Creating Consensus Educational Goals for Pediatric Sepsis via Multicenter Modified Delphi

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ABSTRACT

Clinical care of pediatric sepsis depends on early recognition and basic initial steps and thus focused educational materials for providers in these early phases of care are needed. The authors sought to identify educational goals and establish a framework for those materials.

The authors conducted a Delphi process to create consensus educational goals for the recognition and treatment of pediatric sepsis, focused on the needs of emergency and acute care providers. Experts in pediatric sepsis quality improvement and education were recruited. In each round the experts determined if a particular goal was appropriate for inclusion and provided edits if required. Free-text responses and additional goals were accepted. The primary author deidentified and collated the responses and distributed an updated list of goals prior to each round.

Five experts participated in the Delphi process. After three rounds the panelists unanimously agreed on 14 educational goals. These goals include three on recognition, five on early treatment, three on treatment response, and three on continued treatment.

Using a Delphi process the authors established a list of educational goals for pediatric sepsis care. The experts largely agreed upon the initial set of goals and quickly came to consensus on the majority of topics. This highlights a foundation for any future educational interventions. In addition to creating content standards for pediatric sepsis education, this Delphi process represents a useful tool that may be adaptable to educational content development in other topics.

Sepsis in pediatric patients causes more than 75,000 hospitalizations per year in the United States, with an in-hospital mortality rate as high as 20%.^{1,2} International guidelines for management of pediatric sepsis have been established and emphasize early recognition and rapid treatment. Clinical care of these patients thus requires focused education of emergency and acute care providers on these early steps.^{3–6} Systematic emergency department (ED) quality improvement (QI) programs including direct provider education have improved care and outcomes of pediatric sepsis.^{7–9} Some educational materials regarding

pediatric sepsis were widely available at the time of this work.¹⁰ However, the authors and Delphi participants reviewed the known materials and determined that there was not agreement on educational goals specific to the recognition and treatment of pediatric sepsis. Identifying educational goals is a necessary first step toward developing appropriate educational materials for this population.

The Delphi method is used to achieve expert consensus where there is a lack of published studies.¹¹ It is predicated on the concept that pooled knowledge can capture the collective opinion on a particular

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subject and can be used for a wide range of projects including goal setting, policy determination, and assessment recommendations.^{12,13} The Delphi method is particularly noted for its strength in eliciting consensus while avoiding dominant influences of a particular personality or reputation.^{12,13} The lack of a published educational framework for pediatric sepsis makes this a good candidate for the use of the Delphi process.

METHODS

The authors used a modified Delphi method to develop consensus educational goals. The Delphi method uses an iterative process of individual survey of expert opinion, anonymous summary of responses, and group feedback of the responses, to converge on shared expert opinion.^{11–15} To develop the initial list of educational goals, the authors reviewed existing guidelines.^{4–6,10} Major themes were chosen as the initial seeds for the list of educational goals. In each round experts decided if each goal was appropriate for inclusion and gave free-text justification. The experts could identify any edits or new goals that should be added to the list. The primary author compiled and deidentified all responses. In subsequent rounds the primary author distributed a summary of results and the experts again evaluated any goals where consensus did not exist. After each round any goal that reached consensus for inclusion was removed from further comment. The authors chose a priori to limit the process to three rounds to improve feasibility and facilitate completion.

Experts were recruited through membership in the education subgroup of the Pediatric Septic Shock Collaborative (PSSC) of the American Academy of Pediatrics (AAP) Section on Emergency Medicine. Existing guidelines center on hemodynamic management of septic shock and primarily focused on intensive care treatment. We sought to concentrate on the care of sepsis patients prior to arriving in the intensive care unit (ICU). To be eligible to participate, experts were required to be board certified in either pediatric critical care medicine or pediatric emergency medicine, be a leader in their institution's sepsis QI or educational programs, and be a member of the education subgroup of the PSSC. Of the eight eligible members of the education subgroup, five agreed to participate. At the start of the Delphi process, the panel members had published a median of 12 peer-reviewed publications each, relevant to emergency care of sepsis in

children, and had a median of 5 years of experience since completing fellowship. Included among the experts were members of the American College of Critical Care Medicine (ACCM) Septic Shock Guidelines 2016 writing group, Pediatric Advanced Life Support (PALS) 2015 writing group, AAP Septic Shock Collaborative Advisory Council, Surviving Sepsis Campaign's Pediatric Guidelines Panel, and the Children's Hospital Association Improving Pediatric Sepsis Outcomes Expert Advisory and Steering Committees. Four of the experts worked primarily in an emergency setting and the remaining expert was dual appointed in pediatric critical care and pediatric emergency medicine.

There is no universally recognized threshold to define consensus within a Delphi process so consensus was defined as a simple majority of panelists.^{11,13,15} At the conclusion of the three rounds experts prioritized the goals and all experts approved a final list with goals ranked by order of emphasis.

RESULTS

Overall there was agreement on the original list of educational goals. During the first round, four of five experts suggested the same new goal, and it was thus included. From the original list, one goal was removed, two new goals were added, and four other goals had conceptual revisions (Data Supplement S1, available as supporting information in the online version of this paper, which is available at <http://online.library.wiley.com/doi/10.1002/aet2.10123/full>). After three Delphi rounds the panelists were unanimous on the inclusion of 14 educational goals as necessary for an educational intervention (or product; Table 1).

The process identified three additional themes for potential inclusion. The experts deemed these to be important enough to discuss in this article but to have insufficient or inconclusive evidence to include. These themes are time to treatment, role of transfusion, and choice of sedative for intubation.

All experts agreed that time to treatment was an important point to address and should be included in the goals. However, they disagreed on which specific times to include or when "time zero" should be. Prior guidelines had recommended specific fluid volumes and timing.^{4,6} The 2015 PALS update decreased the emphasis on specific fluid volumes and timing goals and instead emphasized the importance of individualized treatment. The 2017 ACCM

Table 1
Consensus Sepsis Education Goals

1. Recognize the following as signs of possible septic shock requiring action: tachycardia, abnormal capillary refill, abnormal mental status, systolic hypotension, widened pulse pressure, elevated lactate.
2. Initiate early IV access, with large diameter and short length preferred.
3. Initiate IV fluid resuscitation with the appropriate agent and volume.
4. Deliver IV fluids rapidly using rapid delivery system and specifically not with an IV pump.
5. Deliver appropriate antibiotics within 60 minutes of sepsis recognition.
6. Recognize appropriate response to fluid therapy by normalization of or improvement in heart rate, blood pressure, capillary refill time, lactate, and/or urine output.
7. Continue fluid resuscitation and prepare for potential vasoactive agent requirement when septic shock persists despite appropriate initial rapid fluid resuscitation.
8. Recognize fluid overload during resuscitation and appropriately choose adjunctive therapy.
9. Initiate vasoactive infusion, through any access available, when hypotension is present despite appropriate rapid fluid resuscitation.
10. Obtain blood culture prior to giving antibiotics.
11. Recognize and correct hypoglycemia.
12. Differentiate warm vs. cold shock and choose appropriate pressors\ for each.
13. Consider corticosteroids in catecholamine-resistant shock. Recognize recent steroid use as a risk factor for cortisol deficiency. Treat and test appropriately.
14. Recognize and correct hypocalcemia
Additional Considerations
<i>These topics may need to be addressed by educational materials but were deemed to have insufficient evidence or to have too many controversies to include in the above list. Consider evolving evidence and local standards.</i>
a) Specific goal for time to treatment.
b) Role of blood product transfusion.
c) Choice of sedative for intubation.

guidelines focused largely on institutional bundles of care and did not recommend specific timing goals for fluid therapy.¹⁶ In addition, there has been controversy over the potential harm relating to the rapidity of those boluses¹⁷ or the provision of fluid boluses at all.¹⁸

Specific hemoglobin targets exist in some adult and pediatric sepsis guidelines, but more recent data have shown some concern regarding these targets. One expert summarized the current adult literature, on which pediatric guidelines are based, saying “This was always controversial and [the hemoglobin goal] is higher than the evidence-based transfusion thresholds for all other critical illness. PROCESS¹⁹ definitively showed you can achieve the same outcomes without transfusion, and spares an infectious exposure and

costly resource . . . Even if it’s in [existing] guidelines, we can’t ignore higher-quality, more recent evidence.”

Finally, etomidate has historically been recommended against in pediatric septic shock^{20,21} and ketamine has been a frequent choice as a sedative during intubation in pediatric septic shock. However, there was concern that ketamine could not be explicitly recommended given that ketamine is a direct myocardial depressant, an effect noted clinically predominantly in patients who are catecholamine depleted who do not benefit from the catecholamine release typically seen with ketamine use.

We addressed these three controversies in the following ways: rather than a goal referencing specific universal timing, several goals are included referring to “early” and “rapid” care; given the known uncertainties in the advanced therapies discussed above, the authors preferred to allow institutions to choose their recommendations internally and remain open to emerging recommendations and evidence. To ensure that users are aware of these controversies, we included them under a subheading on our list of goals.

DISCUSSION

Using a modified Delphi process the authors established a list of educational goals for the teaching of pediatric sepsis care. These goals encompass recognition, early treatment, evaluation of response to initial treatment, and continued treatment. The expert panel largely agreed upon the initial set of goals, and quickly came to consensus on the majority of the topic areas. This highlights a consistent base for any future educational interventions in this area. Experts agreed to include timeliness of care, but in consideration of the target learner, the changing research landscape, and lack of consensus, chose not to emphasize specific time goals. Among various guidelines and clinical QI initiatives, the definition of when to start measuring time and the provision of specific time goals are the subject of significant debate and ongoing research.^{4–6,18,19,22,23} Emphasizing rapid but individual care addresses these concepts and also allows for inclusion of future guidelines and research insights. Regarding transfusion and intubation medication, these advanced topics fall outside of the target of these educational goals. When breaking down a complex set of guidelines and research into a focused educational framework, in a setting with areas of limited or conflicting research, a balance must

be struck between strict specificity and remaining flexible to future evidence. However, the authors do suggest that any education include discussion of the current controversies and the need to tailor the approach to the individual patient.

LIMITATIONS

Some of the limitations of this study are inherent to the Delphi method. No specific threshold is defined for “consensus” and the a priori choice of a simple majority required only a small number of panelists to agree. Although drawn from multiple disciplines, the expert panel was composed primarily of emergency medicine providers. This may lead to an overemphasis on issues pertinent to the ED setting, although at the outset these goals were targeted to providers of emergent or acute care, rather than focusing on the ICU.

CONCLUSION

These consensus guidelines provide a useful framework for the development and evaluation of an educational intervention regarding pediatric sepsis. In addition to creating national content standards for pediatric sepsis education, this Delphi process represents a useful tool that may be adaptable to educational content development in other topics. Further evaluation is needed to determine how generalizable these goals will be.

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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/aet2.10123/full>

Data Supplement S1. Eliminated themes and explanation.