Revisiting the Emergency Medicine Services for Children Research Agenda: Priorities for Multicenter Research in Pediatric Emergency Care

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Abstract

Objectives: To describe the creation of an Emergency Medical Services for Children (EMSC) research agenda specific to multicenter research. Given the need for multicenter research in EMSC and the unique opportunity afforded by the creation of the Pediatric Emergency Care Applied Research Network (PECARN), the authors revisited existing EMSC research agendas to develop a PECARN-specific research agenda. They sought to prioritize PECARN research efforts, to guide investigators planning to conduct research in PECARN, and to describe the creation of a prioritized EMSC research agenda specific for multicenter research.

Methods: The authors used the Nominal Group Process and Hanlon Process of Prioritization (HPP), which are recognized research prioritization methods incorporating both quantitative and qualitative data collection in group settings. The formula used to generate the final priority list heavily weighted practicality of conduct in a multicenter research network. By using size, seriousness, and practicality measures of each health priority, PECARN was able to identify factors that could be scored individually and were weighted relative to each other.

Results: The prioritization processes resulted in a ranked list of 16 multicenter EMSC research topics. Top among these priorities were 1) respiratory illnesses/asthma, 2) prediction rules for high-stakes/low-likelihood diseases, 3) medication error reduction, 4) injury prevention, and 5) urgency and acuity scaling.

Conclusions: The PECARN prioritization process identified high-priority EMSC research topics specific to multicenter research. PECARN has the capacity to answer long-standing, important clinical controversies in EMSC, largely due to its ability to conduct randomized controlled trials and observational studies on a large scale.

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Pediatric Emergency Care Applied Research Network (PECARN) participants are listed in Appendix A.

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In 1984, federal legislation (PL-98-555) was passed establishing the Emergency Medical Services for Children (EMSC) program to expand access to and improve the quality of emergency care for children.[1] Since then, several groups of EMSC stakeholders and/or experts have developed research agendas to help prioritize EMSC research. One of the earliest efforts was undertaken by the Institute of Medicine (IOM), which organized the Committee on Pediatric Emergency Medical Services, and published the seminal monograph *Emergency Medical Services for Children* in 1993.[2] In 1999, a group of national experts convened by EMSC employed the Rand–University of California (UCLA) consensus process to develop and prioritize topic areas for EMSC research.[3] Also in 1999, a group of emergency medical services (EMS) experts from both the public and the private sectors prioritized a number of medical and surgical conditions integral to EMS outcomes research, for the purposes of research focus and funding prioritization in children and adults.[4] An EMS research strategic plan was recently published,[5] prioritizing the recommendations of the National EMS Research Agenda released in 2002.[6] This strategic plan is likewise focused on EMS research topics in pediatric and adult patients. As elaborated in the recent publication of the IOM report on the future of EMSC,[7,8] there are several current challenges facing EMSC, and the need for multicenter research is specifically highlighted. We also believed that it was important to update the EMSC research priorities, leading to this prioritization process.

In 2001, the Health Resources and Services Administration's Maternal and Child Health Bureau (HRSA/MCHB) EMSC program funded the development of the first collaborative research network in EMSC in the United States.[9] This effort was put forth in partnership with HRSA/MCHB's Division of Research, Education and Training, and the result was the Pediatric Emergency Care Applied Research Network (PECARN), a collaboration of four research nodes comprising 21 emergency departments (EDs) in 11 states and the District of Columbia. In light of the need for multicenter research, and the unique opportunity for such research afforded by the creation of PECARN, we revisited the existing EMSC research agendas to develop a PECARN-specific research agenda. We sought to create this agenda to prioritize PECARN research efforts and to guide investigators outside of PECARN submitting high-priority proposals for consideration of implementation to PECARN. Most importantly, however, the purpose of this article is to describe the creation of a prioritized EMSC research agenda specific for multicenter research.

METHODS

Study Design

We used the Nominal Group Process (NGP) and Hanlon Process of Prioritization (HPP) for the PECARN prioritization process. These qualitative research methods for identifying and organizing lists of priorities[10–15] were chosen because they include both quantitative and qualitative data collection in a group setting. The NGP methodology allows for the free exchange of opinions and the generation of a list of priorities in a structured and nonhierarchical discussion forum.[14] This process was practical for PECARN members to maximize creative participation and ensure balanced input while utilizing each participant's experience and expertise to reach consensus on complex topics. The HPP method provides a means to objectively compare health priorities in a relative framework. Using prevalence, seriousness, and practicality and feasibility for implementation in PECARN of each health priority enabled PECARN to identify explicit factors that could be weighted relative to each other and scored individually.

NGP

The purpose of the NGP is to provide structure to a group discussion when the group is facing the challenge of reaching agreement on complex topics.[11,12,14,15] In the absence of structure and process, the consensus generation is at risk of "spinning wheels" or being dominated by a few individuals who are more vocal than the rest of the group members. NGP is a structured problem-solving or ideas-generating activity in which individuals' ideas are gathered and combined in a face-to-face, nonthreatening group environment. The process is practical for maximizing creative participation in group problem-solving. It assures balanced input from all participants, taking advantage of each person's expertise and experience. NGP is useful for generating and clarifying ideas, reaching consensus, prioritizing, and making decisions on proposed alternative actions.

HPP

The HPP yields relative results that are useful for comparing different and competing priorities.[13,15] Members of the group must work together rather than separately throughout the process, because definitions of the component parts of the process tend to be unique to each working group, and must be developed in a collaborative fashion. Consistency across the scope of programs reviewed is necessary to generate a useful relative ranking. The major advantage to this method is that it considers individual scored and weighted group-specific factors in the generation of the priority list.

Preparatory Work. Participants generated a list of research priorities at the PECARN Steering Committee Meeting in April 2003 during a general brainstorming session. PECARN members in attendance at the following PECARN Steering Committee meeting in October 2003 participated in the initial and subsequent prioritization processes (participants are listed in Appendix A). Using the initially generated list, the participants then created an expanded list of 53 possible research topics that also included priority topics previously identified and ranked by the IOM and other EMSC experts.[2–5] Finally, over 2 days of the February 2004 PECARN Steering Committee meeting, the priority list was discussed and finalized using both NGP (in groups of six to eight individuals) and HPP (in the larger Steering Committee group of EMSC investigators, PECARN staff, and federal representatives) processes. Three expert consultants led the process and facilitated the

groups. The results of this process were presented in part at a national meeting of the American Public Health Association.[15]

Session 1: NGP. 1. We divided the members of the PECARN Steering Committee, other PECARN investigator participants, and federal partners into six groups for discussion of the research agenda and initial prioritization. Participants were randomly assigned to these groups. A process expert facilitated the discussion and prioritization process in each group, assisted by one PECARN staff member per group.

2. After viewing a list of 53 previous EMSC research priorities, participants recorded their top 15 priorities and drafted a brief phrase regarding the importance of each of their priorities.

3. Participants read their priorities aloud to the other members of their group, one at a time in alternating sequence between the participants, until there were no new priorities mentioned in the group. Priorities were listed on a flip chart by the group facilitator. During this process, participants were not allowed to elaborate, critique, or defend their priorities.

4. After all the priorities had been listed by topic, each participant had 1 minute to explain the evidence and logic in arriving at this priority. Other participants had a maximum of 2 minutes to agree, disagree, and/or discuss the relative importance of each priority.

5. After this discussion period, each participant chose his or her top 15 priorities from the list generated by all participants. Facilitators tallied the votes for each priority on the chart.

6. Each participant then wrote each of his or her 15 top priorities described above on a note card. Participants scored the importance of each priority, ranked on a scale of 1 to 5, with 5 representing the highest priority. This process allowed for several priorities with the same rank.

Session 2: Tally of Votes and Ranking of Priorities. After the conclusion of Session 1, facilitators tallied the numbers and the mean rank for each listed research priority within each group. All six facilitators then met and used mean ranks to prioritize the top overall 15 priorities of the large group in order of perceived importance. These raw results are presented in Table 1. The top 15 items individually ranked by importance were meant to be used in the next stage of prioritization. There was one minor modification at this stage: the items "respiratory illness" and "asthma" were initially listed separately, but then combined on the recommendation of many participants, resulting in a "combined priority," which was tied for 7th rank overall. Due to ties, there were actually 16 priorities ranked on this list.

Session 3: HPP. During a subsequent session, held the day after Sessions 1 and 2, participants prioritized the list of 16 top items generated the previous day using a modified form of the HPP. This scoring system included the following three determinants: A = prevalence of the condition (i.e., how many people are affected by the condition or how frequently the problem occurs); B = seriousness of the condition (i.e., morbidity and/or mortality of the condition or the disruption the condition causes to society); and C = practicality/feasibility of the condition for study in PECARN (including the potential for funding research on the topic). Participants scored each item on the list of the top 16 conditions using the three criteria described above on a scale of 1 to 10 (with 10 representing the highest score). The values were then averaged. The final priority score (D) was determined using the equation $(A + 2B) \times C$.

The formula argues that seriousness and the ability to do something about an issue is more powerful than the mere prevalence alone. The formula is designed as a priority-setting tool and provides assistance in separating competing issues. In addition, it also argues that regardless of the prevalence and seriousness of a particular issue, if it cannot feasibly be studied, then

Table 1
Initial Ranking of Research Priorities in Order of Perceived Importance

Point Value	Priority
123	Mental health
117	Medication error reduction
110	Prediction rules for high-stakes/low-likelihood diseases
91	Education/training outcomes
89	Injury prevention
83	Race, ethnicity, and class disparities in health
73	Pain and anxiety management
73	Seizure management
73	Respiratory illness/asthma*
69	Development of treatment algorithms
67	Treatment of infectious diseases
66	C-spine immobilization
62	Urgency and acuity scaling, adjust case-mix severity
61	Practice protocols
60	Improvement in health outcomes for cardiac arrest
57	Best practices in patient care (efficiency of ED flow and overcrowding)
49	Airway management
46	Cost of care, cost-effectiveness
39	Improve access, foster appropriate use
38	Medical informatics
33	Adolescents, especially access to care, transition to adulthood
30	Quality measurement/improvement
30	Access to care, ED waiting times
29	Acute care
27	Utilization of hospital services, ancillary tests
23	Appendicitis treatment
22	Biosurveillance
22	Pediatric equipment and training in general (non pediatric) facilities
21	Qualitative research methodologies
19	Link epidemiologic studies to population-based sets
18	ED and 911 utilization
18	Use and linkages of IS to coordinate patient care
16	Special health care needs
14	Abused and neglected children
7	Training and education

*Respiratory illness and asthma were initially listed separately but subsequently combined into one category and tied for 7th with 73 points.
ED = emergency department; IS = information systems.

resources may be better used somewhere else. Therefore, the feasibility and practicality for studying the problem in PECARN are heavily factored into the formula. The value in weighting the practicality and feasibility in a multiplicative fashion more than other categories was to emphasize the feasibility factor over all others when deciding what to study. This helped PECARN to identify how to best dedicate its research efforts on achievable goals.

Session 4: Discussion and Feedback. At the July 2004 PECARN Steering Committee meeting, we circulated the prioritized list to all participants for discussion and refinement. We asked the participants to identify priorities that they felt were missing from the final list, to provide some checks and balances to the consensus-building process. Twenty-one responses were returned. Additional priorities generated by these responses (designated as the list of a "passionate minority" of participants) included out-of-hospital care (listed on 10 responses) and acute trauma care (mentioned on 4 responses). It became apparent that these topics did not appear on the lists after the initial prioritization process because participants frequently assumed that out-of-hospital care and trauma care would fall under other categories on the list. Participants were also asked to identify health priorities that should be combined into one category. This last step resulted in the combination of the topics of "best practices," "practice protocols," and "development of treatment algorithms" into one category.

RESULTS

The results from our process are summarized in Table 2. Furthermore, in Table 3, we compare the results of our prioritization process with that of other previously mentioned expert panel consensus processes for research in EMSC. Some common EMSC research priorities are notable, but additional unique topics emerged in the PECARN prioritization process. For example, topics such as "prediction rule for high-stakes, low-likelihood diseases" and "C-spine immobilization" can only practically be conducted in the setting of a large multicenter research network because of the large patient volumes needed to obtain results with sufficiently narrow confidence intervals to be of clinical use.

DISCUSSION

Although other EMSC research priority lists have been created in the past decade, the process we describe here is unique in its focus on multicenter EMSC research. Therefore, although some of the topics with high priority appear on multiple lists, others appear uniquely on the list generated for the PECARN network. The final list and rank of priorities was generated both before and after considering the feasibility factor. The priority ranking for three topics changed substantially after factoring in the practicality of conducting the specified work in a multicenter EMSC research network such as PECARN: prediction rules for high-stakes/low-likelihood diseases (from 12th to 2nd place), injury prevention (from 1st to 4th place), and development of treatment algorithms (from 5th to 12th place).

This PECARN research prioritization process identified 16 priority areas and two passionate minority priorities. There were some distinct similarities between the PECARN EMSC research priority list and lists generated by previous EMSC consensus-generating processes and statements.[2–4] Several items were ranked highly on both the PECARN list and the previous lists. For example, respiratory illness/asthma were top ranked in the PECARN priority list, as well as on

Table 2
PECARN Research Priorities (Ranked and Scored)*

Health Priority	Raw Score*	Ranking of Raw Score	PECARN Raw Priority Score	Final Ranking Score
Respiratory illnesses/asthma	394	2	5,376	1
Prediction rules for high-stakes/low-likelihood diseases	343	12	4,811	2
Medication error reduction	391	3	4,698	3
Injury prevention	414	1	4,682	4
Urgency and acuity scaling	358	6	4,419	5
Race, ethnic, class disparities in health	351	8	4,296	6
Mental health	347	10	4,272	7
Treatment of infectious diseases	349	9	4,263	8
Best practices in patient care	362	4	4,203	9
Pain and anxiety management	352	7	4,138	10
Education/training outcomes	345	11	4,021	11
Development of treatment algorithms	361	5	3,991	12
Improvement in health outcomes for cardiac arrest	297	14	3,678	13
Practice protocols	337	13	3,434	14
Seizure management	260	16	3,112	15
C-spine immobilization	287	15	3,083	16

PECARN = Pediatric Emergency Care Applied Research Network.
*To obtain the raw score, we added the prevalence (A) and seriousness (weighted twofold, 2B) for each priority. The formula for calculating the PECARN raw priority score was $D = (A + 2B) \times C$, where C represents the practicality for study in PECARN. See text for details regarding the calculations and weighting.

Table 3
Comparison of Emergency Medical Services (EMS) Research Agendas by Author*

Research Topic:	PECARN (n = 16), Topics	IOM 1993[2] (n = 6), Topic Areas	Seidel[3] (n = 14), Topics	Maio[4] (n = 27), EMS Conditions
Respiratory illness/asthma	1	1	1	3
Prediction rules: high-stakes, low-likelihood diseases	2	—	—	—
Medication error reduction	3	5	5	—
Injury prevention	4	7	3	—
Urgency and acuity scaling	5	2	11	—
Race/ethnic/class disparities	6	5	10	—
Mental health	7	—	1	23, 27
Treatment of infectious disease	8	—	1	17
Best practices in patient care, e.g., efficiency of ED flow/ overcrowding	9	2	14	—
Pain and anxiety management	10	—	6	—
Education/training outcomes	11	6	12	—
Development of treatment algorithms	12	—	—	—
Improvement in health outcomes for cardiac arrest	13	—	8	6
Practice protocols	14	5	5	—
Seizure management	15	—	1	7
C-spine immobilization	16	—	7	—
Development/validation of practical functional/other outcomes	—	3	2	—
Fundamental issues in the development of medical informatics	—	—	4	—
Costs of emergency care: direct, indirect, marginal	—	4	9	—
Public education methods of affecting behavior change: injury prevention, emergency care, EMS use	—	6	13	—
Children with special health care needs	—	—	15	

*In some cases, the wording of our priorities differs slightly from that of the other EMS priority lists. We matched the topics as closely as possible in order to create this table.
ED = emergency department; PECARN = Pediatric Emergency Care Applied Research Network; IOM = Institute of Medicine.

several previous EMSC prioritization lists. With regard to the topic areas common to all lists, participants in the PECARN prioritization process felt that PECARN possesses a unique ability to answer long-standing treatment controversies largely due to the network's ability to conduct randomized controlled trials and observational studies meticulously and on a large scale.

Several research priorities, however, were highly ranked in the PECARN prioritization process that either were not identified or were ranked lower by some or all previous EMSC research prioritization processes. These included the development of prediction rules for high-stakes, low-likelihood conditions; medication error reduction; development of treatment protocols; mental health emergencies; and the investigation of racial/ethnic/class health care disparities in EMSC care. Several items initially ranked highly in importance in the PECARN process were reprioritized by the Hanlon Process based on the individual item's apparent appropriateness for research in the multicenter research environment. Top among these was the reprioritization of prediction rules for high-stakes, low-likelihood diseases. The changes in priority resulting from the Hanlon Process reflect the potential of multicenter research to better investigate certain topics than others. The applicability of these topics to multicenter research was a practical and important component of our prioritization process.

There are several other notable aspects of the PECARN priority list. Specific emphases on mental health emergencies, health care disparities, and medical error reduction likely reflect new priorities for health care in general. Best practices, treatment algorithms, and practice guidelines were also identified as research priorities on the PECARN list. This reflects PECARN's mission and commitment to identifying and disseminating evidence-based practices in EMSC. The relatively low feasibility scores for these entities, however, prevented them from being higher on the final priority list. We believe that the relatively low feasibility scores for these three entities reflects the need for further development of methodologies to promote and measure behavior change and knowledge translation in the EMSC practice communities.[16] It may also reflect the participants' awareness of variation in practice between institutions.

The passionate minority identified research in out-of-hospital care and trauma care as important additional priorities, which other participants agreed on but felt were implicitly included in other priority topics. There is a particular lack and need of high-quality out-of-hospital research, well recognized by the participants of the PECARN process. Out-of-hospital EMSC research is limited by low prevalence of adverse outcomes, similar to pediatric ED care.[6] Very few pediatric out-of-hospital encounters require advanced life support interventions such as intubation, making it difficult to amass the necessary sample sizes to study these interventions at single centers.

There are several barriers that limit the ability to conduct high-quality, useful, and generalizable studies in EMSC. Among the most significant of these is that serious adverse outcomes are relatively uncommon in EMSC, limiting the ability of a single institution or even

a small group of institutions to enroll sufficiently large numbers of patients to test important clinical hypotheses regarding outcomes in EMSC with adequate power. In addition, even if sufficient patient volume were available at one institution, the lack of patient diversity at any particular institution limits the generalizability of findings to other institutions and EMSC settings. Furthermore, the relatively chaotic environment of emergency care settings makes organized, meticulous research difficult to conduct. Despite these constraints, an evaluation of pediatric emergency medicine (PEM) research published between 1987 and 1999 revealed that only 3% of published PEM abstracts were the result of multicenter clinical trials.[17] It is clear that more EMSC research is needed that utilizes research consortia to generate relevant and generalizable data to inform evidence-based practice in PEM. We offer a consensus-derived agenda as well as methodology for considering EMSC research priorities in the context of a research consortium such as the PECARN. This prioritization process could be used for generating research priorities in other multicenter research networks as well. Finally, we recognize that PECARN is a valuable research resource that should be available to all investigators studying acutely ill and injured children, as we have described previously.[9] With this prioritization process, we sought to help guide investigators outside of PECARN when submitting high-priority proposals for consideration of implementation to PECARN.

LIMITATIONS

As in all consensus-building processes, not all topics that were suggested could be listed on a priority list. We recognize that the resulting list is a reflection of the background and training of the participants and that there is disproportionate participation of PEM physicians in PECARN, whereas most children cared for in the ED setting are cared for by general ED physicians.[7,18] Furthermore, this consensus process was completed before the publication of the IOM report on the future of EMSC in 2006.[7] That report, although not specifically identifying a research priority list for EMSC, emphasized the need for multicenter research in EMSC. In addition, both the need for injury prevention research and the need for out-of-hospital research were highlighted.[7] Both of these topics were either highly ranked on the PECARN research priority list or identified prominently by the passionate minority in the process. Finally, there was no representation by pediatric emergency care nurses or out-of-hospital providers or other experts not intimately involved with the PECARN network. Although involvement of such individuals may have made the research priorities more robust, the process focused on multicenter research in EMSC in general and was not based on the idiosyncrasies of PECARN itself.

CONCLUSIONS

The EMSC research priorities identified by the PECARN prioritization process emphasize the unique characteristics of this collaborative research network. PECARN has the capacity to answer long-standing treatment controversies largely due to the network's ability to conduct randomized controlled trials and observational studies on a large scale.

In addition, the large number and diversity of patients in PECARN allows the network to create prediction rules for high-stakes, low-likelihood diseases. These unique PECARN characteristics are reflected in the priority list generated. The priority list also reflects PECARN's capacity to effectively organize and execute important EMSC research. This research may include such critical topics as 1) conducting randomized clinical trials in specific areas (respiratory illnesses, seizures, trauma, mental health) and developing clinical decision rules; 2) developing and disseminating best practices/treatment algorithms to meet new IOM priorities of reducing medical errors and important health care disparities and promoting disaster-preparedness; and 3) improving the infrastructure for coordination of out-of-hospital care with the rest of the EMSC care continuum.

Fundamental to the success of this network is the dissemination of best practices to the EMSC practitioner community. As the PECARN network continues to mature, we will continue to update and refine this priority list, incorporating broad input from EMSC stakeholders. We will also focus on the process of translating research findings into practice, both through translational research studies and through partnerships with key organizations.

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Appendix A

Participants are listed in alphabetical order: E. Alpern, S. Atabaki, M. Badawy, J. Callahan, J. Chamberlain, A. Cooper, H. Corneli, P. Dayan, J. M. Dean, M. Gerardi, T. Glass, J. Goepp, M. Gorelick, M. Gregor, R. Holubkov, J. Hoyle, D. Jaffe, N. Kuppermann, R. Lichenstein, K. Lillis, P. Mahajan, R. Maio, N. C. Mann, S. Miller,* F. Moler, D. Monroe, R. Ruddy, N. Schamban, K. Shreve, M. Shults, T. Singh, R. Stanley, J. Suhajda, S. Teach, D. Treloar, J. Tsung, M. Tunik, A. Walker, S. Wojcik, S. Zuspan (*deceased)

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