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**ORIGINAL CONTRIBUTION**

# Procedural skill maintenance: Perspectives and motivations of pediatric emergency medicine faculty

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**Abstract**

**Background:** Pediatric emergency medicine (PEM) physicians receive training in critical procedures, but these procedures are rare in practice. The literature on maintenance of procedural skills focuses on ways to practice (e.g., via simulation) and pays little attention to motivation's role. Understanding what motivates PEM physicians to maintain procedural skills can inform the design of supportive policies and interventions. Our study explores how PEM physicians conceptualize maintenance of procedural skills, what motivates them to maintain procedural skills, and barriers to procedural skill maintenance.

**Methods:** This was a qualitative study of 12 PEM faculty guided by the self-determination theory (SDT) of motivation. SDT describes a typology that distinguishes extrinsic and intrinsic motivation, with intrinsic motivation based on autonomy, competence, and relatedness. Interviews were transcribed and coded using constant-comparative technique, and interviews continued until thematic sufficiency was achieved.

**Results:** Participants had difficulty defining procedural skill maintenance by specific criteria and expressed ambivalence about external standards for competence, noting the need to account for individual and local practice factors. Three themes characterizing participants' motivation for procedural skills maintenance included: (1) desire to provide optimal patient care and fear of unsuccessful performance (competence), (2) procedural competence as part of the identity of a PEM physician who teaches and performs procedures (competence and relatedness), and (3) desire for accessibility and choice of options in maintaining procedural skills (autonomy). Participants identified lack of opportunities, time, and support as barriers to motivation and skills maintenance.

**Conclusion:** SDT concepts were integral to understanding faculty motivation, and this highlights the need for prioritizing faculty autonomy, competence, and relatedness in designing supports for procedural skill maintenance. Our findings regarding the difficulty in defining maintenance of skills emphasize the need for further discussion and study of this topic.

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## BACKGROUND

Pediatric emergency medicine (PEM) physicians are trained in a variety of critical procedures, yet their opportunities to perform many of these procedures in practice are rare.<sup>1,2</sup> One study of a pediatric emergency department (ED) in the United States found that only 0.22% of patient evaluations required a critical procedure.<sup>1</sup> Low procedural volume can lead to deskilling<sup>3</sup> and is known to be associated with higher complication rates in bedside procedures,<sup>4</sup> leading to patient safety concerns. In two recent survey studies,<sup>5,6</sup> PEM physicians felt maintenance of procedural skills was important and that practice of certain procedures should be done once a year or more frequently. However, what constitutes maintenance of competence in procedural skills is unclear.

Currently, the literature that exists on maintenance of procedural skills primarily focuses on ways to practice procedures outside of clinical practice such as the use of simulation<sup>7,8</sup> or serious games.<sup>9</sup> In emergency medicine, simulation is an important aspect of procedural skills training<sup>7,10</sup> and has been shown to improve procedural skills.<sup>11-13</sup> Anesthesia, another medical field with rare critical events, requires simulation training for Maintenance of Certification in Anesthesiology (MOCA).<sup>14</sup> In aviation, another industry with rare critical events, flight simulators are a key aspect of training.<sup>15,16</sup> While studies of simulation in medical education have shown some improvement in clinical outcomes,<sup>17-19</sup> there are still multiple challenges noted with simulation including improving fidelity, standardization of metrics, and integration into existing educational structures.<sup>20-22</sup>

Overall, this work ignores the important role that motivational factors play in maintenance of procedural skills. Instituting requirements like MOCA assumes extrinsic motivation is sufficient for maintenance of skills. However, requiring certification or even regular training in each of these critical procedures may not be possible and may not be sufficient for competent performance. Especially in fields such as PEM, where there are not clear requirements for maintenance of procedural skills,<sup>23</sup> intrinsic motivators may play a key role. Understanding what motivates physicians to maintain these skills can help with the design of interventions to promote motivation for procedural skill maintenance.

Self-determination theory (SDT)<sup>24</sup> is a major theory in the study of motivational processes. SDT describes motivation on a spectrum from extrinsic to intrinsic, with intrinsic being based on autonomy (control/choice of actions), competence (mastery and ability to succeed), and relatedness (belonging to a group and connection).<sup>25</sup> These factors have been positively associated with medical specialists' motivation for lifelong learning<sup>26</sup> and have also been used to help understand processes in medical education, including how pediatric trainees decide to seek feedback.<sup>27</sup> Interventions designed to support SDT components have been shown to improve motivation and can lead to behavior changes among medical providers and trainees, such as increased adherence to guidelines for preventative health counseling.<sup>28,29</sup>

In this study, we explore the following research questions: (1) How do PEM physicians conceptualize maintenance of procedural

skills? (2) What motivates PEM physicians to maintain procedural skills? (3) What are barriers to procedural skill maintenance? We used SDT as our guiding conceptual framework to understand motivation's role in procedural skills maintenance and how motivation might be incorporated into efforts to support PEM physicians' maintenance of procedural skills.

## METHODS

Using a general qualitative approach<sup>30,31</sup> we conducted 30- to 45-min semistructured interviews with academic PEM physicians from July 2020 to January 2021. Participants were all faculty who worked primarily at one of two academic institutions and had their clinical practice among three different urban, pediatric EDs with patient volumes of approximately 9,000, 18,000, and 50,000, respectively, prior to the COVID-19 pandemic. To recruit participants, we announced the study at faculty meetings and sent out an invitation email to all faculty with information about the study. In addition, we purposefully sampled for a broad range of practice years and prior practice locations. All PEM physicians who volunteered to be in the study were included and received a \$20 gift card. The University of California at San Francisco institutional review board deemed the study exempt.

### Development of survey

We designed a semistructured interview guide using SDT concepts (Appendix S1, available as supporting information in the online version of this paper, which is available at <http://onlinelibrary.wiley.com/doi/10.1002/aet2.10696/full>). Our interview questions focused on participants' conceptualization of procedural skill maintenance as well as motivations and barriers to procedural skill maintenance. We piloted the interview guide with nonparticipant physicians at different institutions to ensure breadth, depth, and clarity of questions and adjusted the guide according to feedback. Nonparticipant physicians included academic physicians who practiced PEM and emergency medicine as well as one physician who practiced a surgical subspecialty.

### Interviews

Our research team consisted of two physicians (MLM, SK), with 7 and 12 years of experience in PEM practice, and a medical education researcher with expertise in qualitative methods (BO). One investigator (MLM), who is a PEM physician at one of the included academic institutions, conducted interviews. The shared background of the interviewer allowed for mutual understanding of the complex situation in maintenance of procedural skills in PEM as well as facilitated ease of discussion. The risk that some comments would be less explicit due to the interviewer's familiarity

was addressed through active participation by the nonphysician researcher (BO) in the development and refinement of the interview guide and review of the transcribed interviews. All interviews were conducted via video conferencing software (Zoom Cloud Meetings), recorded, deidentified, and transcribed, and transcriptions were then reviewed for accuracy. No participants were interviewed more than once.

## Thematic analysis

Consistent with thematic analysis, we (MLM, SK) began data analysis after the first three interviews to identify key concepts and patterns, which were then reviewed by a third researcher (BO). Through this iterative process, we modified our interview guide to further explore themes and concepts and probe for examples that challenged our preliminary themes. We continued to recruit and interview physicians with a wide breadth of practice years and experience until patterns were sufficiently strong and consistent to warrant thematic sufficiency.<sup>32</sup>

We (MLM and SK) independently coded initial interviews for concepts from SDT as well as any additional concepts that were identified as important to understanding how PEM physicians conceptualize maintenance of procedural skills, processes of maintaining skills, sources of motivation, and barriers to skill maintenance. We then discussed and refined the codes with author BO, our nonphysician researcher, and then applied them to additional transcripts. By the fifth transcript the codebook appeared stable. Throughout this process we reconciled any differences in coding with discussion between all three members of our research team. We used Dedoose qualitative analytic software version 8.3.41 (SocioCultural Research Consultants LLC) to code all transcripts. After completion of all coding, we reviewed and discussed all coded excerpts to identify and come to a shared understanding of final themes as a team (MLM, SK, BO). Having both PEM physicians and a nonphysician medical education researcher brought both insider and outsider perspectives to our thematic analysis. This allowed for richer theoretical and practical application of SDT in regard to procedural skill maintenance motivations and barriers.

## RESULTS

### Demographics

We interviewed 12 PEM physicians with 2–22 years of experience on faculty (Table 1). Faculty practiced at at least one Level I trauma center. Faculty also worked shifts with and without learners, including fellows, residents, and medical students. All emergency medicine residency-trained PEM physicians continued to work in adult EDs, but they all practiced the majority of their clinical time in pediatric EDs.

**TABLE 1** Participant demographics (n = 12)

Sex	
Female	67% (8)
Male	33% (4)
Years of practice	2–22 (9.75)
Average shifts worked/month (self-reported) <sup>a</sup>	4.5–13 (2)
Faculty rank	
Professor	25% (3)
Associate professor	50% (6)
Assistant professor	25% (3)
Residency training	
Emergency medicine residency	25% (3)
Pediatrics residency	75% (9)

Note: Data are reported as % (n) or range (IQR).

<sup>a</sup>The majority of shifts are 8 h but range from 6–9 h.

### Thematic analysis

We organized our themes around our research questions (Table 2). For conceptualization of procedural skill maintenance, we noted two main themes reflecting ambiguity in the definition of procedural skill maintenance and ambivalence regarding requirements, particularly if they fail to account for local and individual practice needs. For our second question about motivation to maintain procedural skills and current approaches, we found three themes that incorporated the SDT concepts of competence, relatedness, and autonomy. The themes highlighted commitment to optimal patient care, procedural competence as a core part of identity as a PEM physician, and desire for choice in how to maintain procedural skills. Participants also discussed barriers to motivation in maintaining procedural skills.

### Conceptualization of procedural skill maintenance

#### Procedural skill maintenance lacks a clear definition

Participants intuitively understood the concept of maintenance of procedure skills but found it difficult to state a clear definition that applied to all skills and contexts. Participants also stated maintenance of procedural skills was “more of a gestalt” (interview 10) involving aspects of technical knowledge, troubleshooting, efficiency, safety, and being able to teach the procedure. Participants also interchangeably used “competence” and “maintenance of procedural skills” but had difficulty defining specific criteria for either. Multiple participants further stated a tautology, that being competent or maintaining procedural skills was defined as being able to complete the skill. For example, one participant said “The best way to know that you have competence is by having a successful procedure in a real patient ... You would like to know that you had that competence before you actually had to test it” (interview 2).

**TABLE 2** Major themes around procedural skill maintenance

Topic	Theme	Exemplar quote
Conceptualization of procedural skill maintenance	Procedural skill maintenance lacks a clear definition	"I wish that I could give you some metric that we use, but the reality is that it's more of a gestalt." (interview 10)
	Ambivalence regarding requirements and the importance of adapting any requirements to practice needs	"I hesitate to say 'yes, there should be requirements' because I feel like then it's just gonna end up being on a bunch of mannequins. And we're just going to check off some boxes and say, yeah, we did, you know, 10 intubations a year. But at the same time, having a requirement would force leadership to prioritize maintenance of skills for physicians and give us opportunities to actually do them ... And I'm sure it's different, whether you're at an academic institution versus in the community, based on your volume and your acuity too." (interview 4)
General motivation	Desire to provide optimal patient care and fear of unsuccessful performance (competence)	"I have to be able to do certain skills ... so that the patients can get optimal care. It motivates me. If I can't do it to a level of expertise, then I lose out on my own personal job satisfaction. I haven't done my job. (interview 10) "When I think about [certain procedures], I get scared, and that's how I know that I need to go and practice them." (interview 12)
	Procedural competence as part of the identity of a PEM physician who teaches and performs procedures (competence and relatedness)	"I like procedures a lot and this is part of the draw to a field like PEM. I'm also a teacher in my role ... And so being a good teacher, being a good clinician, those are probably the biggest motivators." (interview 8)
	Desire for accessibility and choice in maintaining procedural skills (autonomy)	"I think it should just be mandated that educational tools and practice sessions should be available ... when I feel as though I might be rusty, it would be nice to have access to be able to practice that procedure." (interview 1)
Barriers to maintenance of procedural skills	Lack of opportunities, time, and support are barriers to motivation and skills maintenance	"It's mostly just convenience and time. Having to seek out these opportunities myself versus them being present ... I guess money and resources would be the other thing. I mean, on the department level, why aren't they providing us more opportunities?" (interview 3)

Many participants discussed knowing their competency by their confidence: "I think a good amount of it for me is some level of comfort and confidence" (interview 8), but then also acknowledged that confidence alone did not equal competency. For example, one participant noted: "We know that people often times over or underestimate their own competence, and competence and confidence are not exactly the same thing" (interview 5).

### Ambivalence regarding requirements and the importance of adapting any requirements to practice needs

The difficulty in defining procedural skill maintenance and competence influenced participants' discussion of requirements. While initially, some participants were in favor of requirements: "I think there should be requirements for a few basic core standard procedures like endotracheal intubation and other airway management, like bag-valve-mask ventilation, and LMA placement. Like these really fundamental lifesaving primary procedures. I think there should be standards for that." (interview 6), as they thought more about it, they recognized the complexity in creating such requirements. We found a tension between the idea that an external system could help objectively evaluate

procedural skill maintenance, given the lack of a clear definition, and the idea that creating such a system would be prohibitively difficult and could lead to a "flawed system" emphasizing "numbers" (interview 3). There was concern that these requirements would not take into account individual characteristics, practice needs, and differences between types of procedures: "Every faculty is different in how they learn, and every faculty is different in what their past experience is, and in the current environment in which they practice. And so defining a universal standard is unlikely to be useful" (interview 9).

### General motivation

We identified three themes regarding motivation for procedural skills maintenance. The SDT components of autonomy, competence, and relatedness were central in these themes.

#### Desire to provide optimal patient care and fear of unsuccessful performance (competence)

When queried about their motivations for maintaining their procedural skills, participants emphasized wanting to provide optimal

patient care and that facility with procedures was an important part of that: "It's mostly so I do the right thing for the patient, so that I'm able to do it proficiently" (interview 11). Participants also emphasized being motivated by wanting to avoid negative outcomes for patients, and some also noted their own lack of confidence and fear in procedural skills as a motivator. For example, when asked about motivations for procedural skill maintenance, one interviewee said: "Not wanting to let a patient down, not wanting to let someone die for lack of an airway right in front of me, that sort of thing" (interview 12).

### Procedural competence as part of the identity of a PEM physician who teaches and performs procedures (competence and relatedness)

Participants stated that being able to teach and perform procedures was an important part of their identity as a PEM physician. In other words, maintaining their procedural skills was a requirement for belonging in PEM: "part of being a PEM physician is having a skillset and a technical proficiency in certain skills and techniques" (interview 7). They also emphasized that as they may be the only available provider to perform a procedure, maintenance of procedural skills was essential to their practice: "Knowing that in the middle of the night, I could be the only person really, or one of few people who could intubate a patient crashing in the emergency room, that to me feels like an absolute need" (interview 5). Participants also emphasized their role as an educator and the need to be able to teach these skills to trainees as a motivator to maintain their procedural skills, with one participant asking: "How could I possibly adequately teach if I were out of date with the skill myself?" (interview 9).

### Desire for accessibility and choice in maintaining procedural skills (autonomy)

Participants listed various current methods of skills practice such as faculty skills sessions, simulation, cadaver labs, teaching others, mental review of procedures, and actual performance of procedures on patients and expressed a desire for more accessibility and availability of practice options. One example of accessibility was having airway "office hours" where faculty could "swing by and practice" on mannequins (interview 3). Similarly, they expressed desire for more accessibility to other avenues of maintaining skills like "a day in the [operating room] OR" for intubation practice (interview 2). Even with access to consultants who could perform certain procedures, some participants wanted to maintain proficiency in those procedures, since they were the person present with the patient in the moment; however, other participants outsourced certain procedures to consultants: "In my environment where there is access to many subspecialists, there are procedures I will actively choose not to do because there is a more qualified person in my institution to do it" (interview 9). Thus, participants expressed a desire for choice

in prioritizing which procedures they focus on for skill maintenance. Some prioritized "high risk and low frequency procedures" (interview 3) while others chose to spend their time on procedures they were more likely to encounter. During one interview, there was a sense of amotivation, or absence of motivation, due to the lack of opportunities to practice:

When I first started, we intubated a lot more kids, and so I was more comfortable with it. In the past five years, I myself have intubated, I think, three in five years. The last time I had to intubate a kid, I wasn't able to get it, the anesthesiologist had to come down ... It's like, "Gosh, I just feel like this is getting away from me ... I'm almost getting to the point where I'm like ... I'm not maybe the best person to intubate these kids, unless there's no one else there." And so, I do think with some of these more uncommon procedures, yeah, I don't have a good way of practicing them, or maintaining them. (interview 11)

Participants' ambivalence about requirements was associated with a general sense of the importance of accessibility, availability and leadership support for any requirements created: "I think if you said, 'You know what? We expect you to do X to prove proficiency. And in order to get you there, we will provide you with X opportunities.' Then I think that would be a good partnership" (Interview 3).

### Barriers to maintenance of procedural skills

#### Lack of opportunities, time, and support are barriers to motivation and skills maintenance

While participants expressed a desire to maintain procedural skills, they noted multiple external barriers that seemed to inhibit their autonomy and ability to practice which then decreased their motivation to practice. One barrier was the lack of opportunities to perform procedures both in their clinical practice and in other settings such as in simulation or, for endotracheal intubation, with anesthesia in the operating room. Regarding clinical practice, participants noted the low volume of procedures and the disincentives to performing procedures themselves while in the ED. These disincentives included having trainees perform procedures: "you go into a training environment, you don't do most of your procedures ... trainees do most of the procedures" (interview 9) and balancing patient flow in the ED and the length of some procedures: "If something is going to take two or three hours of an attending provider's time, that is not a good use of their time ... I do think we have a responsibility to many other aspects of the role as attending provider that certain procedures need to be diverted" (interview 10).

Another participant noted the difficulty of creating their own practice opportunities: "There's an activation energy that it takes to get the mannequin out yourself and practice on your own"

(interview 5). Within simulated practice, participants also noted the lack of high-fidelity simulators and the lack of same equipment and materials used in their clinical environments to create a more realistic practice.

In regard to existing ways participants maintain procedural skills, participants stated the infrequency of skills sessions was a barrier: "These preplanned, way ahead of time, big faculty skill sessions are nice, because you can do multiple skills in one time, but they also can only happen like three times a year" (interview 3).

A universal barrier for participants was the lack of allotted time in their schedule for procedural skill practice. One participant stated: "I'm working a full load already and I've got meetings and things like that going on. I may not want to allocate three more hours of time to doing a workshop on my only day off" (interview 7). Another stated it was unrealistic to regularly maintain procedural skills through online learning and discussions around procedures: "I just straight up don't have the time to do that. And so that would be purely aspirational, and it would be a delight, but it's essentially just impossible the way my schedule is" (interview 6).

Multiple participants also noted how the COVID-19 pandemic, in particular, had made procedural skills maintenance difficult due to inability to gather in person, availability of rooms, decreased patient volumes, and diminished resources.

Finally, participants noted that culture could be a barrier to maintaining procedural skills and normalizing the need for continuous practice would be beneficial. One participant stated, "I think maybe just sort of normalizing continuing education and procedures ... we get a million emails a day about who can teach this or that procedure lab. And I have to imagine that I'm not the only one that's inside like, 'Oh, but I could use a refresher. Where's my procedure lab?'" (interview 12). This quote suggests a need for an environment that recognizes that in addition to being teachers, PEM faculty are learners who need to practice skills to maintain them.

## DISCUSSION

Our study provides insights into the complexity surrounding PEM physicians' conceptualization of procedural skill maintenance, what motivates them to maintain procedural skills, and what barriers impede skill maintenance. There was not a clear definition of procedural skill maintenance among participants; however participants remained motivated to maintain procedural skills, and the SDT components of autonomy, competence, and relatedness were central to their motivation. They emphasized the importance of autonomy, with aspects of accessibility and choice in training options for various procedures as well as methods of practice. Participants noted an unease with certain procedures and a desire for more training and practice. However, they also stated there were multiple barriers to being able to practice and felt there could be more support from their institution and leadership in overcoming these barriers. We discuss how our findings may guide thinking about defining requirements for procedural skills maintenance and the

design of opportunities to practice and evaluate their procedural skills.

Participants differed in their opinion on requirements, but all noted the complexity in creating requirements given differences in practice, training, and individual capabilities. Without clear requirements and standards for performance, faculty may rely on indicators such as confidence, which has been shown to be a suboptimal indicator of competence for clinical skills,<sup>33,34</sup> and therefore faculty may not know how to best prioritize practice. To address these challenges, it may be beneficial for local leadership, institutions, and practice groups, with local physician input, to agree on which procedures physicians should focus on as well as a definition or metric for competence to use within their environment. These guidelines or requirements should also be clearly communicated, because in one national survey study there was disagreement from respondents within the same institutions on if there were requirements and what they were.<sup>6</sup>

Our findings suggest that designing training environments, sessions, and interventions for procedural skills maintenance that support autonomy, competence, and relatedness can benefit PEM physician motivation and overcome barriers. Indeed, studies from other specialties show that support for these motivational components improves physician functioning and well-being and may have clinical benefits.<sup>28,29,35-37</sup>

Regarding autonomy, including local physicians in creating requirements for skills maintenance, as mentioned, supports physicians' sense of autonomy because this would consider physicians' own clinical practice and needs. Supporting physician autonomy is associated with increased job satisfaction, engagement, and improved quality of care.<sup>35,36</sup>

In creating requirements, it is imperative to ensure accessible avenues for meeting these requirements. Currently, both requirements and opportunities for practice differ significantly by institution. For example, in a recent national survey of PEM physicians,<sup>6</sup> nearly all felt maintenance of intubation skills was very or extremely important and the majority of participants felt clinical exposure alone was insufficient. However, 23% had no mandatory requirements for intubation, and options for practice varied widely with many participants practicing during Pediatric Advanced Life Support (PALS) or Advanced Trauma Life Support (ATLS) certification, which are only required to be renewed every 2 and 4 years, respectively, about a quarter having local opportunities for operating room practice, a minority using other simulation practice, and very few using cadaver or animal labs. Another survey study of North American PEM physicians found that opportunities for procedural skill training and practice ranged from 2.5% to 53.1% depending on the skill, with intubation being the most common procedure and simulation being the most common form of practice. This study also noted that only 14.6% of respondents had assessments of procedural skills.<sup>38</sup>

Based on the results from our study, when designing faculty procedural skill opportunities, available resources should be easily accessible, and physicians should have choice in when and how they maintain their skills. To enable accessibility, options for practice

would ideally have flexible timing and prioritize participant's availability, for instance they could be done as drop in "office hours" with an expert, having simulation materials readily available on the fly for individual practice, as prearranged larger sessions with a variety of options to attend for skill maintenance, or by having options for skills maintenance be part of existing institutional meetings.

There have been multiple studies showing that just-in-time training for emergency physicians, where videos and/or materials are available for practice immediately prior to performing a procedure can improve procedural skill knowledge and performance.<sup>39-42</sup> Also, asynchronous learning with open access, often web-based materials, where learners have control over when and where they review has also been shown to be a current method of emergency medicine learning<sup>43,44</sup> and effective for learning and maintaining procedural skills.<sup>45,46</sup> In addition to these examples, other studies have shown that simulation and feedback can also help prevent skill decay<sup>47</sup> and be used in maintenance of procedural skills.<sup>11-13,48,49</sup> Supporting physicians with a multimodal approach to practice opportunities where physicians can choose how to maintain their skills can support autonomy and address barriers of lack of time, materials, and accessibility.

Regarding competence, participants were highly motivated by their intrinsic desire to provide optimal care for their patients and to avoid a negative patient outcome; however, they often felt unclear in how to maintain their skills and lacked the resources and time to be able to practice, which inhibited motivation. These barriers noted by our participants are similar those found in a prior survey study of North American PEM physicians regarding procedural skills training.<sup>38</sup> Participants emphasized the need for opportunities to practice focused on locally relevant procedures with materials that are similar to or the same as those used in practice. Providing practice opportunities with guidance as mentioned above can assist with supporting participants' desire to maintain competence.

Regarding relatedness, emphasizing the PEM identity as a practitioner of procedures and being the provider designated for these emergent procedures to safely care for patients may assist in reinforcing intrinsic motivation. Relatedness has been shown to be a key motivator in physicians' satisfaction with their professional life and with work-related engagement.<sup>37</sup> In our study, being able to teach procedures was also an important part of competency and part of participants' identity. This likely reflects participants' status as academic faculty who work with learners. However, in this context, faculty may find learners as both a source of motivation to practice and maintain skills<sup>50</sup> and as a barrier to motivation because learners' needs to perform procedures and practice may be prioritized over faculty. Creating a culture where PEM faculty are viewed not just as teachers of procedural skills, but also as practitioners who require continuous practice, feedback, and improvement is paramount. One way to accomplish this is through faculty skills practice sessions, with faculty peers; indeed, in a prior study of academic emergency medicine faculty, faculty preferred learning with faculty peers rather than in mixed environments with trainees.<sup>51</sup>

## LIMITATIONS

This study was conducted at a single academic center with policies, approaches, and cultural norms around procedural skills maintenance that may differ from other institutions and practice sites. Our work is exploratory and subsequent work may benefit from studying whether similar themes arise in other contexts such as other academic institutions, rural sites, or community practice. Study participants were selected to have a range of practice years, but other individual factors may influence their viewpoints. Because participation was voluntary, the participants interviewed may not reflect viewpoints of all faculty. Subsequent studies may benefit from exploring a larger sample of participants in which some of these individual and situational factors could be examined.

## CONCLUSIONS

Our study analyzed motivational factors for pediatric emergency medicine faculty in maintenance of procedural skills. These findings could have relevance to other specialties that require maintenance of procedural skills, especially where there is low frequency of procedures clinically. The difficulty in defining competence emphasizes the need for further agreement on how to evaluate and then maintain competence, with an emphasis on local and individual practice needs. Our study also highlights that self-determination theory concepts of autonomy, competence, and relatedness are integral to physician motivations in maintaining procedural skills. Understanding this information has relevance for development of supports to promote maintenance of procedural skills.

## CONFLICT OF INTEREST

The authors have no potential conflicts to disclose.

## AUTHOR CONTRIBUTIONS

Margaret Lin-Martore: study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise, acquisition of funding, administrative, technical or material support, study supervision. Shruti Kant: study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content. Bridget C. O'Brien: study concept and design, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, study supervision.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of the article at the publisher's website.

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