Pediatric critical care community survey of knowledge and attitudes toward therapeutic hypothermia in comatose children after cardiac arrest

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Objective: Therapeutic hypothermia improves neurologic outcome and survival after adult out-of-hospital cardiac arrest. To help us design a prospective hypothermia trial in children, we developed a survey to assess current knowledge and attitude of pediatric critical care providers regarding therapeutic hypothermia and potential impediments to implementing a prospective study.

Design: Anonymous survey.

Setting: Internet-based survey of pediatric critical care community.

Interventions: None.

Results: A total of 159 responders completed the survey. Most respondents (92%) were fellowship-trained in pediatric critical care, with 9.9 ± 6.5 yrs of experience. Many (85%) worked in the United States; 89% were in large tertiary care centers with residency or fellowship training programs. Most (65%) were aware of the adult randomized trials of therapeutic hypothermia, but only 9% (always) or 38% (sometimes) utilize this therapy. The most common reason to use hypothermia was likelihood of patient recovery, absence of life-limiting disease, and presence of coma for ≥1 hr after resuscitation. The majority of responders using therapeutic hypothermia cool their patients to 33–35°C for a duration ranging from as short as 12 hrs to as long as 96 hrs; 91% do not actively rewarm the patient. A majority (81%) agree that a randomized, controlled trial of therapeutic hypothermia in children is ethical, and 95% would be willing to randomize their patients. Finally, 81% thought that therapeutic hypothermia should be studied in other ischemic insults and not just cardiac arrest.

Conclusions: Despite widespread awareness of therapeutic hypothermia’s beneficial effects after arrest, it is not widely used by pediatric critical care clinicians sampled in our survey. Among those using hypothermia, there is wide variation in methodology and end points of therapy. This seems to result from a lack of evidence, difficulty with the technique, and unavailability of explicit protocols. Pediatric studies are needed to assess the safety, feasibility, and effectiveness of therapeutic hypothermia after cardiac arrest and other causes of brain injury. (Pediatr Crit Care Med 2006; 7:7–14)

Key Words: infant; child; critical care; heart arrest; hypothermia; data collection

Survival with good neurologic outcome at hospital discharge is rare after out-of-hospital cardiac arrest (1–5). Therapeutic hypothermia improves survival and neurologic outcome after cardiac arrest in numerous animal and preliminary clinical studies (6–13). Recently, two prospective, randomized, controlled clinical trials were conducted in adults. In the Australian study (14), an out-of-hospital ventricular fibrillation cardiac arrest population with coma were randomized in the field by Emergency Medical Services providers to hypothermia or normothermia. Good outcome (survival and good functional recovery) was observed in 21 of 43 hypothermic patients (49%) vs. 9 of 34 normothermic patients (26%) (p = .046; number needed to treat = 5 [95% CI, 2.3 to 81]) (14). A larger European trial (15) showed favorable neurologic outcome at 6 months with use of therapeutic hypothermia after out-of-hospital ventricular fibrillation cardiac arrest (75 of 136 [55%]) compared with the normothermic group (54 of 137 [39%]). The risk ratio for this study was 1.40 (95% confidence interval, 1.08 to 1.81) and the number needed to treat was 7 (95% confidence interval, 3.6–25) (15). Subsequently, the International Liaison Committee on Resuscitation (ILCOR) recommended the use of therapeutic hypothermia for adult patients with anoxic brain injury after out-of-hospital cardiac arrest (16). There was no recommendation for its use in children because of lack of data.

Preliminary reports in neonates showed that hypothermia is feasible, safe, and has some beneficial effect on neurologic outcome (17–19). There are several randomized, controlled trials of therapeutic hypothermia in neonates with perinatal asphyxia. The Cool-cap study demonstrated that neonates with moderately severe brain injury, as determined by amplitude-adjusted electroencephalogram (EEG), had a significantly reduced likelihood of death or severe disability at 18 months (20). There also are promising results reported in preliminary clinical studies of induced hypothermia in patients with severe stroke, (21) neurologic infection (22, 23), and hepatic encephalopathy (24).
Further studies are needed to evaluate the effectiveness of therapeutic hypothermia in children. The design of these studies should account for current pediatric intensive care unit (PICU) practice and attitudes of intensivists regarding the appropriateness of conducting a randomized clinical trial in a high-risk population. Specifically, because there are convincing data in adults and early data showing a beneficial effect of therapeutic hypothermia in newborns, is there still clinical equipoise to conduct a randomized, controlled trial in children? This survey was designed to answer these questions as part of a planning project for a multiple-center, randomized, controlled trial of therapeutic hypothermia for comatose survivors of pediatric cardiac arrest. We designed a survey instrument to gather information in the following areas from the pediatric critical care community: 1) How many physicians are aware of and use therapeutic hypothermia in children after cardiac arrest? 2) If hypothermia was used, what was the methodology related to timing, duration, method of induction, and rewarming? 3) What was the consensus on the need for a randomized trial and willingness to participate if a trial was conducted?

### MATERIALS AND METHODS

The study protocol was approved by the University of Florida Health Science Center Institutional Review Board. The study was deemed compliant with the Health Insurance Portability and Accountability Act of 1996 (HIPPA) regulations.

#### RESULTS

**Survey Respondent Demographics.** There were 370 visits to the survey site and 159 surveys completed. As shown in Table 1, most of the respondents (92%) were fellowship-trained in pediatric critical care. A total of 33 responders (21%) received training in areas other than pediatric critical care. Only nine (6%) are currently in fellowship training. The mean years of critical care experience was 9.9 ± 6.5 yrs (median, 9 yrs; range, 0–30 yrs).

The mean number of pediatric ICU beds reported by survey responders was 20 ± 11.4, with a range of 4–80 beds. This question asked for the total number of ICU beds where children are admitted, recognizing that in some centers this may represent more than one physical ICU area. The total annual number of pediatric ICU admissions per year ranged from 100 to 3,750, with a mean of 1,066 ± 569. Two thirds of the responders indicated that their unit admits postoperative open-heart surgery patients.

Most of the respondents (89%) worked in units with resident physicians, whereas 49% worked in a PICU with fellows. Most respondents (85%) were from the United States, with 4% each from Europe and Australia–New Zealand, 3% from Canada, 2% from South America, and 1% each from China, Africa, and Central America.

**Knowledge and Attitude About Therapeutic Hypothermia.** Overall, 65% of respondents stated that they were very familiar or familiar with the adult therapeutic hypothermia trials, but relatively few (9%) consistently apply hypothermia in comatose children after return of spontaneous circulation. An additional 38% of responders indicate they use hypothermia sometimes. The most commonly reported indication for using hypothermia is the likelihood of postarrest recovery (61% of responses). Absence of life-limiting disease (43%) and presence of coma for ≥1 hr (32%) were additional relatively common indications.

Of the 90 responders who cool patients at least sometimes, the target temperature covered a wide range, as seen in Table 2. The duration of cooling also covered a wide range; 45 of the 69 responders cool for 12–24 hrs (Table 3). Only 8 of 69 (11.6%) cool for ≥48 hrs. Once cooled, the vast majority (91%) do not actively rewarm the patient.

Most respondents (97%) actively in-

### Table 1. Demographic data of responders

<table>
<thead>
<tr>
<th>Level of training</th>
<th>Fellowship-trained in pediatric critical care</th>
<th>Fellowship-trained in areas other than pediatric critical care</th>
<th>Currently in subspecialty training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>92%</td>
<td>21%</td>
<td>6%</td>
</tr>
<tr>
<td>Years in practice posttraining</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postfellowship in critical care</td>
<td>9.9 ± 6.5</td>
<td>10.3 ± 8.3</td>
<td></td>
</tr>
<tr>
<td>Postfellowship training in other specialties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediatric intensive care unit (PICU) characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of beds in PICU</td>
<td>20 ± 11.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of PICU admissions per year</td>
<td>1066 ± 569</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of PICUs that admit postoperative open heart surgery patients</td>
<td>66%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staffing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICU has residents in training</td>
<td>89%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PICU has fellows in training</td>
<td>49%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic distribution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>85%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe, Australia, and New Zealand</td>
<td>12% (4% each)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South America</td>
<td>2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa and Central America</td>
<td>2% (1% each)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where appropriate, data are expressed as mean ± SD.
randomize children into a hypothermia (22%) that it is ethically appropriate to controlled trial. Overall, many responders ing the ability to conduct a randomized, controlled trial comparing hypothermia (56%) or strongly agree (25%) that an randomized trial comparing hypothermia with normothermia in pediatric cardiac arrest is still ethical. Because it is impossible to blind providers to the use of hypothermia, 49% of responders realized that this may introduce bias, complicating the ability to conduct a randomized, controlled trial. Overall, many responders either agreed (53%) or strongly agreed (22%) that it is ethically appropriate to randomize children into a hypothermia treatment trial using waiver of informed consent.

Study Methodology. There was no consensus on whether children randomized to a normothermia study group should be actively rewarmed to normal core temperature if they were initially hypothermic. Thirty-nine percent thought they should never be rewarmed, 18% thought that they should be rewarmed sometimes, and 42% thought they always should be rewarmed.

Because at least one of the neonatal trials stratified patients into risk groups based on their EEG early after perinatal asphyxia (20), the ability to obtain an EEG may be important in designing a prospective trial in children. Most respondents can obtain an EEG 24 hrs/day (70%). Despite the general availability of an EEG, just 18% frequently or always use a continuous EEG or processed EEG to monitor comatose children after a cardiac arrest. Only 22% frequently or always load with an anticonvulsant as part of postarrest management. Most respondents (71%) always or frequently obtain a computerized tomographic scan or magnetic resonance imaging of the head within the first 72 hrs after the arrest in children who survive for >24 hrs.

Most (75%) are willing to use neuromuscular blockers in postarrest patients being cooled to prevent rigors, and 74% frequently or always attempt to achieve tight glucose control in critically ill patients, such as those after cardiac arrest. Of note, 84% would either strongly agree (25%) or agree (59%) with using a standardized treatment protocol to minimize confounding variables in a treatment trial. Somewhat fewer (67%) thought that their partners would comply with a standardized treatment protocol. In addition, 71% would either strongly agree (19%) or agree (52%) with randomizing children into a hypothermia treatment trial that investigates the effect on outcome of different durations of hypothermia or different methods of inducing hypothermia rather than a comparison of hypothermia with normothermia. Finally, 81% thought that therapeutic hypothermia should be studied in other non–cardiac arrest ischemic insults, as shown in Table 4.

**DISCUSSION**

Our study shows that a majority of survey participants from the pediatric critical care community are aware of the recent evidence showing a beneficial effect of hypothermia on survival and neurologic outcome after cardiac arrest. Despite this high level of familiarity and the recent International Liaison Committee on Resuscitation (ILCOR) statement (16), use of hypothermia in children is uncommon. Several factors may account for this discrepancy. First, most published evidence is in adults with ventricular fibrillation cardiac arrest and cannot be simply extrapolated to children. Although neonatal trials exists, many of these patients experienced perinatal asphyxia and were not in cardiac arrest at birth but rather in low cardiac output states, severely hypoxic, or both and thus are not directly comparable with pediatric cardiac arrest. In addition, the arrest pathogenesis in neonates does not cover the range of conditions seen in older children, and the duration of perinatal ischemia is likely to be quite variable, depending on whether the cause is related to factors preceding birth. Second, there are no published guidelines recommending the use of therapeutic hypothermia in pediatric cardiac arrest. Finally, there is a lack of consensus on the most effective and safest method to cool, which children should be cooled, how patients should be monitored while cool, the depth and duration of cooling, and the method of re-warming, to name a few of the protocol and technical issues that need to be considered in a treatment trial.

Among those who utilize hypothermia, there is poor agreement regarding the effectiveness of this therapy and the depth and duration of cooling. In addition, there is a lack of consistency in its application to specified patient groups. Our survey suggests that the lack of criteria for application of therapeutic hypothermia is a likely reason for its inconsistent use. As suggested by animal data, hypothermia needs to be achieved within 2–6 hrs of injury to be beneficial (26, 27). Another study suggested no benefit of hypothermia when it was induced within 8 hrs of traumatic brain injury (28). Thus, the earlier hypothermia is induced, the better its protective effect. Currently, most studies utilize surface cooling with ice packs or a cooling blanket (14, 15, 17–19). This approach is slow and logistically difficult, especially in busy emergency departments. An intriguing alternative is the rapid administration of a sizeable bolus of ice-cold isotonic intravenous fluid, which was well tolerated in

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**Table 2. Target temperature used for therapeutic hypothermia**

<table>
<thead>
<tr>
<th>Range of Temperature, °C</th>
<th>No. of Responses, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36–37</td>
<td>3 (3)</td>
</tr>
<tr>
<td>35–36</td>
<td>19 (21)</td>
</tr>
<tr>
<td>34–35</td>
<td>37 (41)</td>
</tr>
<tr>
<td>33–34</td>
<td>24 (26)</td>
</tr>
<tr>
<td>32–33</td>
<td>8 (9)</td>
</tr>
<tr>
<td>&lt;32</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
</tr>
</tbody>
</table>

Respondents could select more than one target temperature range.

**Table 3. Duration of cooling**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Frequency, n</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>12–24</td>
<td>2</td>
</tr>
<tr>
<td>24–36</td>
<td>3</td>
</tr>
<tr>
<td>24–48</td>
<td>13</td>
</tr>
<tr>
<td>48</td>
<td>4</td>
</tr>
<tr>
<td>48–72</td>
<td>2</td>
</tr>
<tr>
<td>48–96</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
</tr>
</tbody>
</table>
Table 4. Non-arrest conditions that respondents would consider studying if the affected child was comatose after the event

<table>
<thead>
<tr>
<th>Non-Arrest Condition</th>
<th>No. of Responses, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traumatic brain injury</td>
<td>128 (88)</td>
</tr>
<tr>
<td>Drug-refractory status epilepticus</td>
<td>50 (34)</td>
</tr>
<tr>
<td>Intracranial hemorrhage (e.g., AVM)</td>
<td>42 (29)</td>
</tr>
<tr>
<td>Thrombotic stroke (e.g., patient with sickle cell disease)</td>
<td>27 (19)</td>
</tr>
<tr>
<td>Embolic stroke (e.g., patient with R-L shunt)</td>
<td>37 (19)</td>
</tr>
<tr>
<td>Comatose patient with encephalitis</td>
<td>22 (15)</td>
</tr>
<tr>
<td>Comatose patient with bacterial meningitis</td>
<td>17 (12)</td>
</tr>
<tr>
<td>Hepatic encephalopathy</td>
<td>16 (11)</td>
</tr>
<tr>
<td>Other</td>
<td>15 (10)</td>
</tr>
</tbody>
</table>

AVM, arteriovenous malformation; R-L shunt, right-to-left shunt. Multiple responses were permitted, as evident in the total number of responses; the percentage of responses is the percentage of the total responders (n = 145) who chose at least one category.

...a preliminary trial in adults and rapidly lowered core body temperature (29).

Animal models of hypoxic–ischemic injury suggest the optimum temperature for neuroprotection is between 32°C and 34°C (30). Below this range, there is increased risk of infection, coagulopathy, thrombocytopenia, renal impairment, and pancreatitis (31, 32). Our survey suggests that although there is a wide variation, the majority who cool their patients select a target temperature in the range of 33–35°C. There is no consensus on the duration of hypothermia, and the rate of rewarming is not actively controlled in most units. Most respondents indicate that they try to not rewarmed faster than 1°C/hr, but they admit this is often difficult to control. This variation in rewarming may result from a balanced concern about the known adverse effects of hypothermia on immune function and therefore a desire to minimize the duration of hypothermia balanced by animal and suggestive human data showing that rapid rewarming is associated with greater brain injury. Some experts believe that the benefit of hypothermia observed in a single-center traumatic brain injury study from Pittsburgh (12) occurred because the controls were actively rewarmed at 1°C/hr if they presented with hypothermia. In the subsequent multiple-center trial that failed to demonstrate an overall beneficial effect from hypothermia (28), hypothermic control patients were rewarmed at 0.25°C/hr.

Most respondents thought that a trial of therapeutic hypothermia was important and needed to be studied to gauge the long-term neurologic outcome in children and to gather more convincing data on its safety and effectiveness. Responders realized that the lack of blinded may introduce bias, complicating the ability to conduct a randomized, controlled trial. They also recognized the benefits of initiating hypothermia quickly after return of a stable circulation in adults. Although controversial, they thought it would be ethically appropriate to enroll children in a therapeutic treatment trial using waiver of informed consent. Most would agree to participate in a randomized trial, although interestingly, some of these respondents did not have clinical equipoise regarding the value of therapeutic hypothermia after cardiac arrest.

The majority indicate they would be willing to use a standardized treatment protocol in children with coma after cardiac arrest. This is a key commitment for this type of study because variations in ICU care, such as goals for ventilation, treatment of postarrest myocardial dysfunction, and maintenance of blood glucose concentrations, could influence patient outcome independently of the effects of therapeutic hypothermia. Our survey showed variation in other management interventions, like the routine use of EEGs in postarrest patients, brain imaging studies like computerized tomographic scanning or magnetic resonance imaging, tight glucose control, use of neuromuscular blockade, and prophylactic use of anticonvulsants in postarrest patients. Only 18% of the respondents perform EEG evaluation routinely in postarrest patients, although an adult study showed that, overall, 8% of patients in coma (many of whom had a hypoxic or ischemic pathogenesis) had nonconvulsive status epilepticus (33). The rate of nonconvulsive status epilepticus is unknown in comatose children postarrest, which may explain the low rate of prophylactic treatment for seizures, as reported in our survey. A recent study suggested that early head magnetic resonance imaging is useful to help predict outcome in children with hypoxic coma (34). This may have potential value in assessing risk group and outcome for study design.

There are a few limitations of our study. This survey reflects practices prevalent at the time of the survey, which may change as more evidence is published regarding this treatment modality in different population groups. The response rate for our survey was low (about 12%) of the total subscribers. This calculation assumed that all the PICU list subscribers are active, which is likely not the case. In addition, a wide range of providers may subscribe to the Listserver, whereas the vast majority of responses came from physicians. Thus, the 12% response is a “worse-case scenario.” The recently published e-mail survey of hypothermia in adult cardiac arrest (35) found that 40% of the 2,000 e-mails they initially selected were not functional. Of the remaining 1,400 e-mail survey requests, their response rate was 19%. Thus, we believe that our response rate is similar to that obtained by Abella et al. (35) and others, particularly because most of our respondents were physicians, whereas nurses and respiratory therapists also subscribe to the PICU list. Unfortunately, we have no way of knowing the exact distribution of list members and how many are still active participants. The majority of our survey respondents were from large hospitals and teaching centers, which may bias the degree to which therapeutic hypothermia is used and may not be generalizable to the entire pediatric intensive care community. Moreover, because the responses were anonymous, we have no way of knowing how representative the responders are of the opinions and approaches used by pediatric intensivists nationally or internationally.

CONCLUSIONS

In summary, we found that the sampled pediatric critical care community, although aware of the beneficial effect of therapeutic hypothermia postarrest, is not widely applying this treatment modality currently. This likely results from the lack of evidence in children, difficulty with the technique, and unavailability of explicit validated treatment protocols. The sampled pediatric critical care com-
munity recognized the need for a randomized, controlled trial to evaluate the effectiveness of therapeutic hypothermia, and most are willing to participate in such a study. Pediatric studies are needed to assess the safety, feasibility, and efficacy of therapeutic hypothermia after cardiac arrest and other causes of brain injury.

REFERENCES

1. I am familiar with the details of the two adult trials using therapeutic hypothermia following out-of-hospital cardiac arrest.
   ○ Strongly agree
   ○ Agree
   ○ No opinion/neutral
   ○ Disagree
   ○ Strongly disagree

2. Based on the beneficial effects of hypothermia documented in numerous animal experiments and the results of these two adult trials, I currently induce therapeutic hypothermia in comatose children after return of spontaneous circulation after cardiac arrest (if you never induce hypothermia, skip to question 7).
   ○ Never
   ○ Sometimes
   ○ Always

3. On what basis do you select patients to cool (select all that apply)?
   ○ Likelihood of patient recovery after the arrest
   ○ Absence of life-limiting disease
   ○ Absence of need for vasoactive drug support
   ○ Presence of coma for ≥1 hr postresuscitation
   ○ Other, please specify

4. If you cool patients after arrest, what temperature range do you typically attempt to achieve (you may select more than one box)?
   ○ 36–37°C
   ○ 35–36°C
   ○ 34–35°C
   ○ 33–34°C
   ○ 33–32°C
   ○ <32°C

5. If you cool patients after arrest, how long do you typically keep them cool?

6. If you cool patients, do you actively rewarm them at the end of cooling?
   ○ Yes
   ○ No

7. How fast do you rewarm or allow patients to rewarm after cooling or after they come in cold (degrees Centigrade per hour)?

8. Indicate for which one or more of the following non-arrest conditions you would consider using therapeutic hypothermia after the event if the patient was comatose.
   ○ Embolic stroke (e.g., patient with right to left shunt)
   ○ Thrombotic stroke (e.g., patient with sickle cell disease and stroke)
   ○ Comatose patient with bacterial meningitis
   ○ Comatose patient with encephalitis
   ○ Drug-refractory status epilepticus
   ○ Traumatic brain injury
   ○ Intracranial hemorrhage (e.g., from an AVM)
   ○ Hepatic encephalopathy
   ○ Other, Please Specify

9. Do you actively intervene to prevent fever in postarrest patients (e.g., using cooling blankets, antipyretics, etc.)?
   ○ Yes
   ○ No

10. If you avoid fever in the postarrest patient, at what threshold temperature do you typically order interventions to reduce the temperature?

11. How do you monitor temperature in post-arrest patients (indicate all that are used)?
   ○ Bladder catheter temperature probe
   ○ Esophageal probe
   ○ Rectal temperature probe
   ○ Pulmonary artery catheter
   ○ Tympanic membrane temperature
   ○ Other, please specify

12. If a reasonable process is used for informed consent, would you be willing to randomize comatose postarrest patients to a therapeutic hypothermia vs. normothermia treatment trial?
   ○ Yes
   ○ No

13. Please enter your responses to the following questions by rating your agreement with the statement on a scale of 1–5, where 1 means strongly disagree and 5 means strongly agree.
   1. I believe the inability to blind providers of the treatment allocation may create bias and adversely affect the ability to conduct a randomized clinical trial of therapeutic hypothermia.
      ○ Strongly agree
      ○ Agree
      ○ No opinion/neutral
      ○ Disagree
      ○ Strongly disagree
   2. I have clinical equipoise regarding the value of hypothermia vs. normothermia following arrest.
      ○ Strongly agree
      ○ Agree
      ○ No opinion/neutral
      ○ Disagree
      ○ Strongly disagree
3. If the two multiple-center perinatal asphyxia trials demonstrate a beneficial effect on neurologic outcome, it is still ethical to compare hypothermia to normothermia in comatose, pediatric postarrest victims.
   - Strongly agree
   - Agree
   - No opinion/neural
   - Disagree
   - Strongly disagree

4. Based on many animal studies emphasizing the importance of early hypothermia after a hypoxic-ischemic insult to achieve a good outcome, it is ethically appropriate to randomize patients in a treatment trial using a waiver of informed consent to ensure that hypothermia begins as soon as feasible after patient stabilization.
   - Strongly agree
   - Agree
   - No opinion/neural
   - Disagree
   - Strongly disagree

14. Please enter your response to the following statements on a scale from 1 to 5, where 1 means never and 5 means always.

1. I am willing to use neuromuscular blockers in postarrest patients receiving therapeutic hypothermia to prevent rigors.
   - Always
   - Frequently
   - Sometimes
   - Rarely
   - Never

2. I attempt to achieve tight glucose control in critically ill intubated patients, such as patients after a cardiac arrest.
   - Always
   - Frequently
   - Sometimes
   - Rarely
   - Never

3. I use continuous electroencephalography or processed electroencephalographic monitoring in comatose cardiac arrest survivors.
   - Always
   - Frequently
   - Sometimes
   - Rarely
   - Never

4. I routinely obtain either a computed tomographic scan or magnetic resonance brain imaging study in the first 72 hrs in patients who survive >24 hrs after a cardiac arrest.
   - Always
   - Frequently
   - Sometimes
   - Rarely
   - Never

5. I load comatose survivors of cardiac arrest with an anticonvulsant even if seizures are not observed.
   - Always
   - Frequently
   - Sometimes
   - Rarely
   - Never

16. In a trial designed to test therapeutic hypothermia vs. normothermia, patients who are spontaneously hypothermic after the arrest should be rewarmed to normal core temperature if randomized to the normothermia group.
   - Never
   - Sometimes
   - Always

17. Please enter your responses to the following questions by rating your agreement with the statement on a scale of 1–5, where 1 means strongly disagree and 5 means strongly agree.

1. If I participated in a treatment trial of cardiac arrest patients, I would be willing to adopt a standardized treatment approach to organ system support to minimize confounding variables in the treatment trial.
   - Strongly agree
   - Agree
   - No opinion/neural
   - Disagree
   - Strongly disagree

2. My partners in the pediatric intensive care unit would agree to a standardized approach to organ system support.
   - Strongly agree
   - Agree
   - No opinion/neural
   - Disagree
   - Strongly disagree
3. I would be willing to randomize comatose children postarrest to a hypothermia treatment trial that compares different durations of hypothermia or different methods of inducing hypothermia rather than compared with a normothermic group.
   - Strongly agree
   - Agree
   - No opinion/neutral
   - Disagree
   - Strongly disagree

4. I believe that hypothermia should be studied in patients after other ischemic insults and not just after cardiac arrest.
   - Strongly agree
   - Agree
   - No opinion/neutral
   - Disagree
   - Strongly disagree

18. Are you able to obtain an electroencephalogram 24 hrs/day?
   - Yes
   - No

19. In the context of improving the quality and quantity of survivors of in-hospital pediatric cardiac arrest, do you think there is a more important therapy question other than the use of therapeutic hypothermia?
   - Yes
   - No

20. In addition to survival, what outcome(s) do you think should be used to determine if therapeutic hypothermia is effective? _____

21. Do you use extracorporeal membrane oxygenation (ECMO) in selected pediatric cardiac arrest patients?
   - Yes
   - No

22. If you use ECMO in cardiac arrest victims, have you ever induced hypothermia while administering ECMO to preserve brain function?
   - Yes
   - No

Please Provide Demographic Information Related to Your Training and Current Work Environment.

23. Are you fellowship-trained in pediatric critical care?
   - Yes
   - No

24. Did you receive fellowship or specialty training in area(s) other than pediatric critical care?
   - Yes
   - No

25. Are you currently in fellowship training?
   - Yes
   - No

26. Years of postfellowship practice in critical care: _____

27. Years of postfellowship practice in other clinical specialty area (if applicable): _____

28. Number of intensive care unit beds in your unit (Note: “Unit” in this and subsequent questions includes all beds in units with critically ill children that your team manages): _____

29. Approximate number of annual intensive care unit admissions in your unit: _____

30. Does your unit admit postoperative open-heart surgery patients?
   - Yes
   - No

31. Do you work in a pediatric intensive care unit with residents?
   - Yes
   - No

32. Do you work in a pediatric intensive care unit with fellows?
   - Yes
   - No

33. Please select the country or region where you currently work.
   - United States
   - Canada
   - Central America
   - South America
   - Europe
   - Africa
   - China
   - Japan
   - Russia
   - Southeast Asia
   - Australia/New Zealand