Cureus

Open Access Original Article

DOI: 10.7759/cureus.35869

Review began 12/27/2022
Review ended 02/28/2023
Published 03/07/2023

The Reliability of the Resuscitation Assessment Tool (RAT) in Assessing Emergency Medicine Resident Competence in Pediatric Resuscitation Scenarios: A Prospective Observational Pilot Study

Meaghan J. Mackenzie [1] , Carly Hagel [1] , Yiqun Lin [2, 3] , Andrew K. Hall [4] , Vincent J. Grant [5] , Shirmee Doshi [5]

1. Department of Emergency Medicine, University of Calgary, Calgary, CAN 2. Department of Pediatrics, KidSIM Simulation Education and Research Program, Alberta Children's Hospital, Calgary, CAN 3. Department of Community Health Sciences, University of Calgary, Calgary, CAN 4. Department of Emergency Medicine, University of Ottawa, Ottawa, CAN 5. Department of Emergency Medicine, Alberta Children's Hospital, Calgary, CAN

Corresponding author: Meaghan J. Mackenzie, meaghan.mackenzie2@ucalgary.ca

Abstract

Introduction

Emergency medicine (EM) postgraduate medical education in Canada has transitioned from traditional time-based training to competency-based medical education (CBME). In order to promote residents through stages of training, simulated assessments are needed to evaluate residents in high-stakes but low-frequency medical emergencies. There remains a gap in the literature pertaining to the use of evaluative tools in simulation, such as the Resuscitation Assessment Tool (RAT) in the new CBME curriculum design.

Methods

We completed a pilot study of resident physicians in one Canadian EM training program to evaluate the effectiveness and reliability of a simulation-based RAT for pediatric resuscitation. We recorded 10 EM trainees completing simulated scenarios and had nine EM physicians use the RAT tool to evaluate their performances. Generalizability theory was used to evaluate the reliability of the RAT tool.

Results

The mean RAT score for the management of pediatric myocarditis, cardiac arrest, and septic shock (appendicitis) across raters was 3.70, 3.73, and 4.50, respectively. The overall generalizability coefficient for testing simulated pediatric performance competency was 0.77 for internal consistency and 0.75 for absolute agreement. The performance of senior participants was superior to that of junior participants in the management of pediatric myocarditis ($p = 0.01$) but not statistically significant in the management of pediatric septic shock ($p=0.77$) or cardiac arrest ($p=0.61$).

Conclusion

Overall, our findings suggest that with an appropriately chosen simulated scenario, the RAT tool can be used effectively for the simulation of high-stakes and low-frequency scenarios for practice to enhance the new CBME curriculum in emergency medicine training programs.

Categories: Emergency Medicine, Medical Education, Medical Simulation
Keywords: resident doctor, emergency medicine resident, pediatric resuscitation, resuscitation assessment tool (rat), rat tool, medical education, competency by design, resuscitation, emergency medicine, simulation

Introduction

Pediatric resuscitations are considered low-frequency, high-stakes events in emergency departments in North America [1,2]. One challenge is finding ways to provide emergency medicine (EM) residents with opportunities to demonstrate competence in this specific patient population without compromising safe patient care. The EM education community has recognized that simulation-based education can provide an alternative way to expose residents to rare presentations in a controlled setting [3,4] as well as allow for assessment of competence.

Post-graduate medical education in Canada is in a state of transition from traditional time-based training to competency-based medical education (CBME). As opposed to determining competency based on the number of years of training, CBME aims to do so by having residents prove proficiency in a set number of clinical skills or tasks. The Royal College of Physicians and Surgeons of Canada has implemented Competence by Design (CBD), its own unique model of CBME [5]. The foundation of the program is the assessment of entrustable professional activities (EPAs) [6]. EPAs are defined as "units of professional practice that can be fully entrusted to a trainee once he or she has demonstrated the necessary competence to execute this activity unsupervised" [7]. Assessments of performance on EPAs are designed to be low-stakes but high-frequency assessments to track the achievement of competencies over time. Trainees are promoted to advanced stages of training by demonstrating competence in stage-specific EPAs.

The transition to CBME in emergency medicine in Canada was in July 2018 [8]. This transition requires EM residents to achieve competence in a number of EPAs during each stage of training. Competence in managing pediatric resuscitation is an expectation at all levels of training, with multiple assessments required.

While many assessment tools for EM simulation scenarios have been created and arguments for their validity presented, a limited number have been integrated into the EM residency curriculum as a form of assessment of competence [9]. With the rollout of CBME in EM, programs are facing an increased need to use simulation to provide residents with exposure to uncommon clinical scenarios. EPAs have primarily been designed for the clinical setting, and the assessment guidelines for each EPA are not specific to simulated practice scenarios [5]. Currently, programs are using assessment tools that have not yet been validated for use in simulation to provide assessment data that can influence the progress of trainees.

Queens University (Kingston, Ontario, Canada) created a resuscitation assessment tool (RAT) with the goal of utilizing it within the new CBD curriculum. The RAT generates entrustment scores through an anchored global assessment scale. Recently, the research team from Queens University that created the RAT used it to compare resident performance in the clinical environment relative to the simulated (SIM) environment [10]. Using the RAT, they were able to identify residents who needed support in specific competencies or areas.

There remains a gap in the literature on the use of tools such as the RAT in the new CBME curriculum design, specifically pertaining to the assessment of competence in pediatric resuscitation and pediatric EPAs. There are specified performance expectations for a required number of exposures to pediatric acute care cases, with accompanying assessments of competency in these settings. Additionally, while there is a clearly established transferability from simulated practice to clinical competence for procedural skills [11], that same link has not yet been well established for resuscitation competencies [12].

Our study aims to evaluate the reliability of the RAT as a tool for assessing emergency medicine trainee competence, specifically in pediatric resuscitation scenarios. We aim to achieve this by determining whether the RAT can communicate consistent results independent of the assessor (rater) and if it can correctly identify residents who may need more support in a specific area of competence. The overarching goal of this study is to understand how to strengthen pediatric simulated curricula for EM residents participating in the CBME framework.

Materials And Methods

A prospective observational cohort study of resident physicians in one Canadian EM training program was used to evaluate the effectiveness and reliability of a simulation-based RAT for pediatric resuscitation. The study took place between January 2019 and July 2021 and was carried out in the KidSIM Lab at the Alberta Children's Hospital in Calgary, Alberta, Canada. The study was approved by the Conjoint Health Research Ethics Board at the University of Calgary.

Study setting

The study took place at the University of Calgary's Cumming School of Medicine Department of Emergency Medicine over an 18-month period of time. High-fidelity and age-appropriate mannequins were utilized in the KidSIM Center at the Alberta Children's Hospital. Performance was video recorded from three fixed camera angles to allow adequate views of the trainee, the mannequin, and the monitors.

Study participants

Emergency medicine residents (FRCPC-EM), pediatric emergency medicine fellows, and family medicine residents completing a special competence year in emergency medicine (CCFP-EM) were eligible to participate. We recruited 10 residents, as determined by local resident volume and availability. Participation was voluntary, and residents were assured that their performance would not be shared with anyone outside of the study (program directors or otherwise). They were informed, prior to consenting to participate, that there would be raters from within Calgary as well as across the country. Written consent was obtained from all participants, including video recordings of their performances in the simulation lab.

Assessor training

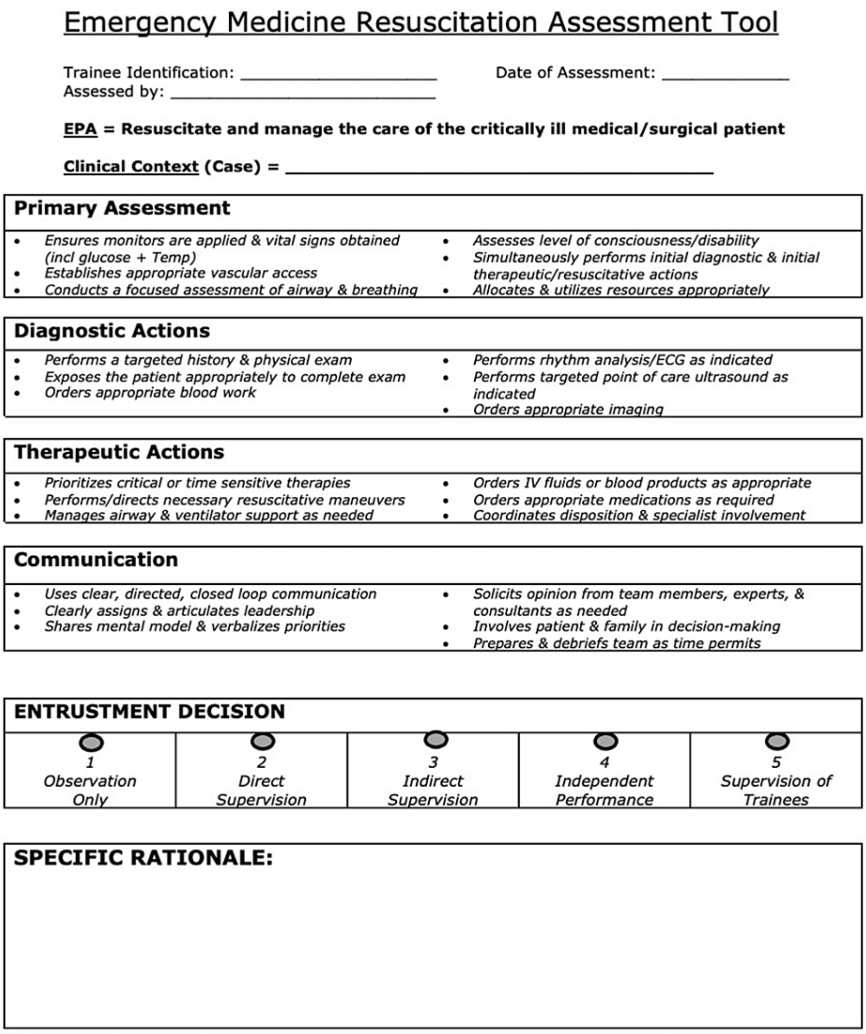
A purposeful sample of practicing EM physicians involved in CBME simulation training for residents was chosen as raters. The authors utilized frame-of-reference training to prepare raters and provided an orientation to the RAT tool prior to reviewing each resident's performance. Each rater received a practice video of a resident physician not participating in the study completing a simulated scenario. The rater was required to watch the video and use the RAT tool to evaluate the performance. After the practice video, a member of the research team (MM) met with each participant over a 30-minute period to go over their evaluation, compare RAT evaluations, and discuss any questions that came up about the tool. Raters were then asked to rate the performance of the study participants in all three scenarios, as detailed below.

A total of nine EM physicians were trained as assessors: three of those physicians were local and unblinded, and six were external EM physicians from across Canada who were blinded to each resident's level of training. Apart from EM training, all raters had specific interests and training in simulated practice, curriculum design, and residency education.

Each EM physician rated four residents for a total of twelve total evaluations. Each resident was reviewed by one unblinded rater and two blinded raters. Raters were blinded to each resident's level of training. Blinded as well as unblinded raters were recruited to ensure that scores were not biased by the rater's awareness of the resident's year of training. To further assess any inconsistencies in rating, all nine EM assessors rated one of the residents.

Measures (RAT)

The RAT was derived from a prior assessment tool, the Queen's simulation assessment tool (QSAT). The QSAT was recently modified in the context of the implementation of CBME to create the resuscitation assessment tool (RAT), with the goal of utilizing it within the new CBD curriculum. The RAT generates entrustment scores through an anchored global assessment scale. The scoring system was derived from the QSAT by developing generic behavioral anchors for resuscitation performance using a modified Delphi process for each domain and replacing the global assessment scale with an entrustment scale. A score of one on the scale translates to "resident only observed the skill," whereas a score of five communicates that the resident has mastered the skill and can supervise trainees (Figure *1*).



Emergency Medicine Resuscitation Assessment Tool

Trainee Identification: ____________________ Date of Assessment: _____________
Assessed by: ___________________________

EPA = Resuscitate and manage the care of the critically ill medical/surgical patient

Clinical Context (Case) = ____

Primary Assessment

- *Ensures monitors are applied & vital signs obtained (incl glucose + Temp)*
- *Establishes appropriate vascular access*
- *Conducts a focused assessment of airway & breathing*
- *Assesses level of consciousness/disability*
- *Simultaneously performs initial diagnostic & initial therapeutic/resuscitative actions*
- *Allocates & utilizes resources appropriately*

Diagnostic Actions

- *Performs a targeted history & physical exam*
- *Exposes the patient appropriately to complete exam*
- *Orders appropriate blood work*
- *Performs rhythm analysis/ECG as indicated*
- *Performs targeted point of care ultrasound as indicated*
- *Orders appropriate imaging*

Therapeutic Actions

- *Prioritizes critical or time sensitive therapies*
- *Performs/directs necessary resuscitative maneuvers*
- *Manages airway & ventilator support as needed*
- *Orders IV fluids or blood products as appropriate*
- *Orders appropriate medications as required*
- *Coordinates disposition & specialist involvement*

Communication

- *Uses clear, directed, closed loop communication*
- *Clearly assigns & articulates leadership*
- *Shares mental model & verbalizes priorities*
- *Solicits opinion from team members, experts, & consultants as needed*
- *Involves patient & family in decision-making*
- *Prepares & debriefs team as time permits*

ENTRUSTMENT DECISION

1	2	3	4	5
Observation Only	*Direct Supervision*	*Indirect Supervision*	*Independent Performance*	*Supervision of Trainees*

SPECIFIC RATIONALE:

FIGURE 1: Emergency medicine resuscitation assessment tool

Simulated scenario administration and evaluation

Each resident completed three standardized simulated cases in the simulation labs. They were each assigned the role of team leader. As described on the Royal College website, the goal of this EPA is to lead a team of healthcare professionals in the emergency department to care for a patient with a medical or surgical life-threatening condition. Their performances were video recorded for later review. KidSIM nurses supported and facilitated the scenarios, keeping each scenario consistent for each resident. Though all the staff was experienced with the mannequins and the scenarios, we reviewed each scenario 30 minutes prior to each simulation session. There were two simulation days, and each day the same KidSIM staff served as facilitators. The scenarios were based on EPA 3.1: resuscitating and coordinating care for critically ill patients (focused on cardiorespiratory arrest, dysrhythmias, shock, respiratory distress, or altered mental status). Our cases included pediatric myocarditis, septic shock (appendicitis), and cardiac arrest. Details on these case scenarios can be found in the appendices.

Statistical analysis

Demographic characteristics of the participants, such as gender and level of training, were summarized with descriptive statistics (count and percentage). The RAT scores of the three scenarios were summarized with a mean and standard deviation.

Generalizability theory was used to evaluate the reliability of the RAT tool. We used R statistical software (www.r-project.org) and "gtheory" packages to estimate the variance components of participants, scenarios (i.e., pediatric cardiac arrest, myocarditis, septic shock (appendicitis), and raters. The three two-way interactions between all three of these variables (raters x scenarios, raters x participants, scenario x participants) and the three-way interaction effects (raters x participants x scenarios) were confounded with random error as a function of the fully crossed design. The generalizability coefficients for internal consistency and absolute agreement of the following two analyses were calculated manually:

(1) A two-random-facet design where both the effects of the rater and scenario are considered random (Figure 2).

$$G_{ABS} = \frac{\sigma_p^2}{\sigma_p^2 + \left[\frac{\sigma_s^2}{n_s} + \frac{\sigma_{ps}^2}{n_s} + \frac{\sigma_r^2}{n_r} + \frac{\sigma_{pr}^2}{n_r} + \frac{\sigma_{sr}^2}{n_s n_r} + \frac{\sigma_{psr,e}^2}{n_s n_r}\right]}$$

$$G_{REL} = \frac{\sigma_p^2}{\sigma_p^2 + \left[\frac{\sigma_{ps}^2}{n_s} + \frac{\sigma_{pr}^2}{n_r} + \frac{\sigma_{psr,e}^2}{n_s n_r}\right]}$$

FIGURE 2: A two-random facet design where both the effects of the rater and scenario are considered random

(2) A two-facet design with one facet fixed. The facet of the rater was considered random, and the facet of the scenario was considered fixed since the same scenario could be used to evaluate the resident's performance (Figure 3).

$$G_{ABS} = \frac{\sigma_p^2 + \frac{\sigma_{ps}^2}{n_s}}{\sigma_p^2 + \left[\frac{\sigma_{ps}^2}{n_s} + \frac{\sigma_r^2}{n_r} + \frac{\sigma_{pr}^2}{n_r} + \frac{\sigma_{sr}^2}{n_s n_r} + \frac{\sigma_{psr,e}^2}{n_s n_r}\right]}$$

$$G_{REL} = \frac{\sigma_p^2 + \frac{\sigma_{ps}^2}{n_s}}{\sigma_p^2 + \left[\frac{\sigma_{ps}^2}{n_s} + \frac{\sigma_{pr}^2}{n_r} + \frac{\sigma_{psr,e}^2}{n_s n_r}\right]}$$

FIGURE 3: A two-facet design with one facet fixed where the facet of the rater was considered random and the facet of the scenario was considered fixed

The variance coefficients were then used to inform a decision study (D-study) to determine the optimal combination of raters and scenarios to maximize the reliability of the assessments.

Due to the small sample size and skewed distribution of the data, non-parametric tests were used for validity tests. The Wilcoxon rank sum test was used to compare the performance of junior (post-graduate years one and two) and senior participants (post-graduate years three, four, and five) in the three scenarios. The Wilcoxon signed-rank tests were used to compare the performances within three scenarios. The RAT score was the only primary outcome we examined. The structure of analysis plan was organized as (1) demographic information, (2) generalizability theory (reliability), and (3) validity.

Results

Participant demographics

A total of 10 emergency medicine residents participated in the study, with four women (4/10, 40%) and six men (6/10, 60%). Eight participants were emergency medicine residents (FRCPC-EM) from post-graduate year one to five (PGY-1: 1/10, PGY-2: 3/10, PGY-3: 3/10, PGY-5: 3/10), one was a pediatric emergency medicine fellow (PGY-4), and one was a former family medicine resident completing a year of emergency medicine training (CCFP-EM) (PGY-3).

Data summary

The mean RAT score for the three pediatric simulated resuscitation performances across participants and raters was 3.97. The mean score for the management of pediatric myocarditis, cardiac arrest, and septic shock (appendicitis) across raters was 3.70, 3.73, and 4.50, respectively. Table *1* provides a summary of mean RAT scores for juniors (PGY-1 or 2), seniors (PGY-3 or above), and total participants in three scenarios.

Scenario	Total	Junior	Senior
Myocarditis	3.70 ± 0.84	3.20 ± 0.68	4.20 ± 0.68
Cardiac arrest	3.73 ± 0.78	3.67 ± 0.82	3.80 ± 0.77
Septic shock (appendicitis)	4.50 ± 0.63	4.47 ± 0.64	4.53 ± 0.64

TABLE 1: Summary of resuscitation assessment scores in three scenarios

Data presented as mean ± standard deviation

Junior: post-graduate years one and two emergency medicine resident; Senior: post-graduate years three to five emergency medicine resident

Generalizability study

The variance components for testing the participants across three pediatric resuscitation scenarios and 10 raters are presented in Table *2*. The overall generalizability coefficient for testing simulated pediatric performance competency was 0.77 for internal consistency and 0.75 for absolute agreement for the 10-rater, three-fixed scenario design. If ignoring the variance components of scenarios, the generalizability coefficient was 0.00, as shown in Table *3*.

	Df	Sum Sq	Mean Sq	Estimated variance	Variance percent (%)
Resident	9	8.926	0.992	0.000*	0.0
Rater	8	2.963	0.370	0.000*	0.0
Scenario	2	15.167	7.584	0.163	21.4
Resident × Rater	18	10.444	0.580	0.076	10.0
Resident × Scenario	18	17.574	0.976	0.186	24.5
Rater × Scenario	16	8.537	0.534	0.053	7.0
Resident × Rater × Scenario, error	36	10.056	0.279	0.282	37.1

TABLE 2: Variance by source

Df: degrees of freedom; Sum Sq: sum of squares; Mean Sq: mean square

*The estimated variances were shown at three decimal places, not exactly 0

The estimated variance for a resident was 1.1 x 10-9. The estimated variance for the rater was 3.9 x 10 -11

Model	σ^2-Rel	σ^2-Abs	G-Rel	G-Abs
2 random facet	0.081	0.137	0.000	0.000
1 random (rater), 1 fixed (scenario) facet	0.081	0.083	0.766	0.748

TABLE 3: Reliability coefficients

σ^2: relevant variance; σ^2: absolute variance; G-Rel: relevant G coefficient; G-Abs: absolute G coefficient

Decision study

A decision study (D-study) was conducted as a hypothetical calculation whereby the number of raters and scenarios were manipulated to achieve a reliability coefficient of 0.70. We found that increasing the number of scenarios did not seem to improve the reliability coefficient. Based on the hypothetical projection of the D-study, two scenarios and six raters would be sufficient to achieve a reliability coefficient of 0.70 (Table *4*).

Number of scenarios	Number of raters	G-Rel	G-Abs
2	8	0.78	0.75
2	7	0.76	0.73
2	6	0.73	0.70
2	5	0.69	0.66
4	8	0.73	0.71
4	7	0.70	0.68
4	6	0.67	0.65

TABLE 4: Generalizability and decision study results for various combinations of scenarios and raters

G-Rel: relevant G coefficient; G-Abs: absolute G coefficient

There was an agreement between blinded and unblinded evaluators throughout each scenario.

Validity evidence

The performance of senior participants was superior to that of junior participants in the management of pediatric myocarditis (junior vs. senior median score: 3 vs. 4, p = 0.01). The performance difference in the management of cardiac arrest and septic shock (appendicitis) didn't yield statistical significance (septic shock: p = 0.77; cardiac arrest: p = 0.61). We found that across all levels of training, residents performed better on the septic shock (appendicitis) case and consistently scored lower on the myocarditis and cardiac arrest cases (septic shock vs. cardiac arrest/myocarditis median score: 5 vs. 4, p = 0.01) (Figure *4*).

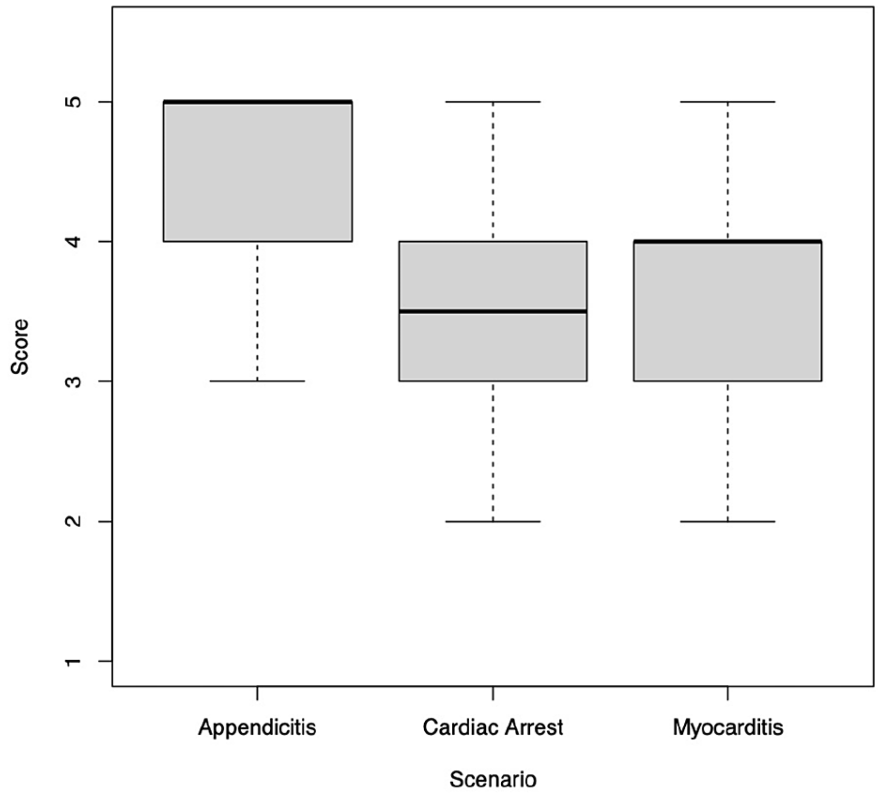


FIGURE 4: The rating scores for three simulated scenarios

Discussion

Our findings suggest that the RAT tool can be used reliably for the simulation of pediatric resuscitation scenarios as a practice to enhance the CBME curriculum. The tool was found to be reliable in this context, where raters are trained and calibrated appropriately to properly use the tool using a frame of reference approach. It was able to show good agreement between multiple raters and therefore can be trusted to give residents consistent results. The variance between raters was 0.0% (Table 2). An agreement amongst raters is necessary when using a tool to evaluate residents and promote them to new stages of training based on simulated performance.

Simulation-based education provides many advantages, including exposure to infrequent but critical clinical scenarios [13,14], the opportunity to record and review sessions to provide more robust feedback, and the ability to assess teamwork, communication, and crisis resource management skills. This type of education is particularly useful in pediatric resuscitations, which are low-frequency, high-stakes events. For simulation to be utilized effectively for assessment, there are many considerations, including the reliability and validity of the assessment tools and processes, the relevance of outcome measures, feasibility, and rater training [15].

The RAT was also able to reliably identify pediatric resuscitation topics and themes that residents struggled with and could therefore be used to determine the content for future simulations. Residents consistently scored higher on the septic shock (appendicitis) case and lower on the myocarditis and cardiac arrest cases (Figure 4). This was independent of training level. There was a great degree of variance among scenarios (21.4%), which reflects performance differences based on the scenario itself. Senior residents consistently scored higher than junior residents across all scenarios, with the largest gap in the myocarditis case (Table 1). Of note, in the myocarditis case, the performance of the senior residents was superior with statistical significance (junior vs. senior median score: 3 vs. 4, p=0.01). However, in the cardiac arrest and septic shock cases, the difference was not statistically significant. This was likely the case for a few reasons, the first of which was the small sample size. This study was designed for generalizability theory (for reliability), not for establishing discriminant validity evidence. The other contributor was likely the difficulty and complexity of each scenario. If cases are too difficult or too easy for participants, it makes it more difficult to differentiate participants. It is postulated by the authors that the decrease in performance related to the management of pediatric myocarditis, as compared to pediatric septic shock, is likely because residents are less familiar with more severe and uncommon pediatric presentations. This simulated scenario has been used for resident training in the KidSIM lab previously without prior identification of an issue with the scenario itself.

However, another potential confounder that could have influenced the difference in score could have been the specific delivery of the case, although we followed the scenario card in a precise fashion. Altogether, this highlights that in order to keep simulated practice high yield, case selection must be done carefully to highlight cases that learners encounter less frequently. Competency in these cases should be achieved prior to being confidently promoted to the next stage in training.

Limitations

Despite providing support for the use of the RAT tool in the emergency medicine CBD curriculum, there are a few noteworthy limitations that deserve mention in our study. Given the small sample size, the variability in resident scores may be overstated, and the generalizability of our results should be taken in context. While the low number of participants is a limitation, the lack of variance among our residents and raters gives important information on the structure of simulated scenarios moving forward. Future work with a variety of challenging cases would be important to assess the variance between learners based on experience and skill level.

The authors were initially concerned that the data collection could also carry inherent bias. We recruited three local raters, all of whom knew the residents they were rating. This could have created a bias in the scores given. In contrast, blinded external raters were also used, and they were found to have an agreement with the local raters (Table *2*). Unfortunately, a blinded rating is not possible in the clinical environment, even in simulated practice, due to logistical constraints.

Conclusions

The RAT was found to be reliable when raters are appropriately trained and there is good agreement with zero variance between multiple raters. Therefore, the RAT can be trusted to give residents consistent evaluations. Additionally, the tool was able to reliably identify resuscitation topics that residents struggled with, which will help educators choose content for future simulated scenarios.

Finally, we also found that the resident level of training and rater blinding did not impact the reliability of the tool. Overall, this study demonstrates that the RAT is a reliable tool to implement in the evaluation of emergency medicine residents for pediatric resuscitation scenarios in a simulation curriculum within CBD training.

Appendices

The three simulation scenarios used to assess the reliability of the RAT tool were cardiac arrest (Figures *5*, *6*), myocarditis (Figures *7*-*9*), and septic shock due to appendicitis (Figures *10*-*12*).

SIMULATION SCENARIO Page 1/2

CASE: Cardiac Arrest – Pediatric

Case Introduction (Child):

• You are in the Pediatric Emergency Department and just a PATCH call. They are transporting an 8-year-old male who has been feeling unwell x 5 days with persistent fever, vomiting, diarrhea, and lightheadedness. They have established an IV, ETA is 1 minute.

Note: Upon transfer to the ED stretcher patient loses his pulse and EMS comes in doing CPR with a brief history, stating that he just lost his pulse in the ambulance bay.

Other History: • Unknown
Provide this ONLY IF ASKED: stools are bloody for the last 24 hours

Scenario Stage	Patient condition	Simulator Parameters	Expected Intervention	Cues	Confederate Roles – if needed
VT Pulseless	**History** • 8-year-old boy • PMH: unknown • EMS **report that he became apneic** on route (bags easily) and just lost his pulse upon transfer/arrival • IV obtained **Condition:** • Unconscious, unresponsive, apneic And **PULSELESS** **Physical Exam** • T 36.5, HR 0, RR 0, SpO2 N/A • Monitor: VT • CNS: unconscious, eyes closed • CVS: No Pulses Palpable, CRT 8 sec, mottled • Resp: no spontaneous resp, clear	**Vitals** • T 36.5 • HR 0 • RR 0 • SpO2 N/A • BP N/A **Condition** • No Palpable Pulse • CRT 8 sec **Rhythm** • VT **Moulage** • Dress in shorts/shoes • 20G IV in right AC with connector	**Airway** • maintainable **Breathing** • re-confirms apnea • Continues bagging patient • Check SpO2 **Circulation** • Identify No Pulses • Directs continuation of CPR • Apply leads and turn on monitor • Recognize and verbalize Pulseless VT • Directs 1st attempt defibrillation at 2J/kg • Directs immediately resumption of CPR • Direct preparation and delivery of epinephrine • Direct 2nd attempt defibrillation at 4J/kg • Direct immediately resumption of CPR • Direct preparation of amiodarone • Direct 3rd attempt defibrillation at 4-10J/kg • Search for and treat H's and T's	**Cues:** No Pulse VT	**RN will** • Connect pt to monitor • Simulate drawing up meds, handing meds to team for administration • Not offer information about vital signs or change in rhythm • Not perform Chest compression if asked **RT will** • Bag at a rate of 60 bpm until instructed to change rate • Confirm no pulse and no spontaneous respiratory if asked to assess pt. • Not offer information about vital signs or change in rhythm • Not perform Chest compression if asked
VT	**Condition:**	**Vitals**	**Airway**	**Cues:**	**RN will**

SD0105
Key Words (for database):
Author: Adam Cheng
Date last revised: September 1, 2017

FIGURE 5: Cardiac arrest simulation scenario (part 1 of 2)

SIMULATION SCENARIO Page 2/2

CASE: Cardiac Arrest – Pediatric

6 min	• Unconscious, unresponsive, apneic **Physical Exam** • T 36.0, RR 0, HR 0, SpO2 N/A • Monitor: VT • CNS: unconscious, eyes closed • CVS: No Pulses Palpable, CRT 8 sec, mottled • Resp: no spontaneous resp, clear breath sounds with ventilation	• T 36.5 • HR 0 • RR 0 • SpO2 N/A • BP N/A **Condition** • No Palpable Pulse • CRT 8 sec **Rhythm** • VT	• Airway secured **Breathing** • Identify Apnea • continue bagging patient • Check SpO2 **Circulation** • Identifies No Pulses • Directs continuation of CPR • Reassesses rhythm • Recognizes and verbalizes VF • Directs attempt defibrillation at 4-10J/kg • Directs immediately resumption of CPR • Directs preparation and delivery of epinephrine • Recognizes cause (hyperkalemia) **Management of hyperkalemia** • Stabilizes cardiac membrane: calcium gluconate 10% solution 0.5ml/kg over 5 min • Provides therapy to Shift K+ into cells • Insulin/Glucose • Beta 2 agonist • NaHCO3 • Ensures no K+ administered • Consider need for dialysis	No pulse VT Lab results return (if ordered) • Prompt MD to check a CBG if no lab were ordered.	• Provide lab results if asked
ROSC @ 6 min Palpable pulses					

FIGURE 6: Cardiac arrest simulation scenario (part 2 of 2)

SIMULATION SCENARIO Page 1/3

CASE: Myocarditis – Toddler

SCENARIO
Case Introduction: *(Scenario given to participants)*
Scenario Given to Participants (report from EMS):

2-6 year old male (depending on mannequin used) with 4 day history of fever, cough, vomiting and general malaise. Parents are concerned because he seems more lethargic this a.m. and they decided to call EMS.

- *Has not voided in past 24 hrs.*
- *They started a 20 ga. IV in his left AC and gave a 20 mL/kg bolus of NS en route.*

VS on arrival: HR 170, R 32, BP 78/62, O2 sat 93%, Temp 38.0. pale, CRT 4 sec. quiet and tired
Weight: 27 kg (6 yo) or 14 kg (2 yo) estimated by parents

Case Progression:
Available Collateral History: *(Information given if requested)*

- *Previously healthy young boy.*
- *Takes Dexedrin for ADHD (if using 6 yo).*
- *No known allergies.*
- *Immunization up to date.*

The Script:

Scenario Transitions / Patient Parameters	Effective Management	Consequences of ineffective management	Notes
1. Assessment of child in shock • T- 38 • HR 170: NSR • RR 32 • BP 78/62 • SA02: 93 on RA • CRT: 4 seconds, pale. cool • GCS: 15 – slow to respond to verbal cues, lethargic • Chest: A/E good, diffuse crackles to bases, no indrawing • no evidence of rash	--begin primary survey with adjuncts - 100% O2 - confirm vascular access - rapid IV fluid boluses 20 ml/kg with reassessment - best given as fast as possible - push / pull (infant) - pressure bag (any age) - may order labs and CXR	- slow deterioration in BP	- Oxygen often forgotten as therapeutic for Sepsis and poor perfusion states - Acceptable to support oxygen delivery with O2 via NP – high flow non rebreather mask
2. Recognition of deterioration of patient following bolus of fluids (recognition of cardiogenic shock) • HR 180: NSR • RR 40	- slow down IV rate or stop entirely -consider further adjuncts: CXR, ECG - consider pressor - consider intubation -consider consult PICU	- patient deteriorates quickly with ↓ BP and sats	Treating patient as "shock and only shock" will result in further compromise by increasing demands on compromised heart

FIGURE 7: Myocarditis simulation scenario (part 1 of 3)

Page 2/3

SIMULATION SCENARIO

CASE: Myocarditis – Toddler

• BP 70/p • SA02: 80'3 on RA (depends on O2 delivery device) • CRT: 4 seconds, • CVS: distal pulses weak. pale. cool. • GCS: 15 – slow to respond to verbal cues, lethargic			May misdiagnose as CHF and treat with IV lasix. Clinical context of fever with acute infection should point to viral illness. Paradoxical reaction to IV boluses and CXR should suggest cardiogenic shock (myocarditis) Pressor options: Dopamine – easiest to use, standard concentration and pre-mixed bag. Has alpha and beta effects. Alpha increases SVR which puts more strain on the heart therefore not ideal choice Dobutamine – optimal for mainly beta effect which increases inotropy (squeeze/contraction) and chronotropy (rate)without the alpha effect of increasing SVR Epinephrine – good overall choice but still has alpha effect Norepinephrine – has more alpha effect than Epinephrine Ketamine contraindicated for myocardial depressant effects Midazolam can exceed maximum if applied per kg without considering max
3. Support and management of a child with myocarditis • HR 188: NSR • RR 40 • BP 64/30 (depends on Pressor) • SA02: 80'3 on RA (depends on O2 delivery device) • CRT: 4 seconds,	- repeat blood gas? - consult and prepare for transfer	- slowly deteriorates into PEA (based on low perfusion)	-may improve patient and end scenario at any point with appropriate intervention

FIGURE 8: Myocarditis simulation scenario (part 2 of 3)

Page 3/3

SIMULATION SCENARIO

CASE: Myocarditis – Toddler

• CVS: distal pulses weak. pale. cool. • GCS: 15 – slow to respond to verbal cues, lethargic			

FIGURE 9: Myocarditis simulation scenario (part 3 of 3)

SIMULATION SCENARIO

Page 1/3

CASE: Septic Shock (warm) – Ruptured Appendix Pediatric

SCENARIO

Case Introduction:
An 8 y.o. girl with a 3 day history of nausea, vomiting, generalized abd pain which localized to RLQ. Patient has stopped eating and drinking with decreased urine output.

Past medical history
Constipation.

Available Collateral History: normally healthy, Febrile for 2 days, IUTD, NKA

The Script:

Scenario Transitions / patient parameters	Effective Management	Consequences of Ineffective Management	Notes

1. Initial assessment of a child with poor perfusion
• **T:** 38.7
• **HR:** 150
• **BP:** 102/35
• **SA02:** 95 % RA
• **RR:** 32 no increased WOB
• **Chest:** clear
• **CRT:**brisk
• **CVS:** flushed, bounding peripheral pulses, mucus membranes tacky, dark circles under eyes
• **CNS:** GCS 15
• **ABD:** peritoneal signs
• states pain is 10/10 to RLQ on examination
• Chem Strip 6.5mmol
	▪ Systematic head to toe assessment
	▪ Appropriate delegation of roles and responsibilities
	▪ Recognize abnormal findings –warm shock abnormal VS
	▪ Begin sepsis screening
	  ▪ Put patient on Nasal Prongs
	  ▪ Check Chem Strip
	  ▪ Collect a Urine
		▪ Move to phase 2	• Pt is in too much pain and can't stand on scale to be weighed. Measures 20 kg on broselow tape.

FIGURE 10: Septic shock due to appendicitis simulation scenario (part 1 of 3)

SIMULATION SCENARIO

Page 2/3

CASE: **Septic Shock (warm) – Ruptured Appendix Pediatric**

2 Identify sepsis and begin treatment ☐ **T:** 39.0 ☐ **HR**: 160 ☐ **BP:** 102/35 ☐ **SA02**: 97 % 2 L N/P ☐ **RR**: 32 no increased WOB ☐ Pt. Nauseated post administration of pain médication	▪ Prioritize treatment goals: ▪ Vascular access ▪ Labs and either CBG or VBG (if available) ▪ fluid bolus: rapid 20 cc/kg then reassess ▪ Consider antibiotics: ▪ **Cefazolin/Metronidazole** o <25 kg: 500mg/250 mg o 25-40 kg: 1 g/500mg ▪ >40kg: 2g/500mg ▪ Ampicillin 50/mg/kg/dose, Gentamycin 2.5mg/kg/dose, Metronidazole 10 mg/kg/dose **OR:** ▪ Piperacillin/Tazobactam 75 mg/kg/dose **OR:** o ▪ Administration of pain medication Fentanyl or Morphine ▪ Consult General Surgery	▪ ↑ tachycardia, ↓Bp and if fluid not given rapidly	-pt is not becoming mottled with CRT 2-3 seconds. - nauseated with lots of abd pain - stabilize patient at any time post fluid bolus -prep patient for the OR
3. Progressive deterioration with decompensated shock ▪ **T**: 39.2 • **HR**: 158 • **BP:** 78/42 • **SA02**: 97 if appropriate O2 • **RR**: 36 unchanged WOB • **CVS**: CRT-5 seconds, extremities cool, increased mottling, weak peripheral pulses • **CNS**: Eyes open. Becoming quiet	▪ Recognize the need for on-going aggressive fluid resuscitation (3-4 boluses of 20cc/kg NS given over 5 min each) ▪ Begin: Ionotrope: dopamine ▪ **The OR calls for the patient**		▪ **May stabilize patient and end scenario at anytime after fluid boluses or move to inotrope and intubation**

SD0017
Key Words (for database): Sepsis, Appendicitis
Author: Traci Robinson, Vince Grant
Date last revised: June 29, 2014

FIGURE 11: Septic shock due to appendicitis simulation scenario (part 2 of 3)

SIMULATION SCENARIO

Page 3/3

CASE: **Septic Shock (warm) – Ruptured Appendix Pediatric**

Debriefing Points

Knowledge:

1. Review septic shock
   - Maldistribution of circulatory blood flow imbalance of oxygen supply and demand. In septic shock an infectious agent has triggered a response that compromises systemic perfusion, oxygen delivery and utilization
   - How to recognize
   - Review widening and narrowing pulse pressure
     - As narrowing pulse pressure occurs, impending circulatory collapse
     - Narrowing Pulse Pressure is a drop in systolic and a rise in diastolic pressure
     - Normal Pulse pressure is 40 – 50 in a child
2. What are the important components of early goal directed therapy for septic shock
   - Rapid fluid administration
   - Early antibiotics
3. Review assessing if a child is responding to treatment
   - Peripheral perfusion, VS, urine output, LOC

FIGURE 12: Septic shock due to appendicitis simulation scenario (part 3 of 3)

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. The Conjoint Health Research Ethics Board, University of Calgary issued approval REB19-0093. This research study has been approved by the Conjoint Health Research Ethics Board at the University of Calgary. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** The research team was awarded the Office of Health and Medical Education (OHMES) Scholarship by the University of Calgary on January 22, 2019. This scholarship is awarded annually to medical research projects looking to tackle issues within the new competency by design residency curriculum. The project received $2040 in funding, which was used to give honoraria to the KidSIM staff and our statistician, as well as Starbucks and VISA gift cards as a thank-you to our study participants. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Gerein RB, Osmond MH, Stiell IG, Nesbitt LP, Burns S: What are the etiology and epidemiology of out-of-hospital pediatric cardiopulmonary arrest in Ontario, Canada?. Acad Emerg Med. 2006, 13:653-8. 10.1197/j.aem.2005.12.025
2. Donoghue AJ, Abella BS, Merchant R, Praestgaard A, Topjian A, Berg R, Nadkarni V: Cardiopulmonary resuscitation for in-hospital events in the emergency department: a comparison of adult and pediatric outcomes and care processes. Resuscitation. 2015, 92:94-100. 10.1016/j.resuscitation.2015.04.027
3. Royal College of Physicians and Surgeons of Canada: CanMEDS 2015 Physician Competency Framework. Frank JR, Snell L, Sherbino J, (ed): : Royal College of Physicians and Surgeons of Canada, Ottawa; 2015. https://canmeds.royalcollege.ca/uploads/en/framework/CanMEDS%202015%20Framework_EN_Reduced.pdf.
4. Mills DM, Williams DC, Dobson JV: Simulation training as a mechanism for procedural and resuscitation education for pediatric residents: a systematic review. Hosp Pediatr. 2013, 3:167-76. 10.1542/hpeds.2012-0041
5. Competence by design: Canada’s model for competency-based medical education . (2021). Accessed: September 1, 2021: https://www.royalcollege.ca/rcsite/cbd/competence-by-design-cbd-e.
6. Karpinski J, Frank JR: The role of EPAs in creating a national system of time-variable competency-based medical education. Acad Med. 2021, 96:S36-41. 10.1097/ACM.0000000000004087
7. Ten Cate O, Taylor DR: The recommended description of an entrustable professional activity: AMEE Guide No. 140. Med Teach. 2021, 43:1106-14. 10.1080/0142159X.2020.1838465
8. Sherbino J, Bandiera G, Doyle K, et al.: The competency-based medical education evolution of Canadian emergency medicine specialist training. CJEM. 2020, 22:95-102. 10.1017/cem.2019.417
9. Hall AK, Chaplin T, McColl T, et al.: Harnessing the power of simulation for assessment: consensus recommendations for the use of simulation-based assessment in emergency medicine. CJEM. 2020, 22:194-203. 10.1017/cem.2019.488
10. Weersink K, Hall AK, Rich J, Szulewski A, Dagnone JD: Simulation versus real-world performance: a direct comparison of emergency medicine resident resuscitation entrustment scoring. Adv Simul (Lond). 2019, 4:9. 10.1186/s41077-019-0099-4
11. Clark CA, Mester RA, Redding AT, et al.: Emergency subglottic airway training and assessment of skills retention of attending anesthesiologists with simulation mastery-based learning. Anesth Analg. 2022, 135:143-51. 10.1213/ANE.0000000000005928
12. Prudhomme N, O'Brien M, McConnell MM, Dudek N, Cheung WJ: Relationship between ratings of performance in the simulated and workplace environments among emergency medicine residents. CJEM. 2020, 22:811-8. 10.1017/cem.2020.388
13. Boulet JR: Summative assessment in medicine: the promise of simulation for high-stakes evaluation . Acad Emerg Med. 2008, 15:1017-24. 10.1111/j.1553-2712.2008.00228.x
14. Okuda Y, Bond W, Bonfante G, et al.: National growth in simulation training within emergency medicine residency programs, 2003-2008. Acad Emerg Med. 2008, 15:1113-6. 10.1111/j.1553-2712.2008.00195.x
15. Hagel CM, Hall AK, Dagnone JD: Queen’s University Emergency Medicine simulation OSCE: an advance in competency-based assessment. CJEM. 2016, 18:230-3. 10.1017/cem.2015.34