Priorities for Pediatric Prehospital Research

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Abstract: Up to 3 million US children are cared for by emergency medical services (EMSs) annually. Limited research exists on pediatric prehospital care. The Pediatric Emergency Care Applied Research Network (PECARN) mission is to perform high-quality research for children, including prehospital research. Our objective was to develop a pediatric-specific prehospital research agenda.

Methods: Representatives from all 4 PECARN nodes and from EMS agency partners participated in a 3-step process. First, participants ranked potential research priorities and suggested others. Second, participants reranked the list in order of importance and scored each priority using a modified Hanlon method (prevalence, seriousness, and practicality of each research area were assessed). Finally, the revised priority list was presented at a PECARN EMS summit, and consensus was sought.

Results: Forty-two representatives participated, including PECARN representatives, EMS agency leaders, and nationally recognized prehospital researchers. Consensus was reached on the priority ranking. The prioritization processes resulted in 2 ranked lists: 15 clinical topics and 5 EMS system topics. The top 10 clinical priorities included (1) airway management, (2) respiratory distress, (3) trauma, (4) asthma, (5) head trauma, (6) shock, (7) pain, (8) seizures, (9) respiratory arrest, and (10) C-spine immobilization. The 5 EMS system topics identify methods to improve prehospital care on the system level.

Conclusions: PECARN has identified high-priority EMS research topics for children using a consensus-derived method. These research priorities include novel EMS system topics. The PECARN EMS pediatric research priority list will help focus future pediatric prehospital research both within and outside the network.

Key Words: trauma, pain, asthma, resuscitation, research, medical services, PECARN; research consensus, respiratory distress

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Participants who contributed to the development of the priorities are listed in Appendix A.

A pproximately 30 million children are evaluated in emergency departments (EDs) each year in the United States,1 of whom an estimated 1.5 to 3 million (5%–10%) arrive by ambulance.2 Children account for approximately 10% of all emergency medical service (EMS) transports.3,4 Because the needs of children treated in the prehospital setting are different from those of adults, prehospital care providers must have appropriate equipment, training, and safe and effective protocols to treat children. Research on pediatric prehospital care is crucial to determine its safety and efficacy.

Although we have had more than 35 years of experience with prehospital care in the United States, there is limited research specific to pediatric prehospital care. The bulk of the research on prehospital care has focused on the adult population. Consequently, little of the care provided by EMS to pediatric patients is based on evidence from prehospital care research.5,6 Many factors contribute to the limited research in pediatric prehospital care. These include infrequent pediatric transports, EMS systems that were developed primarily for adults, a relative paucity of prehospital researchers, the burden of community consultation to obtain a waiver of or exception from informed consent, and the absence of a pediatric-specific EMS research agenda.6–12

The Pediatric Emergency Care Applied Research Network (PECARN) is a national research network established in 2001, whose mission is to perform high-impact research for children across the continuum of care, including in the prehospital setting.13 PECARN has initiated efforts to conduct prehospital research. Although PECARN has developed a research agenda, it was not specific to the prehospital setting, making it difficult to appropriately focus efforts in this area.14 There have also been previous attempts to develop priority lists for research in EMS,6,7 but these have not focused specifically on pediatric prehospital research. An additional group, appointed through the Emergency Medical Services for Children (EMSC) program, published research priorities regarding emergency care for children but they focused on hospital care and did not include the prehospital setting.12

The objective of this project was to develop a pediatric-specific prehospital research agenda to help provide a focus for pediatric prehospital research, particularly for research conducted within PECARN.

METHODS

PECARN is funded by the Maternal and Child Health Bureau’s EMSC program and is well positioned to conduct multisystem pediatric EMS research. PECARN consists of 22 hospital EDs across the United States. To perform prehospital research, PECARN sites recently partnered with the EMS agencies that transport children to their EDs. In addition, PECARN convened a prehospital research summit in September 2007 in Atlanta, GA, to foster the research relationship between these agencies and the PECARN sites. Each PECARN ED was invited to send a representative from their ED and a representative from...
one of the EMS agencies with which they had partnered. In addition to EMS representatives selected by PECARN nodes, many nationally recognized EMS experts were also invited to participate. Before the summit, we charged these participants with the development of an initial list of research priorities, including a list of system topics, that would be finalized at the summit.

We developed the pediatric prehospital research priorities in 3 steps. In the first step, participants received by e-mail a list of unranked, proposed pediatric prehospital research topics. In addition to this list, participants received a selection of relevant literature on prehospital research priorities and pediatric prehospital care.6,7,12,15 The unranked list included 29 research topics that were identified in these prehospital and EMSC priority articles. We asked the participants to rank the topics in order of importance and to suggest any additional topics that were missing from the list.

The participants responded that the priority list included a mix of clinical and system topics, making it difficult to rank them as 1 group. Therefore, we separated them into 2 lists: one with clinical and one with system topics. The clinical topics included disease and injury entities for which prehospital research is needed. The system topics included functions, analyses, and study methods to predict, improve, and monitor prehospital care.

We collected participant responses by e-mail and collated them into 2 revised, ranked lists of research priorities, including the newly suggested topics.

In the second step, we sent the prioritized lists of topics to the participants by e-mail. The participants reranked these lists in order of importance, taking into account the added topic areas. They also scored each clinical priority item using a modified Hanlon method.14,16,17 The modified Hanlon method, also referred to as the Basic Priority Rating System, creates a priority score for each topic that is based on (1) the prevalence of the condition (A), (2) the seriousness of the condition (B), and (3) the practicality/feasibility of studying the condition (C). The participants scored each topic in each of these areas using a scale from 1 to 10. A priority score was then calculated using the following formula \((A + 2B) \times C\).14,16,17 Respondents were asked to rank the system topics based solely on importance. The system topics were not scored using this modified Hanlon method because the measurement of prevalence of the condition was not applicable to many of the system topics. We collated participant responses, and the priority list was reorganized based on the calculated priority scores.

In the third and final step, we presented the revised priority list to the participants at the EMS summit. Before providing the list, presentations were given that provided an introduction to the PECARN and its research infrastructure and a history of prehospital care including issues with conducting research in the prehospital setting. After the presentations, we held a moderated discussion to review the revised priority list and to reach consensus on the ranking of pediatric prehospital research priorities.

## RESULTS

A total of 42 participants contributed to the development of the pediatric prehospital research agenda priorities, including PECARN representatives (n = 20), EMS agency representatives (n = 9), and nationally recognized prehospital researchers (n = 13). Twenty-six of the participants were physicians. The initial e-mail was sent to 42 participants and 24 responded (57%). In addition to the original 29 topic areas, 13 topics were added to the list based on participant suggestion.

In the second step, the revised, ranked clinical and system priority lists were sent to 42 participants and 24 responded (57%). We calculated modified Hanlon scores for each response based on the raw scores they submitted for the clinical topics. For each clinical topic, the respondents’ scores were summed. We ordered the clinical topics from highest summed score to lowest, and ordered the system topics based on the summed score of importance rankings.

All 42 of the participants who were invited to rank the priority list during steps 1 and 2 participated at the summit. The final EMS summit, consensus derived priority lists for clinical and system topics are shown in Table 1. During the EMS summit, the item most discussed was pain, which scored among the top 15 clinical priorities using the modified Hanlon method yet did not score as highly as many participants expected. This was because of the pain receiving lower scores on the measure of “seriousness of condition” when compared with the other topics on the list. For example, it is unlikely that someone will die of pain, whereas many pediatric patients will die of respiratory arrest. The modified Hanlon method gives priority to topics that have high scores in the seriousness of condition category. The consensus process discussion allowed for a more complete evaluation of the rankings and adjustments when necessary. Everyone at the summit agreed that pain and pain management was an important clinical topic, and based on this consensus, the priority score for pain was changed from 11 to 7. Other than for pain, there was little change between the e-mail ranked lists and the final consensus list agreed on at the summit.

## DISCUSSION

We have developed a pediatric-specific prehospital research priority list through a national consensus process, which included participants from pediatric emergency medicine and EMS. This priority list will be used by PECARN to prioritize the pediatric EMS research the network performs. The priority list was developed by a broad multidisciplinary group of clinicians, researchers, and administrators who specialize in pediatric and

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### TABLE 1. Final Clinical and System Topics in Priority Rank Order

<table>
<thead>
<tr>
<th>Clinical Topics</th>
<th>System Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>Topic</td>
</tr>
<tr>
<td>1</td>
<td>Airway management</td>
</tr>
<tr>
<td>2</td>
<td>Respiratory distress</td>
</tr>
<tr>
<td>3</td>
<td>Trauma</td>
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<tr>
<td>4</td>
<td>Asthma</td>
</tr>
<tr>
<td>5</td>
<td>Head trauma</td>
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<tr>
<td>6</td>
<td>Shock</td>
</tr>
<tr>
<td>7</td>
<td>Pain</td>
</tr>
<tr>
<td>8</td>
<td>Seizures</td>
</tr>
<tr>
<td>9</td>
<td>Respiratory arrest</td>
</tr>
<tr>
<td>10</td>
<td>C-spine immobilization</td>
</tr>
<tr>
<td>11</td>
<td>Cardiac arrest</td>
</tr>
<tr>
<td>12</td>
<td>Injury prevention</td>
</tr>
<tr>
<td>13</td>
<td>Children with special needs</td>
</tr>
<tr>
<td>14</td>
<td>Poisoning</td>
</tr>
<tr>
<td>15</td>
<td>Abuse and neglect</td>
</tr>
</tbody>
</table>

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prehospital emergency care; therefore, these research priorities have a broader application for pediatric prehospital research beyond PECARN.

The ranking of the clinical priority list was developed so that the ranks were weighted by prevalence, seriousness, and feasibility of conducting research on the topic. The modified Hanlon formula places more emphasis on seriousness of the condition and the ability to conduct research than the number of patients with the problem. The method is a priority-setting tool and helps to differentiate between competing issues. The top 15 clinical research priorities identified using the modified Hanlon method remained the same after discussion at the EMS summit. This project has several limitations. The response rate to the e-mailed surveys was low. However, all participants attended the summit and participated in the group discussion. The final ranked list represents the opinion of all summit attendees. Given that the rankings changed little at the summit, a non-response bias is less likely. A further limitation is that the modified Hanlon scoring system places greater weight on the severity of a condition and the feasibility of researching a condition, so less serious conditions or serious conditions that are difficult to measure are less likely to score highly and may not be present on the final priority list. However, by combining the surveys with the consensus meeting, we were able to ensure that lower ranking topics could be added or given a higher ranking if participants felt they were a priority. The change in the prioritization of pain management is an example of how this potential limitation was minimized.

Finally, our selection of participants may have introduced selection bias into the priority list and decreased its generalizability. However, the participants were from a wide variety of agencies across the United States and included nationally recognized experts in both pediatric emergency care and EMS. They also came from a variety of backgrounds including physicians, paramedics, researchers, and administrators.

A decade ago, Maio et al7 developed the only prior pediatric prehospital research priority list. In comparing the PECARN EMS summit list to that of Maio et al, there were several clinical topics included in both, including airway management, respiratory distress, trauma, shock, seizures, respiratory arrest, cardiac arrest, and poisoning. New clinical topics identified by the PECARN EMS summit included asthma, pain, cervical spine immobilization, injury prevention, children with special needs, and child abuse/neglect.

New EMS system topics identified by the PECARN EMS summit included effectiveness of out-of-hospital interventions, knowledge and skill deterioration, patient outcomes, evaluation of the impact of overall EMS system changes on children, and training effectiveness. The work by Maio et al did not consider system topics. This separation of clinical and EMS system topics is a different approach than has been taken in developing previous priority lists. The system topics were felt to be important by the PECARN EMS summit participants. The inclusion of EMS system topics in this research priorities list argues that future analyses on prehospital research include assessment of EMS system design and training issues, which are separate from clinical care, yet are likely to affect outcomes.

CONCLUSIONS

PECARN is a valuable national research resource that has embraced pediatric prehospital issues as part of its mission. The EMSC-supported EMS summit produced new priorities for prehospital pediatric research. The clinical and system research priority lists were created using a consensus-derived method and supported by a multilateral group of pediatric emergency researchers, EMS researchers, and EMS system leaders. This priority list provides a focus for future pediatric EMS research both within and outside the PECARN.

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REFERENCES


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