# Defining a Focused Pediatric Emergency Medicine Curriculum for Emergency Medicine Residents: A Case Study at Michigan Medicine

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## ABSTRACT

**Objectives:** Emergency medicine (EM) is dedicated to the treatment of urgent and emergent illness requiring physicians to evaluate, treat, and diagnose patients of all ages. EM residency provides the foundation of knowledge enabling trainees to care for any patient. However, specific pediatric curriculum guidance from governing bodies is limited. The literature includes two potential curricula that are cumbersome to implement. Our primary objective was to identify the components of this curricula that were specific to pediatric emergency medicine (PEM). Secondary objectives were to provide a methods framework and to compare the results with the American Board of Emergency Medicine Model of Clinical Practice (EM Model).

**Methods:** With the modified Delphi technique, iterative rounds of expert panels sought to reach consensus on PEM-specific topics. We utilized the published curricula as the foundation and focused this list using a group of local experts. Predetermined consensus was defined as 80% agreement.

**Results:** The literature-derived list of 190 topics was reviewed by the expert panel. Experts identified 92 PEM-specific topics, and the remaining 98 topics were deemed adequately covered by general EM curricula. All topics reached consensus after three rounds. The final list was sorted in accordance with the EM Model categories. Redundant topics were consolidated resulting in 68 PEM topics. Of these 68 topics, we identified 20 topics (five of which are critical) that were incompletely covered by the EM Model.

**Conclusions:** Emergency medicine residency programs should focus their PEM curriculum by deliberately assessing their coverage of key PEM topics. The methods of this study can be replicated to yield locally applicable results in other EM programs. Additionally, the next iteration of the EM Model of Clinical Practice should inform their PEM topics from the available curricula in the literature.

More than 80% of children requiring emergency care are seen in general emergency departments (EDs) by emergency medicine (EM) physicians without pediatric emergency medicine (PEM) fellowship

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Table 1
Targeted Needs Assessment PEM Topics Sorted by EM Model Category

| 1. Signs, Symptoms, and Presentations | 2. Abdominal and GI | 3. Cardiovascular | 4. Cutaneous | 5. Endocrine, Metabolic, and Nutrition | 7. HEENT | 8. Hematologic | 9. Immune system | 10. Systemic Infections | 11. Musculoskeletal | 12. Nervous System | 14. Psycho/behavioral | 16. Thoracic–Respiratory | 17. Toxicologic | 18. Trauma | 19. Procedures and Skills | 20. Other Core Competencies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recognize a sick child | Intussusception | Neonatal congenital cardiovascular presentations | Recognize and manage Henoch-Schonlein purpura | Acute DKA and hyperglycemia | Acute otitis media (including high-dose amoxicillin)* | Recognition of emergencies in febrile sickle cell disease† | Know signs and symptoms of Kawasaki's disease | Pediatric sepsis† | Musculoskeletal injuries by age (including Salter Harris and nursemaids) *† | Febrile seizures | Abuse and neglect: recognition, diagnosis, evaluation, and resources* | Assessing child for aspirated foreign bodies | Diagnosis and stabilization involving small-dose ingestions dangerous or fatal to toddlers†,‡ | Management and diagnosis of pediatric C-spine injury*† | Intubation and airway management of pediatric patients*,† | Laws pertaining to medical personnel responsibility for child abuse and neglect |
| The approach to the febrile or septic neonate | Malrotation/volvulus | Idiopathic hypertrophic subaortic stenosis (hypertrophic cardiomyopathy) | | Neonatal hypoglycemia†,‡ | Management of ocular emergencies: tips and tricks for examination | Recognition of uncommon but serious hematologic disorders | | Persistent fever over 7 days† | Key decision rules: Kocher criteria for septic joint | Age-appropriate neurologic assessment† | Psychosocial differences based on developmental milestone*† | Lung disease of prematurity* | | Common traumatic conditions: blunt abdominal trauma | Establish rapport and perform an examination on patients of varying ages and cooperation*† | General administrative, legal, and ethical issues involved with treating children in an ED |
| Diagnosis of children with a pediatric/toddler limp | Management of necrotizing enterocolitis (medical and surgical) * | Recognition of pediatric heart failure†,‡ | | CAH shock in neonates †,‡ | Foreign-body removal: nose or ear* | Leukemia | | Knowledge of vaccination schedules and disease*† | Slipped capital femoral epiphysis | Manage special-needs children: cerebral palsy† | Manage special-needs children: autism† | Treatment of acute presentations of cystic fibrosis | | Pediatric burn management | Neonatal resuscitation and procedures* | |
| Vital sign, physiologic and anatomic differences by age group*† | Pyloric stenosis | Myocarditis | | | | | | | | | Diagnosis and management of sexual abuse | Asthma | | Application of head CT rules*† | Application of rules for fluid resuscitation (bolus and maintenance)*† | |
| Jaundice | Ingested foreign bodies | Postoperative congenital heart disease child †,‡ | | | | | | | | | | Bronchiolitis | | | Pediatric trauma resuscitation | |
| Red stool† | Meckel's diverticulum | | | | | | | | | | | Croup | | | Chest tube placement in pediatrics*† | |
| Vomiting: by age group | Biliary atresia † | | | | | | | | | | | | | | How to take a pediatric history*† | |
| Constipation | | | | | | | | | | | | | | | Lumbar puncture in neonates† | |
| | | | | | | | | | | | | | | | Pediatric dosages antipyretics*† | |
| | | | | | | | | | | | | | | | Pediatric dosing for resuscitation medications*† | |
| | | | | | | | | | | | | | | | Pediatric dosage of sedation medications*† | |

The following categories were omitted because there were no topics in the category: 6. Environmental; 13. OB/gynecology; and 15. Genitourinary/renal.
CAH = congenital adrenal hyperplasia; DKA = diabetic ketoacidosis; GI = gastrointestinal; HEENT = head, eye, ears, nose, throat system; PEM = pediatric emergency medicine.
*Topic combined or condensed for ease of use.
†Topic incompletely covered by ABEM EM Clinical Model.
‡Topics that are critical for EM physicians.

training.[1] Pediatric patients have critical differences in physiology, disease processes, and management. Thus, EM physicians must deliberately prepare to care for pediatric patients.[2] The Accreditation Council for Graduate Medical Education (ACGME) states that EM residents must care for patients "at the extremes of age," complete at least 1 month of pediatric critical care, and have dedicated pediatric exposure.[3] The American Board of Emergency Medicine (ABEM) outlines the relative importance of topics on the certification exam in the Model of Clinical Practice (EM Model); current guidelines state pediatrics will be a minimum of 8% of the examination.[4,5] However, clear curricular recommendations are lacking. In an effort to better define a PEM curriculum for EM residents, Mitzman et al.[6] developed a list of PEM curriculum topics, skills, and experiences. The authors concluded that their comprehensive curriculum provides a starting point for program directors, but would have to be adapted to individual EM residencies prior to implementation. Their list of topics overlaps with general EM topics. We sought to identify which topics from their list needed a dedicated PEM didactic curriculum in our residency by engaging our local experts in a Delphi process. We also outline our process here to demonstrate how other programs can utilize a similar process for their site. Finally, we compare our list of PEM specific curriculum topics to the EM model to identify important PEM topics that may be missing from curricula from EM residencies using this as their sole source of guidance for curriculum design.

## METHODS

### Study Design

The Delphi process is a validated method to determine expert consensus using iterative rounds of consensus building.[7] It represents an evidence-based approach to curriculum design.[8–10] We implemented a multiround Delphi process to determine local expert consensus on PEM-specific topics needing dedicated didactic sessions in our EM residency, chosen from a previously developed comprehensive PEM curriculum. We allowed for as many rounds as necessary to reach our a priori defined threshold for consensus (80% agreement). Characteristics of our Delphi process included selection of an appropriately sized group of experts, performance of iterative rounds, maintenance of anonymity, and opportunities for panelist to generate content. All rounds were completed asynchronously via online responses. The institutional review board determined this study to be exempt.

### Selection of Expert Panelists

The expert panel consisted of 10 faculty who are board certified in PEM (6), EM (6), and pediatrics (4). Additionally, all faculty serve as program directors of the EM residency or PEM fellowship or hold other educational leadership positions. Five members have advanced training in medical education. These local experts were chosen for their in-depth knowledge of our local training environment.

### Study Protocol

The original list of topics as developed by Mitzman et al. is a comprehensive list of PEM topics that overlap with general EM topics, distinguishing these is essential to avoid redundancy in didactic planning. This comprehensive list was reviewed by the research team and a preliminary designation of "PEM-specific topic" or "general EM topic" was made for each topic using the following definitions:

> PEM topic: these topics are specific to the pediatric population or have clinically significant differences in diagnosis or management (e.g., pyloric stenosis [this occurs only in the infant age group] or pediatric sepsis [underlying differences in physiology lead to distinctly different management]).
>
> EM topic: these topics have similar underlying pathophysiology and treatment between adults and pediatrics and, thus, could be included as part of a teaching session on the topic (e.g., anaphylaxis—although there are slight variations, the foundation of treatment and diagnostic criteria are the same for all ages).

These preliminary designations formed the basis of the Delphi response instrument for round 1. The instrument was piloted for content and clarity with 18 physicians not involved in our study, during a medical education seminar. We sought to maintain content and process response validity through these methods.

### Round 1

The lists of PEM-specific and general EM topics were given to the expert panelists electronically. Experts

were each asked to agree or disagree with the preliminary designation (PEM specific vs. general EM) for each topic. Additionally, they were asked if there were any necessary PEM topics not included on the original list. Results were analyzed and topics were categorized as PEM topics with consensus, EM topics with consensus, and topics without consensus (see Data Supplement S1, Appendix S1, available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1002/aet2.10455/full).

### Round 2

In round 2, experts were anonymously fed back the PEM and EM topics that had reached consensus and asked to confirm agreement. For the topics that did not reach consensus, experts were again asked to designate the topic as PEM or EM and provide a written justification. Results were analyzed and topics were categorized as PEM specific or general EM based on the previously described definition of consensus. For those items that did not reach consensus, free-text responses were analyzed and coded; categorization was adjudicated by the authors, consistent with methods for an in-person Delphi process (see Data Supplement S1, Appendix S2).

### Round 3

Experts were anonymously fed back the list of PEM and EM topics that reached consensus and asked to confirm their agreement (see Data Supplement S1, Appendix S3).

## RESULTS

Nine of 10 invited experts participated in the Delphi process. Panelists started with the original 190 topics identified by Mitzman et al., presorted by the research team into PEM specific and general EM topics. Following the first round, consensus was met on the classification for all but 16 topics. During round 2, the remaining topics were categorized based on panel consensus, or by author adjudication based on analysis of free-text comments from the panelists. Round 3 was performed to allow expert review and consensus was confirmed. This resulted in 92 PEM-specific and 98 general EM topics. The experts did not identify any additional topics not included on the original list.

To compare our list of PEM-specific topics to the EM model, we first reviewed the 92 PEM topics and condensed them as appropriate based on author judgement of redundancy. For example, "chest tube placement on infants" and "chest tube placement on young children" were combined. Table 1 depicts our results sorted by the EM Model categories,[4] with redundant noted. This resulted in a final PEM curriculum of 68 topics, which represents the final list of PEM-specific topics identified for our EM residency program. When compared with the EM Model, 20 of our identified PEM-specific topics are not adequately covered in the EM Model.

## DISCUSSION

Using a modified Delphi method, with a previously developed comprehensive PEM curriculum as a starting point, our local EM education experts were able to identify 68 topics that require a focused PEM curriculum in our residency program. This manageable amount of content should be incorporated into an existing EM curriculum. While our list is likely influenced by idiosyncrasies of our training program, our methodology is easily replicated to yield site-specific results. Program directors could replicate these methods to ensure that they are covering key PEM topics and ensure that their general EM didactics cover the nuances of pediatric emergencies. Local experts can be EM, Peds/PEM, or EM/PEM trained and should include individuals involved in didactic education. Those with advanced training in medical education should be included and assist in this process.

Importantly, our process identified 20 PEM topics not adequately covered in the most recent version of the EM Model. In particular, five of these topics have distinct management and high risk of morbidity: recognition of pediatric heart failure, postoperative congenital heart disease, neonatal hypoglycemia, congenital adrenal hyperplasia shock in neonates, and small-dose ingestions dangerous to toddlers. We suggest that based on our results here, as well as the previous work by Mitzman et al., that these topics should be considered for addition or modification in the development of the next model.

## LIMITATIONS

The Delphi process is limited by unconscious bias. To mitigate this, we included a diverse panel of experts. Another limitation is that the results reflect our institutional environment. However, this process can be

replicated at other EM training programs. Our study was limited by survey response rate due to family leave and leadership transitions. Despite this we maintained participation of greater than 70% for the first two rounds. The third round had 90% participation to confirm consensus. The single expert who did not participate in round 3, did not participate in any of the prior rounds; thus all our available experts agreed upon final topic designation.

## CONCLUSIONS

Using a robustly developed, previously published, comprehensive pediatric emergency medicine curriculum for emergency medicine residency programs as the foundation, we were able to identify a manageable list of 68 pediatric emergency medicine–specific topics that require dedicated teaching in our emergency medicine residency program. Other emergency medicine training programs could consider following a similar process in planning their curricula to ensure adequate pediatric emergency medicine education for their trainees.

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## Supporting Information

The following supporting information is available in the online version of this paper available at http://onlinelibrary.wiley.com/doi/10.1002/aet2.10455/full

**Data Supplement S1**. Supplemental material.