Effects of Pediatrician Characteristics on Management Decisions in Simulated Cases Involving Apparent Life-Threatening Events

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Objectives: To study variations in the way pediatricians would evaluate and manage an infant with an apparent life-threatening event.

Subjects and Methods: A survey was mailed to the chief residents of all pediatric residency training programs in the United States in which respondents were presented with a simulated case and asked how they would manage an infant who had experienced an apparent life-threatening event that did not require resuscitation. The survey also explored each physician's tolerance of uncertainty, knowledge of apparent life-threatening events, experience, fear of litigation, responsiveness to parental demands, and propensity to order tests.

Main Outcome Measures: Presumed decisions to prescribe antibiotics and/or order home apnea monitoring in a simulated case of an infant who had experienced an apparent life-threatening event not requiring resuscitation.

Results: Logistic regression analysis revealed 2 characteristics that made significant and independent contributions to respondents' presumed decision to prescribe antibiotics: (1) experience with an adverse outcome, and (2) propensity to order diagnostic tests. Presumed decisions to order a home apnea monitor were notably affected by fear of litigation.

Conclusions: These findings suggest that differences in pediatricians' characteristics contribute to variations in care. Efforts to make management more uniform must consider that decisions are influenced by a host of different characteristics and experiences.


In recent efforts to reduce cost, there has been increased emphasis on reducing variation in the delivery of health care, resulting in the development of numerous practice guidelines, consensus statements, and critical pathways. Various authors have attempted to analyze the factors that may contribute to variations in care. Most of this work has focused on physicians who provide services for adults and has not focused on the role of many features unique to pediatric practice, including interactions with parents and the uncertainties inherent in assessment of infants and children.

This study was designed to assess whether pediatricians would behave consistently when confronting a problem unique to the care of infants and children and to identify potential characteristics that might impact management decisions. Apparent life-threatening events (ALTEs) in infants, which have been defined by a National Institutes of Health Consensus panel as being “frightening to the observer and characterized by prolonged apnea ( >20 seconds in duration), color change (perioral cyanosis), and change in muscle tone (limpness)” are a problem unique to pediatrics. Apparent life-threatening events represent a condition for which there is observed variation in evaluation and management, and in which there is tremendous uncertainty for health care professionals. Physicians often cannot identify a specific origin for these events and must decide how to evaluate and manage them in the face of conflicting views in the international medical literature and in their own communities on children's subsequent risk of death from sudden infant death syndrome. While the ori-
SUBJECTS, MATERIALS, AND METHODS

Residency training programs in the United States providing training in categorical pediatrics were identified from the American Medical Association’s Graduate Medical Education Directory, 1988. A survey taking approximately 10 minutes to complete was addressed to the chief resident of each program, and included a cover letter stating that the survey was intended to identify how pediatricians approach evaluation and management of a common pediatric problem. Respondents were informed that all responses were anonymous and that they should assume that there were no correct or incorrect responses. No incentives were provided and respondents implied consent to participate in the study by filling out the survey. Chief residents were selected because of their unique position as pediatricians who have completed residency training and who are likely to be aware of current international medical literature due to their role as teachers. Furthermore, they were expected to have less variation in some of the measured characteristics that were hypothesized to influence decision making.

MATERIALS

The survey included a simulated case of a well-appearing 8-week-old infant who, according to the mother, had just experienced an ALTE. According to the simulated case, the child was now in the emergency department, appeared healthy, and had no clinically significant findings on physical examination. Respondents were asked to develop a differential diagnosis and list the studies they would order in evaluating this infant. They were asked whether they would hospitalize the infant, prescribe antibiotic treatment for presumed sepsis and, in the absence of further spells and/or a clear origin for the ALTE, whether they would order home apnea monitoring.

Based on a review of the international medical, physician’s knowledge base, responsiveness to patient demand, fear of litigation, experience with an adverse outcome, propensity to order tests, and tolerance of uncertainty were selected as physician characteristics that might provide insight into why variations in practice arise. As a surrogate marker for physician knowledge, the number of diagnoses in a differential diagnosis generated by the respondents that were included on a consensus list of appropriate diagnoses developed by the authors was summed. As a surrogate for responsiveness to parental demand, residents were asked whether they would order home apnea monitoring for another child for whom there were no indications (no risk factors, no history of apnea, and no family history of sudden infant death, but for which the parents were demanding “just in case.” The effect of fear of litigation on residents’ decisions was estimated using a 5-point Likert scale. Potential responses ranged from (value of 5) fear of litigation would significantly increase the services I prescribe to (value of 1) fear of litigation would significantly decrease the services I prescribe. Respondents also were asked whether they had been involved in the care of an infant who had experienced an ALTE and subsequently experienced sudden infant death (experience with an adverse event). Propensity to order tests was measured by summing the number of different tests each resident would order in the evaluation of the case. Single test items such as the level of serum sodium, chloride, or potassium were combined into a serum chemistry study that was considered as a single test. To assess the tolerance of uncertainty, residents were asked to record the highest indirect serum bilirubin level at which they would discharge (without follow-up serum bilirubin level determination) a vigorous 48-hour-old bottle-fed infant from the hospital with no blood group incompatibility. Hyperbilirubinemia often affects newborns and is a common pediatric problem with a wide divergence of opinion about management. In instances like the full-term infant with no blood group incompatibility where there is no historical or physical evidence that might influence what a physician chooses to do, there is a numerical value on which individuals must base their decisions.

DATA ANALYSIS

Comparison of respondents’ characteristics based on their presumptive decisions to start antibiotic therapy or order home apnea monitoring was performed using $\chi^2$ analysis. An a priori decision was made to use multiple logistic regression to identify independent predictors of these presumed decisions, even if some individual factors did not contribute to univariate differences. All statistical analyses were performed using a commercially available software program (SPSS, version 4.0, SPSS Inc, Chicago, Ill), with a type I ($\alpha$) error threshold of $P=.05$.

RESULTS

Chief residents from 131 (65%) of the 201 pediatric residency training programs in pediatrics returned completed questionnaires after 2 mailings. Comparison of respondents with nonrespondents revealed no differences for geographic location or program type (university vs nonuniversity affiliated). Due to the nature of the sampling frame, no other demographic comparisons were possible between respondents and nonrespondents.

Respondents averaged 3.4±1.4 (mean ± SD) diagnoses in their differentials. Most respondents would consider sep-
sis (73%), seizures (73%), and gastroesophageal reflux (61%).

Few would include child abuse or shaken impact syndrome (18%), apnea associated with a respiratory syncytial virus infection (13%), or poisoning (5%). Respondents would have ordered an average 5.9±2.1 (mean ± SD) tests per evaluation. The most frequent tests that respondents would order were a complete blood cell count (79%), blood and cerebrospinal fluid cultures (75%), chest x-ray film (72%), electroencephalogram (61%), and serum chemistry studies (57%). Fewer would have ordered gastroesophageal reflux studies (38%) and pneumograms (36%). Studies that would have been ordered least frequently included computed tomographic or magnetic resonance imaging scans of the head (10%), urine toxicology screening (4%), or studies for inborn errors of metabolism (2%).

All but 1 respondent (99%) stated that they would admit the infant to the hospital. Most (60%) would not prescribe antibiotic treatment, but most (70%) would order home monitoring.

One fifth (21%) of the respondents indicated they would respond to parental demand and order home monitoring for a healthy infant with no identifiable risk factor. As indicated by their responses, fear of litigation prompts 102 (80%) of the respondents to order more tests than they believe necessary (values of 4 or 5 on the Likert scale). Almost one third (30%) reported personal knowledge of an adverse outcome in a child who had experienced an ALTE. As hypothesized, the scenario used to assess tolerance of uncertainty yielded a wide range of responses. The median serum bilirubin level at which respondents indicated they would not arrange follow-up monitoring for an otherwise healthy infant with no identifiable risk factors was 171 µmol/L (10.0 mg/dL) (reference range, 102.6-307.8 µmol/L [6-18 mg/dL]).

To gain insight into which characteristics might have affected the expressed decisions, we compared the means and distributions of each of the independent variables for those who would presumably choose to initiate antibiotic therapy with those who would choose not to treat and for those who would presumably choose to order home apnea monitoring with those who would choose not to order home apnea monitoring (Table 1). Physicians who would administer antibiotics to the healthy-appearing infant were more likely to have had previous experiences with bad outcomes in infants with ALTEs (43.1% vs 19.5%, \( \chi^2 = 7.7, P = .005 \)), and listed more diagnoses on their differentials (3.6±1.5 vs 3.1±1.3, \( F = 3.86, \chi^2 = 7.7, P = .05 \)). No differences were identified between the 2 groups for propensity to order tests, tolerance of uncertainty, fear of litigation, and responsiveness to parental demand. There were no significant differences in the characteristics of physicians who would order home apnea monitoring vs those who would not.

Logistic regression analysis was performed to assess the relative effect of the independent variables on physicians’ presumed decisions to prescribe antibiotic therapy. Two variables made significant and independent contributions to respondents’ presumed decisions to initiate treatment (Table 2). Physicians who would presumably choose to treat were more likely to have had personal experience with an adverse outcome in an infant with an ALTE, and had greater propensities to order tests than their nontreating colleagues. This model correctly classified 67.5% of the responses to the question concerning antibiotic use (model goodness of fit=117.7, \( P = .36 \)).

A similar logistic regression analysis was performed to assess the relative effect of the independent variables on physicians’ decisions to order home monitoring (Table 3). Fear of litigation was the only independent predictor identified for this decision. The more a resident indicated that his or her practice behavior was influenced by a fear of being sued, the more likely they would be to order home monitoring. This model correctly predicted 71.2% of all responses to the question concerning home monitoring (model goodness of fit=117.7, \( P = .17 \)).

Results of this study suggest that pediatricians vary in their reported evaluation and management of infants with a

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### Table 1. Characteristics of Physicians Prescribing Antibiotic Therapy and Ordering Home Apnea Monitoring for an Otherwise Healthy Infant With an Apparently Life-Threatening Event (ALTE)

<table>
<thead>
<tr>
<th>Physician Characteristic</th>
<th>Would Prescribe Antibiotic Therapy*</th>
<th>Would Order Home Apnea Monitoring†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n = 51)</td>
<td>No (n = 77)</td>
</tr>
<tr>
<td>Adverse experience with ALTEs, % of respondents</td>
<td>43.1†</td>
<td>19.5</td>
</tr>
<tr>
<td>Propensity to order tests, No. of tests ordered§</td>
<td>6.6±2.0</td>
<td>5.5±2.1</td>
</tr>
<tr>
<td>Increase in services due to fear of litigation, % who would increase services</td>
<td>77.3</td>
<td>78.4</td>
</tr>
<tr>
<td>Knowledge, No. of diagnoses in differential§</td>
<td>3.6±1.5</td>
<td>3.1±1.3</td>
</tr>
<tr>
<td>Responsiveness to parental demand, % ordering monitor for parents demanding, even without indications</td>
<td>23.5</td>
<td>18.2</td>
</tr>
<tr>
<td>Tolerance of uncertainty, serum bilirubin level at which respondent would discharge a healthy infant from the hospital, µmol/L (mg/dL)</td>
<td>177±37 (10.4±2.2)</td>
<td>193±41 (11.3±2.4)</td>
</tr>
</tbody>
</table>

* Based on 128 responses.
† Based on 117 responses.
‡ \( P = .005 \), \( \chi^2 \).
§ Expressed as mean ± SD.
|                         | Would Prescribe Antibiotic Therapy* | Would Order Home Apnea Monitoring† |
|                         | Yes (n = 83)                       | No (n = 34)                       |
| Adverse experience with ALTEs, % of respondents | 43.1‡ | 19.5 |
| Propensity to order tests, No. of tests ordered§ | 6.6±2.0 | 5.5±2.1 |
| Increase in services due to fear of litigation, % who would increase services | 77.3 | 78.4 |
| Knowledge, No. of diagnoses in differential§ | 3.6±1.5 | 3.1±1.3 |
| Responsiveness to parental demand, % ordering monitor for parents demanding, even without indications | 23.5 | 18.2 |
| Tolerance of uncertainty, serum bilirubin level at which respondent would discharge a healthy infant from the hospital, µmol/L (mg/dL) | 186±41 (10.9±2.4) | 189±37 (11.1±2.2) |

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history of an ALTE and that their decisions represent complex processes influenced by adverse experiences, tendency to order tests, and fear of litigation. These characteristics do not affect all decisions equally, but rather vary in their relative influence from one decision to another. For example, respondents’ presumed decisions to prescribe antibiotic therapy in a simulated case involving a healthy-appearing child were influenced by adverse experiences and the propensity to order tests. Presumed decisions to order home monitoring were also affected by concerns about being sued.

The selection of an ALTE as a clinical situation where there are no clear correct or incorrect responses was intentional. While review of respondents’ choices to verify full understanding of the survey did not reveal any obvious errors in judgment, the study was not designed to determine if chief residents were engaging in “appropriate” practice. The absolute difference in the number of diagnoses included in individual differential diagnoses (a surrogate for chief resident knowledge) was not believed to be clinically significant, but was included to delineate the individual physician’s ability to create a differential diagnosis, which is clinically significant. When controlling for all other factors in the multivariate analysis, knowledge did not make independent contributions to decision making, but was included in the final model based on review of the pertinent literature.

Clinical factors have been demonstrated by several studies to be among the most important factors in predicting decisions made by physicians. These studies demonstrate that physicians tend to rely on recognition of signs and symptoms of illness when faced with a medical decision. Other factors are also thought to affect decision making. Features of the medical environment, including supply of hospital beds, physician to patient ratios, third-party coverage, and methods of physician reimbursement have been shown to affect the amount of care provided and contribute to the observed practice variations. Patients’ sociodemographic status, demands, and preferences contribute to practice variations as well.

Individual physician personality characteristics have also been shown to exert strong influence on provider behavior. Many of these characteristics related to physician personality are influenced by genetic and environmental influences early in life. For this reason, some variation in care may be due to characteristics that may not be as susceptible to elimination. These difficult-to-change characteristics might explain the mixed results produced by various attempts to influence physician practice.

Pauker and Kassirer relate clinical decision making in cases such as the simulated case in the current study to a threshold model for action. It is possible to interpret the serum bilirubin level at which a pediatrician might discharge a low-risk infant as a threshold for action, but since the risks of a healthy full-term infant developing substantial complications from hyperbilirubinemia are low, but unknown, this level has parallels to the decision making of a pediatrician faced with a child with an ALTE.

Several potential limitations of this model to study medical decision making should be addressed. Chief residents may not be truly representative of pediatric practice as a whole, as residents in referral centers might have more recent personal experiences with infants having ALTEs and might be less affected by financial considerations than most practicing pediatricians. They may also have knowledge of the most recent international medical literature regarding this problem. Furthermore, it is likely that chief residents would have a more narrow range of uncertainty than physicians who have been practicing for varying periods. Residents have been used as subjects in previous studies providing insight into practicing physician behavior. This study was intended to identify potential characteristics that contribute to variations in decision making. To generalize the results of this study, a survey that includes practicing pediatricians at varying stages in their career would be needed.

### Table 2. Predictors of the Decision to Prescribe Antibiotic Therapy in a Scenario Involving an Apparent Life-Threatening Event (ALTE) in an Otherwise Healthy Infant

<table>
<thead>
<tr>
<th>Physician Characteristic</th>
<th>Multivariate Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adverse experience with ALTEs, % of respondents</td>
<td>2.62* (1.09-6.32)</td>
</tr>
<tr>
<td>Propensity to order tests, No. of tests ordered</td>
<td>1.27* (1.01-1.58)</td>
</tr>
<tr>
<td>Increase in services due to fear of litigation, 1 (would decrease) to 5 (would increase)</td>
<td>1.58 (0.84-2.96)</td>
</tr>
<tr>
<td>Knowledge, No. of diagnoses in differential</td>
<td>1.18 (0.88-1.59)</td>
</tr>
<tr>
<td>Responsiveness to parental demand, % ordering monitor for parents demanding, even without indications</td>
<td>1.14 (0.43-3.08)</td>
</tr>
<tr>
<td>Tolerance of uncertainty, serum bilirubin level at which respondent would discharge a healthy infant from the hospital</td>
<td>0.85 (0.71-1.02)</td>
</tr>
</tbody>
</table>

*P = .03, $\chi^2$.

### Table 3. Predictors of the Decision to Order Home Apnea Monitoring in a Scenario Involving an Apparent Life-Threatening Event (ALTE) in an Otherwise Healthy Infant

<table>
<thead>
<tr>
<th>Physician Characteristic</th>
<th>Multivariate Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous adverse experience with ALTEs, % of respondents</td>
<td>2.01 (0.72-5.65)</td>
</tr>
<tr>
<td>Propensity to order tests, No. of tests ordered</td>
<td>0.99 (0.79-1.26)</td>
</tr>
<tr>
<td>Increase in services due to fear of litigation, 1 (would decrease) to 5 (would increase)</td>
<td>2.18* (1.11-4.25)</td>
</tr>
<tr>
<td>Knowledge, No. of diagnoses in differential</td>
<td>1.17 (0.82-1.65)</td>
</tr>
<tr>
<td>Responsiveness to parental demand, % ordering monitor for parents demanding, even without indications</td>
<td>2.95 (0.79-11.2)</td>
</tr>
<tr>
<td>Tolerance of uncertainty, serum bilirubin level at which respondent would discharge a healthy infant from the hospital</td>
<td>1.01 (0.83-1.23)</td>
</tr>
</tbody>
</table>

*P = .02, $\chi^2$. 

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In addition, we asked respondents how they would respond to a hypothetical case rather than assessing after the fact how they treated an actual patient. Using a hypothetical case may seem initially to create artificial responses. In reality, standardization of scenario features allows direct comparisons of physician behavior without the numerous confounders that actual cases might introduce, and has been shown previously to be a valid predictor of physician behavior.30-34

Pediatric chief residents exhibit significant variation in their presumed evaluation and management of a simulated case which includes features unique to the practice of pediatrics. Understanding why variations exist may be an important prerequisite for successful attempts to reduce or eliminate care perceived to be of marginal value. Furthermore, identifying individual physician characteristics that promote variation allows for incorporation of physician needs, concerns, and fears into strategies to optimize the delivery of health care to children.

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