STUDENT TEACHING AND EVALUATION

Self-reported experience and competence in core procedures among Canadian pediatric emergency medicine fellowship trainees

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ABSTRACT

Objective: We sought to determine the frequency with which fellows in accredited Canadian pediatric emergency medicine (PEM) fellowships perform specific procedures, the level of confidence fellows have in their abilities and whether there are differences in self-perceived success between first- and second-year fellows.

Methods: A national survey was developed that focused on 24 PEM procedural skills. The survey asked respondents how many times they had performed these procedures within the past 12 months and within the past 3 years. Respondents were then asked to rate their confidence in successfully performing each of the 24 procedures.

Results: Of the 46 surveys sent to PEM fellows, 32 (70%) were returned. Most respondents were in their second year of training and the vast majority had previous training in pediatrics. In order of frequency, the most common procedures performed were closed reduction of fractures, peripheral intravenous insertion, complex laceration repair and endotracheal intubation. Of the surveyed skills, oropharyngeal/nasopharyngeal airway insertion was deemed the most successful (100% success rate for second-year fellows v. 92.5% success rate for first-year fellows, $p = 0.01$). Similarly, second-year fellows had a higher self-perceived success rate for intraosseous line insertion than did first-year fellows (95.0% v. 80.0% for second- and first-year fellows, respectively, $p < 0.001$).

Conclusion: In surveying PEM trainees across Canada, we have described the frequency and self-perceived success rate for 24 important procedures. This information may be helpful for program directors in evaluating future directions and opportunities for training of their PEM trainees.

Keywords: pediatric emergency medicine, education, clinical competence

RÉSUMÉ

Objectif : Nous avons cherché à déterminer la fréquence à laquelle les fellows des programmes de fellowship en médecine d'urgence pédiatrique (MUP) au Canada effectuent des techniques d'intervention, le niveau de confiance qu'ils ont dans leurs capacités, et s'il y a des différences à l'égard de la réussite auto-évaluée entre les fellows de première et de deuxième année.

Méthodes : Nous avons mené une enquête nationale qui portait sur 24 techniques d'intervention en MUP. Dans le sondage, nous avons demandé aux répondants combien de fois ils avaient effectué

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ces techniques au cours des 12 derniers mois et des 3 dernières années. Nous leur avons ensuite demandé d'évaluer leur niveau de confiance à exécuter avec succès chacune des 24 techniques.
Résultats : Des 46 questionnaires envoyés aux fellows en MUP, 32 (70 %) ont été retournés. La plupart des répondants étaient en deuxième année de formation et la grande majorité avait une formation préalable en pédiatrie. En ordre de fréquence, voici la liste des techniques les plus couramment réalisées : réduction orthopédique de fractures, installation d'un accès intraveineux périphérique, réparation de lacérations complexes et intubation endotrachéale. Des techniques d'intervention ayant fait l'objet du sondage, l'insertion d'une canule oropharyngée ou nasopharyngée a été jugée la plus réussie (taux de réussite de 100 % pour les fellows de deuxième année contre un taux de réussite de 92,5 % pour ceux de première année, $p = 0,01$). Parallèlement, les fellows de deuxième année percevaient un plus haut taux de réussite pour l'insertion de la ligne intra-osseuse que ceux de première année (95,0 % contre 80,0 %, $p < 0,001$).
Conclusion : Les résultats de notre sondage des résidents en MUP au Canada rapportent la fréquence de l'exécution de 24 techniques d'intervention et l'auto-perception du taux de réussite de ces techniques. Cette information peut être utile pour les directeurs de programmes qui réfléchissent à l'orientation future de la formation des fellows en MUP et aux possibilités de formation qui s'offrent à eux.

Introduction

Pediatric emergency medicine (PEM) is a rapidly evolving subspecialty in Canada, the United States, Australia and the United Kingdom.[1] A PEM practitioner requires expertise in specific procedures; however, guidelines pertaining to the nature of training necessary to acquire these skills have not been created in Canada. The PEM practitioner is further challenged in acquiring the necessary skills because many involve procedures that are rarely performed on pediatric patients.

The Royal College of Physicians and Surgeons of Canada oversees all Canadian training programs in PEM. The college recognized PEM as a subspecialty in 2000. To acquire PEM certification, a trainee must complete a 2-year postgraduate fellowship program in PEM after completing either the FRCP emergency medicine residency program or a pediatrics residency program. A mandatory PEM fellowship examination commenced in the fall of 2008; however, procedural proficiency is not expected to be a component of the evaluation.[2]

Within pediatrics there are few standardized, objective, validated, uniformly accepted methods of assessing competence in specific procedures. A list of 125 competencies for PEM was recently published by the college.[2] Researchers evaluating large lists of procedural skills in other countries found many of the skills to be inappropriate; some skills were deemed better acquired in medical school, some did not reflect the current standard of care and others involved procedures that were too infrequently performed to establish or maintain competence during training.[3] A PEM curriculum subcommittee in the United States evaluated a list of 120 skills. Graduates were found to have limited exposure to 49 PEM skills and no exposure to 22 PEM skills. The authors of the study also found that the skills recorded in documented lists were not appropriately maintained by new graduates.[4]

To determine the current state of PEM training in Canada, as well as the directions for future training, we sought to ascertain the frequency with which fellows in accredited Canadian PEM fellowships perform specific procedures, the level of confidence fellows have in their abilities and whether there are differences in self-perceived success between first- and second-year fellows.

Methods

We reviewed a list of 120 core competences identified by the 1993 curriculum subcommittee for PEM in the United States.[5] A focus group consisting of the Postgraduate Education Committee for PEM fellowship at the Children's Hospital at the London Health Sciences Centre identified 24 PEM procedures perceived to be commonly performed and to have more relative importance in the acute resuscitation setting. The list of these 24 PEM procedures was then distributed to the PEM consultants at the Children's Hospital for review and feedback. A survey was then created to determine the number of times each of the 24 procedures were performed by fellows within the past 12 months and within the past 3 years (Box 1). The survey also addressed the confidence of the respondents in successfully performing each procedure. The survey included demographic data as well, such as age, sex, year of training and certifications.

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Approval was obtained from the Children's Hospital research ethics board, which considered completion of the survey an implication of consent. The survey was pilot tested on 15 fellows from across Canada who were attending a PEM conference in 2005. Based on feedback obtained from the pilot group, we revised the survey and then redistributed it by mail in April 2005 to all 46 PEM fellows in accredited PEM fellowship programs across Canada using a modified Dillman technique.[6] Reminders were sent out twice in 2-week intervals after the initial survey.

Data were analyzed in SPSS version 14.0 (SPSS Inc.). Means and standard deviations (SDs) were used to report normally distributed continuous variables. The median and range was used to report skewed continuous variables. Categorical variables were expressed as percentages. The Mann–Whitney test was used to compare differences in skewed continuous outcomes between first- and second-year fellows. $P < 0.05$ was considered statistically significant.

Results

Of the 46 surveys sent to PEM fellows, 32 (70%) were returned. The demographic characteristics of the respondents are listed in Table 1. The mean age of respondents was 31.3 (SD 2.3) years and 68.8% of respondents were male. Most respondents were in their second year of training and had prior training in pediatrics.

Box 1. List of procedures included in the survey

Oropharyngeal/nasopharyngeal airway insertion
Upper airway foreign-body removal
Endotracheal intubation
Needle cricothyroidotomy
Surgical cricothyroidotomy
Change of tracheostomy tube
Needle thoracotomy for tension pneumothorax
Tube thoracostomy
Thoracentesis
Peripheral intravenous insertion
Femoral intravenous insertion
Subclavian intravenous insertion
Internal jugular intravenous insertion
Umbilical vein intravenous insertion
Intra-arterial line insertion
Intraosseous line insertion
Pericardiocentesis
Electrical cardioversion
Electrical defibrillation
Vaginal delivery
Arthrocentesis
Fracture closed reduction
Dislocation relocation
Complex laceration repair

The 24 procedures included in the survey are reported in Table 2. Closed reduction of fractures, followed by peripheral intravenous insertion, complex laceration repair and endotracheal intubation where the most commonly performed procedures. Second-year fellows reported performing significantly more upper airway foreign-body removals, oropharyngeal/nasopharyngeal airway insertions and intraosseous line insertion procedures than did the first-year fellows ($p < 0.05$).

Perceived success rates for the 24 procedures are reported in Table 3. The success rate was highest for oropharyngeal/nasopharyngeal airway insertion: second-year fellows reported a median success rate of 100% (range 90%–100%) and first-year fellows reported a success rate of 92.5% (range 0%–100%, $p = 0.01$). Second-year fellows also reported a significantly higher median success rate for intraosseous line insertion at 95.0% (range 80%–100%) compared with 80% for first-year fellows (range 0%–100%, $p < 0.001$).

Discussion

PEM requires both medical and procedural expertise, yet skill competency is expected to be part of the formal examination of graduates in the current curriculum of the Royal College of Physicians and Surgeons of Canada. All PEM graduates must have a signed "Final in training evaluation report" form that evaluates procedural skills that were observed during training in order to take the exam.

The documentation and evaluation of procedure proficiency

Table 1. Demographic characteristics of survey participants

Characteristic	% of respondents*
Mean (SD) age, yr	31.3 (2.3)
Male	68.8
Year of training	
First	37.5
Second	62.5
Prior training in pediatrics	94.0
Prior training in EM	6.0
PALS provider	78.1
PALS instructor	31.3
ATLS provider	59.4
ATLS instructor	3.1
ACLS instructor	3.1
Mean (SD) estimated ED volume	52 687.5 (11 990.4)

ACLS = advanced cardiac life support; ATLS = advanced trauma life support; ED = emergency department; EM = emergency medicine; PALS = pediatric advanced life support; SD = standard deviation.
*Unless otherwise indicated.

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is an evolving area in the educational literature. Many subspecialties, including internal medicine and surgery, have undertaken the evaluation of procedural skills as part of their training requirements.[7] Within pediatrics there are few standardized, objective, validated and uniformly accepted methods of assessing competence in technical skills.[8]

Current US emergency medicine trainees are required to track procedures performed in a procedure log. However, there are no minimum numbers of procedures required for board certification.[9,10] In Australia, emergency medicine trainees are required to complete a pediatric log book which details their experience with pediatric patients and procedures.[11]

Regardless of training requirements set by governing bodies, the actual effect of program size, program type and year of training on procedural skill acquisition has not been extensively studied. Paul and King[12] evaluated US trainees for the effect of various residency and hospital settings to determine the factors that influenced the range of skills performed. The authors concluded that there were few statistically significant differences in procedure experience between the different program formats and that there were large variations in the type and number of procedures recorded by emergency medicine programs.

Furthermore, there is little consensus regarding a standardized list of skills that would be appropriate to evaluate. Farion and Morrison[3] attempted to refine an emergency medicine procedure skill list by undertaking a national survey to determine procedural frequency and self-assessment of competence. They undertook a rigorous 3-step approach to define a "core" group of 127 procedures that were appropriate for postgraduate acquisition and for emergency medicine certification. These were based on the endorsement of actively practising emergency physicians certified by the Royal College of Physicians and Surgeons of Canada. The authors noted that many previously defined procedural skills were inappropriate because some skills were better acquired in medical school, some skills did not reflect the current standard of care and other procedures were too infrequently performed to establish or maintain competence during training.

In 1993, a large list of 120 technical skills was published

Table 2. Number of procedures performed by first- and second-year pediatric medicine fellows

	Median (range) performed		
Procedure	By first-year fellows, $n = 12$	By second-year fellows, $n = 20$	p value
Fracture closed reduction	5.5 (0–30)	12.0 (0–40)	0.06
Peripheral intravenous insertion	3.5 (0–15)	4.0 (0–100)	0.21
Complex laceration repair	3.0 (0–8)	3.5 (0–20)	0.74
Endotracheal intubation	2.5 (0–6)	3.5 (0–12)	0.45
Upper airway foreign-body removal	0.0 (0–2)	2.0 (0–24)	0.02
Oropharyngeal/nasopharyngeal airway insertion	1.0 (0–4)	2.5 (0–10)	0.04
Dislocation relocation	1.0 (0–10)	1.0 (0–6)	0.92
Femoral intravenous insertion	0.5 (0–2)	1.0 (0–5)	0.31
Intra-arterial line insertion	0.0 (0–2)	0.0 (0–6)	0.41
Intraosseous line insertion	0.0 (0–1)	1.0 (0–3)	0.02
Tube thoracostomy	0.5 (0–2)	1.0 (0–2)	0.31
Umbilical vein intravenous insertion	0.0 (0–10)	0.0 (0–3)	0.80
Arthrocentesis	0.0 (0–1)	0.0 (0–5)	0.39
Needle thoracotomy for tension pneumothorax	0.0. (0–2)	0.0 (0–2)	0.66
Electrical cardioversion	0.0 (0–2)	0.0 (0–1)	0.50
Thoracentesis	0.0 (0)	0.0 (0–3)	0.50
Internal jugular intravenous insertion	0.0 (0)	0.0 (0–2)	0.50
Change of tracheostomy tube	0.0 (0–1)	0.0 (0–2)	0.92
Subclavian intravenous insertion	0.0 (0–1)	0.0 (0–1)	0.96
Electrical defibrillation	0.0 (0–1)	0.0 (0–1)	0.95
Vaginal delivery	0.0 (0)	0.0 (0–1)	0.83
Needle cricothyroidotomy	0.0 (0)	0.0 (0)	—
Surgical cricothyroidotomy	0.0 (0)	0.0 (0)	—
Pericardiocentesis	0.0 (0)	0.0 (0)	—

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by a curriculum subcommittee for PEM in the United States, and a study evaluating 63 graduates was performed. The study had a survey completion rate of 51% and the authors found that of 117 skills analyzed, graduates had limited exposure to 49 skills and no exposure to 22 skills. The authors of the study also found that the skills recorded in documented lists were not being maintained by these new graduates.[4]

We are not aware of any previously published studies of a procedural skill list for PEM within a training program setting. We felt that the first step to establishing such a list was to survey the trainees in PEM to determine their perceived success rates and frequency of exposure to procedures. Since the completion of our survey, the Royal College of Physicians and Surgeons Subspecialty Standards in Pediatric Emergency Medicine published a comprehensive list specifying the procedural standards in the objectives of training in 2007.[2] This list is composed of 125 items ranging from the interpretation of radiographs to the placement of central lines.

The acquisition of procedural skills occurs in many ways, often at various stages of one's career. Nevertheless, the acquisition of core life-saving skills deemed necessary for PEM should be acquired primarily in the fellowship training program.

It could be argued that skills acquisition is often obtained through different modalities including didactic lectures, skills stations, animal laboratories and model simulation. There have been numerous studies reporting novel procedural skill techniques involving animal laboratory settings and computer-based technologies.[13–17] It is noteworthy that the 5 procedures we identified in which trainees felt least competent were also among the 8 least frequently encountered procedures. The development of novel techniques for the acquisition of these particular skills should be an important priority for PEM.

For some procedures we found a wide range of results among respondents. For example, exposure to intravenous insertion and dislocation reductions varied widely. The variation in exposure to these skills may be related to a number of factors including the trainees' elective rotations (orthopedics and anesthesia may allow for greater or lesser exposure), the frequency with which these procedures are carried out in their local department and who primarily performs the procedures. Further research in this area may lead to opportunities for improving exposure to infrequent

Table 3. Self-estimated procedure success rate of first- and second-year pediatric medicine fellows

	Median (range) self-estimated success rate		
Procedure	First-year fellows, *n* = 12	Second-year fellows, *n* = 20	*p* value
Oropharyngeal/nasopharyngeal airway insertion	92.5 (0–100)	100.00 (90–100)	0.01
Endotracheal intubation	90.0 (20–100)	90.0 (20–100)	0.86
Complex laceration repair	90.0 (0–100)	90.0 (70–100)	0.74
Intraosseous line insertion	80.0 (0–100)	95.0 (80–100)	< 0.001
Tube thoracostomy	77.5 (0–100)	95.0 (0–100)	0.13
Needle thoracotomy for tension pneumothorax	87.5 (0–100)	95.5 (0–100)	0.29
Umbilical vein intravenous insertion	85.0 (0–100)	90.0 (0–100)	0.80
Fracture closed reduction	80.0 (0–95)	80.0 (50–95)	0.31
Electrical cardioversion	80.0 (0–100)	90.0 (0–100)	0.31
Electrical defibrillation	77.5 (0–100)	90.0 (0–100)	0.26
Peripheral intravenous insertion	80.0 (0–100)	80.0 (0–95)	0.60
Dislocation relocation	72.5 (0–100)	75.0 (0–100)	0.58
Upper airway foreign body removal	72.5 (0–100)	77.5 (0–100)	0.35
Femoral intravenous insertion	67.5 (0–100)	77.5 (0–95)	0.77
Change of tracheostomy tube	47.5 (0–100)	80.0 (0–100)	0.33
Intra-arterial line insertion	60.0 (0–95)	77.5 (0–100)	0.06
Thoracentesis	30.0 (0–100)	77.5 (0–100)	0.14
Vaginal delivery	50.0 (0–100)	70.0 (0–100)	0.74
Arthrocentesis	40.0 (0–80)	60.0 (0–100)	0.20
Internal jugular intravenous insertion	50.0 (0–100)	45.0 (0–100)	0.99
Subclavian intravenous insertion	40.0 (0–100)	50.0 (0–80)	0.80

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PEM procedures. Our results suggest that training programs need to ensure both the teaching of procedures and assessment of learners' skills.[17–20]

Limitations and future questions

Our study had a number of limitations, in large part because it was a retrospective survey. Although we obtained a response rate of 70%, the sample size of just 32 PEM fellows may limit generalizability. In addition, the reported frequency of procedure performance was based only on recall, which was impossible to verify objectively, thus global estimates were subject to all the vagaries of memory over time and recall bias. Although our findings are a starting point, these data do not necessarily translate directly into the current state of PEM training or skill competence in Canada.

The 24 procedural skills we surveyed were developed as a starting point for a discussion of this aspect of PEM training. There was no systematic review leading to agreement as to the "core" competences with regard to procedural skills within PEM. In addition, a list of 125 competences defined by the Royal College of Physicians and Surgeons of Canada now exists.

The scope of this study was narrow: it was limited to Canadian fellows undertaking pediatric fellowship training at the time of this survey. Therefore, its relevance and generalizability to training programs in other countries may be limited.

Further research is required to establish the core group of competences for the specialty of PEM. Moreover, the frequency and type of exposure necessary for competence in each procedure should be defined.

Conclusion

In surveying PEM trainees across Canada, we have described the frequency and self-perceived success rate for 24 important procedures. This information may be helpful for program directors in evaluating future directions and opportunities for training of their PEM trainees.

Competing interests: None declared.

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