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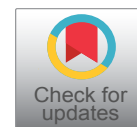
RESEARCH ARTICLE

Characterization of Pediatric Procedural Competency in Emergency Physicians

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Abstract

Background: Medical and traumatic resuscitation are among the core competencies of emergency medicine. When compared to adult patients, the frequency of high acuity pediatric patients requiring procedures is low. Currently in emergency medicine practice, especially in academic settings, maintaining proficiency in high acuity and low frequency pediatric procedures may be a problem for physicians after completing training.

Objective: To determine the comfort level of physicians trained in Emergency Medicine in performing high risk, low frequency pediatric procedures.

Methods: A survey was administered to a cohort of graduated physicians after completion of Emergency Medicine or Emergency Medicine/Pediatrics residency programs from the Indiana University School of Medicine. Each physician's perceived competency in several pediatric procedures, including intubations, lumbar punctures, tube thoracostomies, peripheral IVs, central venous catheter placement, and intraosseous needle placements, was measured using a 10-point Likert-type scale.

Results: One hundred eighty-one physicians completed the survey (44.9%) during an eight-week period. Despite the majority of respondents only having performed the aforementioned procedures less than twice in the past year while working in emergency departments that saw less than 25,000 pediatric patients per year, 37.6% reported feeling at least somewhat confident in all of the above procedures.

Conclusion: Perceived competency in certain pediatric procedures among emergency medicine-trained physicians varied depending on training background, years in practice, and number of pediatric visits at their clinical site.

this knowledge base is the ability to perform specific procedures. When compared to adult patients, the frequency of high acuity pediatric patients requiring procedures is low [1]. Additionally, in the pediatric population, there may be more of a reliance on subspecialists to manage aspects of a patient's care, leading to less exposure and comfort with these procedures. Currently in emergency medicine practice, especially in academic settings, maintaining proficiency in high acuity and low frequency pediatric procedures may be a problem for physicians after completing training [2]. 75% of emergency departments see less than 7000 pediatric patients per year on average, which may lead to decreased preparedness for this patient population [3]. When graduated physicians enter jobs where they supervise other professional trainees or in which the volume of pediatric patients requiring intervention remains low, the ability to remain proficient in these life-saving skills declines [4]. As already demonstrated in prior surveys, mandatory training for some of these skills is lacking at many institutions [5]. The goal of this study is to identify emergency physicians' comfort with certain pediatric procedures, as well as identify methods they implement to keep up with these competencies.

Studies thus far have demonstrated that the practice of emergency medicine without supplemental practice may not be enough to maintain skills [6]. Also, surveys have shown that emergency physicians are significantly less comfortable in pediatric resuscitations and cardiopulmonary arrests when compared to adults [7]. Low-fidelity and high-fidelity simulation has been shown to be an increasingly important method used by providers in skill maintenance [8]. Other centers have looked into

Introduction

Medical and traumatic resuscitation are among the core competencies of emergency medicine. Implicit to



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other modalities, including workplace-based assessments and e-learning [9]. The aim of this study is to determine the comfort of emergency physicians in performing the following skills in pediatric patients: Tube thoracostomy, endotracheal intubation, central venous access, lumbar puncture, peripheral access, and intraosseous needle placement. Furthermore, this study aims to identify the means by which providers maintain their skills at their individual institutions.

Through this survey, the goal is to provide groundwork for establishing programs by which emergency physicians can maintain pediatric procedural competency. Research evaluating emergency medicine providers' procedural competencies in the pediatric population is limited, and this survey will serve as a framework for future studies to evaluate residency education and continued training of the emergency physician in pediatric procedures. Since 89% of pediatric visits occur in non-children's hospitals, ensuring the preparedness of the adult emergency physician for any pediatric procedure is indispensable [3]. As information is gathered from physicians of varied backgrounds, we hope to identify the scope of the general emergency physicians' comfort level with pediatric procedures, the frequency in which these procedures are completed, and what modalities have proven subjectively most effective in skill maintenance for general emergency physicians.

Materials and Methods

Institutional Review Board committee approval was obtained from the Indiana University School of Medicine. A survey was administered to 403 graduated physicians from Indiana University School of Medicine Emergency Medicine and Emergency Medicine/Pediatrics residency programs during February and March 2018. The Emergency Medicine Residency program at IU School of Medicine is a three-year program, while the Emergency Medicine/Pediatrics combined program is a five-year program. The survey was created on RedCap and delivered to an alumni listserv of physicians via email. Each recipient was assigned a unique identifier on the RedCap system. The survey only allowed for one response per unique identifier, and no responses were duplicated. Baseline physician demographics were obtained, which included type of residency training, years in practice since residency, practice environment, community of patients served, annual pediatric patient volume, presence of trainees, number of weekly clinical hours, career effort, and geographic location. Physicians were then asked to rate their competency in several pediatric procedures, including intubations, lumbar punctures, tube thoracostomies, peripheral IVs, central venous catheter placement, and intraosseous needle placements. Confidence in performing each of these procedures was measured using a 10-point Likert-type scale (1 = not at all confident, 5 = somewhat confident, 10 = very confident). The annual number of these pro-

Table 1: Characteristics of survey respondents (n = 181).

	n (%)
Board certification	
• Emergency Medicine Residency	156 (82.6)
• EM Residency/PEM Fellowship	2 (1.1)
• EM/Peds Combined Residency	20 (11)
• Other*	3 (1.7)
Years in practice	
• 0-2 years	27 (14.9)
• 3-5 years	41 (22.7)
• 6-10 years	42 (23.2)
• 11-15 years	29 (16)
• > 15 years	42 (23.2)
Presence of trainees in department	
• Yes	149 (82.3)
• No	32 (17.7)
Clinical hours per week	
• < 10 hours	8 (4.4)
• 11-20 hours	17 (9.4)
• 21-30 hours	60 (33.1)
• 31-40 hours	81 (44.8)
• > 40 hours	15 (8.3)
Career effort	
• Clinician	91 (50.3)
• Administrator	2 (1.1)
• Educator	3 (1.7)
• Clinician/Educator	46 (25.4)
• Clinician/Administrator	35 (19.3)
• Clinician/Researcher	1 (0.6)
• Other^	3 (1.7)

*Includes 2 Emergency Medicine + EMS Fellowship, 1 Emergency Medicine + Toxicology Fellowship; ^Includes 2 Clinician/Administrator/Educator, 1 Clinician/Entrepreneur.

cedures they perform, as well as their main method for maintaining competency in each of these procedures, was also surveyed.

Results

181 (44.9%) physicians completed the survey during an 8-week period. The majority of responders were board certified in emergency medicine only (82.6%), while others had completed training in an EM/pediatrics residency, EM residency and PEM fellowship, or EM training with other fellowship training (Table 1). Most of those surveyed conveyed working in a mixed-age emergency department in an urban or suburban community (Table 2). All respondents cared for pediatric patients with variation in the number seen per year in their respective practice environments. The majority of respondents performed the aforementioned procedures less than twice in the past year and worked in emergency departments that saw less than 25,000 pediatric patients per

Table 2: Characteristics of survey respondents' practice environment (n = 181).

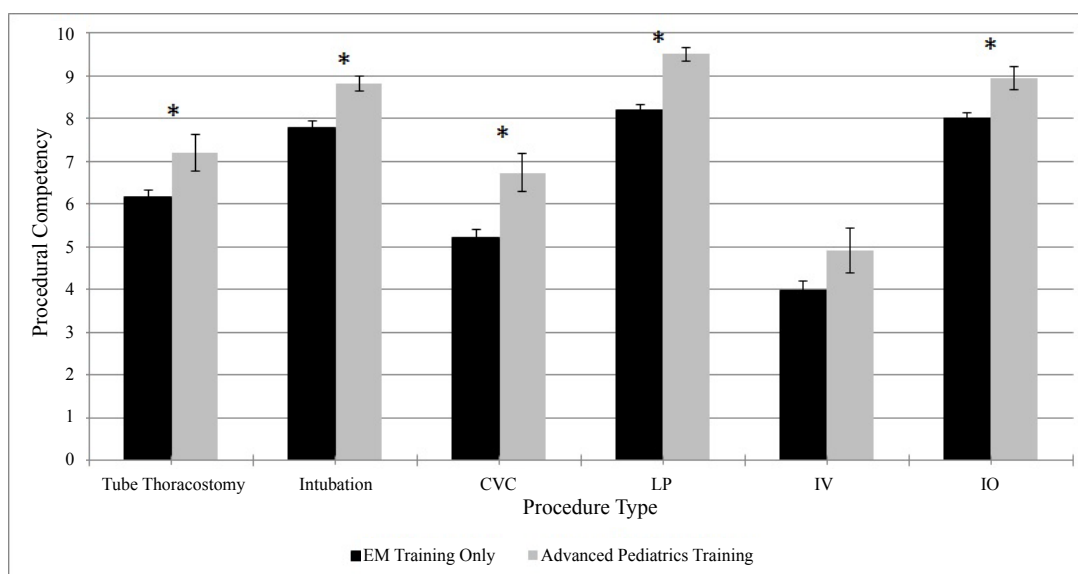
	n (%)
Practice environment	
• Pediatric emergency department	9 (5.0)
• Emergency department, mixed age	161 (89.0)
• Other*	11 (6.1)
Practice setting	
• Academic institution	54 (29.8)
• Community facility	126 (69.6)
• Military facility	0 (0)
• Other^	1 (0.6)
Surrounding community	
• Urban	79 (43.6)
• Suburban	83 (45.9)
• Rural	15 (8.3)
• Other#	4 (2.2)
Number of pediatric visits	
• < 25 k	143 (79.0)
• 25 k-50 k	23 (12.7)
• 50 k-75 k	10 (5.5)
• 75 k-100 k	2 (1.1)
• > 100 k	3 (1.7)
Geographical location	
• Northeast - New England	4 (2.2)
• Northeast - Middle Atlantic	0 (0)
• Midwest - East North Central	118 (65.2)
• Midwest - West North Central	8 (4.4)
• South - South Atlantic	6 (3.3)
• South - East South Central	7 (3.9)
• South - West South Central	12 (6.6)
• West - Mountain	16 (8.8)
• West - Pacific	10 (5.5)

*Includes combination of adult and pediatric EDs, adult-only ED, ICU, urgent care; ^Includes 1 mix of community and academic; #Includes mixes of diverse sites.

year, comparable to the national average. However, 37.6% reported feeling at least somewhat confident in all of the above procedures: Intubations, lumbar punctures, tube thoracostomies, peripheral IVs, central venous catheter placements, and intraosseous needle placements. On the other hand, 18% of the respondents felt less than somewhat confident in performing a tube thoracostomy, a potentially life-saving procedure, in a pediatric patient.

Physicians who had further training in pediatrics either through fellowship or the combined program expressed significant greater confidence in all of the pediatric procedures except for IV placement ([Figure 1](#)). Learner presence in the emergency department did not affect physician's perceived procedural competency ([Figure 2](#)). Physicians who have a greater number of years in practice express greater competency in tube thoracostomies and lumbar punctures compared to those with less years in practice; however, the average number of hours worked per week by physicians did not affect confidence in pediatric procedures ([Figure 3](#) and [Figure 4](#)). Providers at hospitals with a greater annual number of pediatric visits state a greater comfort with pediatric lumbar punctures; there were no other significant differences in the other procedures ([Figure 5](#)). Work environment, namely academic versus community setting, did not affect physicians' self-reported competency in pediatric procedures ([Figure 6](#)).

In addition to identification of confidence levels, methods for maintaining competence in each of these pediatric procedures were ascertained from the respondents. While most expressed attaining practice through emergency department experience and simulation events (mainly adults), there were several other educational opportunities, including EMS ride-alongs, online

**Figure 1:** The effect of more advanced pediatric training on pediatric procedural competency.

*indicates a significant difference in procedural competency every procedure except IV placement; CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

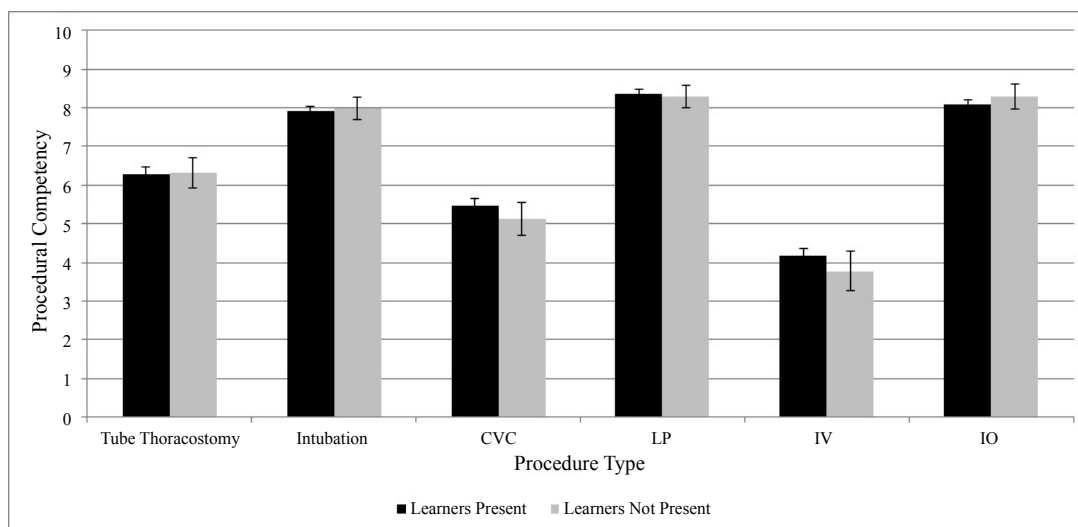


Figure 2: The effect of learner presence on pediatric procedural competency.

No significant differences were detected between the two groups. CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

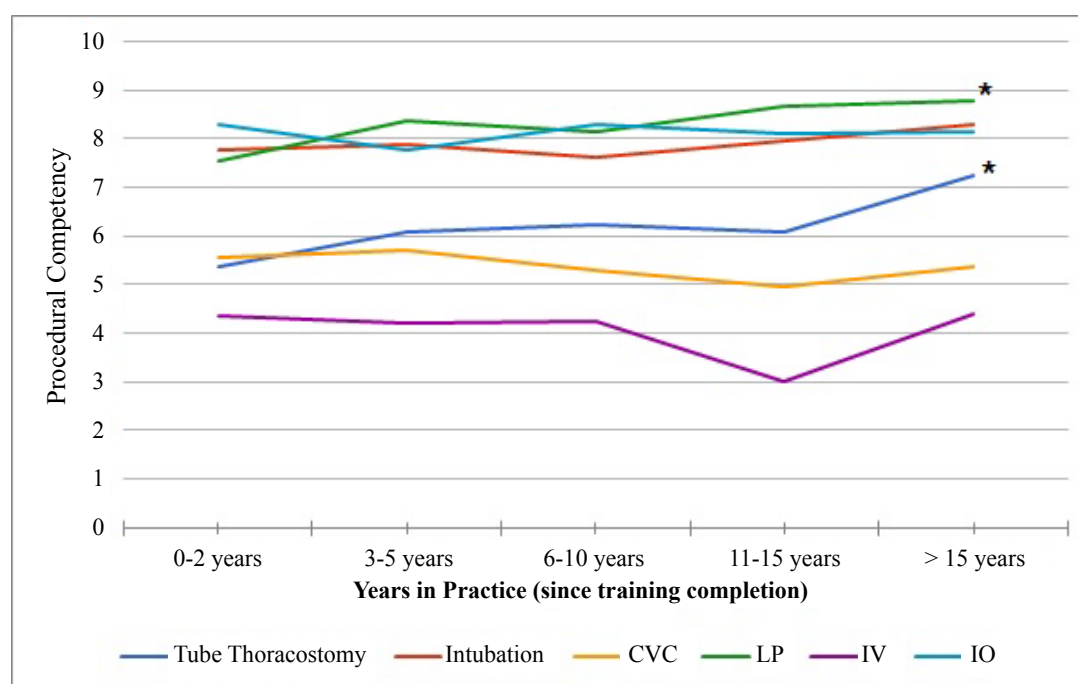


Figure 3: Pediatric procedural competency in EM-trained physicians by years in practice.

*indicates significant difference in procedural competency in certain procedures based on years in practice; CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

videos, attending resident lectures, supervision of learners, and OR time for practice.

Discussion

Emergency physician graduates claim to be at least somewhat comfortable with most of the skills surveyed in this study. However, there still remains some uncertainty with life-saving procedures in the pediatric population. A number of factors may account for their responses given. First and foremost, extensive exposure to the pediatric population during training, or lack thereof, may play a role in physicians' comfort level. Beyond technical skills, situational preparedness when

responding to a critically ill child may play a role in the emergency physician's confidence with procedures. Furthermore, as evidenced by several respondents, many of these procedures are rarely performed on real pediatric patients in the emergency department, and practice is sought out in other settings, such as simulation centers, operating rooms, and cadaver labs. The frequency of high-acuity pediatric patients overall is low, leading to possible skill decay over time. Additionally, exposure to these procedures during training in an Emergency Medicine residency program, may be changing as well. Demonstrated by the increased comfort expressed by those further out in practice, despite requirements wi-

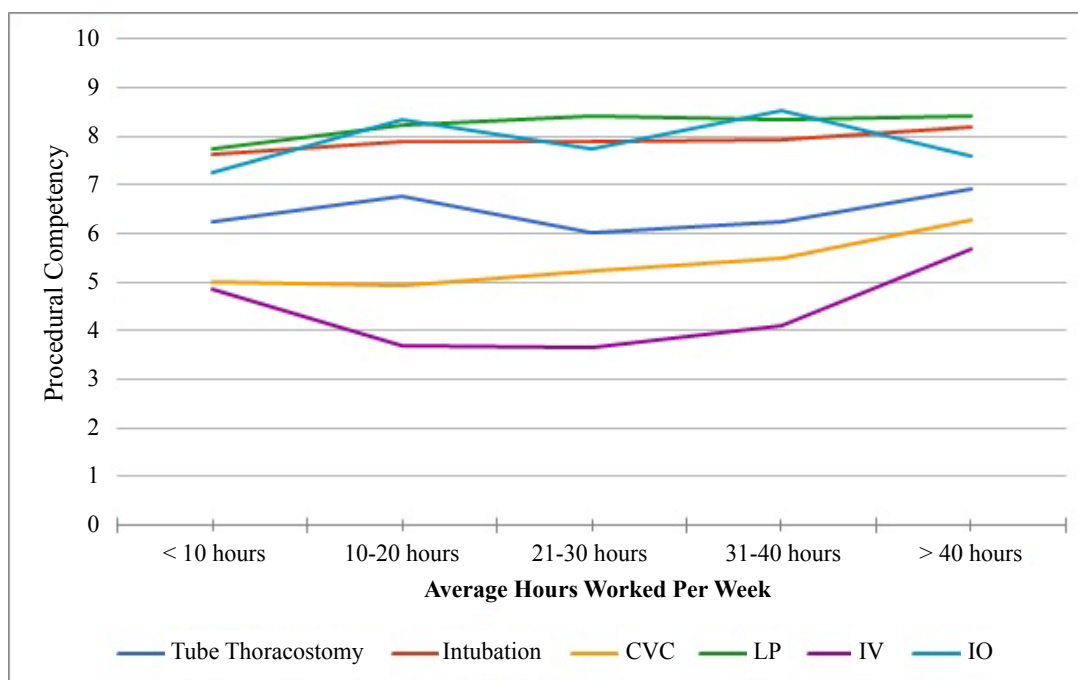


Figure 4: Pediatric procedural competency in EM-trained physicians by hours worked per week.

No significant differences were detected. CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

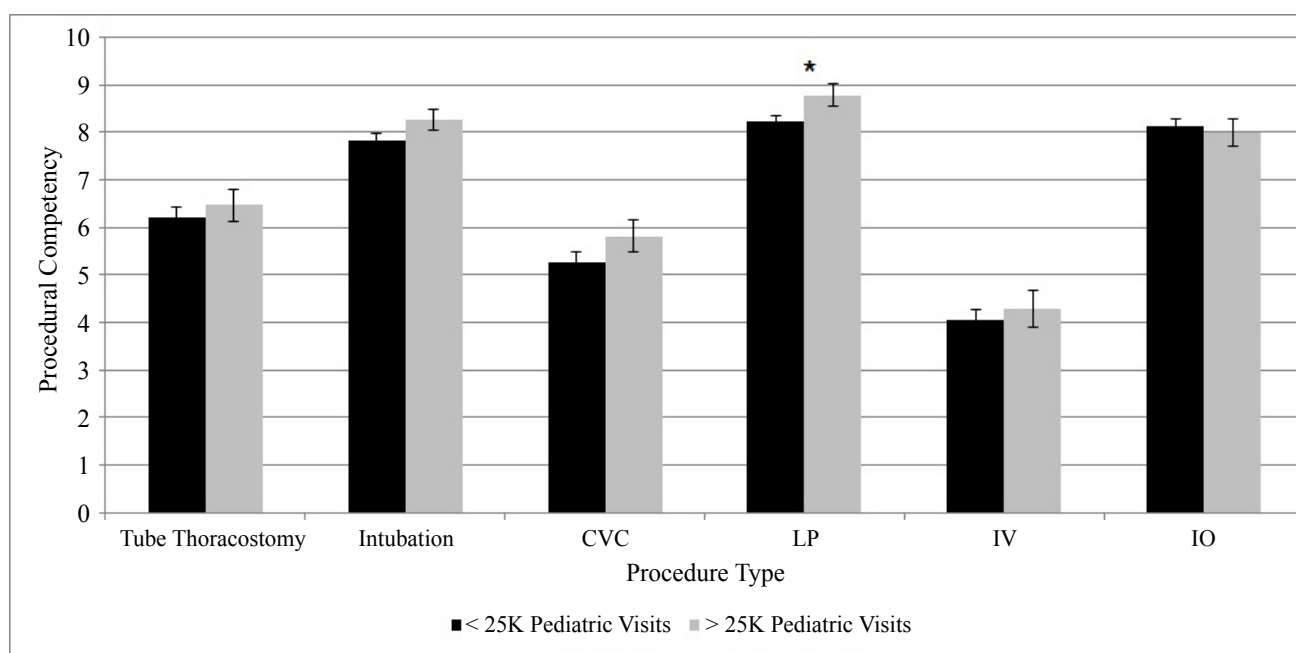


Figure 5: The effect of number of pediatric visits on pediatric procedural competency.

*indicates significant difference in procedural competency based on number of annual pediatric visits. CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

thin programs, a decreased frequency in performing certain procedures may be occurring. This particular change may be secondary to simple changes in management guidelines, such as fewer lumbar punctures performed in febrile infants [10]. Also, emergency medicine residents may be performing fewer central venous catheter placements in the Emergency Department, as short-term pressor therapy is being routinely administered through peripheral access. Finally, in the pediatric

population, there may be more of a reliance on subspecialists to manage aspects of a patient's care, leading to less exposure and comfort with these procedures.

Performance of pediatric procedures during resuscitative efforts is a core tenet of emergency medicine. At the training level, it seems apparent that exposure to pediatrics and the procedures required for the care of critically ill children must remain a paramount priority for Emergency Medicine residency programs. Beyond

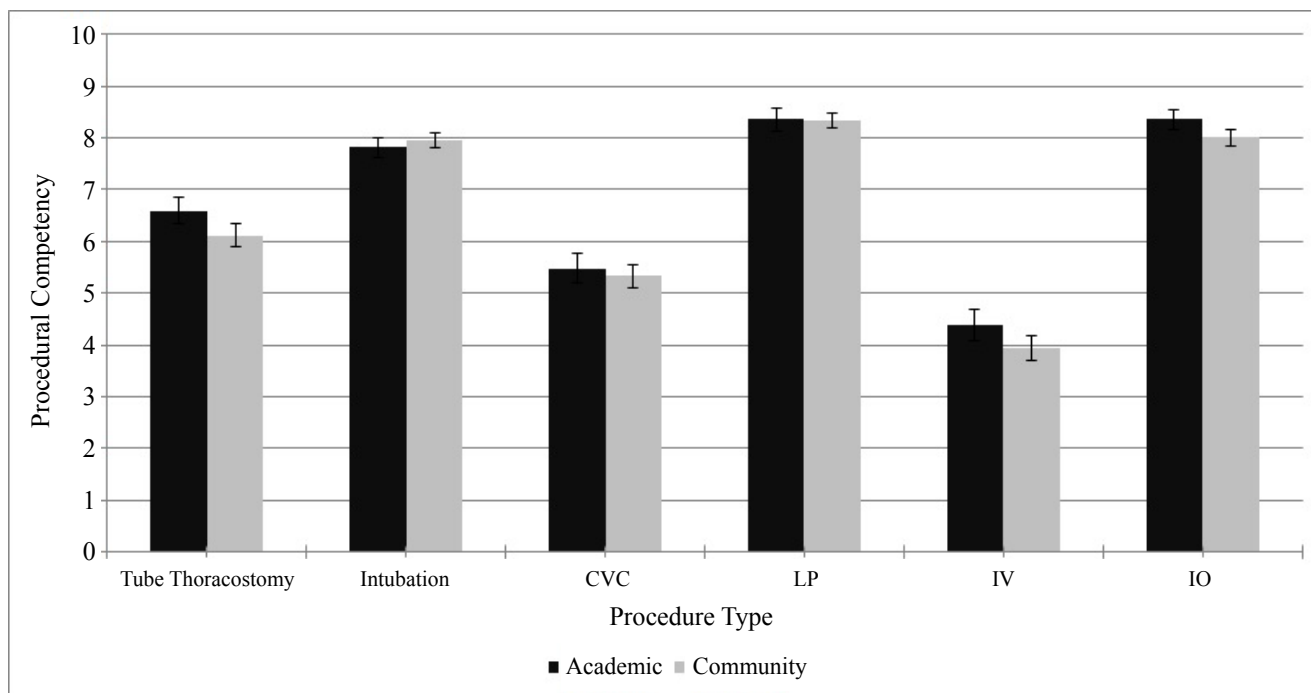


Figure 6: The effect of hospital setting on pediatric procedural competency.

No significant differences were detected between the two groups. CVC: Central Venous Catheterization; LP: Lumbar Puncture; IV: Intravenous Line Placement; IO: Intraosseous Line Placement.

initial training, emergency physicians must continue to be lifelong learners and seek to maintain not only up-to-date medical knowledge but also skills competency. Seeking out opportunities for continued practice, especially in the less familiar population of pediatrics, is crucial to preventing skill decay.

Limitations

This study had several limitations. As stated, the survey administered only measured physicians' self-assessed comfort level with pediatric procedures. Actual performance evaluation was not completed and thus may differ from the stated responses. This survey was only sent to physicians who had graduated from the Indiana University School of Medicine training programs. Given this limitation, there is a lack of generalizability of these results to emergency physicians of other training programs.

Conclusion

In summary, perceived competency in certain pediatric procedures among emergency medicine-trained physicians varied depending on training background, years in practice, and number of pediatric visits at their clinical site. Emergency physicians have employed varying methods in order to maintain competency in pediatric procedures, including direct patient care, simulation, the operating room, educational opportunities, and other practice settings, such as the ICU. However, there are still several providers who have not practiced some of these skills since residency training, and lack of confidence in certain procedures remains. As providers in a field in which resuscitation is a core component of

practice, procedural competency in the less familiar pediatric population is critical. Provider characteristics associated with decreased perceived procedural competency should be targeted as potential sources for improvement in skill enhancement. Further research into a wider array of emergency physician practice can bring us closer to providing the highest level of care for our pediatric population.

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