency medicine training early and often.

Parameter	Traditional method	Teaching for adaptive expertise
Emphasis	Efficient learning of well-known illness scripts and prototypic examples	Developing expertise that can match any variation or situation that is presented
Unit of Adaptation	Environment is adapted to the learner	Learner learns to adapt to the environment
Learning support	Allowing learners to gain full confidence within their comfort zones	Give learners approaches for adapting outside their comfort zones
Progression	Progressive withdrawal of learning supports as learners near competence	Progressive addition of adaptive behaviors
Endpoint	Full withdrawal of learning supports at competence.	No endpoint – coaching long-term for continued improvement, innovation, and adaptation

**Table 2.** Conditions that optimize learning for adaptive expertise.

Conditions for learning adaptive expertise:	Examples:
Learning from a wide range of examples	Exposure to a variety of patient and illness presentations, varying in context and severity, repeated over time
Challenging learners to develop new approaches	Encouraging learners to identify gaps in their understanding and to step beyond their comfort zones, intentionally building, testing, and applying new approaches to even familiar conditions <sup>17</sup>
Encourage deep mechanistic understanding	Returning to first principles when considering how and why a condition may present in varied fashion. Asking “What if...?” and “Why?” when faced with routine problems.
Learning through repeated opportunity for application of both routinization and innovation	Alternately seeking to improve efficiency, apply innovation, and attend to the balance between them. “Is this the wheezing patient that requires a bespoke solution?”

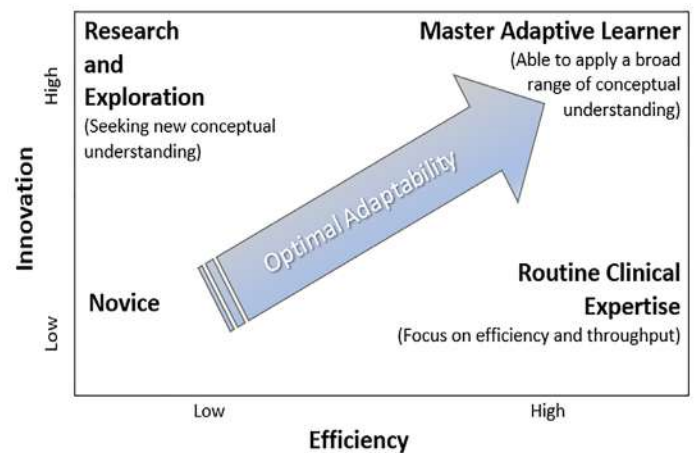
varied repetition, the adaptive clinician learns how to deal with not just rare cases but also the “not-yet-encountered”

variants. The learner understands to trust their instinct, but to be aware of atypical presentations or complexities of illness that require new or adapted approaches to diagnosis or treatment. As faculty we can ask the learners to identify the uniqueness of each patient case and to approach care with flexibility and inquiry.

Further, as we train residents we have a tendency to scaffold their learning, risking keeping them in their comfort zone. To develop adaptive expertise, it can be helpful to pull residents outside their comfort zone, *challenging them to develop new approaches* to situations. Through this process they develop flexibility to match whatever a situation presents.

Another method of optimizing for adaptation is to encourage a *deep mechanistic understanding* of illness to be able to approach new patient presentations. Through this deep understanding the learner may step beyond usual recipes to innovate new approaches. In patients with COVID-19, application of routine ventilation strategies was quickly shown to be inadequate. A mechanistic understanding of pulmonary function allows recognition of potential optimal ventilation strategies and patient positioning when confronted with the striking differences required in COVID-19 management.

Finally, to recognize how to balance adaptation and efficiency, learning must contain *opportunities for application* of each. It does little good to emphasize efficiency only in routine cases or to emphasize innovation only in unusually complex scenarios. As residents focus on patient volume and flow, they may lose their deeper learning of mechanisms, variability, and clinical curiosity. Educators do well to highlight opportunities to innovate even in relatively mundane situations, and to identify opportunities to practice efficiency even in highly complex cases. In this way, EM learners can be positioned in the so-called “optimal adaptability corridor,”<sup>15</sup> being able to appropriately balance routinization with innovation, a skill unto itself (Figure).



**Figure.** The balance of routine expertise (efficiency) and adaptive expertise (innovation) bound the optimal adaptability corridor (adapted from Bransford et al.<sup>15</sup>).

It should come as no surprise that these conditions – a wide range of examples informed by a deep mechanistic understanding and an opportunity to explore both innovation and efficiency – sound familiar to the emergency physician. During COVID-19, EM practice moved from routine to adaptive expertise.

If we can now remain intentional about training for adaptability, it is possible that EM training programs *can be* the shining examples of training for adaptive expertise. As a maturing field, EM has retained its penchant for cutting edge innovation and its deserved reputation for flexibility and adaptability. As we continue to digest the worldwide response to the individual and system stressors brought about during the ongoing pandemic, it is not too soon to begin to celebrate the adaptability that EM has demonstrated. As educators, however, we need to focus on how we will teach for adaptability to ensure our learners are prepared for whatever the next disruptions will be. There must be room in our educational models for both business as usual (and how to do business as usual better), and for exploration beyond the bounds of what is usual. We believe that emergency physicians are well equipped to set the standard for learning the personal and organizational capacity for adaptability.

As we consider the training of future adaptive experts, we must recognize that their expertise will include negotiating the balance between compiled routine expertise (efficiency) and reflective, disruptive and on-demand expertise (innovation), and the ability to identify when to toggle between them (adaptability).<sup>18</sup> Our training mindset must continue to mirror these processes: nimble, flexible, and responsive to the changing needs of our health systems and our learners. When the system strains under stress, this adaptive expertise becomes not just admirable, but necessary.

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*Conflicts of Interest:* By the WestJEM 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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# Education Research Training for Academic Emergency Medicine Educators

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Electronically published December 17, 2021

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.9.54152

[West J Emerg Med. 2022;23(1)59–61.]

## INTRODUCTION

This special issue of the *Western Journal of Emergency Medicine*, co-sponsored by the Council of Emergency Medicine Residency Directors (CORD) and the Clerkship Directors in Emergency Medicine (CDEM), serves as a snapshot of the current state of emergency medicine (EM) education research and focuses on relevant topics published by a diverse group of education scholars. Our field has seen marked increases in scholarship, publication venues, funding, and training opportunities for EM education research over the past decade.<sup>1-3</sup> However, a lack of expertise in education research is still one of the main perceived barriers to educators reaching their scholarship goals.<sup>4-6</sup> Educators who are new to research may not be aware of avenues to access the training, collaboration, and mentorship they need to achieve their

scholarship goals. These avenues are now myriad and include everything from do-it-yourself episodic training, either in the digital space or in person, to longitudinal doctorate degree programs. Our aim in this piece is to describe available options for faculty development in education research, presented in the below table, along with references for exemplar programs. This table may be used by educators, mentors, and department leaders to determine the best fit for individual faculty development needs.

## ACKNOWLEDGMENTS

The authors would like to thank the following education researchers for their critical review of this piece: Teresa Chan, MD, MHPE; Jonathan Ilgen, MD, MCR; Nicole M. Deiorio, MD; and Jaime Jordan, MD.

**Table 1.** Opportunities for faculty development in education research.

Type	Description	Unique considerations (benefits/drawbacks)	Examples
Podcasts	Audio recordings of conversations or presentations about education research	Benefits those who prefer audio media, allows flexibility, may be accessed while doing other activities, allows the listener to feel connected to experts in the field and builds a sense of community.	KeyLIME podcasts <sup>7</sup> Hot Topics in Med Ed Podcasts <sup>8</sup>
Blogs	Web-based repository for resources and discourse about education research	Convenient and searchable, may be peer-reviewed or crowd-sourced. Media may include articles, podcasts, videos, infographics, and discussion forums. Quality and accuracy may be variable.	ICE blog <sup>9</sup>
Webinars	Broadcast or recorded web-based training sessions that may be stand-alone, or part of a series	Often can be watched asynchronously, which adds flexibility. Lower cost than conferences. Scalable for a large number of learners.	AMEE Webinars <sup>10</sup> GWU Education Research Modules <sup>11</sup> CAEP Education Scholarship Committee Workshops <sup>12</sup>
Digital conversations	Digital platforms (such as twitter, WhatsApp, Slack) allow organizations to host scheduled discussions centered on education research	Because conversation occurs in real time, digital platform chats can allow researchers access to expertise and promote networking and community.	Twitter #MedEdChat series <sup>13</sup> Institutional educational community exchanges (Slack platform)

KeyLIME, Key Literature in Medical Education; ICE, International Clinical Educators; AMEE, Association for Medical Education in Europe; GWU, George Washington University



Table 1. Continued.

Type	Description	Unique considerations (benefits/drawbacks)	Examples
Episodic training	Intermittent sessions held at institutions, through national organizations, or at national education conferences	Flexible, and allows faculty to select sessions based on needs or interests. May be difficult to translate into action and lack benefits of longitudinal programming and developing a community.	Institutional Education Grand Rounds SAEM Education Summit <sup>14</sup> CAEP Education Academic Symposia <sup>15</sup> McMaster Health Professions Education Research (HPER) course <sup>16</sup> AAMC meeting and regional GEA workshops <sup>17,18</sup>
Certificate-type programs	Longitudinal programs, which may vary in duration and format, but provide an education scholarship curriculum	May result in more holistic training than episodic sessions, with increased ability to network and collaborate. Virtual or hybrid options may increase flexibility and decrease cost.	Institution-specific health professions education research certificate programs MERC, MERC at CORD <sup>19-21</sup> ALIEM Faculty Incubator <sup>22,23</sup> Harvard Macy Institute <sup>24</sup> ARMED MedEd <sup>25</sup>
Post-graduate fellowships	Dedicated 1-2 year experience after residency training and prior to a faculty position	Fellowships vary in structure, duration, and focus. Dedicated 2-year fellowships may include an advanced degree. Opportunities for experiential learning and close mentorship.	EM education research fellowships <sup>26,27</sup> Royal College of Physicians and Surgeons of Canada Area of Focused Competency (AFC) Clinician Educator Diploma Program <sup>28</sup>
Master's Degree Programs	Dedicated master's program that can be pursued at any point in career and confers a degree that is recognized externally	Options include MEd, MHPE, MEHP, MCR, MMed, and other master's degree options. Programs vary in duration, format, and flexibility, with increasing virtual and hybrid options. Benefits include cohort and mentorship.	FAIMER database for master's degree programs <sup>29</sup>
Doctorate Degree Programs	Dedicated doctorate program that can be pursued at any point in career and confers a degree that is recognized externally	Options include EdD, PhD, or other advanced graduate degrees. Highest level of training available. Programs vary in duration, format, and flexibility, some with virtual or hybrid options. Optimal for developing a program of research and mentorship.	FAIMER database for doctorate degree programs <sup>30</sup>

SAEM, Society for Academic Emergency Medicine; MERC, Medical Education Research Certification; CORD, Council of Residency Directors; ARMED MedED, Advanced Research Methodology Evaluation and Design in Medical Education; EM, emergency medicine; FAIMER, Foundation for Advancement of International Medical Education and Research

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**Conflicts of Interest:** By the WestJEM 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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## Faculty Recruitment, Retention, and Representation in Leadership: An Evidence-Based Guide to Best Practices for Diversity, Equity, and Inclusion from the Council of Residency Directors in Emergency Medicine

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Submission history: Submitted June 19, 2021; Revision received June 19, 2021; Accepted August 2, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.8.53754

Improving the recruitment, retention, and leadership advancement of faculty who are under-represented in medicine is a priority at many academic institutions to ensure excellence in patient care, research, and health equity. Here we provide a critical review of the literature and offer evidence-based guidelines for faculty recruitment, retention, and representation in leadership. Recommendations for recruitment include targeted recruitment to expand the candidate pool with diverse candidates, holistic review of applications, and incentivizing stakeholders for success with diversity efforts. Retention efforts should establish a culture of inclusivity, promote faculty development, and evaluate for biases in the promotion and tenure process. We believe this guide will be valuable for all leaders and faculty members seeking to advance diversity, equity, and inclusion in their institutions. [West J Emerg Med. 2022;23(1)62–71.]

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### BACKGROUND

Many academic institutions are prioritizing diversity, equity, and inclusion (DEI) in an effort to improve the recruitment, retention, and leadership advancement of faculty who are under-represented in medicine (UIM)\*.<sup>1,2</sup> Diversity in leadership provides many benefits, including the ability to reduce implicit bias in care, allow for diversity of thought and perspectives in institutional-level decisions, and improve visibility of UIM faculty who are frequently overlooked

and under-represented in positions of power.<sup>3</sup> Other benefits include understanding of social justice implications and improved student outcomes in the areas of professionalism, humanism, and cultural competency.<sup>4,5</sup> In emergency medicine (EM), where diverse pathology, patient populations, and workflows are inherent, DEI efforts are a vehicle toward excellence in patient care, research, and health equity.

In medical education, lack of a diverse faculty can impede residency recruitment efforts for UIM candidates.<sup>6–8</sup> Programs

\* Under-represented minority (URM) was a term defined by the Association of American Medical Colleges (AAMC) consisting of Black, Mexican-American, mainland Puerto Rican, and Native American (referring to American Indian and natives of Alaska and Hawaii) racial groups. In 2004 the AAMC expanded this definition to “under-represented in medicine” (URiM or UIM); UIM references those ethnic and racial populations in the medical profession who are under-represented relative to their respective numbers in the greater population. For consistency, we will use the term UIM, although we acknowledge the variable usage both in literature and in practice.

that demonstrate diversity through a higher percentage of UIM faculty had higher proportions of UIM residents.<sup>7,8</sup> However, recent data on residents from the 20 largest specialties over 11 academic years (2007-2018) found that no specialty represented either the Black or Hispanic populations comparable to the overall United States population.<sup>9</sup> In light of the critical role that faculty diversity plays in resident recruitment, optimizing patient care, and workplace culture, we sought to summarize the current literature and provide best practice recommendations for faculty recruitment, retention, and representation in leadership.

### CRITICAL APPRAISAL

This article is the seventh in a series of evidence-based best practice reviews from the Council of Residency Directors in Emergency Medicine (CORD) Best Practices Subcommittee.<sup>10-15</sup> With the assistance of a medical librarian, we searched MEDLINE via PubMed for articles published from inception to January 21, 2021, using robust and sensitive keyword variations that relied on PubMed's automatic term-mapping to apply the appropriate medical subheadings terms focused on diversity, equity, and inclusion (Appendix). We also reviewed the bibliographies of all relevant articles for additional studies. Articles were screened independently by two authors to evaluate for any papers addressing recruitment and retention for faculty. We included articles if either author recommended inclusion.

The search yielded 2080 unique articles, of which 70 were deemed to be directly relevant for inclusion in this review. When supporting data was not available, recommendations were made based upon the authors' combined experience and consensus opinion. The level and grade of evidence were provided for each best practice statement according to the Oxford Centre for Evidence-Based Medicine criteria (Tables 1 and 2).<sup>16</sup> Prior to submission, the manuscript was reviewed by the entire CORD Best Practices Subcommittee. It was subsequently posted to the CORD website for two weeks for review and feedback from the entire CORD community.

### RECRUITMENT STRATEGIES

#### Institutional Mission Statements

Diversity and inclusion should be part of every institution's mission statement to provide evidence of the explicit commitment to these principles as well as its importance to the advancement of health equity for the community.<sup>1,17</sup> Institutions need to be authentic to a mission of diversity and inclusion with action, not just rhetoric.<sup>18</sup> One radiology department created a departmental diversity web page as part of their recruitment efforts, which included an explicit statement of their diversity mission and videos from program leadership.<sup>19</sup> The University of Michigan tied diversity to its mission of academic excellence (referred to as the "Michigan Mandate") and allocated 1% of the university's budget annually for diversity initiatives. As a result of this,

**Table 1.** Oxford Centre for Evidence-Based Medicine Levels of Evidence.<sup>16</sup>

Level of evidence	Definition
1a	Systematic review of homogenous RCTs
1b	Individual RCT
2a	Systematic review of homogenous cohort studies
2b	Individual cohort study or a low-quality RCT*
3a	Systematic review of homogenous case-control studies
3b	Individual case-control study**
4	Case series or low-quality cohort or case-control study***
5	Expert/consensus opinion

\*defined as <80% follow up; \*\*includes survey studies and cross-sectional studies; \*\*\*defined as studies without clearly defined study groups.

RCT, randomized controlled trial.

**Table 2.** Oxford Centre for Evidence-Based Medicine grades of recommendation.<sup>16</sup>

Grade of evidence	Definition
A	Consistent level 1 studies
B	Consistent level 2 or 3 studies or extrapolations* from level 1 studies
C	Level 4 studies or extrapolations* from level 2 or 3 studies
D	Level 5 evidence or troublingly inconsistent or inconclusive studies of any level

\*\*"Extrapolations" are where data is used in a situation that has potentially clinically important differences from the original study situation.

UIM matriculation doubled, UIM faculty markedly increased, and more UIM faculty were promoted to leadership positions and received tenure.<sup>20</sup>

#### Expand the Candidate Pool

Networking and peer support from other UIM faculty are essential to decreasing the sense of isolation and increasing satisfaction among UIM faculty.<sup>1,21,22</sup> A scoping review noted that the lack of a "critical mass" of UIM faculty was a deterrent to new UIM faculty applicants, further perpetuating the imbalance.<sup>18</sup> Modeled after the Rooney Rule in National Football League policy, one program required the inclusion of at least two qualified UIM candidates representing diversity in the applicant pool for each position and invited at least one of these candidates to participate in an on-campus interview.<sup>23</sup> In cases where there is little faculty diversity, the 2008 CORD Academic Assembly Diversity Workgroup recommended expressing that you are actively recruiting for



diverse racial and ethnic backgrounds as well as using the institution's local and community demographics to highlight the diversity of the patient population.<sup>24</sup> A 2011 survey found that medical student diversity was the strongest predictor of faculty diversity, highlighting the need to establish early pipelines and pathways.<sup>25</sup> The Center for Multicultural and Community Affairs (CMCA) at the Mount Sinai School of Medicine created a dedicated council in 2008 to improve coordination of outreach, recruitment, and retention activities of UIM physician and non-physician scientists by including representatives institution-wide to support efforts from pre-matriculation through postgraduate training.<sup>26</sup>

### Create Diverse Recruitment Committees

Recruitment committees should be composed of a diverse group of members and/or institutional diversity leaders (eg, Chief Diversity Officer, Assistant Dean of Diversity).<sup>1</sup> Diversity recruitment should be a joint effort between UIM and non-UIM faculty so that it does not unduly burden UIM faculty.<sup>18,22</sup> Responsibilities of a diversity-oriented recruitment committee are outlined in Table 3.<sup>1</sup> As part of a successful, multifaceted strategic plan to promote diversity at the University of Michigan Department of Surgery, a standing departmental recruitment committee was selected via nomination. Members were intentionally selected to ensure diversity with respect to gender, race, academic rank, and subspecialty. The committee identified a diverse pool of applicants that had been previously overlooked while maintaining faculty excellence.<sup>23</sup>

**Table 3.** Responsibilities of recruitment committees.<sup>1</sup>

1. Define diversity criteria for potential candidates.
2. Create a diversity statement.
3. Implement a strategic process for recruitment of diverse candidates.
4. Monitor the success of the recruitment initiatives.
5. Advocate for change throughout the institution.

Similarly, the Mount Sinai Diversity Leadership Council was established to promote diversity in faculty recruitment, retention, and development. Senior-level faculty representatives (Diversity Liaisons) from all departments were chosen to enhance faculty diversity and report diversity metrics (eg, trends, climate, faculty mentoring, advancement) to the Dean. They also developed specific departmental action plans under the guidance of department chairs and shared best practices for improving faculty diversity, retention, development, and advancement.<sup>26</sup>

### Incentivize Stakeholders and Create Accountability

Tracking institutional and departmental diversity metrics is necessary to set goals, identify effective strategies and opportunities for improvement, and incentivize success.<sup>26,27</sup>

This process could include tracking promotion, retention, and leadership positions among UIMs vs non-UIMs.<sup>27,28</sup> This could also include assessing the climate of inclusion with surveys, interviews, and focus groups to measure the prevalence of bias and discrimination and to document continued challenges, microaggressions, and other barriers to an inclusive workplace culture.<sup>27-29</sup> Institutional and departmental dashboards should include diversity and equity goals to monitor performance.<sup>1,30,31</sup>

Incentive bonuses, academic promotion, and eligibility to leadership positions for all faculty could be tied to participation in diversity and inclusion activities and performance metrics on diversity outcomes.<sup>32</sup> The Medical University of South Carolina developed an assessment tool for each department that included quantitative and qualitative variables (eg, UIM individuals recruited, grand rounds/seminars on diversity, UIM speakers, activities related to healthcare disparities and social determinants of health, and implementation of cultural competency training). Department chairs were required to complete the assessment annually, develop annual diversity goals, and report the results institution-wide, with end-of-year incentives tied to their results.<sup>33</sup>

External reporting of departmental and residency diversity compared with national data can be useful to rally support for recruitment resources.<sup>17,34</sup> Funding agencies (eg, the National Institutes of Health [NIH]) could consider an institution's demonstrated commitment to diversifying faculty when making funding decisions, particularly for diversity fellowships and grants.<sup>35</sup>

In the United Kingdom, the National Health Service (NHS) adopted a Workforce Race Equality Standard for all NHS organizations, requiring that they meet measurable improvement on nine diversity metrics, including adequate representation of UIM staff and senior leadership, UIM representation on organizational boards that reflect the demographics of the community, reductions in reports of discrimination, and annual open publication of progress.<sup>36</sup> This led to reduced discrimination reports and improvements in UIM promotion.<sup>37</sup> The Athena Scientific Women's Academic Network was created to increase representation and equity for women in science, technology, engineering, and medicine.<sup>38</sup> Institutions that improved gender parity were given awards, and in 2011 government funding from the National Institute for Health Research was restricted to those institutions.<sup>38</sup> This restriction of government funding led to improvements in career satisfaction, job opportunities, and professional development.<sup>38</sup> A similar model could be used for UIM faculty.

### Inclusive Marketing and Targeted Recruitment

Language, images used for marketing, and the process of disseminating promotional materials should be assessed for bias and barriers to UIM recruitment and include clear non-discrimination policies.<sup>27</sup> Links to diversity and inclusion web pages at the program, departmental, and institutional levels can be used to highlight current successes and future

goals.<sup>24,34</sup> Openings should be posted on the job sites of societies representing under-represented groups (e.g., National Hispanic Medical Association).<sup>23</sup> Social media can also be used to emphasize the institution's commitment and progress in DEI efforts and engage potential candidates.<sup>23,39</sup> Aggressive recruitment and hiring of competitive UIM candidates, even when the department is not engaged in an official search, can establish a culture that prioritizes resource allocation to faculty diversity.<sup>31,40</sup> Department chairs should use the network of diverse faculty, diversity committee members, and national conferences to identify potential candidates.<sup>40</sup>

### Recruitment Packages

Existing debt, compounded by salary inequities and lower rates of generational wealth, can impact career choices by UIM physicians.<sup>40-42</sup> One study found that UIM faculty were more likely to report needing to supplement their income vs non-UIM faculty.<sup>41</sup> This has led some UIM faculty to pursue non-academic positions and UIM physicians with significant debt to have greater attrition rates.<sup>21,41,43</sup> This suggests that debt reduction programs, which benefit all faculty, may result in reduced attrition rates for UIM faculty.<sup>41</sup> In fact, institutions should consider targeted funding initiatives and recruitment packages specifically for UIM faculty,<sup>17,44</sup> as medical school recruitment packages (eg, salaries, research and development resources, flexible work hours, and environment that promote growth and success) were found to be the primary factor in the recruitment of UIM faculty.<sup>31</sup> In 2004, one otolaryngology department created a multifaceted effort to actively recruit and retain diverse faculty, which included an evaluation of salary.<sup>45</sup> Over a 10-year period, they saw a significant increase in the percentage of women and UIM faculty, as well as the resolution of salary differences for women.<sup>45</sup>

### Holistic Review, Standardization, and Faculty Ambassadors

Faculty selection should employ a holistic review of candidate applications.<sup>19,30</sup> Holistic review emphasizes the need to assess characteristics that the institution values. For example, one group asked questions that were behavior-based on topics related to clinical practice, education, leadership, and diversity and inclusion (eg, "What do you see as the fundamental characteristics of an inclusive environment?").<sup>23</sup> They also sought to standardize the interview process by conducting group interviews for each candidate, having the same committee member ask the same question of all candidates, and using a standardized evaluation tool and scoring system.<sup>23</sup> Another group used faculty ambassadors, which connected a current UIM faculty member with faculty recruits from various departments during the interview process. The ambassador shared their experiences, discussed the work environment, the community, and social opportunities.<sup>33,46</sup> Following the interview, all candidates, hires, and committee participants should be asked to assess the overall strategy and provide feedback of the program.<sup>23,47</sup>

### Implicit Bias Training

Interviewees are subject to biases of the interviewer, particularly when assessing the "fit" of a candidate.<sup>48</sup> This can be particularly problematic for women and UIM candidates, with one study finding that fictitious resumes of Black candidates were rated more negatively than those of White candidates.<sup>49</sup> In surgical and procedure-based disciplines, even the evaluation of technical skills is subject to bias, impacting recruitment and advancement.<sup>23</sup> Therefore, it is important to engage in anti-bias training for interviewers,<sup>27,50</sup> with one program requiring its recruitment committee to complete the Implicit Association Test and an Association of American Medical Colleges (AAMC) online unconscious bias seminar.<sup>23</sup>

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#### Best Practice Recommendations:

1. The institutional and departmental mission statements should include an explicit commitment to diversity, equity, and inclusion. (Level 5, Grade D)
  2. Institutions and departments should make focused efforts to expand the candidate pool with diverse candidates. (Level 4, Grade C)
  3. Departmental and institutional recruitment committees should include diverse membership. (Level 4, Grade C)
  4. Institutions should incentivize all stakeholders and increase accountability for diversity efforts. (Level 3b, Grade C)
  5. Departments and institutions should engage in inclusive marketing and targeted recruitment of UIM candidates. (Level 3b, Grade C)
  6. Institutions should consider recruitment packages and debt reduction programs for UIMs and ensure equitable salaries (Level 3b, Grade C)
  7. Interview committees should use a holistic review of applications and consider faculty ambassadors. (Level 3b, Grade C)
  8. Interviewers should undergo implicit bias training. (Level 4, Grade C)
- 

## RETENTION STRATEGIES

### Establish a Culture of Inclusivity

Improving diversity cannot occur without creating a climate of inclusion that promotes cultural understanding and cultural competency.<sup>1,33,51</sup> The AAMC outlines a four-step process for assessing an institution's culture with reflective questioning, data collection, synthesis and analysis to identify barriers, and the creation and assessment of outcomes (Table 4).<sup>52</sup> Facilitated discussions on race and racism can create constructive dialogues to reduce prejudice and misinformation.<sup>1,22</sup> Faculty should undergo organization-wide training to identify and respond to structural racism, address personal biases (via implicit association testing and bias training), and have pathways of accountability for intolerance and discriminatory behaviors through effective formal channels (eg, human resources, supervisors, ombudsman).<sup>18,29,30,53</sup> The system must support individuals subjected to discrimination and reporters of

**Table 4.** American Association of Medical Colleges four-step process\* for assessing institutional culture.

Step 1: Reflective Questions	Begin the process of understanding diversity and inclusion in your institution by personal reflection on relevant criteria.
Step 2: Data Collection	Gather qualitative and quantitative indicators of diversity and inclusion at your institution.
Step 3: Synthesis and Analysis	Carefully identify the areas of strength and opportunities for development at your institution.
Step 4: Leverage Findings	Translate the products of your assessment into institutional outcomes through communication with stakeholders and institutional change agents.

\*Adapted from AAMC.<sup>52</sup>

discrimination who fear retaliation.<sup>29</sup> Institutional policies must also combat structural racism in evaluations, compensation, promotions, and leadership opportunities including annual reviews to assess for bias.<sup>22,29,54</sup>

### Address Unique Burdens of UIM Faculty

Faculty who are UIM experience differential treatment secondary to their race and ethnicity, impacting wellness, mental health, academic productivity, and increasing turnover.<sup>1,42</sup> They also describe feeling increased scrutiny and the need to represent the entirety of their race/culture with a pressure to be near-perfect in both clinical and non-clinical environments.<sup>22</sup> The lack of inclusion and recurrent microaggressions they experience or witness causes feelings of stress, anxiety, hopelessness, social isolation, and expendability.<sup>1,29,55</sup> To combat these, some experts have recommended wellness initiatives that specifically address the unique experiences and challenges of UIM faculty.<sup>22,42</sup>

These UIM faculty, especially junior UIM faculty, are often disproportionately asked to participate in administrative/committee responsibilities, volunteer in community settings, and mentor UIM students or residents relative to non-UIM faculty.<sup>18,43,56</sup> Although it is helpful for the institution to have UIM role models for trainees, this can undermine UIM faculty success and career development by decreasing the time available to participate in scholarly work that is more valued (eg, grants, publications) while balancing clinical work.<sup>1,40,57,58</sup> Diversity initiatives should not impose a “tax” on UIM faculty, but should be an institutional goal where all administrators and leaders are trained to recognize and address biases and are responsible for implementing diversity and inclusion initiatives. Educational value units or equivalent credit should also be created to recognize and reward diversity work via non-clinical time, career advancement, and financial compensation.<sup>31</sup>

While diversity has been lauded as a means to decrease healthcare disparities and provide a pool of physicians to care for underserved patients, UIMs should not be selectively steered or expected to care for underserved populations. The medical workforce as a whole should share responsibility for meeting the healthcare needs of the underserved. The repetitive mention in the literature of UIM physician service commitment to vulnerable populations reinforces a narrative that may limit UIM practice, research, and leadership opportunities.<sup>4</sup> Similarly, the argument for physician-patient concordance creating better healthcare outcomes may limit UIM physicians’ ability to practice in all regions and may lead to the perception that similar benefits would be seen with non-UIM physicians (eg, White patients would receive better care from White physicians).<sup>4</sup> Therefore, it is important to support UIM faculty interests and avoid making assumptions about their preferred patient populations or fields of research.

### Institutional Diversity Leaders

Many institutions have introduced a Chief Diversity Officer (CDO), whose responsibilities include initiating, developing, and ensuring compliance with institutional and federal diversity strategies. The CDO may also promote health equity research, ensure equitable sourcing of vendors, support affinity marginalized groups, and address disparities in the patient experience.<sup>31</sup> To be effective this individual must have the power and influence to enact change.<sup>59</sup> Creating a CDO position without institutional diversity efforts has not been shown to significantly impact faculty diversity.<sup>60</sup> In addition to the CDO position, institutions should consider assistant/associate deans of diversity. The Medical University of South Carolina created a diversity office staffed by a senior associate dean for diversity, an associate dean for resident inclusion and diversity education, a manager for recruitment, and a manager for diversity initiatives.<sup>33</sup> A radiology department created a Vice Chair of Diversity as part of its efforts to increase diversity. They also collaborated frequently and directly with the institution’s Office of Diversity and Associate Vice Dean of Diversity.<sup>19</sup>

### Leadership and Academic Advancement

While racial/ethnic minorities consist of 40% of the US population, UIM physicians comprise only 9% of medical school faculty and 18% of medical students.<sup>3,61</sup> Although data from the AAMC shows that UIM representation has increased over time, UIMs are less likely than their non-UIM colleagues to be promoted from assistant to associate professor and from associate to full professor.<sup>42,62,63</sup> Over a 10-year period, the probabilities of promotion were lower and probabilities of attrition were higher for UIM faculty and women.<sup>41</sup> UIM physicians are less likely to hold administrative leadership positions in various departments,<sup>3,64-66</sup> serve as program directors,<sup>67,68</sup> receive NIH research awards,<sup>3</sup> grants,<sup>26</sup> and receive tenure<sup>69</sup> than their non-UIM peers. Even after adjusting for tenure status, degree, gender, and NIH award status, UIM



faculty have significantly longer time to promotion when compared to their White counterparts.<sup>1</sup> Therefore, it is critical to ensure UIMs are advanced equitably and to assess for bias in the promotion and tenure process. Transparency regarding the criteria for promotion, a systematic plan to address disparities in promotion, and consistent mentoring of UIM faculty to meet these criteria is also necessary.<sup>1</sup> Additionally, UIM faculty should be sought out for new leadership positions and all institutions should prioritize a diverse leadership team.<sup>69,70</sup>

### Faculty Development Programs

A 2012 study found that only 29% of medical schools had faculty development programs specifically targeted to UIM faculty.<sup>62</sup> Effective faculty development programs should be institution-wide, rather than just select departments and divisions.<sup>17</sup> One institution created an institution-wide diversity program with structured individual mentoring to UIM faculty, specific professional development opportunities, social events, and salary support for scholarly endeavors, which led to an increase in the percentage of UIM faculty from 4% to 7%.<sup>62</sup> Another institution initiated a strategic plan to increase diversity among its students, resident physicians, and faculty, which involved an expansion of pipeline and mentoring programs (ranging from high school to faculty), and nearly doubled the number of UIM faculty.<sup>33</sup> One medical school sponsored educational programs for faculty leadership development, including programs specific to UIM faculty resulting in a doubling of the number of UIM faculty.<sup>71</sup>

The Harold Amos Medical Faculty Development Program (AMFDP), a national program of the Robert Wood Johnson Foundation, was instituted to support academic physicians from historically disadvantaged backgrounds to promote faculty diversity and address health inequity. In a study using the 2003-2008 application period, scholars (individuals who were funded by AMFDP) and non-scholars (individuals who completed final-round interviews but were not funded) were compared. Scholars and non-scholars had similar levels of academic productivity with no differences in publications, federal grant awards, or federal grant dollars. However, scholars were more likely to report attaining a leadership position, earning a promotion to associate professor or higher, and remaining in academic medicine.<sup>3</sup>

Institutional support to help UIM junior faculty, particularly clinician-investigators, can be accomplished by creating internal faculty development programs, institutional minority faculty development awards, and salary support/protected time as the faculty member awaits independent funding.<sup>40</sup> Programs should have formal didactics on teaching, manuscript writing, preparation of grant applications, leadership, and training in additional areas critical for research (eg, biostatistics).<sup>31,35</sup> Guidance on negotiation, grants management, mentoring, and work-life balance is also beneficial.<sup>3</sup> The Mount Sinai CMCA established a Faculty Scholars Program that engaged over 60 junior faculty in formal research training and academic development programs. Fourteen of the scholars ultimately

participated in a sponsored Master of Science in Clinical Research or Master of Public Health program.<sup>26</sup>

### Local Mentorship and Sponsorship

A qualitative study of UIM pediatric emergency physicians underscored the need for early mentorship and opportunities to enter a leadership pathway.<sup>22</sup> However, there has been a dearth of UIMs in academic medicine to serve as mentors and role models.<sup>21</sup> Both UIM and non-UIM faculty should receive mentor training and serve as mentors for UIMs.<sup>32</sup> Another qualitative study of Black students emphasized the importance of having both UIM and non-UIM mentors.<sup>55</sup> In the strategic plan for diversity by the Medical University of South Carolina, each department developed a mentoring plan, identified a mentoring champion as a liaison to the Dean's Office, and paired junior faculty members with senior faculty for academic and professional development.<sup>33</sup> Senior faculty are instrumental for mentorship, and inclusion on grants can help advance a UIM junior faculty's career and potential for future grants.<sup>43</sup> Jeffe et al found that mentored K awardees had higher rates of retention and promotion. There was also a greater likelihood of promotion among assistant professors who received NIH awards.<sup>41</sup> Therefore, it is important to support and mentor UIM clinician-researchers.

Non-UIM faculty more commonly receive sponsorship (senior members who amplify and promote junior members) than UIM faculty.<sup>18</sup> In a study of women faculty in medicine, women were less likely to be nominated for awards or new positions with UIM women most negatively impacted. The authors posited that social circles and familiarity created a perpetual culture of nominating the same White males for opportunities.<sup>72</sup> Thus, diversity councils and diversity champions who have both resources and influence are necessary to support UIM faculty retention and career advancement.<sup>18</sup>

### Promote National Organization Membership

In semi-structured interviews of women in academic emergency medicine at various stages of their careers, active participation in a national, woman-focused organization was found to engender opportunities and relationships that facilitated leadership. Membership increased access to mentors and sponsors, enabled scholarly work via peer mentorship and collaboration, assisted with navigating through barriers and bias, presented opportunities for awards, recognition, and speaking engagements, and cultivated a sense of belonging.<sup>73</sup> Similarly, a survey of members in the Academy for Diversity and Inclusion in Emergency Medicine within the Society for Academic Emergency Medicine found that participation led to more publications, didactic presentations, grand round presentations, and mentor/mentee relationships.<sup>74</sup> The Association of Black Cardiologists aims to promote diversity, boost collegiality in the field, and promote health disparities research and interventions. Through its scholarships, this group was able to partially fund cardiology subspecialty training for 44 Black cardiologists.<sup>75</sup>



The Academic Pediatric Association (APA) Research in Academic Pediatrics Initiative on Diversity (RAPID) is sponsored by the NIH National Institute of Diabetes and Digestive and Kidney Disorders. It is the first research-education program aimed at the successful recruitment, retention, and professional advancement of diverse early-career faculty in general academic pediatrics who are pursuing research careers. The RAPID key components include small research grants for young investigators, mentoring with faculty from the National Advisory Committee, networking at the annual Pediatric Academic Societies meeting, and career development at the annual two-day RAPID conference. The conference discusses research skills such as grant writing, publishing, presenting at national meetings, recruiting minority patients, and implicit bias, and addresses the unique challenges of minority faculty. There are also monthly conference calls to discuss research progress as part of a peer network. These RAPID scholars produced 56 publications and presented nationally. Participants felt the program helped them attain additional funding, NIH awards, and grants, and amplified their career trajectory. As participants were required to join the APA, it also increased the diversity of the national organization.<sup>76</sup>

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#### Best Practice Recommendations:

1. Establish a culture of inclusivity. This should include cultural competency and bias training, as well as initiatives to identify and address discrimination. (Level 3b, Grade B)
  2. Avoid overusing UIM faculty for administrative and mentoring positions and ensure that UIM faculty are properly supported and recognized for their contributions. (Level 3b, Grade C)
  3. Create institutional diversity leadership positions, such as a Chief Diversity Officer or Assistant/Associate Dean of Diversity, that are backed by institutional support. (Level 3b, Grade C)
  4. Ensure UIM faculty are promoted appropriately and evaluate for biases in the promotion and tenure process. (Level 3b, Grade C)
  5. Create faculty development programs specifically focused on UIM faculty. (Level 3b, Grade B)
  6. Pair UIM faculty with both UIM and non-UIM mentors. Leaders should sponsor qualified UIM faculty for opportunities. (Level 3b, Grade C)
  7. Promote and support engagement with national organizations. (Level 3b, Grade B)
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#### LIMITATIONS

While we used a comprehensive search methodology, it is possible some pertinent articles may have been missed in the current review. However, we sought to minimize the risk by reviewing all related studies in the bibliographies of included articles, using content and topic experts and undergoing pre-submission review and approval by the CORD community.

Another limitation is the paucity of interventional studies and those focused on EM specifically. When robust, EM-specific data was not available, we used studies from other medical specialties, health-related professions, and expert opinions. Thus, some proposed recommendations may not be as effective for EM, and further studies are needed to ensure pertinence to EM.

#### CONCLUSION

Recruitment, retention, and advancement of UIM faculty are critical to increasing diversity, equity, and high-quality clinical care and trainee education within emergency medicine. This paper summarizes key strategies and provides best practice recommendations. We hope this manuscript will inform readers on how best to promote each of these components.

#### Appendix. Search strategy.

((((medical education OR meded[tiab]) AND (recruitment OR recruit\* OR retention[tiab] OR retain\* OR pipeline)) AND (diversity OR diverse OR inclusive OR underrepresented OR minority OR minorities OR ethnic OR ethnicity OR ethnicities OR racial OR race OR tokenism OR token[tiab] OR Black OR Asian OR Blacks OR Asians OR Puerto Rican OR Mexican American OR Native American OR American Indian OR Alaskan Native OR Hawaiian OR African American OR Hispanic OR Latino OR Latinx OR Latina)) AND (physician OR doctor OR trainee OR residency OR trainees OR residency OR interns OR intern OR faculty))

#### ACKNOWLEDGMENTS

We would like to thank the Council of Residency Directors in Emergency Medicine for its support of our committee and this project. We would also like to thank Samantha Kaplan, PhD for her assistance with the literature search.

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**Conflicts of Interest:** By the WestJEM 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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# Making Our Preference Known: Preference Signaling in the Emergency Medicine Residency Application

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*Section Editor:* Jeffrey Love, MD and Danielle Hart, MD

Submission history: Submitted July 1, 2021; Revision received October 29, 2021; Accepted October 28, 2021

Electronically published December 17, 2021

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.53996

[West J Emerg Med. 2022;23(1)72–75.]

The number of applications to individual emergency medicine (EM) residency programs has markedly increased over the past decade.<sup>1-3</sup> As a result, residency programs have difficulty reviewing applications holistically and struggle to identify applicants who are truly interested in their program. These challenges were exacerbated by the COVID-19 pandemic: programs received more applications; and away-rotation restrictions limited EM applicants' ability to express, and programs to identify, interest in a residency program or geographic region.<sup>2</sup> Additionally, the Association of American Medical Colleges reported a concern for maldistribution of interview offers to the highest tier applicants, leaving other well-qualified students with a paucity of interviews – a trend that would threaten the success of the Match for all stakeholders.<sup>4</sup>

The graduate medical education community has made several proposals and implemented innovations in the residency application process in an attempt to help programs identify best fit applicants with the highest likelihood of matching into their program. Some of these innovations, such as the Standardized Video Interview in EM and the required secondary application essay in otolaryngology (ENT), proved ineffective.<sup>5,6</sup> Other practices, such as application filter use, increasing costs per application, implementing caps on applications or interviews, and early or phased cycle matches potentially exacerbate existing inequities for applicants, particularly those who are under-represented in medicine,

financially disadvantaged, or lacking mentorship.<sup>7-9</sup> One new innovation, preference signaling (PS), has the potential to be fair and equitable for all applicants as well as low cost and low effort for both residency programs and applicants alike.

Preference signaling is a concept rooted in game theory and developed in labor economics to address the challenge of employers not being able to perform a detailed analysis of all potential applicants and aiding them with identifying high-yield employee prospects. Preference signaling allows applicants to assign virtual “tokens” to their most desired employers, providing applicants the opportunity to communicate their interest, and employers the ability to focus their attention on these most “serious” applicants.<sup>10</sup>

While used by the American Economic Association since 2006, PS only recently gained attention in the residency application process. It was first proposed in the orthopedics and ENT literature in 2017 and 2018, respectively, followed by a promising computer simulation model by ENT in 2019, and implementation by ENT during the 2020-2021 application season.<sup>11-14</sup> During the 2020-2021 application season, each applicant to ENT was able to assign five allotted tokens to desired programs via the Otolaryngology Program Directors Organization (OPDO) website over a two-week period, after which their list was finalized. The OPDO then distributed the lists to individual programs on the same day that the Electronic Residency Application Service (ERAS) opened for

application review by programs.<sup>15</sup> Table 1 shows unpublished preliminary data from the ENT 2020-2021 trial.<sup>14,16</sup> Urology implemented a similar PS program for the 2021-2022 residency application cycle via the American Urologic Association website.<sup>17</sup> Internal medicine, general surgery, and dermatology have also implemented PS in the 2021-2022 residency application cycle as a component of a supplemental application through ERAS.<sup>18</sup> Applicants and programs for all participating specialties have the ability to opt out of PS.<sup>15,17,18</sup>

If managed by a reputable national organization, PS in EM could credibly increase transparency in a process that is high stakes for both applicants and programs, allowing applicants to define program and geographic preference and programs to identify more seriously interested applicants in an equitable manner.<sup>11,19,20</sup> It has the potential to provide lower quartile applicants more visibility, when they may otherwise be filtered out of consideration due to low board scores, geography or other factors, and may over time curtail some of the overapplication behavior should applicants discover favorable responses at signaled programs.<sup>16,19</sup> Preference signaling may also attract programs' attention to applicants previously thought to be "out of their league" and not viable matches.<sup>21</sup> Allowing the ability to signal preferences with the initial application might also cut down on the amount of time spent on extra applicant communication, such as time spent by applicants drafting emails to specific programs delineating interest, and time spent by program leadership and coordinators responding to those communications. Additionally, it stands to reason that as more applicants receive and accept their most desired interviews (rather than accept offers from less-desired programs), it would potentially relieve interview congestion, opening earlier interviews to middle- and lower-tier

applicants.<sup>13</sup> Similarly, programs could more efficiently assign interview invitations to higher probability matches, potentially reducing interview cancellations.<sup>11</sup>

Some reasonable concerns have been raised about PS. Preference signaling may not actually decrease the number of applications from students.<sup>21,22</sup> By forcing an expression of preference early in the season, PS may disadvantage applicants who may be unclear regarding which programs are a good fit or wish to find their fit in programs during the interview process. Similarly, applicants may change their preferences during the season but would not have the opportunity to reassign their tokens. Programs may hold bias against applicants that do not assign them a token, potentially causing these programs to disregard applicants who may be a strong fit for their environment. Additionally, tokens are valuable due to their scarcity and may be unintentionally devalued by programs that receive a disproportionate number of tokens. It is also worth mentioning that there may be unforeseen challenges or consequences with the PS model for both applicants and programs that have yet to be discovered.

Some important practical considerations must be addressed before PS is implemented. The number of ideal signal tokens per applicant is unclear. The use of too many tokens risks diluting their value and raises the potential for token non-use to be a signal of disinterest. Too few tokens could require applicants to choose arbitrarily between their top programs and may leave programs with too small a pool of signaled applications to make a difference in their review approach. While ENT used five signals during their initial trial, they have decreased this to four for the 2021-2022 application cycle.<sup>14</sup> Dermatology is using three signals for the 2021-2022 application cycle, whereas internal medicine,

**Table 1.** Preliminary preference signaling data from the 2020-2021 otolaryngology application season<sup>a</sup>.

Program data	Applicant data
<ul style="list-style-type: none"> <li>● 100% participated (125 programs)</li> <li>● 100% received signals               <ul style="list-style-type: none"> <li>○ The top 10 programs comprised 21% of all tokens</li> <li>○ Top 20: 38%</li> <li>○ Top 30: 52%</li> </ul> </li> <li>● 90% of program directors would continue a similar process in the future (reported after match)</li> </ul>	<ul style="list-style-type: none"> <li>● 558/632 applicants participated</li> <li>● 93% received an interview from ≥ 1 signaled program               <ul style="list-style-type: none"> <li>○ 15% received interviews from all 5 signaled programs</li> <li>○ 25% from 4</li> <li>○ 21% from 3</li> <li>○ 22% from 2</li> <li>○ 10% from 1</li> <li>○ 7% from 0</li> </ul> </li> <li>● Overall, 18% interview offer rate               <ul style="list-style-type: none"> <li>○ Non-signaled programs: 14% interview offer rate</li> <li>○ Signaled programs: 58% interview offer rate</li> </ul> </li> <li>● Lowest quartile of applicants demonstrated 33% increase in interview offers at signaled programs</li> <li>● Around 50% of signals are sent to programs from the same geographic region as their home program</li> <li>● Fall survey: 70% satisfied/10% dissatisfied</li> <li>● 75% would continue a similar process in the future (reported after match)</li> </ul>

<sup>a</sup>Data sources can be found in manuscript references 14 and 16.

surgery, and urology are using five signals.<sup>17,18</sup> Given each of these specialties varies from EM in the number of programs, available positions, number of applicants and average number of applications per applicant, it will be challenging to determine an ideal number of signals based on other specialties' experience.<sup>1,2,23</sup>

Of the specialties implementing PS for the 2021-2022 match cycle, general surgery aligns most closely with EM with regard to the number of programs and applicants at 331 and 2908, respectively, compared to 273 and 3734 in EM, but the number of available positions is almost half that in surgery at 1569 compared to 2840 in EM, again making a comparison challenging.<sup>23</sup> However, given that the use of five tokens is the most common initial start point, we would recommend the same for EM, with adjustments made in future years based on program and applicant feedback as well as Match data.

The best approach for assigning tokens is also unclear. While ENT suggests applicants divide tokens between "reach" programs and programs for which they are competitive, economics research suggests it is ideal to use all tokens on programs where an applicant is competitive.<sup>10,24</sup> Finally, it has been suggested that a continuous-variable system may be more ideal than the current binary PS system, allowing applicants to signal degree of preference in a program by dividing 100 points among prospective programs (eg, all 100 to one program or 20 for each of five programs).<sup>22</sup>

While smaller specialties such as ENT and urology have had success with using their own websites and program director organizations to coordinate PS, we recognize that the much greater number of EM residency programs and applicants to EM may make this exceedingly challenging for the Council of Residency Directors in EM to coordinate and/or finance. Therefore, we would propose using the ERAS platform, as larger specialties like internal medicine and surgery have opted to do. We also support the ENT model of applicants finalizing signals prior to ERAS application opening for programs, which will allow programs to more effectively allocate time to holistic application review and identify high-yield applicants for interview.

Despite these uncertainties, the recurring challenges and current application climate provide a compelling case for trialing PS. We recommend exploring interest in PS from all EM residency application stakeholders, continuing to learn from the experiences of ENT, urology, dermatology, internal medicine, and surgery, and investigating methods for potential implementation of a PS pilot in EM for the 2022-2023 application season. While PS may not decrease the raw number of applications, it could address the largest flaw in the current system: the lack of ability for applicants to communicate, and programs to discern, genuine interest.<sup>19</sup> By allowing applicants and programs to understand each other better, we believe that PS has the potential to allow for a more sustainable and equitable match process that might create more ideal matches for all candidates and programs with less friction along the way.

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**Conflicts of Interest:** By the WestJEM 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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# An Inexpensive, Wearable Patella Reduction Trainer

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Section Editor: Douglas Ander, MD and Christine Stehman, MD  
 Submission history: Submitted May 8, 2021; Revision received December 11, 2021; Accepted December 8, 2021  
 Electronically published January 3, 2022  
 Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)  
 DOI: 10.5811/westjem.2021.12.53140  
 [West J Emerg Med. 2022;23(1)76–78.]

## BACKGROUND

Acute patellar dislocation is a painful condition that can be effectively managed with prompt reduction. Successful reduction requires confidence, which comes with experience. Patellar dislocation is not prevalent enough for every emergency physician to encounter it in a live patient during residency training. Although the reduction maneuver is straightforward, trainees are often initially unsure of hand positioning and attempt to reduce the patella primarily with medial pressure. Simultaneous knee extension is an important component of the reduction, creating patellar and quadriceps tendon laxity and making for a smoother, less painful reduction. Many available videos demonstrate extension poorly and show the difficulty with which the reduction is performed when primarily medial patella pressure is used.<sup>1,2</sup>

Simulation is an established modality for teaching procedures. Benefits include learning positioning, approach, and troubleshooting. However, there are currently no commercially produced trainers to teach and learn patellar reduction. Outside of live patient care, we most frequently teach the procedure using the bare, undislocated knee of a volunteer.

## OBJECTIVES

We set out to develop a wearable, low-cost trainer and determine whether the trainer would be preferred to a bare knee as a teaching tool. We undertook this project during a time when COVID-19 limited our ability to gather for learning outside of emergency department (ED) shifts. Consequently, we chose to pilot the trainer on shift and looked to determine the feasibility of this format for future teaching.

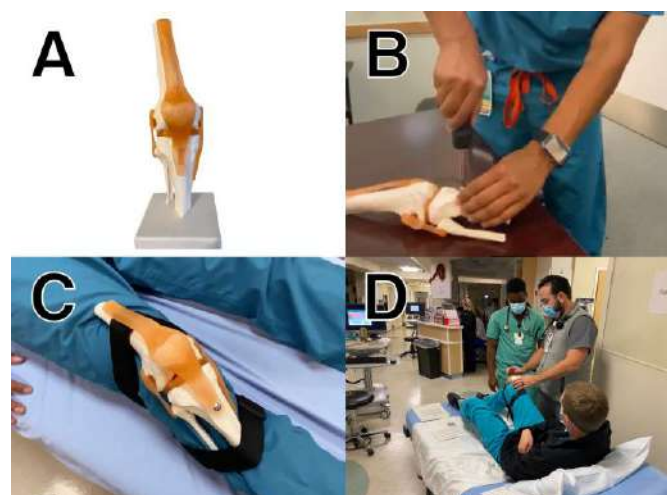
## CURRICULAR DESIGN

### The Trainer

We created the trainer from an anatomic knee model (Axis Scientific, Evanston, IL; [www.amzn.com/B00KZO8GES](http://www.amzn.com/B00KZO8GES)).

We removed the base and disconnected the patellar tendon (Figure). We used the screw from the base to re-attach the patellar tendon. This allowed the tendon to rotate laterally when the patella dislocates. We attached straps (Magarrow, Guangdong, China; [www.amzn.com/B07H19C24Z](http://www.amzn.com/B07H19C24Z)) to the femur and tibia so that the trainer could be worn on a facilitator's knee. We needed two additional screws for this, which we had from a previous project. The only tool required was a Phillips head screwdriver. Our total cost for the trainer was \$60 and assembly took about 30 minutes.

A reduction with the trainer showing our preferred hand position and technique can be seen here: [youtu.be/qi3pHpNjfWc](https://youtu.be/qi3pHpNjfWc).



**Figure.** The base of the trainer is an anatomic knee model (A). The “patellar tendon” is removed and reattached with a screw so that the tendon can rotate laterally and allow dislocation (B). Straps are attached to make the trainer wearable (C). We deployed the training in our pediatric emergency department (D).

## Teaching Session and Data Collection

We aimed to mirror a typical clinical teaching arrangement by pairing a novice with an experienced clinician. Through investigator consensus, we defined an “experienced” clinician as one who had performed three or more live patellar reductions. We defined a “novice” as a clinician who had performed fewer than three live patellar reductions.

We conducted 20 teaching sessions with a single trainer over multiple shifts. One novice and one experienced clinician participated in each session, for a total of 40 participants. All participants provided consent. The experienced clinician used the investigator’s bare knee to teach the novice how to perform a patellar reduction. The novice then performed a patellar reduction on the bare knee. Next, the process was repeated on the opposite knee with the wearable trainer. Last, both the experienced physician and the novice completed a survey. Investigators did not intervene until the session was complete. Sessions lasted 5-10 minutes. Novices did not receive any standardized instruction and experienced physicians were free to teach the procedure as they saw fit.

We developed survey items and responses based on design principles for medical education questionnaires.<sup>3</sup> We pilot tested the survey among our author group (one medical student, three resident physicians, and two faculty physicians) to improve clarity and functionality but did not collect further survey validity evidence. We sought to compare teaching/learning utility and collect data on the trainer’s realism. These two constructs are commonly evaluated in simulation studies for gathering validity evidence.<sup>4,5</sup> We also planned to measure the trainer’s effect on novice confidence. The survey and study protocol can be viewed here: <https://tinyurl.com/6php4a3a>.

We compared survey constructs in Stata version 12.1 (StataCorp, LLC, College Station, TX) using a Wilcoxon matched-pairs test. The study was reviewed by our institutional review board, which determined that it did not meet the definition of human subjects research and was exempt from further review.

## IMPACT/EFFECTIVENESS

Survey completion rate was 100%. Experienced physicians rated the trainer higher than the bare knee as a teaching tool, with a median bare knee usefulness of 3/5 (“moderately useful,” interquartile range [IQR] 2.5-4) and a median trainer usefulness of 4/5 (“very useful,” IQR 4-5,  $P = 0.01$ ). Novices rated the trainer higher than the bare knee as a learning tool, with a median bare knee usefulness of 3/5 (“moderately useful,” IQR 2.5-4) and a median trainer usefulness of 4/5 (“very useful,” IQR 4-5,  $P = 0.0004$ ). Experienced physicians rated the feeling of reduction with the trainer as “moderately realistic” (median 3/5, IQR 3-4) and the movements needed to reduce the trainer’s patella as “very realistic” (median 4/5, IQR 3-4). They stated that they would be “very likely” to use the trainer for just-in-time training if it were available during a shift (median 4/5, IQR 4-5).

Novice confidence improved after the session, with a median confidence before the session of 2/5 (slightly confident; IQR 1-3) and a median confidence after the session of 4/5 (very confident; IQR 3.5-5,  $P < 0.0001$ ).

We piloted these sessions on shift and were able to do 20 sessions with 40 participants in about six hours. One strength of an on-shift session is that trainees are already present in the ED. A drawback is that facilitators must dedicate time to organizing the additional sessions. Our routine was to set up the station, announce our presence to faculty, residents, and students on shift and then wait for short breaks in patient care when participation was possible. We recommend scheduling sessions at a time when the ED census is typically lower. We found it helpful to have space available near or in the ED. We have since held similar sessions with other trainers and recommend choosing procedures that can be done quickly. We created subsequent trainers that addressed more complicated joint reductions,<sup>6</sup> but we found that the simplicity of the patella reduction trainer made for better durability over multiple reductions.

Our study has limitations. Our sample size was relatively small. There is poor agreement regarding how to determine a sample size for studies that evaluate the utility and realism of simulation trainers.<sup>4,7</sup> Our sample size is comparable to that of similar existing studies.<sup>4</sup> We were able to demonstrate a statistically significant difference in survey constructs with this sample size.

## CONCLUSION

Our patellar dislocation trainer filled an identified, technical skills training need in our program. It was rated as a better teaching/learning tool than a bare knee. We deployed the training on shift, a format that we plan to continue moving forward. The low cost of the trainer makes it a feasible just-in-time teaching tool.<sup>8</sup> We hope to evaluate its utility in this context in the future.

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*Conflicts of Interest:* By the WestJEM 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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# Effects of Brief Mental Skills Training on Emergency Medicine Residents' Stress Response During a Simulated Resuscitation: A Prospective Randomized Trial

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Section Editor: Jeffrey Love, MD and Danielle Hart, MD

Submission history: Submitted June 29, 2021; Revision received October 19, 2021; Accepted October 29, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.53892

**Background:** Acute stress impairs physician decision-making and clinical performance in resuscitations. Mental skills training, a component of the multistep, cognitive-behavioral technique of stress inoculation, modulates stress response in high-performance fields.

**Objective:** We assessed the effects of mental skills training on emergency medicine (EM) residents' stress response in simulated resuscitations as well as residents' perceptions of this intervention. **Methods:** In this prospective, educational intervention trial, postgraduate year-2 EM residents in seven Chicago-area programs were randomly assigned to receive either stress inoculation training or not. One month prior to assessment, the intervention group received didactic training on the "Breathe, Talk, See, Focus" mental performance tool. A standardized, case-based simulation was used for assessment. We measured subjective stress response using the six-item short form of the Spielberger State-Trait Anxiety Inventory (STAI-6). Objective stress response was measured through heart rate (HR) and heart rate variability (HRV) monitoring. We measured subjects' perceptions of the training via survey.

**Results:** Of 92 eligible residents, 61 participated (25 intervention; 36 control). There were no significant differences in mean pre-/post-case STAI-6 scores (-1.7 intervention, 0.4 control;  $p = 0.38$ ) or mean HRV (-3.8 milliseconds [ms] intervention, -3.8 ms control;  $p = 0.58$ ). Post-assessment surveys indicated that residents found this training relevant and important.

**Conclusion:** There was no difference in subjective or objective stress measures of EM resident stress response after a didactic, mental performance training session, although residents did value the training. More extensive or longitudinal stress inoculation curricula may provide benefit. [West J Emerg Med. 2022;23(1)79–85.]

## INTRODUCTION

Emergency medicine (EM) residents often encounter highly stressful clinical situations and must perform life-saving interventions with limited time, resources, and background

information. Resuscitation requires a rapid and dynamic integration of numerous cognitive processes including information-gathering, communication, decision-making, and physical skills.<sup>1</sup> It has been demonstrated that high levels of



acute stress and anxiety can critically impair physician decision-making.<sup>2</sup> Additionally, high levels of perceived stress have been shown to impair healthcare professionals' clinical performance in acute resuscitation scenarios.<sup>3-5</sup> Other high-stress realms such as the military, aviation, athletics, and business have adopted and cultivated mental skills techniques to enhance performance under pressure; however, similar programs have been notably absent in medical training.<sup>6,7</sup>

Stress inoculation, a multistep, cognitive behavioral technique, has been demonstrated to be effective across numerous high-performance domains.<sup>8-11</sup> Stress inoculation involves three phases: 1) learning about the effects of acute stress on performance; 2) acquiring and rehearsing specific mental skills and coping strategies to optimize performance under stress; and 3) applying these skills and strategies to real-world, high-stress environments.<sup>8</sup> Mental skills training has been shown to enhance performance and coping in stressful situations in pilots, police, military special forces, professional athletes, and surgeons.<sup>12-16</sup> While resident physicians frequently encounter stressful clinical resuscitations, there are no formal Accreditation Council for Graduate Medical Education (ACGME) recommendations for educating resident physicians about the impacts of acute stress on performance; nor is there mention of the potential role of mental skills training to optimize performance under stress.

While assessing EM residents during clinical patient resuscitations is desirable, simulation provides a controlled and reproducible environment for examination of variables that contribute to both objective and subjective stress as well as assessment of clinical performance.<sup>17</sup> Simulated resuscitation scenarios have been demonstrated to elicit high levels of subjective and objective measures of stress in EM residents, allowing extrapolation of findings from simulation to clinical medicine.<sup>18</sup>

In this study our aim was to assess the implementation of a brief mental skills training on perceived and actual stress in EM residents during simulated resuscitation scenarios. We hypothesized that the intervention group would have less subjective stress as measured by pre- and post-simulation scores on the six-item, short form of the Spielberger State-Trait Anxiety Inventory (STAI-6).<sup>19,20</sup> Secondary outcomes included physiologic measures of stress (ie, heart rate [HR] and heart rate variability [HRV]) and residents' perception of the stress- inoculation skills training program.

## METHODS

### Study Design

This study was a multicenter prospective educational trial performed at seven ACGME-accredited EM residency programs in Chicago, Illinois. The study was reviewed and approved by each institution's institutional review board.

### Subjects

Eligible subjects for this study were postgraduate year (PGY)-2 EM residents at the participating programs during

### Population Health Research Capsule

What do we already know about this issue?

*Acute stress impairs physician decision-making and clinical performance in resuscitations. Emergency medicine (EM) residents often encounter highly stressful clinical situations.*

What was the research question?

*We studied the effects of mental skills training on EM resident stress response in simulated resuscitations, as well as resident perceptions of this intervention.*

What was the major finding of the study?

*There was no difference in subjective or objective stress measures of EM resident stress response after a didactic mental performance training session, although residents did value the training.*

How does this improve population health?

*High levels of acute stress and anxiety can critically impair physician decision-making. Providing physicians with stress-modulating techniques is essential to optimizing clinical performance.*

the study period January–February 2020. Participation in the study was voluntary. Informed consent was obtained from all subjects. Based upon prior studies, we anticipated a 20% difference in STAI-6 scores between groups. Power analysis, with power 0.8 and alpha 0.05, yielded a minimum of 36 subjects needed in each group.

Study investigators recruited eligible participants in January 2020 during each EM program's weekly resident educational conference. During the recruitment session, the investigator conducted an overview of the study with the eligible participants and obtained consent for participation in the study. At that time subjects were randomized into intervention or control groups in an alternating fashion based on last name. Due to lower than anticipated attendance at residency conferences on the days of enrollment, residents were offered the opportunity to enroll into the control group on the day of the simulation assessment. In addition, some initially enrolled subjects were not present on the day of the simulation assessment due to conflicts with rotations and therefore were not included in the data collection.

### Study Protocol

At the time of study enrollment, each resident completed a pre-intervention survey that assessed perceptions about the

incorporation of mental skills training and stress inoculation principles into residency training as well as prior exposure to these techniques (Supplemental Material).

During the recruitment session, faculty study investigators provided a 20-minute interactive, didactic session to the intervention group about the effects of acute stress on performance, specific mental skills to mitigate the effects of stress, and the application of these skills to high-stress clinical scenarios. The mental skills training was based on the "Breathe, Talk, See, Focus" (BTSF) approach to performance under pressure. The BTSF tool is a memory aid and training primer to help individuals rapidly employ mental skills proven effective in non-medical, high-stress domains.<sup>21,22</sup> The tool itself consists of a four-step technique: 1) Breathe: Introduction to the concept of a ritualized form of breathing, such as "box breathing"; 2) Talk: Positive self-talk, recited with intention and repeated frequently; 3) See: Visualization of successful completion of a task; and 4) Focus: Use of a cue word to turn on selective attention.<sup>21</sup> During the lecture itself, residents were introduced to the BTSF tool and also had the opportunity to practice using the tool as a group. Participants in the intervention group were strongly encouraged to review the BTSF tool and to attempt to implement these mental skills in their own clinical practice.

Each spring, all PGY-2 residents in Chicago area EM programs participate in an annual city-wide simulation assessment. While the assessment is based on the ACGME milestones and residents are given feedback on their performance, no participating residency uses the information to impact a resident's standing, and this information is disclosed to the residents prior to participation. This study was designed to coincide with this event. Described in detail elsewhere, the simulation assessment consists of two procedure assessments and two high-fidelity, mannequin-based critically ill patient scenarios.<sup>23</sup> During each of the four assessments, the PGY 2-resident is observed by a faculty member from a different residency program using a dichotomous checklist containing essential management actions corresponding to EM milestones. The PGY-2 residents are not informed of the content of the cases prior to participation in the assessment. One of the critically ill patient-simulation cases served as the study assessment. Participants were not aware of which case served as the study assessment.

Upon arrival for the PGY-2 simulation assessment in February 2020, residents in both the intervention and control groups completed a STAI-6 survey. The STAI-6 is a psychological inventory assessing anxiety about an event (state anxiety) and anxiety level as a personal characteristic (trait anxiety). While anxiety and stress are not synonymous, the inventory has been used in prior research as a surrogate for acute stress response.<sup>24</sup> Both intervention and control group residents wore Polar H10 heart rate monitors (Polar Electro Oy, Kempele, Finland). Prior research has demonstrated correlations between the STAI-6 and HR and cortisol levels

as well as a correlation between the STAI-6 and HRV during intubation attempts.<sup>25,26</sup> Mefford et al also used HRV as an outcome measure in the evaluation of stress-modifying interventions and demonstrated that HRV may serve as an index of autonomic arousal.<sup>26</sup> Similarly, Kim et al concluded that neurobiologic evidence suggests that HRV can be used as an objective measure of psychological stress.<sup>27</sup> Pre-simulation physiologic parameters of HR and HRV were measured for a duration of five minutes using the Elite HRV application (Elite HRV, Asheville, NC) installed on the iPod Touch, 7<sup>th</sup> generation (Apple Inc., Cupertino, CA).

Immediately prior to the start of the assessment case (and after pre-simulation HR and HRV were measured), residents randomized to the intervention group were provided a five-minute refresher on stress inoculation techniques and particularly in BTSF. The HRV and HR recordings were initiated five minutes prior to the assessment case and were recorded continuously until the case concluded. Biometric data was measured before, during, and after the simulation case. The following variables were recorded for each subject: HR (mean); minimum HR (lowest measured HR value); and maximum HR (highest measured HR value); HRV (mean). We calculated relative changes in all variables between baseline and during the simulation case.

As soon as the assessment case concluded, residents completed a second STAI-6 assessment. Upon completion of the PGY-2 simulation assessment, all residents completed the post-intervention survey (Supplemental Material).

## RESULTS

### Characteristics of Study Subjects

Among seven EM residency programs, there were 92 eligible PGY-2 EM residents. Ultimately, 47 residents underwent randomization after informed consent at the time of initial study enrollment. On the day of the PGY-2 simulation assessment, an additional 23 residents were consented for participation in the control group. Nine residents who initially were enrolled did not ultimately complete the study (six control and three intervention): three did not participate in the simulation assessment at all, one did not complete the surveys, and five declined to participate in the study. In total, 61 residents participated in the study, including 25 residents in the intervention group and 36 in the control group. There were no significant differences in age, gender, or ethnicity between the control and intervention groups (Table 1).

### Primary Results

The change in the pre- and post-resuscitation STAI-6 scores was not different between groups (-1.7 intervention, 0.4 control;  $p = 0.38$ ), and there were no significant differences in mean pre- and post-resuscitation STAI-6 scores between groups (Table 2). In the control group, the mean STAI-6 scores pre- and post-resuscitation were 40 (standard deviation [SD] 6.6) and 41 (SD

**Table 1.** Subject demographic data.

	Intervention	Control	p-value
Experience			
Military	2 (15.4%)	1 (8.3%)	1.0
Law enforcement	0 (0.0%)	0 (0.0%)	N/A
Firefighting	1 (7.7%)	1 (8.3%)	1.0
Aviation	2 (15.4%)	2 (16.7%)	1.0
Sports	7 (53.9%)	6 (50.0%)	0.85
Arts	5 (38.5%)	4 (33.3%)	0.79
Age			
20-25	0 (0.0%)	0 (0.0%)	
25-30	15 (62.5%)	27 (77.1%)	
30-35	8 (33.3%)	6 (17.1%)	
>35	1 (4.2%)	2 (5.7%)	0.33
Gender			
Male	18 (75.0%)	22 (62.9%)	
Female	6 (25.0%)	13 (37.1%)	0.33
Race			
Black	0 (0.0%)	4 (11.1%)	
White	15 (62.5%)	16 (44.4%)	
Latinx	2 (8.3%)	1 (2.8%)	
Asian	6 (25.0%)	4 (11.1%)	
African	0 (0.0%)	0 (0.0%)	
Middle Eastern	1 (4.2%)	0 (0.0%)	
Native American/Inuit	0 (0.0%)	0 (0.0%)	
Pacific Islander	0 (0.0%)	0 (0.0%)	
Other	0 (0.0%)	11 (30.6%)	<0.01

\*P-value <0.05 indicates significance.

\*\*% is based on the number of individuals who answered each question.

5.9). In the intervention group, the mean STAI-6 scores pre- and post-resuscitation were 41.33 (SD 10.54) and 39.6 (SD 9.73). For reference, scores on the STAI-6 range from 20-80 with higher scores indicating more anxiety.

### Secondary Results

There were no significant differences in biometric data between groups (Table 3). The mean maximum HR during simulation was 133 in the control group and 136 in

the intervention group ( $p = 0.97$ ). The mean minimum HR during simulation was 70 in the control group and 71 in the intervention group ( $p = 0.76$ ). There was no significant difference in mean HRV between groups (-3.8 millisecond [ms] intervention, -3.8 ms control;  $p = 0.58$ ).

We found no significant group differences in the pre-intervention survey (Table 4). There were, however, significant differences in the post-intervention survey (Table 4). In response to the question "How relevant is the topic of stress inoculation to the resident physician?" 91% of the intervention group responded "very relevant" compared to 26% of the control group ( $p < 0.01$ ). In response to the question "How important is it to include education about stress inoculation topics in residency training?" 75% of the intervention group responded "very important" compared to 28% of the control group ( $p < 0.01$ ).

### DISCUSSION

In this multicenter, prospective educational trial of mental skills training for PGY-2 EM residents we found no demonstrable differences in subjective or objective measures of stress responses between the intervention and control groups. Nevertheless, there were statistically significant differences between the groups on the post-intervention surveys regarding resident perceptions of the importance of mental skills and stress-inoculation training in EM residencies. These differences were present only on the post-intervention survey, indicating that EM residents appreciated the value of this program only after exposure to this training.

Multiple prior studies have demonstrated the deleterious effects of acute stress on physician decision-making, physical performance, and performance during simulations.<sup>2-5</sup> Relatively few studies have directly investigated the role of mental skills training and stress inoculation in mitigating these effects. A 2016 study of surgery trainees examined the impact of a mental skills curriculum on subjective stress.<sup>24</sup> A study of novice PGY-1 EM residents demonstrated an association between perceived stress and anxiety and biometric data (HRV) when performing endotracheal intubations on live patients.<sup>26</sup> To the best of our knowledge, this is the first study to investigate the effects of mental skills training on EM resident-perceived stress and anxiety as well as biometric data during a high-stress, simulated resuscitation. While our study failed to find significant differences between the groups in the self-reported

**Table 2.** Comparisons of mean State-Trait Anxiety Inventory-6 scores between control and intervention groups.

	Intervention n = 25	Control n = 36	p-value
Pre-case STAI-6 score, mean ± SD	41±11	40.2 ±6.6	0.13
Post-case STAI-6 score, mean ± SD	40 ±9.7	41 ±5.9	0.83
Change in STAI-6 score, mean ± SD	-1.7 ±3.3	0.4 ±6.6	0.38

STAI-6, six-item short form of the Spielberger State-Trait Anxiety Inventory; SD, standard deviation.

**Table 3.** Comparison of mean biometric data between control and intervention groups.

	Intervention n = 25	Control n = 36	p-value
Baseline HRV, ms (mean ± SD)	55 ±8.5	55 ±9.0	0.94
Change in HRV, ms (mean ± SD)	-3.8 ±8.7	-3.8 ±10	0.58
Baseline HR, bpm (mean ± SD)	83 ±10	87 ±11	0.11
Baseline maximum HR (mean ± SD)	118 ±36	131 ±44	0.06
Max HR during simulation (mean ± SD)	136 ±42	133 ±35	0.97
Change in maximum HR (mean ± SD)	18 ±29	1.8 ±48	0.29
Baseline minimum HR (mean ± SD)	61 ±13	64 ±11	0.38
Minimum HR during simulation (mean ± SD)	71 ±61	70 ±17	0.76
Change in minimum HR (mean ± SD)	8.7 ±11	5.4 ±14	0.46

HRV, heart rate variability; ms, millisecond; SD, standard deviation; HR, heart rate; bpm, beats per minute.

**Table 4.** Comparisons of pre- and post-intervention survey responses\*.

	Control pre-study	Intervention pre-study	Control post-study	Intervention post-study
How valuable would it be to incorporate a formal stress inoculation curriculum into EM residency training?				
Very valuable, n (%)	6 (40%)	3 (18%)	10 (28%)	18 (75%)
Somewhat valuable	6 (40%)	6 (35%)	14 (39%)	4 (17%)
Neutral	3 (20%)	6 (35%)	11 (31%)	1 (4.2%)
Not valuable	0 (0%)	2 (12%)	1 (2.8%)	1 (4.2%)
How relevant is the topic of stress inoculation to the EM resident physician?				
Very valuable, n (%)	7 (47%)	6(35%)	9 (26%)	19 (91%)
Somewhat valuable	6 (40%)	6 (35%)	14 (40%)	2 (13%)
Neutral	2 (13%)	4 (24%)	12 (34%)	0 (0%)
Not valuable	0 (0%)	1 (5.9%)	0 (0%)	0 (0%)

\*% is based off the number of individuals who answered each question.

EM, emergency medicine.

and biometric data, the measurement of these parameters in the setting of a simulated resuscitation during which a group of subjects employed a mental skills technique was novel.

There are several possible explanations for the lack of significant differences in the STAI-6 and biometric data between the intervention and control groups. The intervention group received the initial training lecture approximately one month prior to the simulation assessment, and with the exception of the five-minute refresher prior to the simulation assessment there were no formal intervening reinforcements of the technique with the subjects. While the intervention subjects were encouraged to practice the BTSF tool during the month between the initial introduction and the simulation, utilization was not tracked. The lack of deliberate practice and delay from the initial exposure could have attenuated the benefits obtained from the introductory lecture, and decreased STAI-6, biometric, and performance data differences between the groups. It is also possible that the BTSF model is an ineffective method

of performance enhancement under stress in EM residents.

This seems less likely, however, as mental skills training has been shown to enhance performance and coping in stressful situations in other elite performance realms such as aviation, law enforcement, military special forces, professional athletics, and surgery, and that the BTSF model was developed by drawing on elements of similar effective paradigms.<sup>12-16,21</sup>

Our tested residents were in their second year of residency and may have already learned methods with which to manage stress in acute resuscitation scenarios based on either former didactic exposure or clinical experience. It is also possible that more of a stress effect would be demonstrated in a real-life scenario rather than a simulated one. Finally, to detect a 20% difference between groups we anticipated needing to enroll 36 subjects into each group. Due to conflicts impeding ability to participate, the intervention group only had 25 residents, which may have decreased our ability to detect a difference between the groups.



Future studies should focus on longitudinal investigations of mental skills training and stress-inoculation programs in which the mental performance tools are periodically reinforced prior to study assessment. Studies could also examine long-term resident perceptions of mental skills and stress-inoculation curricula, as well as resident perceptions of their own performance after being exposed to these topics. Finally, wearable technology such as the HR monitors used in this study could be used to measure biometric data during in vivo resuscitations or other high-stress medical scenarios.

## LIMITATIONS

There are several important limitations to this study. Foremost, initiatives to change behavior often require substantial time investment, training, and practice. While our stress response intervention was designed to be brief and easily implemented, the lack of directed and longitudinal exposure to the concepts likely affected the results. We also used the STAI-6 as a measure of acute stress response. While this has been previously used in other studies assessing similar stress response, it has not been independently validated in this utilization. In addition, although this was a multicenter trial, the study population was a convenience sample of PGY-2 residents in one specific geographic area. Furthermore, while subjects receiving the mental skills training were encouraged to use the techniques learned in the didactic session during the weeks preceding the simulation assessment, overall utilization was likely variable and not measured.

There were also a number of subject-specific, non-controlled confounders that may have impacted the biometric data, including stimulant ingestion (eg coffee, energy drinks), prescribed medications, sleep quality/duration in the preceding evening, and nutritional intake. Additionally, while the pre-simulation biometric data was gathered prior to the subjects participating in any simulated cases, it is possible that the subjects were anticipating the simulations and therefore were in a heightened physiologic state. Furthermore, the pre-simulation biometric data was collected for five minutes, which may not have been enough time to establish a completely accurate physiologic baseline for each participant. These factors may have confounded the biometric data.

We also did not examine resident performance in the simulated scenario as an outcome in the study. There could be an unexamined difference in stress response based on performance that was not determined. Finally, there were a few discrepancies in the biometric data (ie, a record heart rate in the mid-200s) that did not make physiologic sense and may have been due to artifact from the HR monitors and the biometric data-aggregation application. Such discrepancies may have skewed the biometric data.

## CONCLUSION

A brief, didactic mental skills training intervention did not demonstrate significant differences in subjective or

objective measures of stress responses in EM residents during a simulated resuscitation. Residents in the intervention group were more likely to rate mental skills training as relevant and important. Future investigations involving comprehensive, longitudinal stress inoculation curricula are warranted.

## ACKNOWLEDGMENTS

The authors would like to acknowledge:

Tarlan Hedayati, MD, Cook County Health, Chicago, IL  
Kasia Gore, MD, Rush University, Chicago, IL  
Rodney Fullmer, DO, Swedish Covenant Hospital, Chicago, IL  
Robert Rifenburg, DO, Resurrection Medical Center, Chicago, IL  
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*Conflicts of Interest:* By the WestJEM 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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# Resident Perceptions of a Publicly Disclosed Daily Productivity Dashboard

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Submission history: Submitted June 27, 2021; Revision received October 21, 2021; Accepted October 29, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.53874

**Introduction:** Following resident requests, we created a public metrics dashboard to inform residents of their daily productivity. Our goal was to iteratively improve the dashboard based on resident feedback and to measure the impact of reviewing aggregate data on self-perceived productivity.

**Methods:** A 10-question anonymous survey was completed by our postgraduate year 1-3 residents. Residents answered questions on the dashboard and rated their own productivity before and after reviewing aggregate peer-comparison data. Using the Wilcoxon signed-rank test we calculated summary statistics for survey questions and compared distributions of pre- and post-test, self-rated productivity scores.

**Results:** All 43 eligible residents completed the survey (response rate 100%). Thirteen (30%) residents “rarely” or “never” reviewed the dashboard. No respondents felt the dashboard measured their productivity or quality of care “extremely accurately” or “very accurately.” Seven (16%) residents felt “very” or “extremely pressured” to change their practice patterns based on the metrics provided, and 28 (65%) would have preferred private over public feedback. Fifteen residents (35%) changed their self-perceived rank after viewing peer-comparison data, although not significantly in a particular direction ( $z = 0.71$ ,  $P = 0.48$ ).

**Conclusion:** Residents did not view the presented metrics as reflective of their productivity or quality of care. Viewing the dashboard did not lead to statistically significant changes in resident self-perception of productivity. This finding highlights the need for expanding the resident conversation and education on metrics, given their frequent inclusion in attending physician workforce payment and incentive models. [West J Emerg Med. 2022;23(1)86–89.]

## INTRODUCTION

The number of patients seen per hour is a common metric used in evaluating the on-shift performance and productivity of attending emergency physicians.<sup>1-4</sup> Sharing productivity metrics can have some impact on clinician performance<sup>5</sup> and has been shown to increase emergency medicine (EM) resident satisfaction with their evaluation and feedback processes.<sup>6</sup> The productivity of EM residents at various

stages in training has been previously characterized,<sup>7-9</sup> but there is little standardization in how residency programs use productivity data in resident education, what format is most useful, and how residents perceive and apply the data.<sup>10</sup>

Residents at our urban, academic institution, which has an annual patient volume of over 90,000 patients, requested more feedback regarding their productivity directly from residency leadership and through the annual Accreditation Council for

Graduate Medical Education (ACGME) resident survey.<sup>11</sup> In response, we developed an automated resident productivity dashboard, which has been distributed daily via email to the entire residency since 2016. The dashboard mimics the one provided to attending physicians by our department's administrative group and includes a table of the following productivity data attributed to individual residents by name, as extracted from the electronic health record (EHR) every 24 hours: total number of patients seen; number of patients admitted; median time to admission order for admitted patients; and median time to discharge instruction printing for discharged patients. The dashboard displays this data for each specific shift, attributed to the individual resident working on a given day, and as such is dependent on fluctuations in variables such as patient volumes, case complexity, and bed availability. It is sent as a daily email to the departmental listserv, allowing a public, side-by-side comparison of individuals. There is no immediate functionality to generate a longitudinal report for oneself via the email (although this can be obtained through the software by an administrator), and dashboard data has not been used in the formal assessment of resident performance.

Objectives of our study were the following: 1) to assess residents' perceptions of the productivity dashboard; and 2) to measure the impact of reviewing aggregate dashboard data on residents' assessment of their own productivity.

## METHODS

We sent an anonymous electronic survey focusing on resident experience with the daily dashboard to post-graduate year (PGY) 1-3 residents in our four-year EM residency during an in-person, residency-wide retreat in July 2019 (Supplement 1). The survey was developed by residency leaders through an iterative process, which included final editing after piloting by residency members exempt from the study who provided feedback on survey questions. The PGY-4 residents were excluded as their supervisory role was too variable within the clinical structure of our residency (eg, PGY-4 residents may or may not electronically sign up for patients if they are supervising a junior resident).

The 10-question survey queried residents' perceptions and perceived educational benefit of the daily dashboard, how often it was reviewed, how reflective it was of their actual performance, and how each resident felt their own productivity compared to that of their peers. After completing the first part of the survey, each resident was provided with their personal aggregate productivity data averaged over all shifts during the previous 10 months along with aggregated, matched peer-comparison data in a similar format to the daily dashboard, but with longitudinal data points rather than on a per shift basis. Residents were then asked again how they compared to their peers. Finally, residents were asked to identify additional quality and performance metrics that they would be interested in receiving. Most responses were

collected on a five-point Likert scale, along with an option for write-in suggestions for improving the dashboard. This study was deemed exempt by the Yale University Institutional Review Board. All participants provided informed consent prior to beginning the survey.

We calculated summary statistics for the general survey questions. The distributions of pre- and post-comparison self-ratings were analyzed using the Wilcoxon signed-rank test with the Pratt modification for observed differences of zero.<sup>12</sup> Free-text responses were not comprehensive enough to warrant formal qualitative analysis.

## RESULTS

All 43 eligible PGY 1-3 residents completed the survey, for a response rate of 100%. One resident was ineligible due to participation as an investigator in the study. Thirteen (30%) residents reported "rarely" or "never" reviewing the dashboard. None felt the dashboard measured their productivity or quality of care "extremely accurately" or "very accurately" (Figure 1). Almost all residents expressed interest in receiving personalized lists of 72-hour returns (37, 86%) or in-hospital escalations of care within 24 hours (39, 91%).

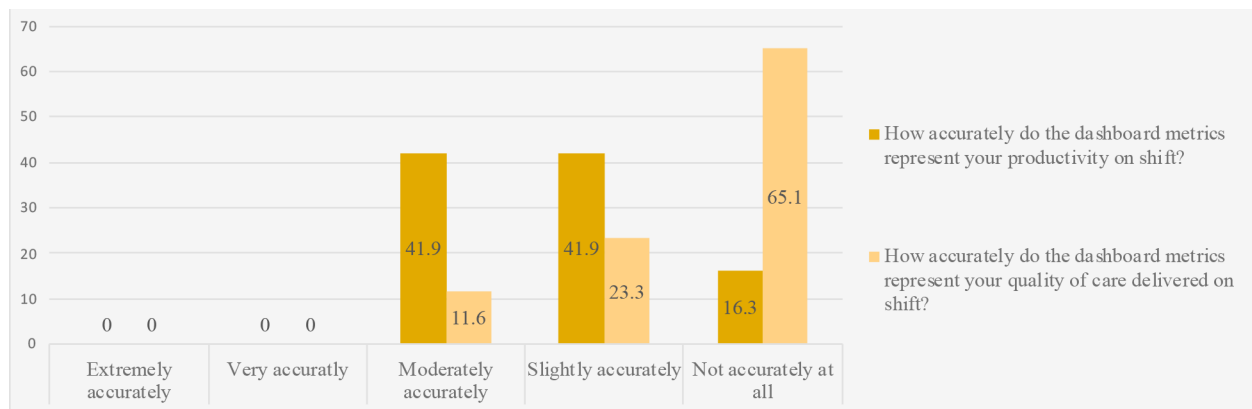
Seven (16%) residents felt "very" or "extremely pressured" to change their practice patterns based on the metrics provided, while most felt moderate (15, 34.9%), slight (11, 25.6%), or no pressure at all (10, 23.3%). Twenty-eight (65%) would have preferred private feedback, rather than the public distribution of data. Most residents (18, 41.9%) felt neutral about how "helpful" the peer-comparison data provided during the survey was. Fifteen residents overall (35%), and 38% of residents reporting "rarely" or "never" looking at the dashboard, changed their self-perceived rank after viewing peer-comparison data. The overall change in how residents perceived themselves after review of the comparison data—ie, viewing themselves more positively or more negatively than before—did not show a significant trend in one particular direction ( $z = 0.71$ ,  $P = 0.48$ ).

Free-text feedback collected consisted of only five brief comments, including concerns about "gaming the system" resulting in inaccurate data collection on the dashboard and the department valuing "throughput over high quality, thorough care."

## DISCUSSION

The development and dissemination of productivity data has been requested by our residents both informally and formally through the annual ACGME survey, and this is an area of interest to many residents and educators.<sup>10,13-15</sup> The resident sentiment regarding our implementation, however, was mixed. Residents seemed skeptical of how accurately the data provided reflected their work, feeling it was less accurate in reflecting their quality of care than their productivity. The origin of this sentiment warrants further investigation since higher resident confidence in the fidelity of the data presented could drive





**Figure 1.** Residents' perceptions of the accuracy of a productivity dashboard.

higher future resident engagement with our dashboard.

Residents in a prior study appeared to have a more positive reception of their productivity metrics.<sup>6</sup> One possible reason for this difference is that their data was provided privately, whereas ours made public the information to and about a potentially vulnerable population of trainees. Discomfort with comparison itself, however, does not make it unimportant or invalid, as most attending physicians will encounter at least some metric comparisons to a benchmark in their careers, and this may even be an intrinsic motivator for improvement.<sup>1</sup>

After comparing themselves to the mean productivity of their peers, about a third of residents revised their impressions, with fewer classifying themselves as average. While previously published findings have found that residents tend to overestimate their abilities,<sup>16-18</sup> respondents in our study were equally likely to be optimistic or pessimistic about themselves: some shifted to a higher perceived productivity, while a slightly greater number shifted to a lower perceived productivity, although there was no significant trend in either direction. One possible explanation for the lack of significant change is that residents may already have had an overall accurate impression of themselves or because they did not trust the data provided and so did not update their impressions. Furthermore, those residents who “rarely” or “never” looked at the daily dashboard changed their self-rating after seeing the aggregate data 38% of the time, compared to 35% for the overall group. This raises the question of what impact looking at the dashboard more or less frequently may have on self-perceived productivity.

We did not compare actual productivity metrics before and after the review of aggregate peer-comparison data due to the survey's anonymization procedure. Further studies could evaluate whether there is any correlation between resident self-perception and actual metrics, as well as whether review of the aggregate data had any effect on metrics after such an intervention.

We applied the insights derived from the survey to develop a revised resident dashboard, which is personalized and confidential to each resident and displays the resident's metrics with anonymized peer-comparison data. It also contains follow-up lists of each resident's patients who “bounce back” after discharge or have an escalation of care after admission. These lists link the resident directly to the patient's chart in our facility's EHR. The revised dashboard is currently undergoing pre-release testing.

### LIMITATIONS

As previously discussed, we did not include the PGY-4 class in our survey due to their supervisory role in our emergency department. In the future, to include input from the class closest to entering the workforce, leadership could standardize how and when supervising PGY-4 residents sign up for patients electronically. Additionally, given that residents have had access to the daily dashboard showing data for individual shifts over the past three years, this survey was not the first time that they received their productivity data. However, it was the first time that they saw it in such aggregate format that is presumably less dependent on daily fluctuations in departmental factors. Certainly, the prior exposure may have already affected some residents' perceptions of themselves. Receiving the daily dashboard may have a more significant effect; however, this was not within the scope of this study.

### CONCLUSION

Responding residents do not view patient-per-shift and patient-per-hour metrics as reflective of their true productivity or quality of care. Viewing the dashboard did not lead to any statistically significant changes in self-perceived resident productivity. This data highlights the need for expanding the resident conversation and education on metrics, given their frequent inclusion in attending workforce payment and

incentive models. This exploration of resident perceptions of a metrics dashboard can be of use when designing similar dashboards for other institutions.

This work was presented as a poster at the Connecticut College of Emergency Physicians Scientific Assembly & Annual Meeting in September 2019.

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**Conflicts of Interest:** By the WestJEM 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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# Student Doctor Network: Fake News or Facts for Emergency Medicine Applicants?

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Submission history: Submitted June 9, 2021; Revision received December 15, 2021; Accepted October 27, 2021

Electronically published January 5, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.10.53581

**Introduction:** Residency applicants use multiple resources to guide their application process including the Student Doctor Network (SDN), a publicly available online forum for the discussion of various topics in medical education. In recent years, specialty-specific forums for residency applicants to self-report their own application information have become popular. These forums allow other applicants to review self-reported data from their peers to inform their own application process. The accuracy of this resource is unknown. To determine whether the SDN is an accurate source of information for emergency medicine (EM) applicants, we compared self-reported SDN data to objective data from the National Resident Matching Program (NRMP).

**Methods:** We retrospectively reviewed self-reported SDN data by DO and MD candidates from EM forums for the 2014, 2016, and 2018 residency application cycles. These data were compared to the NRMP charting outcomes for each respective year.

**Results:** A total of 360 EM applicants self-reported data on the SDN during the years reviewed. The majority of these applicants (79%) posted for the 2018 application cycle following transition to a Google Docs spreadsheet. For the first two years of analysis, mean United States Medical Licensing Examination (USMLE) scores were similar to SDN reports. For the most recent year studied, applicants who posted to SDN reported higher mean (USMLE) Step 1 (234, 95% confidence interval [CI], 233-236) and Step 2 scores (250, 95% CI, 248-251) when compared to NRMP data (231 and 241). Reported contiguous residency program ranks were similar to NRMP in all years, and the proportion indicating Alpha Omega Alpha Honor Medical Society membership was similar to NRMP only for the most recent year studied.

**Conclusion:** Self-reporting on SDN showed a slight bias toward higher USMLE step scores in the most recent year when compared to objective NRMP data. Self-reporting on SDN has increased in recent years, but it is unknown whether this increase will lead to more accurate information for EM applicants. Given the self-reported nature of the SDN, applicants should use SDN forums with caution. [West J Emerg Med. 2022;22(1)90–94.]

## INTRODUCTION

Medical students interested in emergency medicine (EM) have multiple resources available to assist them during their residency application process.<sup>1-3</sup> The National Resident Matching Program (NRMP), for example, publishes data from medical students entering the match process within each medical specialty.<sup>4</sup> The NRMP's *Charting Outcomes in the Match* publications include applicants' mean United States Medical Licensing Examination (USMLE) step scores, and

Alpha Omega Alpha (AOA) Honor Medical Society status. Advisors, mentors, and other official resources provide applicants with additional information on the application process including application approaches, interview strategies, and general statistics for residency programs.<sup>5,6</sup> Despite these resources, medical students are often unaware of how their residency application compares to their peers, leaving applicants to use other, less official, resources with undetermined accuracy.<sup>7</sup>

One commonly used online resource is the Student Doctor Network (SDN, [www.studentdoctor.net](http://www.studentdoctor.net)), which offers an online forum for students, residents, and attending physicians to discuss past and current experiences with the match process, among other topics. The SDN hosts forums for its online community by subject matter spanning all stages of medical education. The forums are available for public viewing, but posting is restricted to those with an account on the website. In recent years, it has become common for residency applicants to provide self-reported data from their own residency application.<sup>8,9</sup> These data can then be accessed by other potential applicants to evaluate the competitiveness of their own application. Applicants who use this data to inform their own application process must do so with caution, as these posts are anonymous and there is no mechanism to ensure their accuracy.

A comparison of self-reported SDN and NRMP data in the comparatively small field of radiation-oncology showed bias of aggregate self-reported test scores toward higher-scoring applicants.<sup>9</sup> There are no studies to date comparing self-reported SDN data with NRMP's published data in the larger field of EM. As SDN represents a potential source of important information for EM applicants, our goal in this study was to compare SDN data with NRMP data to determine whether self-reported SDN data is an accurate representation of the typical EM applicant.

## METHODS

This was a retrospective analysis of self-reported applicant data within EM forums on the SDN. Those who reported on the SDN either used the forum system on annual threads for EM applicants or, in the case of the 2017-2018 application cycle, a Google Docs spreadsheet (Google LLC, Mountain View, CA) was created that allowed users to anonymously add their own data without creating an account on the SDN. Links to this spreadsheet were posted to the SDN and the website Reddit ([www.reddit.com](http://www.reddit.com)) (Reddit Inc., San Francisco, CA).<sup>10</sup> With the forum system, respondents replied to the original thread with a post to provide their application information in a structured format under their SDN username. These were subsequently aggregated by the researchers. The spreadsheet allowed anonymous users to provide the same structured data in an already aggregated format.

We performed data collection and analysis for the 2014, 2016, and 2018 application cycles because those were the years with corresponding NRMP publications.<sup>11-15</sup> For the purposes of this study, DO and MD applicants were pooled. Given the different application experiences of international medical graduates (IMG) applying for EM residency, such as the average number of applications submitted, we excluded IMGs from analysis.<sup>16,17</sup>

The variables collected from the SDN included those available in NRMP publications such as USMLE Step 1 and 2 scores, AOA status, and number of contiguous ranks as well as those commonly included in SDN forums, including number of residency applications and number of accepted

### *Population Health Research Capsule*

What do we already know about this issue?  
*Medical students often use various online resources to help guide their residency application process.*

What was the research question?  
*How accurate is self-reported data regarding emergency medicine applicants on the Student Doctor Network (SDN)?*

What was the major finding of the study?  
*Self-reported data on SDN showed slight bias toward higher USMLE scores compared to objective NRMP data.*

How does this improve population health?  
*Online resources are often relied on heavily by medical students, but should be used with caution when applying to emergency medicine residency.*

interview invitations. Given the self-reported nature of the SDN, there were missing data points that were not included in analysis. We obtained comparison data from NRMP *Charting Outcomes in the Match* for 2014, 2016, and 2018. The NRMP provides means and proportions but not distributions, so we did not perform direct statistical comparisons with SDN data. We analyzed data by descriptive statistics using Microsoft Excel (Microsoft Corporation, Redmond, WA). Descriptive data are reported as means with 95% confidence intervals (CI) to match NRMP reports, where applicable, while medians and interquartile ranges (IQR) were used for non-parametric data not reported by NRMP. This study was reviewed by our institution's institutional review board and deemed exempt because it used de-identified and publicly available information.

## RESULTS

In total, there were 360 applicants with self-reported information on the SDN in the years 2014, 2016, and 2018, representing 7.3% of all EM applicants during the time period. The majority (79%) of SDN applicants self-reported in the 2018 application cycle, which used a Google Docs spreadsheet instead of a typical SDN forum. This sample represented 14.5% of all EM applicants for that year. The mean USMLE Step 1 and Step 2 scores reported by applicants was 235 and 249, respectively. Table 1 shows cumulative, self-reported SDN applicant data for the included years. Table 2 shows a comparison of SDN data by year with corresponding data reported by the NRMP. As the



**Table 1.** Summary of Student Doctor Network data from 2014, 2016, and 2018.

Variable	Value
Mean number of contiguous ranks (95% CI)	12 (11-13)
Mean USMLE Step 1 score (95% CI)	235 (233-237)
Mean USMLE Step 2 score (95% CI)	249 (248-251)
AOA, n (%)	
Yes	29 (8%)
No/Unknown	331 (92%)
Couples match, n (%)	
Yes	6 (2%)
No	0 (0%)
Unknown	354 (98%)
Any research, n (%)	
Yes	24 (7%)
No	47 (13%)
Unknown	289 (80%)
Median number of applications submitted (IQR)	45 (35-62.25)
Median number of interviews received (IQR)	20 (12.25-26.5)
Median number of interviews attended (IQR)	13 (6-16.75)
Matched on rank list, n (%)	
1	12 (3%)
2	0
3	6 (2%)
4	1(0.3%)
5	0
6	1(0.3%)
7	1(0.3%)
Unknown	339 (94%)

CI, confidence interval; USMLE, United States Medical Licensing Examination; AOA, Alpha Omega Alpha Honor Medical Society; IQR, interquartile range.

NRMP data represents true population totals, 95% CIs were not calculated. In general, those who posted on the SDN had similar USMLE step scores and a similar number of contiguous ranks. For 2018, however, aggregated USMLE step scores from the SDN showed a higher average than reported by the NRMP. The mean number of applications submitted per applicant was 53 with a median of 45, indicating a positive skew.

## DISCUSSION

From the information provided by EM applicants on the SDN and those compiled by the NRMP, the mean USMLE Step 1 and Step 2 scores reported for applicants by the NRMP was similar to those self-reported by applicants. While the average USMLE Step 1 and Step 2 scores were higher on the SDN self-reported data than the NRMP for all years compared, they were typically within the 95% CI of the mean. Exceptions to this were noted in 2018, indicating that for this year, the SDN had a bias toward higher scoring applicants. One possible explanation for this discrepancy is that applicants with lower scores may be less willing to publicly disclose their test scores, even anonymously.

Applicants should interpret anonymously self-reported examination scores with caution. The average number of contiguous ranks between the SDN and NRMP, however, were similar in all years studied. According to the NRMP, applicants with 12 contiguous ranks had approximately a 95% probability of matching, which is a valuable data point for future applicants.<sup>4</sup> Given that most categories, in aggregate, appear similar to NRMP data while some show important differences, it is unclear how applicants should best use the SDN as a potential data source to inform their own application process.

With the use of Google Docs in 2018, there was a nine-fold increase in the number of users posting data using the SDN compared to 2016. This has been observed in previous studies comparing these two sources and is likely due to the ease of use, anonymity, and ability to access the spreadsheet from either the SDN or Reddit.<sup>8,9</sup> As more users

**Table 2.** Comparison of Student Doctor Network and National Resident Matching Program data.

	SDN 2014	NRMP 2014	SDN 2016	NRMP 2016	SDN 2018	NRMP 2018
Applicants (n)	42	1,371	31	1,576	286	1,972
USMLE Step 1 score (Mean, 95% CI)	235 (229-240)	230	238 (234-243)	233	234 (233-236)	231
USMLE Step 2 score (Mean, 95% CI)	245 (241-250)	243	248 (242-254)	245	250 (248-251)	241
Number of contiguous ranks (Mean, 95% CI)	12 (11-13)	11.9	12 (10-13)	11.2	12 (10-14)	11
AOA Membership* (%)	27%	12%	33%	13%	13%	12%

\*Applicants not indicating an AOA status were presumed to not be AOA members.

SDN, Student Doctor Network; NRMP, National Resident Matching Program; USMLE, United States Medical Licensing Examination; CI, confidence interval; AOA, Alpha Omega Alpha Honor Medical Society.

contribute in future years, it is possible that the differences noted between SDN and NRMP data will decrease, as was seen with the percentage of applicants that claimed AOA status. Alternatively, given the ease with which users can anonymously post, some posts on the Google Doc may not be accurate and the spreadsheet may be unavailable periodically due to inappropriate and/or offensive posts and necessary maintenance.

There was considerable variability in the reported number of residency applications submitted by SDN users, with an interquartile range of 35 to 62.25 applications. It is unknown whether the range among applicants was due to counsel from advisors, perceived strength or weakness of individual applications, or a combination of the two. This is an important consideration for applicants as medical students are applying to more residency programs, often at significant personal cost.<sup>18,19</sup> At the current 2021 Electronic Residency Application Service (ERAS) fee structure, the average number of applications from the current study (53) would cost \$1187 per applicant.<sup>20</sup> For medical students, most with limited to no income, this cost is unreasonable but may be deemed necessary to “keep up” with their peers. While advisors may counsel against an inordinate number of applications per applicant, students may be influenced by noting how many programs their peers report on the SDN that they are applying to. Applicants, advisors, and ERAS should explore ways to address the increasing number of applications and limit the costs of the application process to avoid placing applicants from less privileged financial backgrounds at a competitive disadvantage.

## LIMITATIONS

There were several limitations to this study. For the 2018 application cycle, users did not self-report data on successful matching; so this was excluded from analysis. Although the anonymous forum dramatically increased the number of users who posted information, it is likely that many users simply stopped using the website after a successful match. As both NRMP aggregated data and SDN data are anonymous, direct comparisons of these data in individual applicants was not possible. Similarly, data collection techniques significantly differ between the two sources. Further, given the small sample size from the SDN, conclusions regarding its accuracy should be tempered.

## CONCLUSION

Self-reported EM applicant data on the Student Doctor Network is similar to data provided by the NRMP with a bias in recent years toward higher self-reported standardized test scores. With the emergence of Google Docs as a centralized and more anonymous avenue for self-reporting data, a dramatic increase in applicants providing information was noted for the most recent application cycle. Whether this trend will provide more accurate data for potential EM residency applicants remains to be seen.

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*Conflicts of Interest:* By the WestJEM 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 Medicine Residents' "Just World" Bias Is Not Associated with a Biased Case Mix

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Section Editor: Jeffrey Love, MD and Abra Fant, MD

Submission history: Submitted June 14, 2021; Revision received November 9, 2021; Accepted November 15, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.53658

**Introduction:** Belief in a just world is the cognitive bias that “one gets what they deserve.” Stronger belief in a just world for others (BJW-O) has been associated with discrimination against individuals with low socioeconomic status (SES) or poor health status, as they may be perceived to have “deserved” their situation. Emergency medicine (EM) residents have been shown to “cherry pick” patients; in this study we sought to determine whether BJW-O is associated with a biased case mix seen in residency.

**Methods:** We assessed EM residents on their BJW-O using a scale with previous validity evidence and behavioral correlates. We identified chief complaints that residents may associate with low SES or poor health status, including psychiatric disease, substance use disorder (SUD); and patients with multidisciplinary care plans due to frequent ED visits. We then calculated the percentage of each of these patient types seen by each resident as well as correlations and a multiple linear regression.

**Results:** 38 of 48 (79%) residents completed the BJW-O, representing 98,825 total patient encounters. The median BJW-O score was 3.25 (interquartile range 2.81–3.75). There were no significant correlations observed between BJW-O and the percentage of patients with multidisciplinary care plans who were seen, or patients with psychiatric, SUD, dental or sickle cell chief complaints seen; and a multiple linear regression showed no significant association.

**Conclusion:** Higher BJW-O scores in EM residents are not significantly associated with a biased case mix of patients seen in residency. [West J Emerg Med. 2022;23(1)95–99.]

## INTRODUCTION

The emergency department (ED) is often viewed as the gateway to medical care for patients with limited access to resources. Regardless of their ability to pay, anyone who comes through the door is guaranteed a medical screening examination and lifesaving care. However, frequent visits to the ED by patients with less emergent complaints can be perceived as “illegitimate” by clinicians working in already overburdened EDs, leading to stress among healthcare workers and potentially lower quality care for patients.<sup>1</sup> Physician cognitive biases have previously been demonstrated with regard to which patients are most “deserving” of care,<sup>2</sup> who will be the most “difficult” to treat effectively,<sup>3</sup> or a sense

of futility in providing additional care.<sup>4</sup>

The belief in a just world (BJW) is a well-studied cognitive bias that “one gets the things that they deserve in life.” When viewed through the lens of one’s own life, this viewpoint can be a protective coping mechanism and is associated with higher rates of satisfaction and fulfillment, and less burnout.<sup>5</sup> However, when applied to others, it has been associated with discrimination against individuals with low socioeconomic status (SES) or poor health.<sup>6</sup> There is very limited data on BJW in healthcare. One small study suggested that higher BJW in physicians and nurses was associated with less empathetic feelings toward perinatal mothers.<sup>7</sup> Another study on undergraduate students showed that students with



high BJW were most likely to say that they would help a fictitious patient who was not responsible for their illness.<sup>8</sup> Evidence is mixed, however, on whether implicit biases uniformly manifest in the clinical environment.<sup>9,10</sup>

Previous studies have shown that emergency medicine (EM) residents "cherry pick" the patients they see during their training, selectively choosing specific chief complaints faster than others.<sup>11</sup> However, this has not been shown to be a universal phenomenon.<sup>12</sup> In this study we sought to examine whether resident physician BJW for others (BJW-O) is associated with a biased case mix seen during residency training.

## METHODS

This was a cross-sectional, retrospective study that took place at a single, midwestern, academic institution from 2019-2021, and examined patient encounters from 2016-2020. All residents currently in training were eligible, as well as the most recently graduated class (48 total). The clinical site where we conducted the study is a 58-bed, tertiary care facility with approximately 60,000 patient visits annually. The majority of patients evaluated in the ED were White and insured by Medicare/Medicaid, with Black patients making up 11% of visits, Hispanic patients 7%, and Asian patients 3%. Substance use disorder (SUD) encounters are primarily for alcohol and pharmaceutical polypharmacy. Residents are assigned to work in one of three areas, North, staffed by 2-3 residents/advanced practice providers (APPs), including at least one postgraduate year (PGY)-2 or PGY-3 resident, South, staffed by 2-3 residents/APPs, including at least one PGY-3 resident, or pediatrics, staffed with 2-3 residents. For most of the study, clinicians on North or South were able to assign themselves to any adult patient in the department; in mid-2019 pods were created, dividing the responsibility for the ED beds roughly in half. Residents spend 5/13 blocks at the main clinical site during their first year, 6/13 in second year, and 8/13 in their third year.

Two authors (one faculty and one resident EM physician) identified groups of patients who may have been perceived by ED residents as having low SES or poor health status based on a review of the literature. Patients with multidisciplinary care plans, patients with psychiatric, SUD, and dental or sickle cell disease chief complaints were selected as surrogate markers, as patients visiting the ED for these complaints have been shown to be vulnerable to clinician bias and stigma,<sup>1</sup> and patients who present frequently to the ED have previously been shown to be of lower SES and have significant medical issues.<sup>13</sup> Patients with multiple ED visits within a short time frame that are felt to be avoidable are flagged by a multidisciplinary team including nursing, EM, primary care, and relevant specialists who develop a care plan that can then be implemented during their visit to ensure consistency. These patients are prominently flagged on the electronic health record track (EHR) board (Epic Systems Corporation, Verona, WI) to ensure that there are no opportunities for these care

### *Population Health Research Capsule*

What do we already know about this issue?  
*Belief in a just world (BJW) has been associated with discrimination against individuals with low socioeconomic status or poor health.*

What was the research question?  
*Is resident physician BJW for others (BJW-O) associated with a biased case mix seen during residency training?*

What was the major finding of the study?  
*Emergency medicine residents' BJW-O is not associated with a biased patient case mix seen.*

How does this improve population health?  
*BJW does not appear essential to assess as part of resident selection or training to ensure a comprehensive training experience.*

plans to be missed. Patients with this flag appearing in their chart were used as a proxy for frequent ED visitors, as the population that visits the ED most frequently can be highly variable over time and these patients are not easily identifiable without experience or closely examining the chart.

We used the patient's assigned chief complaint to categorize encounters, as this was the information most likely accessible to residents when assigning themselves to patients. Encounters with a listed chief complaint of "psychiatric problem," "anxiety," "depression," and "suicidal" were included in the analysis as psychiatric encounters. Encounters with a chief complaint of "drug/alcohol issues," "alcohol intoxication," and "overdose" were included as SUD encounters.

To create "percentage seen" metrics for patients with complex care plans or with psychiatric and SUD chief complaints we abstracted from the EHR each resident's number of encounters with patients in each of these categories as the first assigned resident at the residency's main ED site and then divided by their total number of patients seen in this ED during residency up to that point. We also examined the percentage of shifts worked in the South pod of the ED, as residents were in closer proximity to the rooms generally used for patients with psychiatric chief complaints and may have felt compelled to assign themselves to these patients. Patients received at sign-out were not included in a resident's total, as residents have less agency in determining which of these patients they are assigned to.

Residents were administered the Belief in a Just World Scale (Appendix A), which measures both BJW for self (BJW-S) and BJW-O. Scores for each scale range from 1 to 5; higher scores represent stronger BJW-O and scores of 3 or lower have been categorized as "low BJW," while scores of 4 or higher have been categorized as "high BJW."<sup>7</sup> Strong validity evidence for BJW in an undergraduate population exists,<sup>14</sup> and BJW has previously been shown to be stable over time<sup>15</sup> and to correlate with real-world behavioral outcomes in a general French population.<sup>6</sup> The instrument was administered to residents via computer-based survey (Qualtrics, Provo, UT) and delivered by email. Participation was fully voluntary. While results could not be kept anonymous due to the need to match with personal encounters data, all responses were kept strictly confidential and stored on password-protected computers.

A multivariable linear regression model was fitted to BJW-O as response variable, with characteristics of interest (percent of patients with multidisciplinary care plans, psychiatric chief complaints, SUD chief complaints) included as predictor variables. We also included in the model the percentage of shifts worked in the South pod as a covariate to adjust for potential confounding. Linear regression assumptions were checked, and all hypothesis testing was two sided, with significance set as  $p$ -value  $< 0.05$ . We calculated Pearson correlations ( $r$ ) between BJW-O and each of the variables of interest, together with 95% confidence intervals for  $r$  and corresponding  $p$ -values. A  $p$ -value  $< .05$  was considered statistically significant. All statistical analyses were performed with R v4.0.3 (The R Project for Statistical Computing, Vienna, Austria).

This study was determined to be exempt quality improvement under the University of Wisconsin-Madison Institutional Review Board guidelines.

## RESULTS

Responses from 38/48 residents (79% response rate: 10 PGY-1, 10 PGY-2, 10 PGY-3, and 8 PGY-4) were available for analysis with no missing data noted for any variable of interest, representing 98,825 total patient encounters with a median of 2,691 patients per resident (interquartile range

[IQR] 1,785-3,364). The median BJW-O score was 3.25 (IQR 2.81–3.75). Table 1 summarizes the linear multivariable regression model coefficients. Dental pain and sickle cell disease were dropped from the analysis, as there were too few of these cases per resident.

None of the four predictor variables in the model was found to have a statistically significant impact on BJW-O. The regression model showed a multiple  $R^2$  value of 0.09883, indicating that 9.88% of the variability observed in the BWJ-O scores could be explained by the four predictors investigated.

From the correlation results shown in Table 2, a nonsignificant small correlation of BJW-O with the percent of patients with a multidisciplinary care plan ( $r = 0.174$ ,  $p = 0.297$ ) and with SUD ( $r = 0.107$ ,  $p = 0.521$ ) was found among the main variables of interest, and small nonsignificant correlations of BJW-O with the auxiliary variables of percent of patients with dental chief complaints ( $r = 0.203$ ,  $p = 0.223$ ), and with BJW-S scores ( $r = 0.098$ ,  $p = 0.56$ ).

## DISCUSSION

The BJW-O scores do not appear to explain the percentage of patients with multidisciplinary care plans or the percentage of patients with psychiatric or SUD chief complaints seen by residents. While residents demonstrated a broader range of BJW-O scores (1-4.9) than previously reported in healthcare providers (2.3-4.7),<sup>7</sup> this study contrasts with what has been seen in other experimental work on BJW-O;<sup>6</sup> however, it is consistent with other literature on the impact of implicit biases.<sup>10</sup>

While it is tempting to take the lack of evidence of BJW-O bias affecting residents' case mix found here as evidence of lack of bias toward these patients, it remains possible that this bias appeared in other ways. This study did not examine the care that was delivered to patients; patients perceived to have poor health status or low SES could have received slower care, lower doses of pain medication, or a less thorough evaluation. The original study on EM resident "cherry-picking" also examined the time elapsed before residents picked up each patient rather than case mix.<sup>11</sup> It is also possible that the BWJ-O bias manifested in slower pickup times instead of altered case mix.

**Table 1.** Results of multiple linear regression model evaluating the impact of percentage of patients seen with complex care plans, and psychiatric or substance use disorder chief complaints and the percentage of shifts on a resident's belief in a just world for others.

	Estimate	Std. error	Statistic	$p$ -value	Lower 95% CI	Upper 95% CI
Intercept	3.154	2.371	1.33	0.192	-1.669	7.977
Care plan %	0.445	0.313	1.421	0.165	-0.192	1.082
Psych CC %	-0.17	0.2	-0.849	0.402	-0.576	0.237
SUD %	0.405	0.444	0.913	0.368	-0.497	1.307
South %	-0.038	0.035	-1.094	0.282	-0.109	0.033

CI, confidence interval; CC, chief complaint; SUD, substance use disorder.

**Table 2.** Correlations (Pearson's *r*) of "belief in a just world for others" scores with belief in a just world for self and the percentage of patients seen with a care plan, psychiatric, substance use disorder, and sickle cell or dental pain chief complaints.

Variable	Mean (SD)	<i>r</i>	Lower 95% CI	Upper 95% CI	<i>p</i> -value
BJW-O	3.26 (0.85)				
BJW-S	4.73 (0.36)	0.098	-0.229	0.405	0.56
Care plan %	4.95 (0.47)	0.174	-0.155	0.467	0.297
Psych CC %	4.05 (0.73)	-0.076	-0.386	0.25	0.649
SUD CC %	1.40 (0.32)	0.107	-0.22	0.413	0.521
Sickle cell CC %	0.19 (0.11)	0.028	-0.294	0.344	0.868
Dental CC %	0.32 (0.15)	0.203	-0.125	0.49	0.223
South shift %	53.16 (4.09)	-0.157	-0.454	0.171	0.346

SD, standard deviation; CI, confidence interval; CC, chief complaint; BJW-O, belief in a just world for others; BJW-S, belief in a just world for self; SUD, substance use disorder.

The lack of association that was found may reflect medical complexity mitigating any potential "selection effect." For example, a patient with a SUD chief complaint could be a patient with polysubstance overdose requiring intubation, while a patient with a psychiatric chief complaint could be an acute threat to staff requiring chemical restraint. Alternatively, social desirability bias, where residents feel motivated to exhibit their virtuous behavior and altruism to their co-workers may exert a corrective effect against BJW bias and has been postulated in other studies of physician behavior.<sup>16</sup> This motivation may be especially powerful in EM, where the unofficial motto is, "Anyone, Anything, Anytime."<sup>17</sup> Residents also only exert a certain amount of control over their next patient; random chance plays a large role that may have attenuated any potential effects.

For program directors, these results should be encouraging. At this time, it appears that BJW does not need to be assessed as part of resident selection or training to ensure a comprehensive training experience. However, more research should be done to confirm these findings.

## LIMITATIONS

This was a single-center study, conducted with four residency classes, at the primary ED training site. It was conducted at a large, tertiary care academic center that sees a relatively low volume of uninsured and undomiciled patients; it is possible that results would be different in a different medical setting with a different patient population, or with a larger sample size. This was a correlational study; it is possible that other factors not controlled for, such as percentage of night shifts worked, had a larger influence on case mix. Burnout has also been shown to affect BJW,<sup>18</sup> which could also explain the differences that were found. Additionally, BJW has been shown to vary by race.<sup>19</sup>

For this study we chose chief complaints that the author group felt may be perceived to be associated with low SES or poor health status; it is possible that the groups chosen were not perceived by residents in this way, or that other groups

might have been more affected. Patients' chief complaints also may not have matched their true reason for presentation. Operational changes, such as a switch to a pod system and the COVID-19 pandemic, may have also affected resident case mix in unpredictable ways.

## CONCLUSION

Higher resident BJW-O scores were not correlated with a lower percentage of patients with multi-disciplinary care plans, or psychiatric, SUD, dental or sickle cell chief complaints seen in residency. While the assessment of resident personality traits and their impact on training and patient care is in its infancy, this study suggests that belief in a just world for others does not manifest as a biased case mix.

This research was accepted to the Wisconsin Chapter American College of Emergency Physicians Spring Symposium 2020 in Madison, Wisconsin, which was subsequently cancelled due to COVID-19.

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*Conflicts of Interest:* By the WestJEM 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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# Educating Future Educators—Resident Distinction in Education: A Longitudinal Curriculum for Physician Educators

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Submission history: Submitted June 28, 2021; Revision received November 9, 2021; Accepted November 11, 2021

Electronically published December 17, 2021

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.53890

[West J Emerg Med. 2022;23(1)100–102.]

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## BACKGROUND

The Accreditation Council for Graduate Medical Education (ACGME) lists “educating patients, families, students, residents, and other health professionals” as a common core requirement for residency programs in every medical specialty.<sup>1</sup> Residents often play a crucial role in peer and medical student education. Teaching others can solidify resident knowledge, enhance students’ knowledge, and influence career choices.<sup>2,3,4,5</sup>

A 2004 review of existing resident-as-teacher (RAT) curricula outside of emergency medicine (EM) found that they improve resident teaching confidence, teaching organization, and student evaluations, as well as resident motivation to teach and confidence in their teaching skills.<sup>6</sup> Unfortunately, many EM programs lack RAT curricula; a needs assessment revealed that 40% of EM programs lack RAT programming.<sup>7</sup> Furthermore, many residents lack confidence in their teaching abilities.<sup>8</sup> While bedside teaching curricula demonstrated improvement in the educational experience for both residents and medical students and an impact on residents’ pursuit of academic careers, EM RAT curricula are almost exclusively lecture-based.<sup>9,10,11</sup> There is a paucity of literature describing longitudinal RAT programs that emphasize the large scope of skills EM residents need to be effective educators. Furthermore, programs that have been described have required financial and infrastructural support that may not be easily reproduced at other sites.<sup>12</sup>

## OBJECTIVES

Our objective was to create a longitudinal, multimodal RAT curriculum for EM residents that would foster early development of clinician-educators and develop residents’ confidence in their teaching abilities.

## CURRICULAR DESIGN

An elective curriculum, known as Resident Distinction in Education (RDE), was designed at our four-year residency using the six modules for creating an education curriculum described by Farrell et al: clinical teaching; bedside teaching; effective feedback; teaching procedures; teaching with high fidelity simulation; and leading effective lectures and discussions.<sup>13</sup> A scholarly project requirement was included to address the importance of education-based scholarship for clinician-educators.<sup>14</sup>

To create the curriculum, we used pre-existing RAT opportunities within our residency program and added two that have been successful at other institutions. These were subdivided into three domains: teaching; scholarship; and personal learning/development. We assigned a numerical credit to activities proportional to the amount of time a resident was expected to spend in preparation and execution. Historically, prior to the creation of the RDE curriculum our program’s graduates would complete the equivalent of 74 credits over four years simply by participating in residency activities. This was used as a basis to set additional requirements for the RDE certification at 225 credits (Appendix A). We established annual credit requirements within each domain to help residents pace themselves. We then created an interactive spreadsheet listing requirements and credit designation in each domain to help residents track their progress and record the details of their experiences. Participants in the RDE program were all required to read the text *ABC of Learning and Teaching in Medicine*<sup>15</sup> and to participate in journal clubs based on their reading. Two new RAT rotations were created: a clinical teaching elective focused on working with EM sub-interns, and a required bedside teaching rotation

for senior residents. The RDE participants used these rotations to refine their skills by teaching procedures, participating in bedside teaching, and administering mini-lectures to residents working clinically in the emergency department (ED).

The RDE curriculum, introduced in 2018, is open for enrollment in the middle of the intern year as an elective. The directors meet with interested residents annually to track progress. Upon graduation, residents who fulfilled the RDE requirements received a certificate attesting to their dedication and recognizing their efforts and skills as an educator.

**IMPACT/EFFECTIVENESS**

Since its implementation, 28 residents have enrolled in the RDE program. Eight of the enrolled residents have completed residency, and six satisfied all requirements to receive the RDE certificate. The two residents who did not complete the program failed to satisfy the requirements set forth. All six graduates who received the RDE certificate are currently working at academic institutions.

A survey that was deemed exempt by our institutional review board was sent to all graduates who completed the program; one graduate, a co-author of this study, was excluded (n = 5). We created the survey through our university-based, web survey instrument (Qualtrics, Provo, UT). A link to the online survey

was distributed via email to all residency graduates who had participated in the RDE program. No identifying information was collected from participants. The response rate was 100%. In evaluating the objective of fostering resident confidence in their teaching abilities, the survey results showed that all participants felt at least “somewhat confident” in their ability to contribute to education/ scholarship, quality of bedside teaching, and creating/ presenting lectures. All but one resident felt at least “somewhat confident” in giving feedback. “Extreme confidence” was reported by one resident in presenting lectures, and by another in bedside teaching. All respondents stated they would recommend participation in the program to future residents and that their involvement helped solidify their desire to actively incorporate medical education into their future careers (Figure 1).

The RDE program is currently in its third year of implementation, and RDE participants represent about one-third of each residency class. The RDE curriculum was designed to be reproducible within other EM residency programs. The ease of incorporating a similar program would depend on the breadth of pre-existing RAT opportunities at a given residency. However, some components likely exist at other programs, and minimal additional burden should be needed to implement a similar framework. Based on the limited number of participants, the one aspect of the RDE program that many have found

Survey Response No. (anonymous)	I	II	III	IV	V	
With respect to the Resident Distinction in Education (RDE) curriculum:	What challenges did you have?	Limited time	It's an extra time commitment on top of an already busy residency schedule	Becoming aware of curriculum requirements midway through residency made for some "catch up" time rather than those who entered their training with this in mind	Having an abbreviated curriculum due to residency ending	While I spent a lot of time teaching, I did not receive as much teaching about teaching as I would like. That's partly due to the aspects of the curriculum I prioritized, but maybe more of those components should be mandatory.
	How has participation aided in developing of your teaching skills?	Motivated me to expand my lecture bank	Despite its importance in medical education, we have very little formal training on how to educate/ teach. Just taking the time to have dedicated didactic education on how to teach was significantly helpful on developing skills.	A natural interest in education with the availability of this curriculum helped to encourage taking on further teaching opportunities.	Better knowledge of fundamentals of medical education	I really liked that it gave me new ideas for teaching-related projects to do. Some of the components I was already planning on, but others I had not thought of but realized they were a great idea (intern orientation lectures, core content reading). This program provided a lot of opportunities to practice and fine tune my teaching abilities. Not to mention become certain that this is something I want to do in my career.
	What would you change for the future?	Add some reading materials on bedside teaching	More feedback from senior educators (PD/ APDs/ senior attendings) on quality of our teaching, with specific examples of improve our skills. Workshops on FOAMED and/or academic writing for medical education (journals to submit to, etc.) would be helpful	Adding a component that focuses on how to pursue and succeed in a career in education	Incorporate some "observed teaching" sessions as part of the education elective	I think with any new program recognition of its existence and importance can be difficult at first, though I think [program founder] did a great job advertising it and checking in frequently on progress. Maybe coordination check-ins with the bi-yearly mentor meetings would help solidify the program and help residents stay on track.
	How has it impacted your choice of career?	Helped solidify my interest in resident education	I am reassured on my decision to pursue academic medicine (vs full time private practice), with a specific interest in having dedicated education time/ buy down.	Reinforced educational/ teaching interest	Continue down education pathway	I was considering teaching as part of my career before this program, now I am a lot more certain that that's what I want to do.
	Would you recommend participation to future residents?	yes	yes	yes	yes	yes
Rate yourself on the following using the SCALE: no confidence minimal confidence average confidence somewhat confident extremely confident	contribute to education/ scholarship	Somewhat confident	Somewhat confident	Somewhat confident	Somewhat confident	
	quality of bedside teaching	Somewhat confident	Somewhat confident	Somewhat confident	Extremely Confident	
	create and present lecture	Somewhat confident	Extremely confident	Somewhat confident	Somewhat confident	
	to give feedback	Somewhat confident	Average	Somewhat confident	Somewhat confident	
Additional thoughts/ feelings/ feedback	n/a	I like both the tract, and the idea of having learning tracts with residency for various subjects as well as Medical education is particularly helpful because it combines well with other advanced training/ subspecialty interests that lead towards academic tracks.			Good program, hope it continues!	

**Figure 1.** Survey results of graduates who completed the requirements for a Resident Distinction in Education certificate.\*

\*The visual representation differs slightly from that of the survey collected for ease of reproduction in graphical form.

particularly challenging and that led to two residents failing to complete the program was the scholarly project criteria. As of now, the definition of what constitutes a “scholarly project” at our institution is being evaluated and may be broadened.

We want to acknowledge several limitations. First, our program was implemented at a four-year residency with four months of elective time. This may limit reproducibility at programs with less elective time. One solution would be to decrease the total number of credits needed to attain the RDE at those programs. Another limitation is the lack of formal feedback or evaluation of participants’ bedside teaching and lecturing skills beyond self-assessment, which is prone to bias. The graduates rated themselves “average” or “somewhat competent” in their skills based on survey results. No self-evaluations were performed before participation in the program; thus, conclusions cannot be drawn as to the program’s effects on resident skills or level of comfort. The program affiliation with a medical school as well as a large university did provide our resident participants with many diverse teaching opportunities that could be difficult to replicate at programs that lack such affiliations.

The small number of participants did not allow for statistically significant conclusions to be drawn. The “soft” outcomes (Figure 1) based on self-reported confidence without true measures does demonstrate preliminary evidence of effectiveness based on the Kirkpatrick framework, level 1.<sup>16</sup> The responses point to trainees finding their participation in the RDE program influential upon their development, all were “somewhat” or “extremely” confident in the domains evaluated by the survey (an achievement of Kirkpatrick level 1), and all pursued academic careers. Adding student and faculty evaluations of participant residents’ teaching skills, and pre-post self-assessments may allow us to gain a more thorough understanding of this program’s impact. Furthermore, tracking RDE graduates’ career trajectories will allow for conclusions regarding long-term impacts. These longer term and more thorough outcome measures would allow the evaluation of higher Kirkpatrick levels and enable a more robust evaluation of the RDE program’s success.

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*Conflicts of Interest:* By the WestJEM 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 Medicine Virtual Conference Participants' Engagement with Competing Activities

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Submission history: Submitted July 1, 2021; Revision received November 29, 2021; Accepted November 29, 2021

Electronically published January 3, 2022

Full text available through open access at [http://escholarship.org/uc/uciem\\_westjem](http://escholarship.org/uc/uciem_westjem)

DOI: 10.5811/westjem.2021.11.54001

**Introduction:** Residency didactic conferences transitioned to a virtual format during the COVID-19 pandemic. This format creates questions about effective educational practices, which depend on learner engagement. In this study we sought to characterize the competitive demands for learner attention during virtual didactics and to pilot methodology for future studies.

**Methods:** This was a prospective, observational, cohort study of attendees at virtual didactics from a single emergency medicine residency, which employed a self-report strategy informed by validated classroom assessments of student engagement. We deployed an online, two-question survey polling across six conference days using random signaled sampling. Participants reported all activities during the preceding five minutes.

**Results:** There were 1303 responses over 40 survey deployments across six nonadjacent days. Respondents were residents (63.4%); faculty (27.5%); fellows (2.3%); students (2%); and others (4.8%). Across all responses, about 85% indicated engagement in the virtual conference within the last five minutes of the polls. The average number of activities engaged in was 2.0 (standard deviation = 1.1). Additional activities included education-related (34.2%), work-related (21.1%), social (18.8%), personal (14.6%), self-care (13.4%), and entertainment (4.4%).

**Conclusion:** Learners engage in a variety of activities during virtual didactics. Engagement appears to fluctuate temporally, which may inform teaching strategies. This information may also provide unique instructor feedback. This pilot study demonstrates methodology for future studies of conference engagement and learning outcomes. [West J Emerg Med. 2022;23(1)103–107.]

## INTRODUCTION

Emergency medicine (EM) residency programs executed a rapid shift to virtual didactic conferences in response to the safety restrictions resulting from the COVID-19 pandemic. This transition creates questions about effective education, which depends on learner engagement for success.<sup>1–3</sup> Engagement serves as an important and measurable link

between instruction and educational outcomes and is defined as focused attention on a specific task.<sup>4,5</sup> Accordingly, multiple direct-observation tools to assess learner engagement and behaviors exist for the classroom.<sup>5–7</sup>

Audience engagement with virtual didactics is not well-characterized in the graduate medical education (GME) environment. Related work has focused on asynchronous



content and finds short-duration interaction with the resources.<sup>8-10</sup> Information about synchronously delivered virtual content spanning a longer time period is not available. Drawing from existing evidence that the learning environment is a major mediator of learner engagement, it was hypothesized that learners engage in multiple activities during virtual conferences.<sup>4</sup> In this observational cohort study we sought to characterize the competition for learner attention during virtual didactics and to pilot methodology for assessing engagement in this environment.

## METHODS

### Study Setting and Population

This study occurred at a single, four-year EM residency. Didactics occur weekly in a four-hour block, and content is aimed at residents. Potential participants included all conference attendees: EM residents (N = 64); EM faculty; fellows; medical students; and other guests. The number and composition of attendees fluctuates and on average consists of two-third trainees, one-third faculty, and a small number of others. Sessions were all delivered using the Zoom platform (Zoom Video Communications, San Jose, CA).

### Study Design

This was a prospective, observational cohort study during six weekly didactic blocks between May–August 2020 using a brief survey instrument.

### Survey Instrument

Drawing on self-report methodology for measuring attention and engagement, a brief survey was designed (Supplemental figure 1) through iterative discussion among the authors who have expertise in didactic instruction and survey design.<sup>11-13</sup> We brainstormed possible activities that could be done during conference based on personal experience and feedback from trainees. This initial list was aggregated into broad categories. To enhance construct validity, the resulting list of options was piloted with the pediatric EM fellows during their fellowship didactics and resulted in minor revisions. Data from pilot testing was not included in this study. The final two-question survey was deployed using the Zoom polling feature. Participants identified their role (eg, resident, faculty) and reported all activities performed during the preceding five minutes. The institutional review board granted the study exempt status.

### Study Protocol

Deployment was modeled after a modified, signal-contingent experience sampling method.<sup>14</sup> The poll was deployed during virtual residency conference. All potential attendees were notified and explicitly informed that responses were anonymous and without consequences. This was done by e-mail prior to the inception of the study and again prior to each day of data collection.

During each of the six conference days, the poll was deployed 4-10 times and was available for 60-75 seconds. Deployment dates were a convenience sample as determined by the conference schedule between May 20–August 5, 2020. Days with extensive small-group breakout sessions or invited external speakers were intentionally avoided. We collected data on the number of participants and time of deployment. Timing varied considerably with deployments during natural breaks in the schedule to minimize disruption of learning. For analysis, polling instances were aggregated into 30-minute blocks from 10 AM-2 PM. During the initial three days of polling, 10 polls were distributed each day. Residents provided feedback that this number of polls was intrusive, and on subsequent days the number of polls was reduced to minimize interruption to educational content. As a result of longer sessions in the afternoon (eg, grand rounds and morbidity & mortality), more polls inevitably deployed during the first half of conference to avoid interrupting these longer, more sensitive sessions.

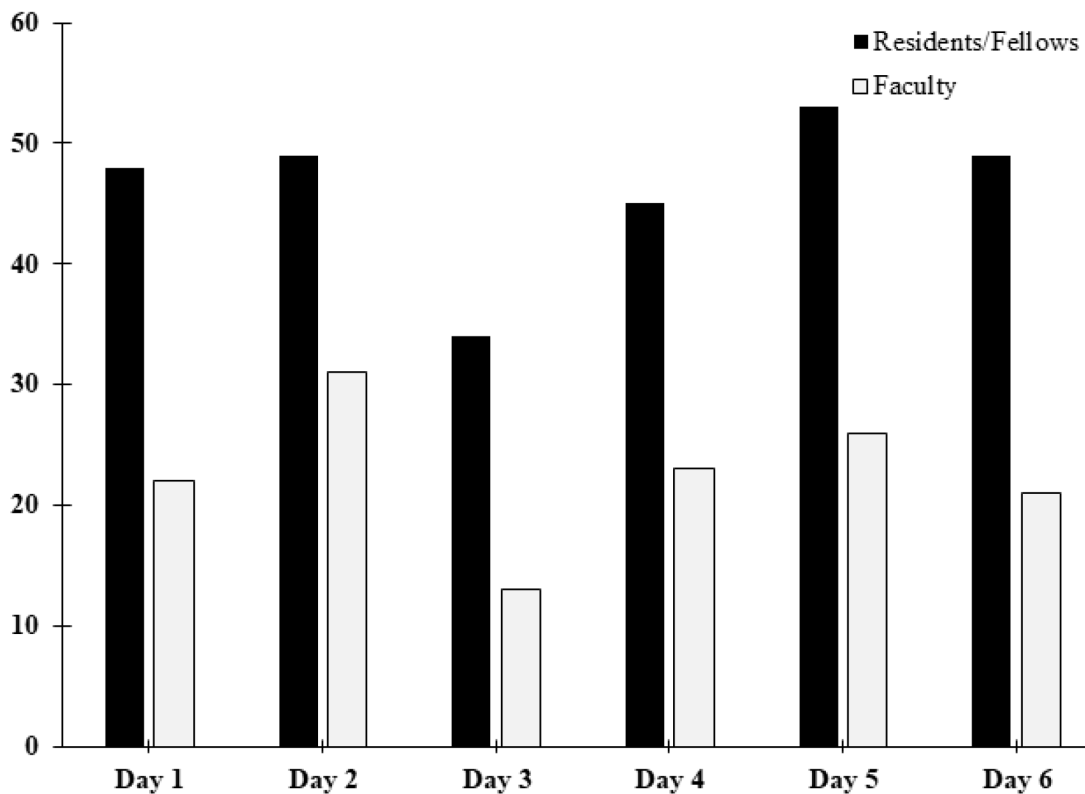
### Data Analysis

We performed descriptive analysis with a focus on trajectories of competing activities (ie, attention) over time. Responses were not linked to individual participants. Analysis was completed with SPSS Statistics software version 27.0 (IBM Corporation, Armonk, NY).

## RESULTS

There were a total of 1303 responses for 40 polls over six non-consecutive conference sessions encompassing 24 hours of delivered content. Average attendance of residents and faculty over these conferences was 69 participants (46 trainees and 23 faculty) and a small number of others by a self-report process. This data may not accurately reflect the attendance at any given moment or the number available to participate in the poll. Assuming consistent presence in conference, we estimated a response rate of 47% (1303 poll responses/2760 potential respondents averaged over all polls). Figure 1 provides a breakdown of resident and faculty presence during each polling day. Respondents identified as “resident” (63.4%), followed by “faculty” (27.5%), “other” (4.8%), “fellow” (2.3%), and “student” (2.0%). Most polls (75.1%) were conducted in the first half of the conference as noted in the Methods section.

In total, 69.2% (902/1303) of respondents reported engaging in multiple activities that included the following: education-related (34.2%); work-related (21.1%); social (18.8%); personal (14.6%); self-care (13.4%); entertainment (4.4%); other (4.1%); and driving (0.2%). These categories are defined in the supplemental materials and summarized in Supplemental Table 2. The average number of activities reported on each poll was 2.0 (standard deviation (SD) = 1.1, range 0-8). The relative frequencies of activities by time of day are presented in Figure 2. Participation in polling and reported



**Figure 1.** Number of residents/fellows and faculty participants for all study days for assessment of participants' engagement with competing activities during virtual conference.

participation in nearly all activities declined in the second half of conference, except for “work.” The relative distribution of activities also remained stable until the last hour of conference where there appeared to be a downward trend. Given the preliminary nature of this study it was not possible to determine the significance. Of all categories, engagement in educational and social activities varied the most.

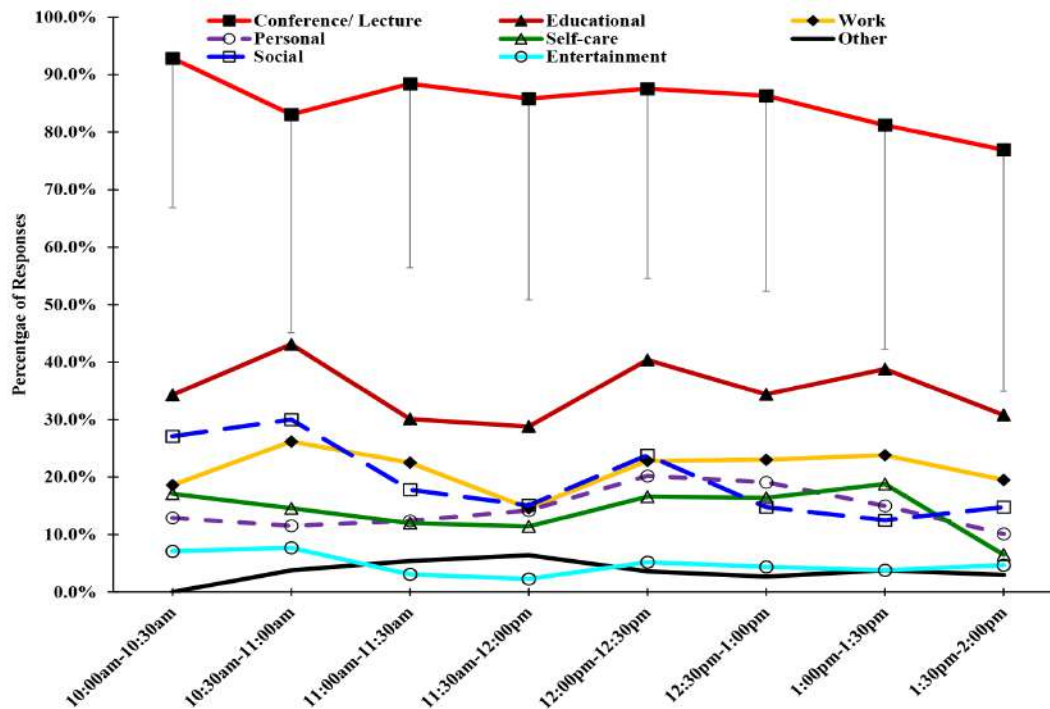
## DISCUSSION

Didactic lecture is an essential element of EM education. Our data illustrates that engagement in conference/lecture is consistently high, although it may decline slightly throughout the four-hour session. In addition, learner attention is frequently divided among competing tasks during virtual conference. Literature suggests that multitasking may only be effectively accomplished when the involved behaviors are entirely automatic.<sup>15</sup> Since didactics are intended to introduce unfamiliar material, competing activities may result in “disruption in the primary task” of conference, which is learning.<sup>15</sup>

One potential solution is the thoughtful incorporation of otherwise competing tasks into didactics, which may decrease task-switching and increase engagement. In a comprehensive review of social media in the classroom, Van Den Beemt et al describe methods to link social media use to intended learning outcomes.<sup>16</sup> Such an intentional inclusion of social media or

any other competing activity may allow participants to bypass the pitfall of unstructured multitasking. Of course, this may be more challenging with personal, high-priority tasks such as childcare. In these circumstances, an additional structured task as described above could represent an added barrier to engagement. Understanding the magnitude and impact on learning of such personal demands may also be an early step in developing solutions.

Educators may be able to use engagement data to more effectively structure conferences to optimize learning. An apparent decline in engagement in the final hour of each conference day was noted. While this finding is of unclear significance within our pilot dataset, if this finding is sustained in more comprehensive work, educators may intentionally plan topics and intervention strategies to increase and sustain engagement such as those involving more active learning approaches during predictable periods of decreased engagement metrics. Examples of applicable techniques include case studies, team-based learning, collaborative learning approaches, and specific tasks to demonstrate higher level learning outcomes.<sup>17,18</sup> Annansingh's work also suggests that instructional design focused on active learning is particularly important to outcomes in the virtual environment.<sup>18</sup> Polling techniques, similar to those used in our methodology, and the use of Q&A and chatroom



**Figure 2:** Activities engaged in during the last five minutes by emergency medicine conference attendees, across all polls and all days. Data presented as % of respondents by time of day. Mean conference participation was 85.3% (SD = 35.4%). EM, emergency medicine; SD, standard deviation.

functionalities, may also have utility in engaging attendees in the virtual environment.<sup>19</sup>

Finally, this study demonstrates a pilot methodology for future studies of conference engagement and learning outcomes in the GME environment. Self-reported data on audience activities during a given lecture may serve as useful feedback for programs and presenters. Future work can focus on context-related correlations with engagement as well as exploring implications of this methodology on learning outcomes. For example, an increase in “work” or “entertainment” may indicate disengagement, prompting a deeper probe into the cause.

## LIMITATIONS

There are several potential confounders to our study. The nature of polls appearing abruptly on screen may have artificially increased rates of participation by alerting learners back to the Zoom platform. The self-report nature may have impacted results by minimizing reporting of non-lecture activities (ie, social desirability bias). Additionally, a significant percentage of participants did not respond to polls; absence of response may have been unintentional due to distractions or intentional due to a desire not to participate. It is not possible to calculate what impact this had on our results. Some activities, such as driving, inherently prohibit response, and may be under-represented. It is not possible to account for those who did not answer. There was no technical disruption

during conferences at the time of poll deployment, and individual internet connection problems cannot be assessed feasibly. Finally, the content type (eg, lecture, morbidity & mortality, interactive question session) was not controlled for in the analysis. In this pilot study, there was not the capability for this depth of analysis. Learner engagement across the spectrum of virtual lecture types is an area for future research.

## CONCLUSION

Non-conference activities compete for learner attention during virtual residency didactics. This methodology and data could be applied to strategically design conference schedules and the timing of instructional techniques. Our assessment method may also be used to inform feedback to both presenters and programs. Next steps include complementary studies in the in-person didactic setting, multisite reproduction of this study, experimentation with variables such as attendee camera use or educational modality, and an assessment of the correlation between multitasking or task-switching during didactics and learner outcomes.

## ACKNOWLEDGMENTS

The authors sincerely thank Drs. Charles Brown, Peter England, Rob Huang, and Daphne Morrison Ponce as well as staff members Lisa Coon, Brittany Holmes, and Raven-Olivia Kellum. No grant support was used for any part of this submission.

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**Conflicts of Interest:** By the WestJEM 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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