ORIGINAL ARTICLE

Integrating leadership into interprofessional non-acute care pediatric provider resuscitation training

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ABSTRACT

Background and Aim: Due to limited clinical exposure, non-acute care pediatric providers often rely on simulated experiences to maintain resuscitation skills. Few training options designed for the non-acute care setting exist, are often difficult to access, and lack incorporation of non-technical skills. The first five minutes (FFM) is a previously published curriculum designed to train non-acute care providers. The goal of this study was to determine the curriculum's effectiveness during a pilot intervention.

Methods: A single cohort of multi-professional, non-acute care pediatric providers participated. The primary outcome skill was "establishing leadership," and secondary outcomes included other technical and non-technical skills. Learning of outcome skills was assessed using changes in retrospective pre-post self-assessment Likert scale scores. Differences were compared using paired t-tests and ANOVA.

Results: Thirty-seven participants submitted self-assessments. There was improvement in establishing leadership (pre-mean 1.14, post-mean 2.30, $P < 0.01$), and all other objectives studied. Compared to each other, subgroups of nurses, physicians, and respiratory therapists demonstrated significant differences in learning of technical skills, but similar improvements with non-technical skills.

Conclusion: These findings suggest that the FFM curriculum is an effective tool for training non-acute care pediatric providers interprofessional resuscitation skills. Future research should assess provider behavioral changes, retention of training requirements, and patient outcomes.

Relevance for Patients: Traditional resuscitation education programs focus largely, or entirely, on performance of technical skills and algorithmic actions. However, non-technical skills, such as leadership, are crucial to the overall success of resuscitation efforts. The FFM program was developed to incorporate leadership principles into the resuscitation education of non-acute care pediatric inpatient providers, and this curricular evaluation suggests that improvements in participant leadership skills occurred due to the program.

1. Background

Pediatric in-hospital cardiac arrest (IHCA) is a rare event, but one that carries substantial morbidity and mortality. A retrospective study of IHCA from 12 children's hospitals in the United States of America between 2000 and 2009 revealed that survival to discharge was 34.8% and that 4 – 20% of survivors had significant neurological impairment [1]. The burden of outcomes from IHCA events has prompted examination of pediatric in-hospital resuscitation quality and training.

Although providers are often trained with simulated pediatric resuscitation curricula in dedicated courses and training environments, the proficiencies ascertained in these trainings are poorly retained [2,3]. A study of simulated pediatric acute care events on the in-patient wards

of three academic children's hospitals found that 75% and 100% of cases had at least one deviation from accepted basic and pediatric advanced life support standards, respectively [4]. Outside of critical care areas, interprofessional teams of non-acute care providers performed resuscitation efforts alone for the first several minutes.

Given insufficient clinical exposure, non-acute care providers often rely on education to maintain their skills. However, many of the commonly utilized pediatric specific training options are typically intended for physicians and critical care personnel, or difficult to deploy at regular intervals to the large numbers of non-acute care providers within institutions [5-8]. In response, resuscitation education science has encouraged the use of shorter, targeted activities with feedback, called rapid-cycle deliberate practice (RCDP) [9,10]. Activities developed for pediatrics mainly aim to improve guideline compliance by focusing on technical behaviors such as chest compression quality [11-13]. While technical performance is crucial, contemporary resuscitation education literature also cites the importance of non-technical skills (e.g., leadership and communication) in provider training [9]. The importance of leadership has similarly been underscored in the acute care literature, however there has been little attempt to incorporate relevant leadership training using RCDP principles [14-17].

The first five minutes (FFM) curriculum is a previously developed and published initiative that has attempted to address this educational gap for multiprofessional non-acute inpatient pediatric providers [18]. The FFM curriculum is a RCDP activity that incorporates scholarly interprofessional educational methods with existing resuscitation training efforts, including a focus on non-technical skills. The present goal was to perform a curricular evaluation of participant learning, with the primary objective to determine whether the FFM activity resulted in development of leadership skills.

2. Methods

2.1. Design

An observational, single cohort, and prospective study design was used. The project was deemed to represent curricular evaluation by the Institutional Research Ethics Board and was exempt from requiring approval.

2.2. Setting

The study was conducted at a freestanding children's hospital that is part of a university academic health sciences center in Ontario, Canada. The facility has 166 inpatient beds, and multiprofessional providers care for approximately 6000 admitted, 180,000 ambulatory, and 10,000 medical day patients annually. Physician trainees receive consistent resuscitation training, but aside from the few who participate in monthly mock codes, the vast majority of other hospital providers outside of acute care areas do not have any regular resuscitation training. The hospital does not use an early warning system but does regularly provide guidance (i.e., through posters and online policies) and education (i.e., through online modules and in-person education sessions) to ward providers on reasons to activate rapid response and/or code blue team support. Rapid response and

code blue teams staffed by critical care personnel are available 24-h/day, 7-days/week; however, there is a variable amount of time before their arrival. The rapid response team is mandated to arrive within 10-minutes of activation, and the code blue team response is generally within three to five minutes, depending on location and time of day. This curriculum targeted those front-line providers who care for patients in these crucial first few minutes of a medical crisis before the arrival of critical care support.

2.3. Participants

Participants included multiprofessional non-acute care inpatient and outpatient pediatric healthcare providers at the hospital. The following individuals were excluded from participation: previous participation in the FFM curriculum; and acute care providers (i.e., those that work in critical care, emergency department, and perioperative areas).

Aiming to maximize generalizability, we sought to include a variety of participant types. Accordingly, FFM training sessions were scheduled on convenient days and times in multiple clinical areas, in consultation with the corresponding inpatient ward and outpatient clinic managers. Non-acute care providers on-shift on the ward or in the clinic during the scheduled sessions were invited to participate and had their clinical duties covered while receiving training. Ward and unit staff was also contacted by email and invited to sign-up and attend FFM training sessions scheduled to occur on their unit or in their clinic.

2.4. Intervention

The FFM is a small-group, interprofessional, *in situ* simulated pediatric resuscitation activity that uses rapid-cycle deliberate practice methods to teach context-specific technical and non-technical resuscitation skills to non-acute care pediatric providers. A detailed account of the activity, including its development and pilot implementation has been previously described [18]. Each session consists of three to four providers from a specific area (e.g., ward and clinic) that would realistically work together during an actual medical crisis. Typically, five to ten of the 1-h sessions are held by the simulation office each month in various areas of the hospital.

2.5. Outcomes

The primary outcome was development of the non-technical skill of establishing leadership during a resuscitation event as a result of participating in the FFM activity ascertained by participant self-assessment. Secondary outcomes analyzed included the development of both other non-technical as well as technical resuscitation skills. Non-technical secondary outcome skills included: leading a team assessment of airway and breathing, circulation, and Awake-Verbal-Pain-Unconscious (AVPU) rapid neurological assessments, as well as performance of a Situation-Background-Assessment-Recommendation (SBAR) handover. Technical secondary outcome skills were chosen for their importance to context-specific resuscitation practice of participants, and included: Locating, assembling, and using equipment for each of bag-valve mask (BVM) ventilation and suction.

2.6. Measures

Data were collected from participants immediately following completion of the FFM activity (Figure 1). On individual anonymous written forms, participants reported a retrospective pre-post self-assessment (Appendix). The form consisted of a Likert-scale with items that queried confidence in performing each outcome maneuver independently, and responses ranged from zero (not at all confident) to four (extremely confident). Both primary and secondary outcomes were examined by analyzing the difference between pre- and post- self-assessments. A retrospective pre-post self-assessment technique was used to provide a within-participant comparator while avoiding concerns of response-shift biases that may occur with separate pre- and post-assessments [19,20]. The 5-point Likert-scale retrospective pre-post self-assessment approach has shown validity in identifying participant learning within the context of pediatric acute care education, and hence served as the model for the current study [21].

2.7. Analyses

Responses obtained on the self-assessment data forms (Appendix) were summarized descriptively. While Likert-scales report ordinal-level data, 5-point scales may be treated in parametric fashion [22]. Accordingly, pre- and post-activity mean ratings were compared using two-tailed paired t-tests for the overall participant cohort. Subgroup mean differences for nursing, physician, and respiratory therapy providers were compared using one-way ANOVA.

For the purposes of sample size estimation, investigator group consensus was that a one-point increase in leadership response from a single session would be clinically meaningful. Estimating a standard deviation of two, a sample size of 34 would be required to detect the target difference with 80% power and $P < 0.05$ based on a two-tailed exclusion area [23]. An additional 10% of participants were included to account for the potential need for nonparametric data analyses and dropouts, for a total sample size of 37. *Post hoc* analyses of cohort paired differences by way of skewness and kurtosis indices, as well as visual histogram inspection revealed reasonable approximation of normal distribution for each item in the total sample, and so parametric methods were used as planned. Analyses were completed using IBM SPSS Statistics version 25.

Figure 1. Schematic diagram of the retrospective pre-post self-assessment study design.

3. Results

A total of 39 non-acute care-based pediatric health-care providers participated in the FFM activity in the autumn of 2018, of which 37 (94.9%) submitted completed data forms. All participants partook in the FFM activity for the first time. Nursing represented the largest group of participants (18/37, 48.6%), with outpatient ambulatory nurses being the largest provider sub-type (11/37, 29.7%) (Table 1).

3.1. Primary analysis: Establishing leadership

The primary analysis, overall establishment of leadership skills in a resuscitation event, was significant (pre-mean 1.14, post-mean 2.30, difference in scores 1.16, $P < 0.01$). When learning the skill of establishing leadership was analyzed by profession, there was no statistical difference between nurses, physicians, and respiratory therapists ($P = 0.26$).

3.2. Secondary analyses

3.2.1. Non-technical and technical skills

Following participation in the FFM activity, all secondary outcome skills demonstrated significantly increased scores for the cohort (Figure 2). When combined, the participant group reported lower average pre-scores for non-technical skills compared to technical skills (1.2 vs. 2.4, $P < 0.01$). All 37 participants reported that the FFM activity was useful to their current practice and that they would recommend it to a colleague.

3.2.2. Learning differences by provider type

When analyzed individually, each provider group had similar increases in scores for the primary endpoint of establishing leadership (nurses +1.4, physicians +0.9, and respiratory

Table 1. Summary of the non-acute care-based healthcare professionals who submitted completed data forms.

Participants	
Total	**N=37**
Nursing	18 (48.6%)
Inpatient RN	4 (10.8%)
Outpatient RN	11 (29.7%)
Nurse practitioner	1 (2.7%)
RPN	2 (5.4%)
Physician	8 (21.6%)
Staff physician	3 (8.1%)
Physician trainee	5 (13.5%)
Registered respiratory therapist	5 (13.5%)
Inpatient RRT	4 (10.8%)
Outpatient RRT	1 (2.7%)
Other	6 (16.2%)
EEG technician	3 (8.1%)
Cardiac sonographer	1 (2.7%)
Social worker	1 (2.7%)
Technician unspecified	1 (2.7%)

RN: Registered nurse, RPN: Registered practical nurse, RRT: Registered respiratory therapist, EEG: Electroencephalogram
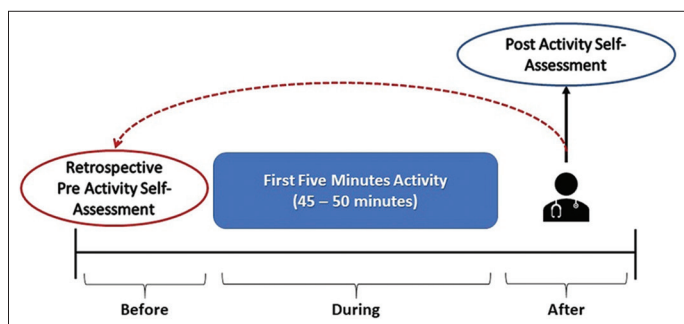
therapists +1.2, ANOVA $P = 0.26$) (Figure 3). Each of the remaining non-technical secondary skills also demonstrated increases in scores that did not statistically differ by provider group. Physicians showed significantly higher increases in scores compared to nurses for the skills of locating BVM device (+1.8 vs. +0.6, $P = 0.012$), locating suction equipment (+1.5 vs. +0.5, $P = 0.026$), assembling suction equipment (+1.6 vs. +0.4, $P = 0.008$), and using suction equipment (+1.5 vs. +0.6, $P = 0.038$). Respiratory therapists demonstrated no changes in pre-post scores for any skills related to BVM or suction use (one respiratory therapist that worked primarily in the outpatient setting reported an increased score in locating the inpatient BVM device).

4. Discussion

Our goal was to determine whether the FFM educational activity leads to learning of non-technical resuscitation skills such as leadership and communication in non-acute care pediatric healthcare providers. The results of our curriculum evaluation in a broad group of provider types demonstrated significant learning of these target skills. While learning of technical skills such as the use of BVM and suction equipment varied between provider types, all providers consistently improved non-technical skills.

The subgroup analyses highlighted differences between various provider types. Physicians experienced learning in all of the resuscitation objectives, which was not unexpected given that non-acute care physician providers rarely encounter resuscitation events. Respiratory therapists unsurprisingly reported virtually no learning in technical skills related to airway and breathing but did demonstrate increased scores with non-technical skills. Nurses showed a mix of learning results. While learning related to non-technical skills appeared similar to their physician and respiratory therapy counterparts, learning of technical skills appeared more variable and limited. This may partly be explained by including nurses that worked in both the inpatient and outpatient settings.

Aside from airway and breathing technical skills for respiratory therapists, non-acute care pediatric providers generally demonstrated a low proficiency and a need for education in both technical and non-technical resuscitation skills; an understandable finding given their clinical exposure patterns and scope. In particular, the results highlight that such non-technical skills are similarly lacking across all provider types, and so providing resuscitation education that includes a focus on leadership skills is needed for all provider types. This is problematic because non-technical skills such as leadership have been linked to improved team resuscitation behaviors, and are considered essential to contemporary resuscitation standards [9,24,25]. The importance for non-acute areas is magnified as unannounced mock codes on pediatric wards have revealed that although a nurse is typically the first-responder, subsequent team formation is highly heterogeneous in composition and timing [4]. Compared to acute care providers and settings such as emergency departments and critical care units, non-acute care providers and settings have the added complexity of lacking an anticipated team and leadership structure. While acute care teams assemble with predictable roles and duties, non-acute care providers form teams unpredictably. Such circumstances should prompt unique educational attention to non-acute care providers.

Non-technical skill training is now commonly included in the resuscitation training of pediatric residents and acute care teams [26,27]. Inpatient first responders, non-acute care providers, also require non-technical skill training based on their scores, with objectives tailored to their contexts. For example, navigating the dynamics of the ad-hoc and unpredictable team formation would
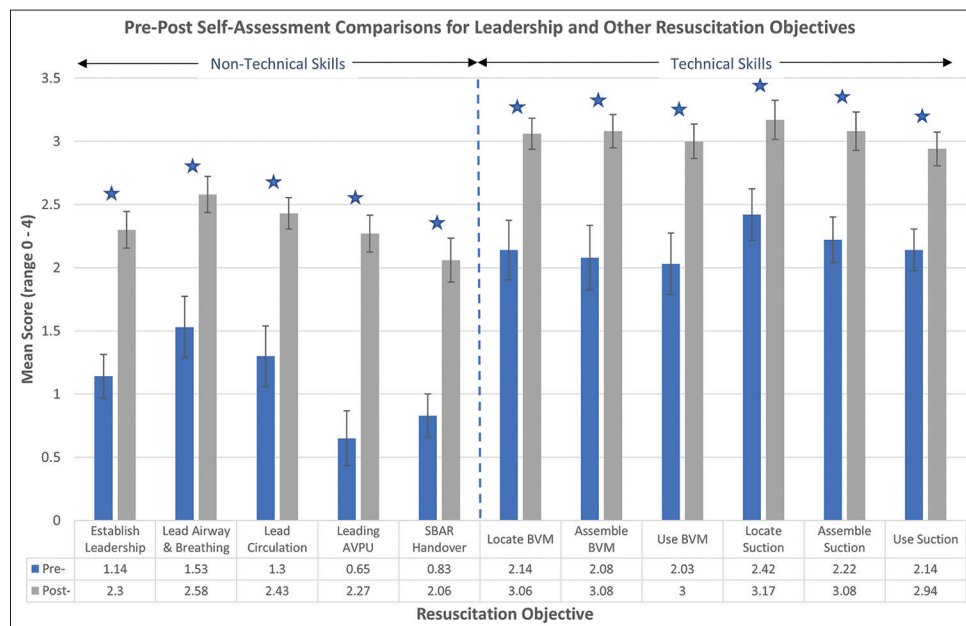

Figure 2. Comparison of pre-post self-assessment scores of overall sample for various leadership and other resuscitation maneuvers. Stars indicate statistically significant pre-post differences ($P < 0.05$). Error bars indicate standard error of the mean. AVPU: Awake-Verbal-Pain-Unresponsive; BVM: Bag-valve mask; SBAR: Situation-Background-Assessment-Recommendations.
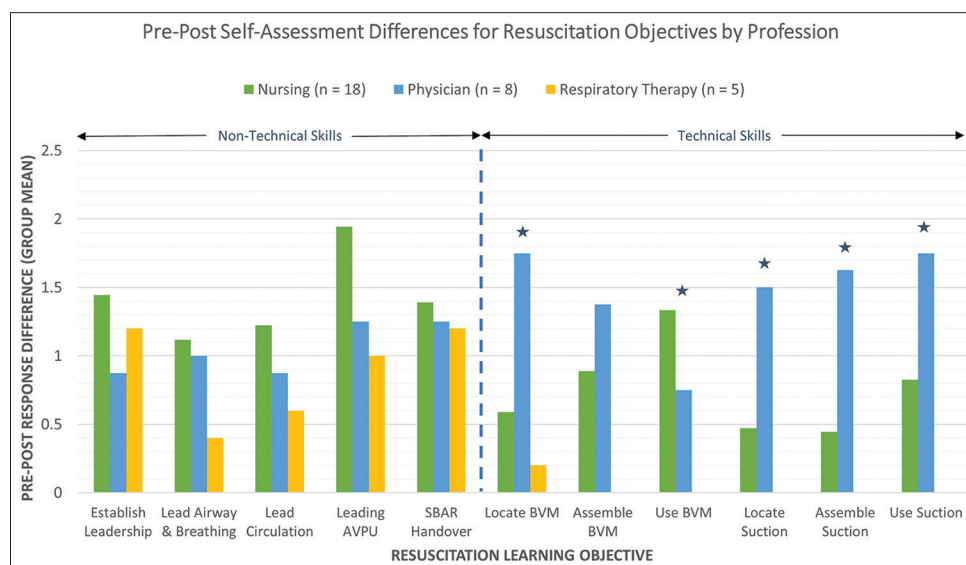
Figure 3. Comparison of pre-post self-assessment scores by profession for various leadership and other resuscitation maneuvers. Stars indicate a statistically significant difference in means among the three groups (between groups ANOVA, *P* < 0.05). Several columns absent for yellow bars (respiratory therapy) due to pre-post difference equaling zero. AVPU: Awake-Verbal-Pain-Unresponsive, BVM: Bag-valve mask, SBAR: Situation-Background-Assessment-Recommendations.

be important to non-acute care providers. However, advanced resource allocation and avoidance of biases leading to misdiagnoses may be less pertinent because the traditional code response team will be onsite for those diagnoses and management. The results obtained as part of our curriculum evaluation support that unique non-technical objectives and the associated training potential exist for non-acute care providers, and should be integrated into resuscitation training programs. We recommend that resuscitation training for non-acute care pediatric providers include integrated, context-specific technical and non-technical skills, as both aspects work together for optimal team performance and patient care.

The curriculum evaluation conducted has several limitations. While the retrospective pre-post self-assessment approach has validity in identifying learning has occurred, it does not necessarily quantify the amount, nor were the specific tool elements subjected to analyses of content/internal structure validity [21]. The evaluation obtained Kirkpatrick level two data, and does not report on changes in provider behavior or patient outcomes [28]. Much of the curricular evaluation was conducted before the COVID-19 pandemic and since then, hospitals have likely increased acute care training and education. Most pandemic-related clinical training, however, tends to relate to facility infection prevention and control practices, rather than targeting specific resuscitation education objectives. In addition, being a flexible, context-specific activity, the FFM may be easily adapted to incorporate the pandemic-related procedures of a given clinical area. Finally, skill retention has been identified as a concern with many resuscitation curricula and was not assessed as part of the current curriculum evaluation.

5. Conclusion

Non-acute care pediatric providers require resuscitation training that integrates technical and non-technical skills. The training should be tailored to their working contexts, which occur before arrival of the traditional code response team. The results of the FFM curriculum evaluation, an activity designed with feasibility and sustainability in mind, suggest that attention to integrating relevant non-technical skills is necessary, and that learning is possible.

Conflicts of Interest

The evaluation received no funding and the authors have nothing to declare.

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Publisher's note

Appendix

Appendix (Online Supplement Only)

First Five Minutes Program Evaluation Questions

Thank you for attending our First Five Program. Please take a moment to provide us with feedback in order to monitor and improve the effectiveness of the program.

All responses are anonymous.

What is your discipline?

☐ MD:

☐ Staff   ☐ Fellow   ☐ Resident

   Specialty: _____

☐ RN   ☐ RRT

Ward: _____

1. Please rate your confidence in being able to perform each of the following tasks independently **PRIOR** to taking this course (*Place an "X" to mark your selection*):

Skill	Not at all confident	Slightly confident	Moderately confident	Very confident	Extremely confident
…establish leadership in a code blue situation					
…locate the bag-mask device in a standard ward room					
…assemble the bag-mask device					
…ventilate a patient using the bag-mask device					
…locate the suction equipment in a standard ward room					
…assemble the suction equipment					
…suction a patient using the ward room equipment					
…lead a team through the airway and breathing assessment of a patient					
…lead a team through the circulation assessment of a patient					
…lead a team through the AVPU assessment of a patient					
…handover a case using SBAR					

2. Please rate your confidence in being able to perform each of the following tasks independently **AFTER** taking this course (*Place an "X" to mark your selection*):

Skill	Not at all confident	Slightly confident	Moderately confident	Very confident	Extremely confident
…establish leadership in a code blue situation					
…locate the bag-mask device in a standard ward room					
…assemble the bag-mask device					
…ventilate a patient using the bag-mask device					
…locate the suction equipment in a standard ward room					
…assemble the suction equipment					
…suction a patient using the ward room equipment					
…lead a team through the airway and breathing assessment of a patient					
…lead a team through the circulation assessment of a patient					
…lead a team through the AVPU assessment of a patient					
…handover a case using SBAR					

3. Was this session useful for your current practice?

    ☐ Yes   ☐ No

       Why, or why not?

    _____

4. Would you recommend this program to a colleague?

    ☐ Yes   ☐ No