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Diagnosis and Management of Food-Induced Anaphylaxis: A National Survey of Pediatricians

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ABSTRACT

BACKGROUND. Food allergy is a common pediatric problem, affecting as many as 6% of young children, yet it is unclear whether pediatricians are well prepared to manage food-induced anaphylaxis.

OBJECTIVE. The purpose of this work was to assess pediatricians' knowledge of diagnosis and management of children with food-induced anaphylaxis.

METHODS. A survey designed to assess food allergy diagnosis and management was mailed to a US national random sample of 1130 pediatricians. Survey questions were based on a clinical scenario involving a child having an anaphylactic reaction after ingesting peanut. Primary outcome measures included correct responses to the 11 questions about anaphylaxis.

RESULTS. A total of 468 pediatricians (41%) responded to the survey. The majority of the respondents were women (58%), spent >50% of their time in a clinical setting (78%), and reported providing care for food allergy patients (86%). Overall, 70% of the pediatricians agreed that the clinical scenario was consistent with anaphylaxis, and 72% chose to administer epinephrine. However, only 56% of respondents agreed with both the diagnosis of anaphylaxis and treating with epinephrine. Most pediatricians (70%) did not recognize that a 30-minute observation period after anaphylaxis was too short. Pediatricians who reported providing care for food allergy patients were more likely to agree with the diagnosis of anaphylaxis (73% vs 59%), with treating the reaction with epinephrine (73% vs 64%), and with prescribing self-injectable epinephrine (83% vs 66%) than pediatricians who did not care for food allergy patients. The more certain that pediatricians were that the child was having an anaphylactic reaction, the more likely they were to agree with treating the reaction with epinephrine. In general, recent continuing medical education was not predictive of improved knowledge.

CONCLUSION. Although the majority of pediatricians seem to have some knowledge of food-induced anaphylaxis, a substantial proportion has knowledge deficits that may hinder their ability to provide optimal care to children with food-induced

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Key Words

anaphylaxis, survey, food allergy

Abbreviations

FA—food allergy

PCP—primary care provider

CME—continuing medical education

AAP—American Academy of Pediatrics

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anaphylaxis. Pediatricians who provide health care for patients with food allergy may be better equipped to manage food-induced anaphylaxis than those who do not. Because continuing medical education was not a significant predictor of increased knowledge, ensuring that pediatric residents develop experience managing patients with food allergies may be a better strategy to educate primary care pediatricians about food allergy.

FOOD-INDUCED ANAPHYLAXIS ACCOUNTS for ~30 000 anaphylactic reactions, 2000 hospitalizations, and 200 deaths each year in the United States.¹ Recent estimates on food allergy (FA) prevalence show that ~6% of young children may be affected.² Approximately 1% to 2% of the general United States population (2.7–5.4 million people) suffer from FAs.³ Allergies to peanuts and tree nuts account for the majority of fatal and near fatal anaphylactic reactions,⁴ and peanut allergic patients may accidentally ingest peanut as often as every 3 to 5 years.⁵ Approximately 6% of anaphylactic reactions initially resolve and then recur within 6 hours; these biphasic reactions are associated with delayed use of epinephrine and may be more treatment resistant than the initial reaction.⁶

Anaphylactic reactions are often unanticipated and can progress rapidly, even when initial symptoms are mild, and the difference between survival and death may depend on rapid recognition of symptoms and timely initiation of appropriate therapy. Established guidelines for the management of anaphylaxis⁷ highlight the important role that primary care providers (PCPs) have in the recognition, education, and referral of patients with food-induced anaphylaxis. An additional study demonstrated the need for emergent treatment of anaphylaxis and the importance of monitoring for biphasic reactions.⁶

Despite the fact that FA is common enough that most pediatricians are likely to care for several patients with FA, little is known about PCP knowledge of food-induced anaphylaxis. A recent small study demonstrated that internal medicine and pediatric medical grand rounds attendees had knowledge deficits regarding the management of anaphylactic reactions to food.⁸ Other studies have shown that physicians often fail to properly administer epinephrine, prescribe self-injectable epinephrine, or refer for specialty allergy care.^{2,9} In one study of fatal reactions to food, only 10% of patients who died had epinephrine with them at the time of death.³ It is not known how many of them had been prescribed epinephrine. Very little has been published regarding pediatrician knowledge of food-induced anaphylaxis, so it is unclear whether the deficiencies observed in these selected study populations are applicable to pediatricians in general. The aim of the current study was to assess pediatricians' knowledge of the diagnosis

and management of food-induced anaphylaxis and to evaluate and identify predictors of anaphylaxis knowledge.

METHODS

Procedures/Survey Instrument

A case-based survey was designed by a pediatrician, a family physician, and a pediatric allergist to assess physician knowledge and attitudes about the diagnosis and management of food allergies and anaphylaxis. The survey instrument presented participants with a clinical scenario of a child having peanut-induced anaphylaxis. Participants were asked to respond to statements regarding diagnosis and management of this scenario. The questions were grouped into different knowledge categories: diagnosis, treatment, counseling, and prevention. In addition, the survey assessed demographic and other potential predictive variables. Of note, "allergy training" was defined by having training beyond residency or continuing medical education (CME) in allergy, and "care for allergy patients" was defined as caring for patients with proven allergy to egg, milk, soy, peanut, tree nuts, wheat, fish, or shellfish.

Because no previously published or validated survey instrument existed, the development of the survey was based on expert opinion and literature published previously.⁷ The survey was pilot tested and revised numerous times with primary care pediatricians and family physicians to evaluate the survey for clarity and inter-operator reliability.

The study population was selected randomly from membership lists of the American Academy of Pediatrics (AAP). The lists were obtained via the AAP's approved supplier, Medical Marketing Services (Wood Dale, IL). Before randomization, subspecialty sections of the AAP were excluded (surgery, cardiology, etc), and a random list of 1200 pediatricians was subsequently obtained. From the list, there were 70 pediatricians identified as subspecialists as indicated on their mailing labels, and they were also excluded, leaving 1130 pediatricians who were mailed a survey. The survey procedure followed a modified Dillman approach.¹⁰ A survey was mailed to the population followed by a reminder letter to all of the potential participants. A second survey was then mailed to those who did not initially respond. Consent was obtained using a cover letter that explained the rationale, risks, and benefits of the study. Institutional review board approval was obtained from the 3 sponsoring institutions: Franklin Square Hospital Center (via the MedStar Research Institute), the University of Maryland, Baltimore, and the Johns Hopkins Medical Institutions.

Data Analysis

Eleven questions on the 21-question survey assessed the respondents' knowledge of diagnosis, treatment, and

management of anaphylaxis. Each question had a 5-point Likert-type response option ranging from “strongly agree” to “strongly disagree.” The correct answers were determined for each question a priori and based on published FA guidelines.⁷ Responses were dichotomized at the point of agreement (eg, “strongly agree” and “agree”) with the “unsure” response counted as incorrect. Of these 11 anaphylaxis questions, we chose 5 key questions (Table 2) that were determined to be the most important diagnostic and management questions as determined by consensus of the researchers and analysis of published guidelines.⁷ The best answers to these questions were used as the outcome measures with the addition of a variable that was created for respondents who both agreed with the diagnosis of anaphylaxis and agreed with treating the reaction with epinephrine: categorized as correctly “recognizing and treating.”

Statistical analysis was performed using SAS 8.2 (SAS Institute, Cary, NC). Variables were initially described using tabular frequencies for categorical variables or means or medians for continuous variables. The statistical significance of relationships between categorical variables and responses to survey questions were assessed by χ^2 analysis. The Cochran-Armitage trend test was used to test for trend. Logistic regression was used to generate odds ratios and to adjust for potential confounders for outcomes. A $P < .05$ was considered statistically significant.

RESULTS

Demographics

Of the 1130 mailed surveys, 4 surveys were undeliverable, 2 were returned blank, 1 individual was reported deceased, 4 returned the survey stating they were no longer in practice, and 20 did not complete the survey and stated they did not practice primary care. A total of 468 pediatricians responded to the survey, representing an overall response rate of 41% but an effective response rate of 42.6% (468 of 1097). Of the respondents, 49 reported having specialized allergy training. Because our goal was not to survey allergists, these surveys were excluded from the analysis, leaving a final sample size of 419.

The majority of the respondents were women (58%) and in private practice (61%) as shown in Table 1. On average, respondents had been out of residency training for 12 years and spent the majority of their time in the clinical setting. The median amount of time spent in the clinical setting was 100% with an interquartile range from 75% to 100%. Reported demographics of AAP membership indicate that 52% of AAP members are men, and 94% provide direct patient care.¹¹ Although 86% of respondents reported caring for FA patients, only 66% reported being comfortable caring for these pa-

TABLE 1 Characteristics of the Respondent Physician Sample (n = 419)

Characteristic	n (%)
Gender	
Male	173 (42)
Female	242 (58)
Setting	
Academic	96 (23)
Private practice	255 (61)
Other	66 (16)
Care for FA patients	350 (86)
Comfortable caring for FA patients	275 (66)
FA CME past 3 y	284 (69)
Recent residency graduate (<10 y)	238 (57)
Mostly clinical (>50% of time)	327 (78)
Geography	
Northeast	138 (34)
Midwest	99 (24)
South	107 (26)
West	66 (16)

Total number of sample. Each question had some missing answers; percentages represent percentage of correct respondents of total respondents for the question.

tients. Almost 70% reported participating in FA CME in the previous 3 years.

Anaphylaxis Outcomes

The best responses to primary outcome questions for a clinical scenario of a 2-year-old child experiencing anaphylaxis are shown in Table 2. Overall, 70% of the pediatricians agreed that the child in the scenario was having an anaphylactic reaction, but a large majority also agreed that the scenario was consistent with oral allergy syndrome. Almost 20% of respondents agreed with the statement that the lack of hives made it unlikely that the child was having an anaphylactic reaction. Although 95% of the pediatricians would appropriately treat with an antihistamine, and 89% would recommend an as-needed antihistamine at home, interestingly, 20% would incorrectly recommend a daily antihistamine to prevent recurrences.

Seventy-two percent of pediatricians agreed with administering epinephrine, and a total of 56% of respondents agreed with both the diagnosis of anaphylaxis and treating with epinephrine. A higher percentage of pediatricians who agreed with the diagnosis of anaphylaxis chose to give epinephrine (81%) than those who were unsure about the diagnosis (64%) or disagreed with the diagnosis (44%; $P < .0001$; Fig 1). In addition, pediatricians who had completed residency training >10 years previously were more likely to agree with administering epinephrine than those who had completed residency training more recently (82% vs 64%; $P < .0001$; Table 3).

Very few pediatricians seemed to be aware that a 30-minute observation period is shorter than the suggested observation period of 4 to 6 hours,⁷ because only 30% disagreed with observing the child for the short

TABLE 2 Correct Responses to Primary Outcome Questions for a Clinical Scenario of a 2-Year-Old Child Experiencing Anaphylaxis

Question	Responses	n = 419; n (%) ^a
He is probably experiencing the oral allergy syndrome	Disagree ^c	124 (30) ^c
	Agree	284 (70)
He is probably experiencing anaphylaxis ^b	Disagree	123 (30)
	Agree ^c	291 (70) ^c
He might be experiencing anaphylaxis but the absence of hives makes this unlikely	Disagree ^c	330 (81) ^c
	Agree	77 (19)
I would observe him closely but not administer any medications	Disagree ^c	375 (98) ^c
	Agree	7 (2)
I would administer Benadryl	Disagree	20 (5)
	Agree ^c	391 (95) ^c
I would administer epinephrine ^b	Disagree	115 (28)
	Agree ^c	296 (72) ^c
After the symptoms resolved and the child had been observed 30 minutes, I would discharge him home ^b	Disagree ^c	122 (30) ^c
	Agree	290 (70)
I would suggest an oral antihistamine as needed for home use	Disagree	44 (11)
	Agree ^c	369 (89) ^c
I would prescribe a daily non-sedating antihistamine to decrease the chance of a severe allergic reaction in the future	Disagree ^c	329 (80) ^c
	Agree	82 (20)
I would not prescribe epinephrine because his symptoms were mild and this was his first occurrence ^b	Disagree ^c	334 (81) ^c
	Agree	80 (19)
I would recommend further testing/referral be done (either by me or by an allergist) ^b	Disagree	58 (14)
	Agree ^c	356 (86) ^c

Scenario: A mother brings her 2-year-old son to your office without an appointment. She states that he had a peanut butter and jelly sandwich ~30 minutes ago and within 10 minutes he started crying and pulling at his mouth. He has some wheezing and his lips are mildly swollen. He does not have hives and is not in respiratory distress. His vital signs are all normal.

^a Total number of sample. Each question had some missing answers; percentages represent percentage of correct respondents of total respondents for the question.

^b Considered the key outcome questions.

^c Considered to be the best answers.

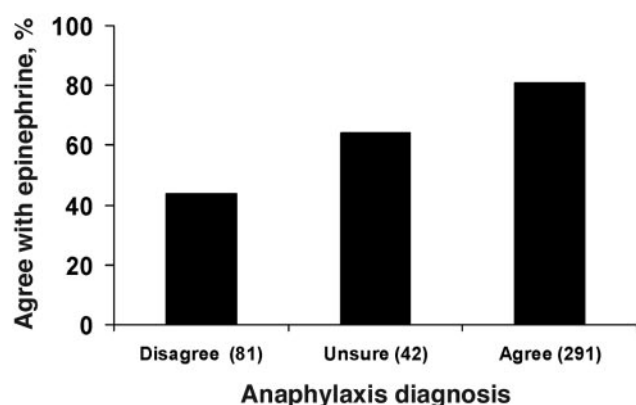


FIGURE 1

Pediatricians were stratified according to whether they agreed, disagreed, or were unsure of the anaphylaxis diagnosis, and these groups are represented on the x-axis with the number in each group indicated in parentheses. The proportion of pediatricians who agreed with administering epinephrine is indicated on the y-axis. $P < .0001$ for trend.

length of observation. Most of the pediatricians chose to send the child home with self-injectable epinephrine (81%) and to refer or do additional testing (86%). Pe-

diatricians who had participated in FA CME were more likely to prescribe self-injectable epinephrine than others (odds ratio: 1.7; 95% confidence interval: 1.0–2.8), but this association was somewhat weakened after adjusting for experience caring for FA patients (odds ratio: 1.6; 95% confidence interval: 0.9–2.7). Interestingly, those who treated the reaction with epinephrine were no more likely to prescribe epinephrine for home than those who did not treat the reaction with epinephrine (87 vs 85%, respectively; $P = .56$).

Pediatricians who reported caring for patients with FA consistently demonstrated greater knowledge of food-induced anaphylaxis. They were more likely to agree with the diagnosis of anaphylaxis (73% vs 59%; $P = .03$), with treating the reaction with epinephrine (73% vs 64%; $P = .20$), and with prescribing self-injectable epinephrine (83% vs 66%; $P = .002$) than those who did not provide care for FA patients. The pediatricians who cared for FA patients were also more comfortable with FA and more likely to have participated in FA CME than those who did not provide care for FA patients. Specifically, 73% of those who cared for FA patients reported feeling comfortable caring for FA patients, but only 31% of those who did not care for FA patients reported feeling comfortable ($P < .0001$). Likewise, 72% of pediatricians caring for FA patients had participated in FA CME as compared with 55% of those who did not care for FA patients ($P = .01$).

DISCUSSION

The findings from this survey suggest that pediatricians are only partially equipped to recognize and treat anaphylaxis. Only 56% of pediatricians were able to both recognize and treat food-induced anaphylaxis as assessed by this case-based survey instrument. These findings are similar to the observations made in a small PCP study⁸ and a study of emergency physicians.⁹ Because almost one third of pediatricians seemed to underestimate the seriousness of the scenario, a large number of children may be at risk if they present to their PCP with an anaphylactic reaction.

Recognizing anaphylaxis may be the most important step in the management of FA patients, because pediatricians were more likely to agree with administering epinephrine if they agreed with the diagnosis of anaphylaxis. In fact, the more certain that respondents were of the diagnosis of anaphylaxis, the more likely they were to agree with administering epinephrine. Although the definition of anaphylaxis has been widely debated, the child in the scenario met the anaphylaxis criteria proposed by a panel of experts participating in the Symposium on the Definition and Management of Anaphylaxis,¹² because he developed acute onset of illness after ingesting a potential food allergen and had involvement of both mucosal tissue and evidence of airway compromise. This finding highlights the need for a widely ac-

TABLE 3 Pediatrician Characteristics and Diagnosis and Management of Food-Induced Anaphylaxis

Characteristic	Agree With Anaphylaxis Diagnosis, %	P	Agree With Treating With Epinephrine, %	P	Disagree With Short Observation, %	P	Agree With Self-Injectable Epinephrine, %	P	Agree With Further Evaluation, %	P
Setting										
Academic	63	.07	73	.92	31	.75	75	.14	85	.83
Other	73		72		29		82		86	
Recent residency graduate										
Yes	73	.11	64	<.0001	32	.26	81	.80	88	.21
No	66		82		27		80		84	
> 50% clinical time										
Yes	73	.05	71	.56	30	.72	82	.09	87	.44
No	62		74		28		74		84	
Currently care for FA patients										
Yes	73	.03	73	.20	30	.21	83	.002	86	.66
No	59		64		22		66		84	
Comfortable with FA patients										
Yes	73	.10	73	.53	29	.76	81	.67	87	.06
No	65		70		30		80		81	
FA CME										
Yes	71	.66	74	.56	30	.25	83	.04	88	.10
No	69		69		28		75		82	

cepted definition of anaphylaxis that can be used to guide physicians in determining appropriate treatment.

Having participated in FA CME was a predictor of prescribing self-injectable epinephrine in the bivariate analysis, but the association was no longer statistically significant after adjusting for caring for FA patients, suggesting that experience with FA patients may be a more important determinant of appropriate management of FA than CME courses. Because caring for FA patients was positively associated with taking an FA CME course, it is likely that pediatricians who care for FA patients are subsequently more likely to participate in FA CME activities. However, because the study was a cross-sectional survey, we cannot exclude the possibility that taking an FA CME course results in an increased willingness to provide primary care for FA patients. Consistent with this observation, results from previous research on CME effectiveness in general have been mixed.¹³ It is possible that clinically based educational efforts, such as academic detailing, which have been used to attempt to reduce the inappropriate use of antibiotics, may prove effective in improving pediatricians' knowledge of food-induced anaphylaxis.¹⁴

Our findings suggest that the most important factor in preparing pediatricians to manage food-induced anaphylaxis may be experience managing FA patients. Pediatricians who reported that they cared for FA patients were more likely to agree that the child in the scenario was having an anaphylactic reaction, that epinephrine be administered to treat the reaction, and that self-injectable epinephrine be prescribed. Although the associations between caring for FA patients and the 5 key anaphylaxis management questions were not all statistically significant, there was a clear trend that pediatricians with experience caring for FA patients were more

likely to appropriately assess, treat, and manage the clinical situation described in the scenario. These findings suggest that pediatricians may be better prepared to manage this condition if they have had adequate experience with FA patients during residency. Consistent with this observation, previous research has demonstrated that pediatric primary care physicians who completed an allergy rotation during residency had higher allergy knowledge and were more likely to refer a patient to an allergist than pediatricians who did not have an allergy rotation.¹⁵ Unfortunately, with the recent changes to resident work weeks, there has been less time devoted to electives, so that many pediatric residents may complete training without adequate exposure to FA. Given the increasing prevalence of food allergies, residency training should include experience with managing patients with FA.

In addition, it is important to note that recent residency graduates were substantially less likely to agree with treating the reaction with epinephrine than less recent graduates, although recent graduates were more likely to agree with the diagnosis of anaphylaxis. Although the survey was not designed to determine the reasons behind this finding, it is possible that recent residency graduates lack familiarity with epinephrine use outside of an intensive care or inpatient setting. This potential explanation is consistent with the observation that epinephrine was commonly used to treat asthma exacerbations as recently as 15 years ago,^{16,17} so that more seasoned pediatricians are more likely to have greater familiarity, and perhaps comfort, with epinephrine. Whatever the reason for the apparent reticence of recent graduates to administer epinephrine, this finding deserves additional study to determine whether this trend holds in other study populations.

Findings from this survey also highlighted some weaknesses in pediatricians' knowledge of food-induced anaphylaxis. For example, 20% of the pediatricians disagreed with prescribing self-injectable epinephrine, potentially putting a large number of children at risk. In addition, less than one third of pediatricians seemed to recognize the need to observe a patient for >30 minutes after an anaphylactic reaction. A recently published summary report from the second symposium on the definition and management of anaphylaxis suggested that an observation period of 4 to 6 hours may be appropriate, although this observation period should be tailored to the individual patient.⁷ This finding is consistent with the findings of the smaller primary care study in which fewer than half of the respondents knew the appropriate length of observation.⁸ It is also apparent that a substantial proportion of pediatricians may be unaware that anaphylactic reactions can occur in the absence of urticaria, so that the diagnosis of anaphylaxis may not be entertained when children present with other signs and symptoms. Another notable finding was that 70% of respondents agreed that the scenario was consistent with oral allergy syndrome, suggesting that the majority of pediatricians may not understand what oral allergy syndrome is.

An important limitation of this study is the overall response rate of the sample. The response rate of 41% is modest and has the potential for bias; however, it is similar to that of other published surveys of physicians.^{18,19} Although it is not clear in which direction the results might be biased because of nonresponse, it is possible that those physicians who felt more knowledgeable about allergies were more likely to respond, leaving actual practice potentially worse than the results in this study. Another limitation is the survey instrument itself. Although the survey was extensively pilot tested and revised, it was not a standardized, validated survey. Because this was the first study of its kind, such previously validated tools were not available. Finally, although we specifically targeted pediatricians who provide primary care, it is possible that some subspecialists who did not provide primary care were included in the sample. If this had occurred to any significant extent, the findings of the study may be an underestimate of the true level of FA knowledge among PCPs, if we presume that subspecialists would have poorer FA knowledge than PCPs. It is also conceivable that the pediatricians who did not care for FA patients were more likely to be subspecialists, but the overall finding that physicians who lack experience with FA patients have poorer knowledge of food-induced anaphylaxis remains relevant. On the other hand, educational efforts should be targeted to those pediatricians who provide or will be providing primary care to children.

In this national sample of pediatricians, most pediatricians seem to be equipped to recognize and manage

food-induced anaphylaxis, but a substantial proportion seem to be poorly equipped to do so. The findings of this study suggest that the deficits in knowledge may be addressed by ensuring that pediatric residents develop experience managing patients with FA.

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