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**Using Simulation to Measure and Improve Pediatric Primary Care Offices
Emergency Readiness**

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Article

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Title* Using Simulation to Measure and Improve Pediatric Primary Care Offices Emergency
Readiness

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1 Structured Abstract*

2 Introduction

3 Emergencies in the pediatric primary care office are high risk, low frequency events which
4 offices may be ill prepared to manage. A simulation-based collaborative improvement program
5 to improve office based emergency response was developed and delivered. This program
6 involved measuring pediatric emergency readiness of outpatient pediatric offices; providing
7 feedback/debriefing with a plan to repeat measurement in six months.

8 Methods

9 This program consisted of two components: preparedness checklists and in situ simulations.
10 The preparedness checklists were derived from the American Academy of Pediatrics guidelines
11 to assess these offices' readiness concerning equipment, supplies, medication and guidelines.
12 Two in-situ simulations; respiratory distress and seizure, were conducted with the
13 interprofessional teams; performance was scored using checklists. At six months the same
14 measurements of pediatric emergency readiness and performance will be completed; data sets
15 will be compared for improvements.

16 Results

17 Twelve pediatric office visits were conducted October through December 2018. Baseline data
18 showed wide variety in preparedness (Range: 47-87%) and performance checklist results
19 (range: 43-100%). Recommendations were made to standardize equipment, medications and
20 procedures across all sites.

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1 Conclusions

2 Our simulation-based collaborative improvement program was successful in measuring pediatric
3 primary care office preparedness. Simulation has potential to improve patient safety in a variety
4 of settings. Through using simulation to measure office emergency preparedness, areas of
5 knowledge deficit and latent safety threats were identified and addressed.

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1 Manuscript Content*

2 Introduction

3 Pediatric emergencies are high risk, low frequency events which can be frightening and
4 frustrating without the appropriate tools and protocols, and adequate staff training. This paper
5 describes the development and implementation of a novel simulation-based collaborative
6 improvement program between pediatric primary care offices and a pediatric academic medical
7 center. A three year review of Emergency Medical Services (EMS) encounters originating in
8 ambulatory settings in Indianapolis showed that the most common presentations requiring EMS
9 transport were respiratory distress, psychiatric/behavioral emergencies, and seizures¹. These
10 findings correlate with those of previous studies². Interestingly, less than 1% of all EMS calls
11 originated in ambulatory settings, illustrating why pediatric offices may be ill prepared to manage
12 these patients.

13 Of importance, Yuknis et al.¹ found that whilst respiratory distress was the most common
14 emergency, no patients required advanced airway management. These findings suggest that
15 the availability of basic life support equipment paired with the adequate skills should be the
16 focus of office based emergency preparedness. Examples of these skills include administering
17 oxygen therapy and nebulized albuterol.

18 The American Academy of Pediatrics³ (AAP) developed guidelines for providers with regard to
19 equipment and training in outpatient settings. This guideline describes two equipment
20 categories: 'essential' for those with an EMS response time of less than 10 minutes and
21 'strongly suggested' for those with longer EMS response times. The EMS response time has
22 implications for the management of pediatric emergencies; those with longer times may require
23 additional equipment for advanced airway management and intravenous access. However, it is
24 important to note that as advocated by Toback² equipment choices should be informed by the

providers' level of experience and comfort in using them. Toback² emphasizes the importance of education and training in emergency response. Since the introduction of the AAP guidelines³ it has been reported that in 2015, 23% of pediatric clinics did not consider themselves to be 'office prepared' and only 25% practiced mock codes⁴.

Our primary aim was to measure and improve emergency preparedness in pediatric offices. A secondary aim was to describe common themes in emergency preparedness across a regional group of offices to guide the development of generalizable improvement interventions. We hypothesized that the preparedness scores would improve from baseline to follow up.

Methods

The simulation-based collaborative improvement program was conducted and facilitated by two simulation education specialists with experience in pediatric emergency care from the pediatric academic medical center. The program was modeled after the Improving Pediatric Acute Care Through Simulation (ImPACTS) interprofessional collaborative whose work has focused on emergency department care⁵. There are twelve pediatric offices associated with the pediatric academic medical center, and all were included. There were two components to the program: preparedness checklists and in situ simulations.

Preparedness checklist: The preparedness checklists were derived from the AAP guidelines³ to assess office readiness in equipment, supplies, medication and guidelines. With all sites within 10 minutes of EMS; the essential equipment checklist was utilized. On the initial visit each site was assessed and all items were checked. If the practitioner was unable to locate a piece of equipment or policy it was considered not available.

In situ simulations: The in situ simulations were conducted with the inter-professional team which included physicians, nurses, medical assistants and patient service representatives. All cases were conducted in the actual office space to promote authenticity; teams were required to

bring their own resources, as the focus was on processes rather than individual performance. However, to reduce the use of consumable items, some items were replaced with reusable simulation equipment. Participants were oriented to simulation concepts such as psychological safety and the need to suspend disbelief. In addition, the features of the manikin (5 year old HAL, Gaumard Scientific, Miami, FL) were explained and a script was given to the person who would role play as parent.

Two scenarios were developed by the simulation education specialists and pediatrician at the pediatric academic medical center; a 7 year old child presenting with asthma and a 5 year old child who seizes in the waiting room. The scenario ended when EMS arrived and the team handed over the care. Two experienced simulation education specialists facilitated the simulations and debriefs. Typically each scenario ran for 10-15 minutes followed by a 30 minute debrief concluding with evaluations by the participants.

Each simulation scenario had a performance checklist which was completed in real time by the facilitators. We measured emergency preparedness through simulation-based evaluation of the processes of care delivered to the child. These checklists were reviewed and developed by content experts on the ImPACTS team. Iterative changes were made following the initial simulations. For example, 'time of seizure documented' was added. In addition, each team was scored for performance on teamwork, communication, situation awareness, decision-making and role responsibility using the Clinical Teamwork Score validated tool (CTS)⁶. These were scored immediately following the visit; the two facilitators discussed the team performance and reached consensus regarding the score given. Following each site visit, data including preparedness checklist, performance checklists and CTS scores was inputted on the ImPACTS database using Qualtrics.

Results

Twelve pediatric offices were visited between October through December 2018, with a total of 143 clinicians participating. This included physicians, registered nurses, nurse practitioners, medical assistants and patient service representatives (see Table 1). Group size varied from 6 to 23 participants.

AAP Readiness Scores

Table 2 presents an overview of each sites' results compared with mean percentage for office preparedness divided into essential equipment, policies and procedures, and overall percentage meeting the AAP guidelines³. The AAP Readiness Scores showed wide variety in essential equipment (43-86), policy and procedures (13-88) and overall score (47-87).

Performance Checklists

Table 3 presents the performance checklist for the respiratory distress and seizure scenario, and a teamwork score based on the CTS for each office. Table 4 summarizes the results of the offices' performance on each element of the performance checklist. Overall, teams ranged from 57-87% of task completion when managing respiratory distress, and 53-100% of tasks for managing a seizing patient. For overall teamwork, the range was 43-75%.

Table 4 demonstrates that initiating documentation, appropriate use of equipment and administration of steroids were the most challenging elements of the respiratory scenario. Patient positioning, documentation, assessment of circulation and administration of rectal diazepam were the most challenging elements in the seizure scenario.

1 Latent Safety Threats

2 The most common latent safety threats identified were expired medications (5 sites), unable to
3 dial 911 directly from landline (2 sites), missing equipment (1 site), and unclear instructions to
4 operate the oxygen tank (1 site).

5 Discussion

6 Twelve pediatric care offices underwent a pediatric readiness assessment and simulation-based
7 education improvement program. Staff members were appreciative of this program of education;
8 they were engaged and committed, rescheduling patient appointments to accommodate the
9 visits. This intervention provided an opportunity to address a number of issues including:
10 technical skills, teamwork and communication strategies and latent safety threats in these
11 practices.

12 Technical skills: Many of the clinicians struggled to turn on the oxygen and were unfamiliar with
13 the technique of administering albuterol with oxygen rather than through the nebulizer. This led
14 to task fixation and a delay in treating the simulated patient. There was a lack of awareness of
15 what resources were available to them. For example, providers would call for suction or rectal
16 diazepam when these were not actually available in the office.

17 Teamwork and communication strategies: The teamwork behaviors expected in an acute setting
18 such as identifying a leader and closed loop communication were not evident in the ambulatory
19 setting. On discussion it was apparent that these teams work closely and constantly together
20 unlike the acute settings where teams invariably change from day to day. Nevertheless we were
21 able to encourage behaviors such as directed communication and clarity of roles. It is of interest
22 to note that low scores on teamwork correlated with low scores on task performance and vice
23 versa.

1 Latent safety threats: Upon inspection of equipment, we were able to identify a number of latent
2 safety threats such as expired emergency medications and missing equipment. These were
3 reported using the Safety Event Reporting System and actioned for follow up on our return visit.

4 Following these visits in consultation with the medical director for these sites, recommendations
5 were made to standardize equipment, medications and procedures across all sites. The wide
6 range of AAP readiness scores indicates that there are opportunities for sharing best practice
7 across sites.

8 One of the strengths of this study was that that it was inclusive to all office staff. This had
9 previously been identified as a limitation by Shenoi et al.⁷ who delivered an education program
10 for Primary Care Pediatricians. They were unable to include all office staff, whereas this study
11 was able to engage all staff to facilitate interprofessional learning and provide valuable insight to
12 those not usually included in emergency care. This is illustrated by this comment made in an
13 evaluation:

14 *“How well everyone worked together isn't new but being a PSR [patient service*
15 *representative] I don't get to see emergency situations very often”*

16 Another strength is that every visit was conducted by the same two simulation education
17 specialists enhancing consistency with delivery, debrief and scoring.

18 A challenge of this program was that some offices were large, for example site 5, was a
19 particularly large office with over 20 participants in the simulation scenarios. This may have
20 affected their score which was comparably low. This will be addressed in subsequent delivery
21 by splitting the larger offices into two groups.

22 In conclusion, our simulation-based collaborative improvement program was successful in
23 assessing the pediatric primary office preparedness. Simulation has potential to improve patient

1 safety in a variety of settings. Through using simulation to explore office emergency
2 preparedness, areas of knowledge deficit and latent safety threats were identified and
3 addressed. This intervention has potential to ultimately impact on patient safety and quality of
4 care.

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Table 1. Total Distribution of Participants for Initial Visit

MD	RN	NP	MA	PSR	Manager	Other	Total Participants
39	12	10	33	26	9	14	143

Table 2. Initial Visit AAP Checklist Results (All scores presented as percentages)

Site	1	2	3	4	5	6	7	8	9	10	11	12	Mean
Essential Equipment	57	62	52	67	81	43	62	62	86	67	86	82	67
Policies & Procedures	38	50	63	38	63	63	63	38	88	63	75	13	54
Overall AAP Readiness	47	56	57	52	72	53	63	50	87	65	80	47	61

Table 3

Table 3. Initial Visit Performance Checklist Results (All scores presented as percentages)

Site	1	2	3	4	5	6	7	8	9	10	11	12	Office Average
Respiratory Distress Performance	86	79	79	71	57	71	87	86	71	79	79	79	77
Seizure Scenario Performance	80	100	80	80	53	67	80	80	80	87	87	73	79
Clinical Teamwork Scale (CTS)	65	69	55	74	43	54	73	75	65	71	60	61	65

Table 4. Summary of Itemized Performance Checklist

Respiratory performance checklist	% offices completing task
Patient assessed immediately	92%
Staff asks for help/activates code	92%
Airway and breathing assessed	100%
Documentation initiated	17%
Appropriate equipment used	100%
Pulse ox applied and reading obtained	100%
Able to use all equipment appropriately	66%
Circulation assessed	92%
Oxygen started	100%
Albuterol started	92%
Medications administered if available	0%
Airway and breathing reassessed	92%
EMS activation	100%
Seizure performance checklist	
Patient assessed immediately	100%
Staff asks for help/activates code	100%
Patient moved to safe position	83%
Time of seizure/events documented	50%
Airway and breathing assessed	100%
Patient positioned to open airway	66%
Appropriate equipment used	92%
Pulse ox applied and reading obtained	92%

Able to use all equipment appropriately	75%
Circulation assessed	41%
Oxygen started if hypoxic	100%
Medications administered if available	25%
Airway and breathing reassessed	100%
EMS activation	100%