RESEARCH ARTICLE

Development and Validation of the Pediatric Resuscitation and Escalation of Care Self-Efficacy Scale

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ABSTRACT

OBJECTIVES: To validate a scale to assess pediatric providers' resuscitation and escalation of care self-efficacy and assess which provider characteristics and experiences may contribute to self-efficacy.

METHODS: Cross-sectional cohort study performed at an academic children's hospital. Pediatric nurses, respiratory therapists, and residents completed the Generalized Self-Efficacy Scale (GSES) and Pediatric Resuscitation Self-Efficacy Scale (PRSES) as well as a survey assessing their experiences with pediatric escalation of care.

RESULTS: Four hundred participants completed the GSES and PRSES. A total of 338 completed the survey, including 262 nurses, 51 respiratory therapists, and 25 residents. Cronbach α for the PRSES was 0.905. A factor analysis revealed 2 factors within the scale, with items grouped on the basis of expertise required. Multiple logistic regression analyses controlling for GSES score, number of code blue events participated, number of code blue events activated, number of rapid response team events participated, number of rapid response team response events called, performance on a knowledge assessment of appropriate escalation of care, and years of experience demonstrated that PRSES performance was significantly associated with GSES scores and number of escalation of care events (code blue and rapid response) previously participated in ($R^2 = 0.29$, $P < .001$).

CONCLUSIONS: The PRSES can be used to assess pediatric providers' pediatric resuscitation self-efficacy and could be used to evaluate pediatric escalation of care interventions. Pediatric resuscitation self-efficacy is significantly associated with number of previous escalation of care experiences. In future studies, researchers should focus on assessing the impact of increased exposures to escalation of care, potentially via mock codes, to accelerate the acquisition of resuscitation self-efficacy.

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Dr Zurca conceptualized and designed the study, designed the data collection instruments, collected the data, conducted the data analyses, and drafted the initial manuscript; Dr Olsen helped design the study and data collection instruments and assisted with data analyses; Dr Lucas helped conceptualize and design the study and data collection instruments; and all authors reviewed and revised the manuscript and approved the final manuscript as submitted.

Pediatric cardiac arrest is rare, especially when compared with cardiac arrest in adult patients.[1] Even with the availability of expert resuscitation, less than half of children suffering in-hospital cardiac arrest survive to discharge.[2] Efforts have shifted toward prevention, with the goal of identifying clinically deteriorating children sooner, thereby preventing arrests from happening altogether. Studies indicate significant decreases in mortality and rates of cardiac arrest after implementation of a rapid response team (RRT) in children's hospitals.[3–8] It has also been demonstrated that RRT implementation significantly decreases delays between initial signs of clinical decompensation and ICU assessment and increases the number of escalation of care (EOC) events.[3,7] As of 2010, most children's hospitals had implemented some variant of an RRT as part of their EOC algorithm.[9]

For a pediatric EOC algorithm to be effective, it needs to be activated in a timely manner. Although earlier studies of pediatric RRT implementation indicate overall favorable perceptions of the RRT by hospital staff,[5,10] barriers to EOC continue to exist. Failure of the afferent limb of the RRT, including recognition of clinical deterioration and knowing how to and actually activating the RRT, has been associated with a higher incidence of cardiac arrest and an increased mortality rate.[11] Thus, the simple availability of a highly skilled EOC team is not by itself effective, and attention must be paid to whether EOC is performed appropriately and efficiently. Different barriers may exist to RRT activation, potentially explaining some of the variation within outcomes associated with RRT implementation between different hospitals.

In previous studies, researchers have assessed barriers to activating the RRT, as experienced by both physicians and nurses. Multiple barriers have been identified in pediatric hospitals, including a preference to contact the attending physician, feeling discouraged to call for help, and fear of criticism, with less-experienced staff more likely to report barriers.[12] In a qualitative study of nurses and physicians in a large children's hospital in the United States, lack of self-efficacy in recognizing deteriorating patients and activating the RRT was thought to strongly determine if appropriate EOC would occur and was 1 of 3 major barriers to calling the RRT for assistance.[13]

Self-efficacy is a process that indicates a person's confidence in their ability to successfully perform the behaviors needed to achieve desired outcomes and is thought to influence motivations and behaviors.[14] Despite the reported effect of self-efficacy on nurse RRT activation,[13] the relationship between self-efficacy and performance in the medical setting has been unclear[15–18] and potentially limited by lack of validated assessment tools. In previous studies, researchers have developed self-efficacy assessment tools for specific resuscitation skills[19,20]; however, existing scales do not encompass the entirety of pediatric EOC, including the intricacies associated with assessing and managing a clinically deteriorating child that may not be in arrest but still requires resuscitation. The main purpose of this study was to develop and validate a scale to measure pediatric providers' self-efficacy in not only providing resuscitative efforts in cardiac arrest but also recognizing and appropriately escalating care when confronted with a deteriorating child. The secondary goal of the study was to assess items that may contribute to pediatric resuscitation self-efficacy. Because self-efficacy is thought to be most affected by personal performance mastery experiences, we hypothesized that providers that had more frequent exposures to pediatric EOC events (codes and RRTs) and more overall experience would have higher pediatric resuscitation self-efficacy.

METHODS

Survey Instruments

Because of a lack of previously validated tools to assess knowledge and attitudes regarding pediatric EOC, de novo survey tools and knowledge assessment questions were generated for the purposes of this study. The survey tools and questions were developed by a small group including the authors with input by members of the institutional Pediatric Resuscitation Committee. The tools were reviewed by a group of content experts, including nurses, respiratory therapists, and physicians, with changes made to ensure clarity and accuracy. Two tools were used to measure self-efficacy. Although the 10-item Generalized Self-Efficacy Scale (GSES) has been previously validated,[21] an additional 10 questions were developed into a Pediatric Resuscitation Self-Efficacy Scale (PRSES) by adapting question stems and formats from the GSES and inserting skills and behaviors important to pediatric resuscitation. The skills and behaviors included items regarding recognition of clinical deterioration, knowing when and how to ask for help, and practical skills such as providing chest compressions and administering medications. The surveys were piloted with a small representative sample of 10 pediatric health care providers and modified on the basis of the results of the pilot testing.

Providers were asked to complete a questionnaire that included the GSES and PRSES. Additional survey items included 5 demographic questions, providers' previous experiences with EOC events, knowledge and attitudes toward pediatric EOC, and a 6-item case-based knowledge assessment of their understanding of how and when to escalate care for clinically deteriorating pediatric patients. Providers that chose either "Agree" or "Strongly Agree" with statements regarding previous hesitation to escalate care were asked to choose from a list of potential barriers, derived from a previous EOC survey in our institution. To provide comparison scores for validation, all 20 PICU charge nurses received an e-mail invitation to electronically complete the GSES, PRSES, and knowledge assessment. The scales and survey tools are available as supplemental material in the online version of *Hospital Pediatrics*. Survey data were obtained and maintained by using REDCap.[22]

Study Design

This was a prospective nonrandomized study performed at a single academic pediatric hospital. At our institution, the pediatric EOC algorithm includes 2 options: code blue team activation for cardiac or respiratory arrests or situations in which expert help is needed emergently or RRT activation for urgent evaluation and/or prearrest resuscitation, in which the RRT has up to 15 minutes to arrive. The teams are composed of physicians, respiratory therapists, and nurses. Because all providers are certified in Pediatric Advanced Life Support (PALS), all providers are expected to be able to perform any role until additional team members arrive. All 56 pediatric residents, 440 nurses (with responsibility for caring for floor or intermediate care–level patients), and 64 respiratory therapists (who rotate in all pediatric units, including the PICU, floor, and intermediate care unit) underwent required training regarding the pediatric EOC protocol in our institution, including team composition and indications for EOC. Participants were asked to complete the self-efficacy scales and survey electronically before completing the Web-based training. Although the training was required, study participation was voluntary. This study was reviewed and deemed as exempt research by the Institutional Review Board at Penn State Hershey College of Medicine.

Statistical Analyses

Descriptive statistics were used to summarize demographics of the sample. The primary outcome measures were (1) generalized and pediatric resuscitation-specific self-efficacy, as measured by the GSES and PRSES, and (2) knowledge of appropriate EOC procedures, as measured by 6 knowledge assessment items on the survey. The GSES and PRSES are each composed of 10 items, with responses scored on a 4-point scale. The responses to each of the scales were summed up to yield a composite score with a range of 10 to 40, with higher responses indicating higher self-efficacy. Reliability of the PRSES was assessed by using Cronbach α. Factor analysis was also performed on the PRSES, by using Eigenvalues >1 for extraction. Factor loadings >0.3 were considered significant. Quantitative analysis of Likert Scale survey data included means and SDs or medians and interquartile ranges, as appropriate. Categorical data were analyzed primarily via Fisher exact or χ^2 analyses, as indicated. Continuous data were analyzed by using *t* tests for normally distributed variables and the Mann-Whitney test for nonnormally distributed variables. Correlations between PRSES score and respondents' experiences were analyzed by using Pearson *r*. Analysis of variance was performed to assess differences between respondents of different professions. Multiple logistic regression analysis was performed to test the relationships between PRSES scores and participants' characteristics that were significant on univariant analysis. Analyses were performed by using SPSS (version 25; IBM SPSS Statistics, IBM Corporation).

RESULTS

A total of 338 participants completed the entire survey, including the demographics and experiences sections and the self-efficacy scales, for a total response rate of 60%. These data are reported in Table 1 and demonstrated an average score of 30.7 on the GSES and 32.5 on the PRSES. In total, 400 participants completed the self-efficacy scales. The Cronbach α reliability score for the entire GSES was 0.906. The Cronbach α reliability score for the entire PRSES was 0.905. Individual item performance is detailed in Table 2. In assessing the factorability of the scale, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.866, and the Bartlett test of sphericity was significant (χ^2 [45; $N = 400$] $= 2707.5$, $P < .001$).

Factor analysis is used to assess whether items in a scale group in certain way, to get a better sense of whether the pattern of participant responses indicates a unique clustering of items in the scale that might describe separate factors within the scale. Ultimately, 2 factors were identified in a factor analysis (Supplemental Fig 1). The first factor was found to explain 55.9% of the variance, and the second factor was found to explain an additional 12.9%, for a total of 68.8% of variance explained. Factor 1 loaded highly on items related to knowing when to ask for assistance (0.922), knowing how to ask for assistance (0.902), providing effective bag-mask ventilation (0.755), identifying a clinically deteriorating child (0.737), providing effective chest compressions (0.707), and using a defibrillator (0.430). Factor 2 loaded highly on items related to administering adenosine for supraventricular tachycardia (0.971), drawing up and administering code epinephrine (0.921), identifying life-threatening dysrhythmias (0.724), locating equipment in the code cart (0.594), and using a defibrillator (0.427) (Table 2).

On initial analysis, total score on the PRSES was significantly and positively associated with GSES score, number of code blue events previously participated in, number of code blue events activated, number of RRT participated in, number of RRT events activated, performance on an EOC knowledge assessment, number of years of experience (for nurses and respiratory therapists), and age (Table 3). There were no significant differences in GSES score, PRSES score, and number of EOC events

TABLE 1 Survey Respondents ($N = 338$)

Demographics	
Profession, *n* (%)	
Nursing ($n = 440$; RR = 60%)	262 (78)
Respiratory therapy ($n = 64$; RR = 80%)	51 (15)
Resident physician ($n = 56$; RR = 45%)	25 (7)
Females, *n* (%)	297 (88)
Age, y[a], mean (SD)	34.5 (10.6)
Years of experience, mean (SD)	10.3 (9.4)
Generalized self-efficacy[b], mean (SD)	30.7 (4.2)
Pediatric resuscitation self-efficacy[b], mean (SD)	32.5 (6.1)
Code blues participated, median (IQR)	2 (0–10)
Code blues called, median (IQR)	0 (0–2)
Rapid response participated, median (IQR)	3 (0–10)
Rapid response called, median (IQR)	0 (0–2)
Race and ethnicity, *n* (%)	
White	305 (90)
Other	11 (3.3)
Asian	11 (3.3)
Latino or Hispanic	11 (3.3)
Previous hesitation to calling code blue, *n* (%)	26 (8)
Previous hesitation to calling rapid response, *n* (%)	65 (38)

IQR, interquartile range; RR, response rate.
[a] Nursing and respiratory therapists only.
[b] Scored 10 to 40, with higher score indicating higher self-efficacy.

TABLE 2 PRSES: Individual Item Performance and Factor Analysis

	Cronbach α If Item Deleted	Factor 1	Factor 2
When confronted with a clinically deteriorating child, I know when to ask for assistance	0.897	0.922	−0.116
When confronted with a clinically deteriorating child, I know how to ask for assistance	0.896	0.902	−0.070
I am confident that I could provide effective bag-mask ventilation for a child in respiratory arrest	0.894	0.755	0.115
I can usually identify a child who is clinically deteriorating	0.899	0.737	0.030
I am confident that I could provide effective chest compressions for a child in cardiac arrest	0.894	0.707	0.166
I am confident that I could use the defibrillator for a child suffering a life-threatening dysrhythmia	0.894	0.430	0.427
If faced with a child in SVT, I could effectively administer a dose of adenosine	0.896	−0.117	0.971
If I know a child's wt, it is easy for me to draw up and administer a code dose of intravenous epinephrine	0.896	−0.068	0.921
I can identify common life-threatening dysrhythmias (SVT), VT, and VF	0.889	0.195	0.724
During a code event, I would be able to locate necessary equipment in the code cart	0.894	0.254	0.594

Overall Cronbach $\alpha = 0.905$. Factor analysis rotation method: direct oblimin with Kaiser normalization. SVT, supraventricular tachycardia; VF, ventricular fibrillation; VT, ventricular tachycardia.

attended or called on the basis of sex; however, there were significant outcomes based on profession (Table 4). Resident physicians had significantly lower GSES scores compared with nurses and respiratory therapists, and nurses had significantly higher PRSES scores compared with respiratory therapists. Respiratory therapists, however, were significantly more likely to participate within code blues and RRTs than either nurses or residents. An additional 14 out of 20 (70%) PICU charge nurses completed the GSES, PRSES, and knowledge assessment. PICU charge nurses scored significantly higher than all other groups on the PRSES, with a mean score of 37.9.

Multiple logistic regression analyses were performed for the PRSES scores, controlling for GSES score, number of code blue events participated, number of code blue events activated, number of RRT events participated, number of RRT response events called, performance on a knowledge assessment of appropriate EOC, years of experience, and age (Table 5). Of the variables tested, scores on the PRSES remained significantly associated with GSES scores and number of EOC events (code blue and rapid response) previously participated in ($R^2 = 0.29$, F [degrees of freedom, 8, 266] $= 13.5$, $P < .001$).

Twenty-six providers indicated cases in which they had wanted to call a code blue but had hesitated. The most common reasons reported for hesitating to call code blues included worrying that their concerns would be minimized (16 out of 26), fear of being ridiculed or chastised (13 out of 26), and feeling unsure about indications for a code blue (8 out of 26). Sixty-five providers reported having previously hesitated to activate the RRT. The most common reasons for hesitating to activate the RRT were worrying that their concerns would be minimized (39 out of 65), fear of being ridiculed or chastised (35 out of 65), being unsure of the benefits of RRT activation (19 out of 65), and being unsure of the indications for RRT activation (19 out of 65). There were no significant differences between nurses, physicians, or respiratory therapists in whether they had hesitated to call a code (χ^2 [6; $N = 333$] $= 4.34$, $P = .63$) or RRT (χ^2 [6; $N = 331$] $= 5.99$, $P = .43$).

TABLE 3 PRSES: Correlation With Respondents' Experiences

	n	Pearson Correlation (r)	P
GSES score	400	0.422	<.001
No. code blue events participated	381	0.227	<.001
No. code blues called	384	0.128	.012
No. rapid response events participated	380	0.169	.001
No. rapid response events called	379	0.135	.008
EOC knowledge assessment performance	400	0.261	<.001
Years of experience (nurses, respiratory therapists)	309	0.159	.005
Age	327	0.126	.023

DISCUSSION

In this study, we developed and validated a scale aimed at assessing pediatric providers' self-efficacy with pediatric EOC. The Cronbach α of >0.9 indicates excellent reliability of the scale. PICU charge nurses were included as an expert comparison group because of their clinical experiences caring for critically ill children, ease with technical skills, and frequent exposure to EOC. PICU charge nurses scored significantly higher than the study cohort on the PRSES, thus providing additional validity to the scale.

The factor analysis indicated that the scale assesses 2 main factors of pediatric resuscitation self-efficacy. Items that primarily loaded with factor 1 appear to relate to the initial recognition of a child requiring EOC as well as the treatment of clinically unambiguous situations (bag-mask ventilation for respiratory arrest and chest compressions for cardiac arrest). Practically, these are skills that are the focus of basic life support training. The items primarily loading with factor 2 relate more to administering specialized and/or focused treatments that require rhythm recognition or equipment only found in medical settings. Practically, these skills are part of PALS training and, in many hospital settings, require opening a "code cart." It is

TABLE 4 One-Way Analysis of Variance: Outcomes by Profession

	Nurses (n = 262)	Resident Physicians (n = 25)	Respiratory Therapists (n = 51)	PICU Charge Nurses (n = 14)	$F_{observed}$ (df)	P
GSES score, mean (SD)	31 (3.8)	28.4 (5.3)[a]	31.8 (3.7)	33.6 (4.1)	6.5 (3, 351)	<.001
PRSES score, mean (SD)[b]	33.9 (4.9)	32.2 (4.1)	31.2 (4.2)	37.9 (2.1)[c]	9.3 (3, 351)	<.001
Code blues attended, mean (SD)	6.9 (16.4)	2.1 (2.4)	20.3 (40.4)[a]	—	9.5 (2, 329)	<.001
Code blues called, mean (SD)	2.8 (19)	0.7 (2.1)	7.5 (35.5)	—	1.2 (2, 332)	.31
Rapid responses attended, mean (SD)	7.3 (21.1)	6.5 (7.1)	22.9 (39.9)[a]	—	8.9 (2, 329)	<.001
Rapid responses called, mean (SD)	2.1 (7.5)	1.5 (2.3)	1.7 (3)	—	0.14 (2, 328)	.87
Knowledge assessment score, mean (SD)	4.7 (1.2)	4.7 (1.1)	4.6 (1)	5.4 (0.85)	1.93 (3, 351)	.12

F, xxx; —, not applicable.
[a] Tukey post hoc test: residents' GSES scores significantly lower compared with other 3 groups.
[b] Tukey post hoc test: nurses PRSES scores significantly higher than respiratory therapists (P = .001).
[c] Tukey post hoc test: PICU charge nurse PRSES scores significantly higher than all other groups.

interesting to note that the PRSES item relating to use of a defibrillator loaded with both factors, potentially reflecting that defibrillation is taught in both basic life support and PALS. Unfortunately, we did not separately measure and thus were unable to control specifically for providers' experiences and comfort using defibrillators.

Although we found statistically significant differences in self-efficacy scores between providers of different professions, it is unclear how meaningful these group differences are as compared with their impact on assessment of individual performance. In 1 previous study, researchers identified lack of self-efficacy as a major barrier to pediatric RRT activation for nurses.[13] In this previous study, nurses with fewer years of experience were especially more likely to doubt their ability to accurately recognize clinical deterioration. In our study cohort, resuscitation-specific self-efficacy was most strongly associated with generalized self-efficacy. This indicates that some amount of resuscitation-specific self-efficacy depends on underlying individual characteristics and personal previous experiences, which may be difficult to modify. However, pediatric resuscitation-specific self-efficacy was also significantly associated with experience with previous EOC events, specifically the number of code blue and RRT events previously attended. Previous experiences with actual EOC events allow providers opportunities to build and practice their skills, thus helping them develop enactive mastery that is vital to building self-efficacy. It is interesting to note that years of experience did not appear to be significantly related to resuscitation self-efficacy, indicating that experience alone may not build self-efficacy, but that self-efficacy is instead affected by particular types of experiences.

TABLE 5 Multiple Logistic Regression Analysis of Components Contributing to Pediatric Resuscitation Self-Efficacy

	β	t	P
GSES score	.46	8.5	<.001
No. code blue events participated	.44	3.7	<.001
No. code blue events called	.03	0.28	.78
No. rapid response events participated	−.35	−2.6	.011
No. rapid response events called	.05	0.81	.42
Performance on EOC knowledge assessment	.09	1.8	.08
Years of experience	−.08	−0.99	.32
Age	.12	1.4	.15

It is important to note the rather low median number of EOC events within which providers in our cohort had participated, especially because resuscitation self-efficacy was associated with the number of code blue events within which providers had participated. Cardiac arrests are relatively rare in pediatrics, compared with adult medicine, decreasing the opportunities for pediatric providers to have these experiences. Simulation has become an important aspect of pediatric training and can be looked to as an important method to increase providers' exposures to EOC events.[23,24] In many ways, certain features of simulation make for ideal educational opportunities by encouraging active learning, collaboration, and prompt feedback in a safe learning environment.[23] It is indicated in multiple studies that simulation-based education positively impacts learners' self-efficacy.[25–28] However, further research is needed to assess the impact of simulated inpatient EOC events on pediatric providers' resuscitation-specific self-efficacy, with the PRSES now available as an assessment tool. More importantly, it should be explored in further work whether increases in resuscitation self-efficacy lead to behavioral changes that improve EOC in actual patient care.

Finally, we were disappointed to find that, in our cohort, close to 20% of providers reported having previously hesitated to activate the RRT. In previous studies, it has been indicated that inexperienced nurses are less likely to have activated the RRT, more likely to be afraid of criticism, and more reluctant to activate the RRT[12,29] and that the clarity with which the criteria for RRT activation is communicated, as well as consistency in acceptance of these criteria between providers, has a large impact on whether nurses feel comfortable activating the RRT.[30,31] To maximize pediatric providers' self-efficacy, institutions should ensure all providers have not only the sufficient resuscitation skills, medical knowledge, and understanding of EOC policies but also strive to nurture a culture that is blame free, open to questioning, and developmental.

Our sample was recruited from a single academic medical center; therefore, it is difficult to assess generalizability of the results. Although most of the respondents were nurses, this reflects the relative numbers of inpatient providers, especially those most often responsible for activating the RRT. Our survey had not been previously validated; however, it was rigorously evaluated with focus groups of medical providers to mitigate threats to validity, and the internal consistency of items within each cluster of items suggests a highly reliable set of scale items. Additional construct validity was obtained via a grouping of scale items and favorable comparison with a group of experts. Finally, although we asked providers about their experiences with EOC, we were unable to account for all potential educational experiences that may have impacted providers' self-efficacy, including respiratory therapists' experiences caring for PICU patients.

CONCLUSIONS

The PRSES is used to measure pediatric providers' self-efficacy and can be used in future studies in which researchers assess the impact of educational interventions on pediatric EOC. Pediatric resuscitation self-efficacy is significantly associated with number of previous code blue experiences, indicating that increased exposure to pediatric EOC events may help pediatric providers build self-efficacy. In future studies, researchers should focus on assessing methods for increasing pediatric provider self-efficacy, including the impact of simulation and mock code programs, and exploring whether increasing pediatric resuscitation self-efficacy is associated with improvement in provider performance and subsequent optimization of clinical outcomes.

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