



# The Simulation-Based Assessment of Pediatric Rapid Response Teams

James J. Fehr, MD<sup>1</sup>, Mary E. McBride, MD<sup>2</sup>, John R. Boulet, PhD<sup>3</sup>, and David J. Murray, MD<sup>1</sup>

**Objective** To create scenarios of simulated decompensating pediatric patients to train pediatric rapid response teams (RRTs) and to determine whether the scenario scores provide a valid assessment of RRT performance with the hypothesis that RRTs led by intensivists-in-training would be better prepared to manage the scenarios than teams led by nurse practitioners.

**Study design** A set of 10 simulated scenarios was designed for the training and assessment of pediatric RRTs. Pediatric RRTs, comprising a pediatric intensive care unit (PICU) registered nurse and respiratory therapist, led by a PICU intensivist-in-training or a pediatric nurse practitioner, managed 7 simulated acutely decompensating patients. Two raters evaluated the scenario performances and psychometric analyses of the scenarios were performed.

**Results** The teams readily managed scenarios such as supraventricular tachycardia and opioid overdose but had difficulty with more complicated scenarios such as aortic coarctation or head injury. The management of any particular scenario was reasonably predictive of overall team performance. The teams led by the PICU intensivists-in-training outperformed the teams led by the pediatric nurse practitioners.

**Conclusions** Simulation provides a method for RRTs to develop decision-making skills in managing decompensating pediatric patients. The multiple scenario assessment provided a moderately reliable team score. The greater scores achieved by PICU intensivist-in-training-led teams provides some evidence to support the validity of the assessment. (*J Pediatr* 2017;188:258-62).

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related article, p 252

Pediatric rapid response teams (RRTs) assist bedside caregivers outside of the intensive care unit (ICU) when a hospitalized child is unstable. The widespread adoption of RRTs has been based on evidence that these teams improve clinical outcomes, decrease the cost of care, and attenuate the stress families and staff experience when a hospitalized child deteriorates.<sup>1-4</sup> The Joint Commission has provided a National Patient Safety Goal for hospitals to improve recognition and response to changes in patient conditions.<sup>5-7</sup>

The composition of RRTs is variable. In academic medical centers, concerns about the effect of sleep deprivation have led the Accreditation Council for Graduate Medical Education to mandate work-hour restrictions and enhanced supervisory requirements for physician-trainees.<sup>8,9</sup> In children's hospitals, nurse practitioners (NPs) and hospitalists increasingly provide clinical care, including leading RRTs, in an interchangeable fashion with intensivists-in-training.<sup>10,11</sup> In community settings, the trend toward round-the-clock in-house coverage of ICUs has increased the use in critical care settings of nurses (registered nurse), NPs, hospitalists, and physician assistants, any of whom may oversee a hospital's RRT.<sup>12-15</sup>

There is evidence of both improvement and lack thereof in patient outcomes in studies of RRTs.<sup>16,17</sup> Numerous factors may contribute to negative results, particularly in pediatrics, including the training and composition of RRTs and the diverse clinical conditions that pediatric RRTs must recognize and manage. In addition, the impact of a RRT may be attenuated at an institution in which there is a strong pre-existing patient care infrastructure.<sup>18</sup> To standardize the preparation of RRTs at pediatric tertiary care centers, a simulation-based training method could be used to provide RRT members with experience in managing a range of conditions that frequently are encountered during a rapid response call. Such an approach also could be used to assess the performance of RRTs.

In this study, we designed simulation scenarios to assess the performance of pediatric RRTs in diagnosing and managing a range of acute conditions that lead to RRT calls. The purposes of the study were to develop a set of scenarios that could be used to educate RRTs and to gather initial evidence to support the

ICU	Intensive care unit
NP	Nurse practitioner
PGY	Postgraduate year
PICU	Pediatric intensive care unit
PNP	Pediatric nurse practitioner
RRT	Rapid response team

From the <sup>1</sup>Anesthesiology & Pediatrics, Washington University School of Medicine, St Louis, MO; <sup>2</sup>Pediatrics, Northwestern University School of Medicine, Chicago, IL; and <sup>3</sup>Research and Data Resources, Foundation for Advancement of International Medical Education and Research, Philadelphia, PA

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validity of the simulation-based assessment score based on the hypothesis that intensivists-in-training who led RRTs would be better prepared to manage the scenarios than NP-led teams.

## Methods

In developing the scenarios, we reviewed critical events that RRTs had encountered and managed at St Louis Children's Hospital. These included respiratory conditions such as asthma exacerbation, respiratory failure, and severe airway obstruction; neurologic conditions such as seizures or a decreased level of consciousness; and cardiac conditions such as arrhythmias, congenital heart disease, and cardiac failure. The scenarios created for the study are similar to premorbid conditions that have led to clinical deterioration prompting a RRT call at other tertiary care pediatric hospitals.<sup>5</sup> The 10 simulation scenarios were designed to reflect a range of ages of children who had cardiovascular, respiratory, and neurologic disease that had either not improved or had worsened during hospitalization (Table I). A scoring sheet example is available in the Appendix (available at [www.jpeds.com](http://www.jpeds.com)). The teams encountered simulations that followed predictable patterns and could be managed by following recognized treatment

algorithms (eg, child with status epilepticus) as well as those that required reassessment and re-evaluation of an atypical presentation that did not adhere to typical heuristics. The 10 assessments included an introductory asthma scenario and the remaining scenarios were divided into 3 sets of 3. Each set of 3 included 1 scenario incorporating an admitting diagnosis based on incomplete data that required further inquiry by the RRT to obtain the correct diagnosis and provide appropriate treatment. The atypical presentation scenarios were (1) a child with increasing dyspnea who was admitted with pneumonia but actually had congestive heart failure; (2) a patient with asthma who had continuing bronchospasm and dyspnea and in fact had aspirated a foreign body; and (3) a 6-week-old infant with poor feeding and lethargy who had been admitted with pyloric stenosis but really had coarctation of the aorta.

The scenarios were created by 2 of the authors and reviewed by intensivists and critical care nurses who all had served as members of RRTs. The scenarios were pilot tested by current pediatric RRT members. Based on the pilot team performances and the feedback they provided, the scenarios were revised and scoring rubrics developed. The scoring included a list of key actions that RRTs would be expected to perform to diagnose and manage the scenario. These key actions were used

**Table I. Pediatric RRT training scenarios**

Scenarios	Responses
1. A 7-year-old patient with asthma attack	Asthma attack: introductory scenario. Team expected to identify and appropriately treat bronchospasm.
2. A 4-year-old, 15-kg boy is admitted following tonsillectomy and adenoidectomy earlier in the day. HR 140, BP 90/60, RR 10, O <sub>2</sub> 93%	Narcotic overdose: team expected to review hospital management. Somnolent and hypoxic. Pupils pinpoint. (oxycodone 5 mg po 2 hours previously).
3. A 2-month-old, 3.6-kg boy with irritability presented to the ED. Antibiotics were initiated after cultures were obtained, and the child was admitted to the floor. On routine vitals, the RN notes that the following VS: HR 260, T 37°C, BP 60/30, RR 50, crying, O <sub>2</sub> 97%.	SVT: team expected to recognize arrhythmia. EKG shows narrow complex, regular tachycardia consistent with SVT. Infant is poorly responsive with decreased perfusion. Therapy is synchronized cardioversion at 0.5-1 J/kg
4. A 10-year-old girl diagnosed with pneumonia is admitted. She continues to have increased work of breathing, more severe tachypnea, and continued wheezing. T 37.5°C, HR 120, BP 90/60, RR 28, O <sub>2sat</sub> 90%	Cardiomyopathy (failed heuristic): team to establish clinical findings of gallop rhythm, hepatomegaly, chest radiograph indicates cardiomegaly. Team corrects diagnosis.
5. A 6-year-old girl with pneumonia was admitted 2 days previously and has been treated with intravenous antibiotics and supplemental oxygen. T 37.5°C, HR 138, BP 90/60, RR 42, O <sub>2sat</sub> 80%	Respiratory failure: team expected to note increasing oxygen requirement, desaturation, and worsening respiratory distress. Prepare for intubation, support ventilation with bag and mask ventilation,
6. An 8-year-old girl with progressive neurologic disorder, seizure disorder, admitted 2 days with dehydration. A seizure that has been ongoing for more than 20 minutes. There is an advanced directive on the chart. T 37.5°C, HR 140, BP 90/60, RR 40, O <sub>2sat</sub> 80%	Status epilepticus management: team expected to determine nature of advanced directive, treat seizure, and support ventilation with bag and mask ventilation
7. A 3-year-old boy diagnosed with exacerbation of asthma, increasing tachypnea and continued wheezing. T 37.5°C, HR 140, BP 90/60, RR 40, O <sub>2sat</sub> 88%	Bronchial foreign body (failed heuristic): team should review maximal asthma management. Review of history and determine undiagnosed cause of tachypnea and wheezing. Evaluation of chest radiograph shows unilateral hyperinflation. Team corrects diagnosis.
8. A 9-month-old boy who was in a motor vehicle collision 3 days previously has been on the surgical ward with pulmonary contusion, concussion, femur fracture, and liver laceration. T 38°C, HR 70, BP 120/60, RR 5, O <sub>2sat</sub> 93%	Increased intracranial pressure: team expected to note poor respiratory effort, somnolence, and support ventilation with bag-and-mask ventilation, prepare to intubate, immediate imaging, need for hyperventilation and mannitol and/or 3% NS.
9. An 8-year-old boy was admitted with several days of fever and cough. Chest radiographs in the ED showed RLL infiltrate. He was found to be less responsive. T 38.5°C, HR 150, BP 70/40, RR 40, O <sub>2sat</sub> 94%	Septic shock: team to provide fluid resuscitation. During resuscitation, continued deterioration in respiratory effort and child needs to be intubated and ventilated. Proper RSI must be undertaken since child was eating throughout the day.
10. A 24-day-old girl with pyloric stenosis was admitted to the surgical ward with vomiting and poor feeding for rehydration and correction of electrolyte imbalance. T 35°C, HR 178, BP 88/54, O <sub>2sat</sub> 95%	Coarctation of aorta (failed heuristic): infant condition is not characteristic of pyloric stenosis. Electrolytes are normal, condition is undiagnosed aortic coarctation, child is noted to have worsening perfusion and tachycardia. Team corrects diagnosis.

BP, blood pressure; ED, emergency department; EKG, electrocardiogram; HR, heart rate; NS, normal saline; O<sub>2sat</sub>, oxygen saturation; po, by mouth; RLL, right lower lobe; RN, registered nurse; RR, respiratory rate; SVT, supraventricular tachycardia; T, temperature; VS, vital signs.

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