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A survey study of index food-related allergic reactions and anaphylaxis management

Tammy S. Jacobs[1], Matthew J. Greenhawt[2], David Hauswirth[3], Lynda Mitchell[4] & Todd D. Green[5]

[1]Department of Pediatrics, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, USA; [2]Division of Allergy & Immunology, University of Michigan, Ann Arbor, MI, USA; [3]Division of Pulmonary, Allergy, Critical Care and Sleep Medicine, Department of Internal Medicine, The Ohio State University and Nationwide Children's Hospital, Columbus, OH, USA; [4]Kids with Food Allergies Foundation, Doylestown, PA, USA; [5]Division of Pulmonary Medicine, Allergy & Immunology, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, USA

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Correspondence
Todd D. Green, Division of Allergy, and Immunology, Children's Hospital of Pittsburgh of UPMC, 4401 Penn Avenue, Suite Floor 3, Pittsburgh, PA 15224, USA.
Tel.: 412 692 7885
Fax: 412 692 8499
E-mail: todd.green@chp.edu

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Abstract

Background: Initial food-allergic reactions are often poorly recognized and undertreated.

Methods: Parents of food-allergic children were invited to complete an online questionnaire, designed with *Kids with Food Allergies Foundation*, about their children's first food-allergic reactions resulting in urgent medical evaluation.

Results: Among 1361 reactions, 76% (95% CI 74–79%) were highly likely to represent anaphylaxis based on NIAID/FAAN criteria. Only 34% (95% CI 31–37%) of these were administered epinephrine. In 56% of these, epinephrine was administered by emergency departments; 20% by parents; 9% by paramedics; 8% by primary care physicians; and 6% by urgent care centers. In 26% of these, epinephrine was given within 15 min of the onset of symptoms; 54% within 30 min; 82% within 1 h; and 93% within 2 h. Factors associated with a decreased likelihood of receiving epinephrine for anaphylaxis included age <12 months, milk and egg triggers, and symptoms of abdominal pain and/or diarrhea. Epinephrine was more likely to be given to asthmatic children and children with peanut or tree nut ingestion prior to event. Post-treatment, 42% of reactions likely to represent anaphylaxis were referred to allergists, 34% prescribed and/or given epinephrine auto-injectors, 17% trained to use epinephrine auto-injectors, and 19% given emergency action plans. Of patients treated with epinephrine, only half (47%) were prescribed epinephrine auto-injectors.

Conclusions: Only one-third of initial food-allergic reactions with symptoms of anaphylaxis were recognized and treated with epinephrine. Fewer than half of patients were referred to allergists. There is still a need to increase education and awareness about food-induced anaphylaxis.

Anaphylaxis is a severe, rapidly progressive, life-threatening allergic reaction. The diagnosis of anaphylaxis is primarily clinical, and based upon symptoms and signs affecting multiple organ systems (cardiovascular, respiratory, gastrointestinal and/or dermatologic), as well as a detailed history of the acute episode, antecedent exposures, and past medical history. Although debate remains over a clinically useful definition of anaphylaxis, the National Institute of Allergy and Infectious Disease (NIAID) and the Food Allergy and Anaphylaxis Network (FAAN) recently published diagnostic criteria to help clinicians recognize the entire spectrum of manifestations of this potentially fatal disorder (1).

Food allergy affects about 6% of children <5 yr of age, and 3–4% of adults in the United States (2). Food-related reactions include a spectrum of presentations with anaphylaxis being the most severe manifestation. Food allergens are especially concerning because of the potential for certain allergens to cause reaction upon first known ingestion, or to be highly associated with severe reactions. Food allergy is the leading cause (among identified triggers) of anaphylaxis in children and is responsible for half of reported anaphylaxis

cases presenting to emergency departments (1, 3–12). The incidence of food-induced anaphylaxis has been increasing, particularly within the pediatric population (13–16).

There is limited prior study of the management of anaphylaxis in pediatric populations, especially studies that examine management of anaphylaxis outside the emergency department setting. In this survey study, we examined the management of food-allergic reactions and anaphylaxis in children that caused them to be urgently evaluated by medical professionals for the first time, before those children and their parents were familiar with the manifestation and treatment of those reactions. We hypothesized that food-related anaphylaxis is under-recognized and under-managed in children with initial severe reactions.

Methods

Study design

We developed an internet-based, parental survey study in conjunction with *Kids with Food Allergies Foundation* to examine the management of food-related anaphylaxis in children. Kids with Food Allergies Foundation is a national non-profit food allergy support organization for families raising children with food allergies. Parents of food-allergic children were recruited from website announcements, social networking posts and targeted membership emails to complete a brief (40 questions, 20 min) online questionnaire regarding food-related allergic reactions in their children that necessitated urgent medical evaluation for the first time. The survey collected responses between July 28, 2010 and January 13, 2011.

Only survey responses of food-related allergic reactions of children under the age of 18 yr that required urgent medical attention for the first time were included. Only respondents who fully completed surveys were included. All information collected was de-identified. The protocol for this study was approved by the University of Pittsburgh Institutional Review Board.

Measures

Survey questions included demographics, past medical history, home medications, family history of allergies, probable food allergen exposure, time of onset of symptoms, symptoms, medical providers, epinephrine treatment, treatment provided other than epinephrine, admission outcomes, and discharge instructions concerning the first food-allergic reaction that prompted evaluation and care by a medical professional. In addition to symptoms, participants were asked about physical examination findings that they remember being told by medical staff.

Statistical analysis

Data were analyzed using StataSE 9.2 (College Station, TX, USA). Anaphylaxis was defined using the National Institute of Allergy and Infectious Disease (NIAID)/Food Allergy and Anaphylaxis Network (FAAN) criteria (1). Specifically, anaphylaxis is highly likely if there is an acute onset of an illness (minutes to several hours) with involvement of the skin/mucosal tissue and at least one of either respiratory compromise or reduced blood pressure. Alternatively, anaphylaxis is highly likely if there are two or more of the following that occur rapidly after exposure to a likely allergen (minutes to several hours): involvement of the skin-mucosal tissue, respiratory compromise, reduced blood pressure or associated symptoms, and persistent gastrointestinal symptoms. The third criterion (low blood pressure after exposure to known allergen) is not applicable in this study because these were index reaction, not food allergen. Based on parental reports of presenting symptoms of these reactions, we identified a subset of survey respondents with food-related allergic reactions as highly likely for anaphylaxis.

Descriptive analyses were performed using mean estimations, medians, and binomial proportion estimations. For binary outcome and exposure variables, odds ratios (OR) were calculated using binary logistic regression models.

Results

Baseline demographic characteristics and past medical history

The survey collected 1700 responses. After inclusion and exclusion criteria were applied, 1361 survey responses qualified for analysis. Nearly all (except 5) reported index reactions occurred between 1990 and 2010. Using NIAID/FAAN anaphylaxis criteria, we identified a subset of 1044 responses of 1361% or 76.7% (95% CI 74.5–79.0%) as highly likely for anaphylaxis (Table 1).

Mean age at the time of the index reactions was 16 months. Just under half (43.8%) of the patients were under 1 yr of age. Approximately one-third (35.9%) of the patients were female. With respect to comorbidities, asthma was present in 18.4% of the patients, including 20.8% of those presenting with symptoms highly likely for anaphylaxis, and 10.4% of those without such symptoms ($p < 0.001$). Allergic rhinitis was present in 16.4% of the patients; 18.0% of those presenting with symptoms likely for anaphylaxis, and 11.0% of those without such symptoms ($p = 0.003$). Atopic dermatitis was present in over half of the patients for both groups. Earlier in the day prior to the allergic events, 2.3% of the patients had taken asthma rescue medications. Significantly, more patients with likely anaphylaxis were on asthma controller medications (4.9%), compared with those without likely anaphylaxis (0.6%) ($p < 0.001$). Less than one-tenth of the patients (8.0%) had taken antihistamines prior to the index reactions, including 9.1% of those with likely anaphylaxis, and 4.4% of those without anaphylaxis (Table 1).

Index food-allergic reaction characteristics

Approximately one-third (29.5%) of food-allergic reactions that required medical attention for the first time reported

Table 1 Demographic characteristics and medical history of patients with food-related allergic reactions with and without anaphylaxis (n = 1361)

Demographics/medical history	Anaphylaxis n (%)	No anaphylaxis n (%)	Total n (%)	p*
Total, n (%)	1044 (76.7)	317 (23.3)	1361 (100.0)	
Demographics				
Mean age (months)	18	12	16	<0.001
Age <1 yr	442 (42.3)	154 (48.6)	596 (43.8)	0.050
Gender (female)	378 (36.2)	110 (34.7)	488 (35.9)	0.624
Medical history				
Asthma	217 (20.8)	33 (10.4)	250 (18.4)	<0.001
Allergic rhinitis	188 (18.0)	35 (11.0)	223 (16.4)	0.003
Atopic dermatitis	596 (57.1)	195 (61.5)	791 (58.1)	0.162
Eosinophilic esophagitis	33 (3.2)	0 (0.0)	33 (2.4)	0.001
Hymenoptera allergy	6 (0.6)	0 (0.0)	6 (0.4)	0.176
Gastroesophageal reflux	150 (14.4)	26 (8.2)	176 (12.9)	0.004
Medications taken prior to event				
Asthma rescue meds	28 (2.7)	3 (1.0)	31 (2.3)	0.070
Asthma controller meds	51 (4.9)	2 (0.6)	53 (3.9)	0.001
Antihistamines	95 (9.1)	14 (4.4)	109 (8.0)	0.007
Gastroesophageal reflux meds	71 (6.8)	16 (5.1)	87 (6.4)	0.264

*The p-value for a chi-square test.

peanut as the food trigger; 27.9% in those with likely anaphylaxis, and 34.7% in those without likely anaphylaxis (p = 0.020). Significantly, more patients with likely anaphylaxis reported milk as the inciting food (35.5%), compared with those without anaphylaxis (28.4%) (p = 0.019). Eleven percent of the patients (11.8%) reported tree nut ingestion prior to the index reaction; 14.2% egg ingestion, 5.1% wheat ingestion, 3.8% soy ingestion, 1.3% fish ingestion, and 0.5% shellfish ingestion (Table 2).

The median time after food ingestion to reported onset of symptoms for the index reactions was within 30 min. About half (48.4%) of the index reactions occurred while the child was eating the inciting food, 79.1% of the reactions occurred within 30 min after food ingestion, 86.0% within 1 h, 93.9% within 2 h, 96.6% within 4 h, and 97.7% within 6 h. There were no significant differences between the group with highly likely anaphylaxis and the group without such symptoms.

Table 2 Foods ingested that resulted in food-related allergic reactions with and without anaphylaxis (n = 1361)

Foods ingested	Anaphylaxis n (%)	No anaphylaxis n (%)	Total n (%)	p*
Total, n (%)	1044 (76.7)	317 (23.3)	1361 (100.0)	
Peanut	291 (27.9)	110 (34.7)	401 (29.5)	0.020
Tree nut	133 (12.7)	28 (8.8)	161 (11.8)	0.059
Milk	371 (35.5)	90 (28.4)	461 (33.9)	0.019
Egg	144 (13.8)	49 (15.5)	193 (14.2)	0.457
Wheat	51 (4.9)	19 (6.0)	70 (5.1)	0.434
Soy	38 (3.6)	13 (4.1)	51 (3.8)	0.705
Fish	15 (1.4)	2 (0.6)	17 (1.3)	0.258
Shellfish	7 (0.7)	0 (0.0)	7 (0.5)	0.144
Other	95 (9.1)	43 (13.6)	138 (10.1)	0.021
Unknown	71 (6.8)	20 (6.3)	91 (6.7)	0.759

*The p-value for a chi-square test.

Almost all of the patients (93.5%) reported developing skin and/or mucosal symptoms. A small percentage (3.5%) of likely anaphylaxis case did not report skin and/or mucosal symptoms. Over half of the patients (61.8%) had respiratory symptoms. This included 79.2% of those with likely anaphylaxis, compared with only 4.4% of those without likely anaphylaxis. One-quarter of the patients (25.4%) reported cardiovascular symptoms, including 32.1% of those with likely anaphylaxis, compared with only 3.2% of those without anaphylaxis. Gastrointestinal symptoms were present in about half of the patients (52.9%), including 66.0% of those with likely anaphylaxis, and in 9.8% of those without anaphylaxis. Biphasic symptoms were present in under one-fifth of patients (17.2%).

Epinephrine administration and anaphylaxis management

Epinephrine administration information was available in 1300 of 1361 survey responses because of missing data or respondent uncertainty. Of those, 988/1300 or 76.0% (95% CI 74.4–79.0%) of index reactions met NIAID/FAAN criteria as highly likely for anaphylaxis. Only 339/988 or 34.3% (95% CI 31.3–37.3%) of patients with food-induced anaphylaxis reported they received epinephrine, compared with 7.7% of patients without anaphylaxis (Fig. 1).

Of the index reactions judged to have anaphylaxis and administered epinephrine, it was administered by emergency departments in 56.1% (190/339), pre-hospital by parents in 20.1% (68/339), by paramedics in 9.4% (32/339), by primary care physicians in 8.3% (28/339), and by urgent care centers in 6.2% (21/339) of cases.

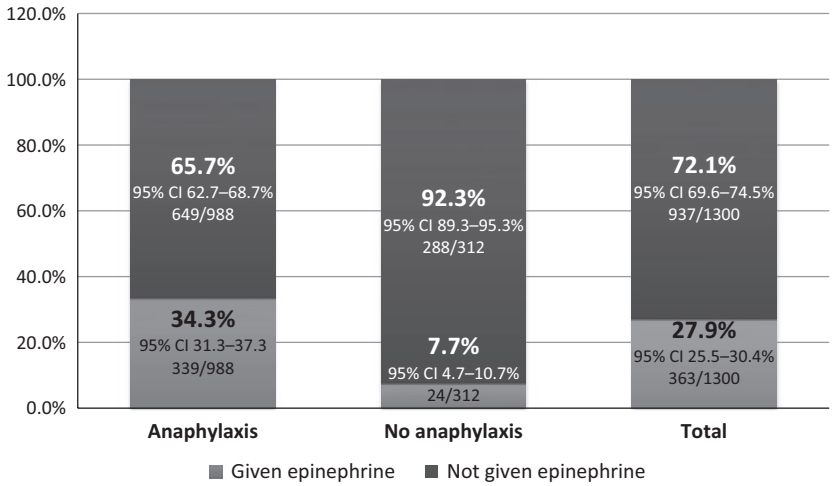

Figure 1 Epinephrine given to patients with food-related allergic reactions with and without anaphylaxis (n = 1300).

The median time between development of symptoms and reported epinephrine administration by all providers combined in likely anaphylaxis cases was between 15 and 30 min. In the likely anaphylaxis cases, median reported response time for epinephrine administration was within 15 min by parents, 15–30 min for paramedics and primary care center, and 30–60 min for urgent care centers to emergency departments. Epinephrine was administered within 15 min of the onset of symptoms in 26.3% of likely anaphylaxis cases, 53.7% within 30 min, 81.7% within 1 h, and 92.9% within 2 h (Table 3).

Factors associated with a decreased likelihood of receiving epinephrine in anaphylaxis included being < 12 months of age (OR 2.26, 95% CI 1.71–2.99), reported milk (OR 1.48, 95% CI 1.11–1.96) and egg (OR 1.52, 95% CI 1.01–1.27) triggers, reporting at least one gastrointestinal symptom (OR 1.35, 95% CI 1.03–1.78), abdominal pain (OR 1.56, 95% CI 1.08–2.24), and diarrhea (OR 1.64, 95% CI 1.14–2.36). Factors associated with an increased likelihood of receiving epinephrine for anaphylaxis included being a known asthmatic (OR 1.39, 95% CI 1.01–1.90), reported peanut (OR 1.45, 95% CI 1.09–1.94), and tree nut (OR 1.50, 95% CI 1.02–2.18) triggers, as well as most skin, mucosal, respiratory and cardiovascular symptoms and signs. Reported wheat, soy, fish or shellfish triggers did not increase or decrease likelihood of receiving epinephrine for anaphylaxis. The year in which the reported index reaction occurred also did not affect the likelihood of receiving epinephrine for anaphylaxis (Table 4).

Table 3 Timing of epinephrine given to patients of food-related allergic reactions with and without anaphylaxis (n = 363)

Timing	Anaphylaxis n (cumulative %)	No anaphylaxis n (cumulative %)
Total, n (%)	339 (93.4)	24 (6.6)
Median time		
All providers	15–30 min	15–60 min
Parents	Within 15 min	Within 15 min
Paramedics	15–30 min	Within 15 min
Primary care center	15–30 min	Within 15 min
Urgent care center	30–60 min	No observations
Emergency department	30–60 min	30–60 min
Within 15 min	89 (26.3)	7 (29.2)
Within 30 min	93 (53.7)	5 (50.0)
Within 1 h	95 (81.7)	4 (66.7)
Within 2 h	38 (92.9)	5 (87.5)
Within 4 h	17 (97.9)	2 (95.8)
>4 h	7 (100.0)	1 (100.0)

Antihistamines were used to treat most (93.1%) index reactions, including 92.4% of those with likely anaphylaxis, and 95.3% of those without likely anaphylaxis. Steroids were additionally used in 81.6% of those reactions, including 80.8% of those reactions with likely anaphylaxis, and 84.5% of those without anaphylaxis. Intravenous fluids, respiratory treatments and/or oxygen were administered in about two-thirds of reactions. Less than 1% of reactions required intubation. About 10% of reactions required admission to the hospital, significantly more for those with anaphylaxis (12.0%) than those without anaphylaxis (3.2%) ($p < 0.001$). Close to 3% of patients with likely anaphylaxis were admitted to the intensive care unit, though none in those without anaphylaxis (Fig. 2).

Discharge care and instructions for food allergy and anaphylaxis

Post-treatment in the subset of index reactions with anaphylaxis, 33.0% were prescribed epinephrine auto-injectors, 16.7% were trained to use epinephrine auto-injectors, and 7.5% were given epinephrine auto-injectors. Approximately 42.3% of anaphylaxis cases were referred to allergists. Less

Table 4 Variables associated with under-treatment (no epinephrine) and variables associated with epinephrine treatment in cases of food-related anaphylaxis (n = 988)

	OR (95% CI)*
Variables associated with under-treatment (no epinephrine)	
Demographic	
Age <12 months	2.26 (1.71–2.99)
Inciting food (prior to event)	
Milk	1.48 (1.11–1.96)
Egg	1.52 (1.01–2.27)
Symptoms	
Having at least one gastrointestinal symptom	1.35 (1.03–1.78)
Abdominal pain	1.56 (1.08–2.24)
Diarrhea	1.64 (1.14–2.36)
Variables associated with epinephrine treatment	
Past medical history	
Asthma	1.39 (1.01–1.90)
Inciting food (ingested prior to event)	
Peanut	1.45 (1.09–1.94)
Treenut	1.50 (1.02–2.18)
Transport by ambulance	4.28 (3.07–5.96)
Symptoms	
Skin symptoms	
Facial erythema	1.49 (1.14–1.94)
Facial edema	2.07 (1.58–2.71)
Generalized hives	1.48 (1.13–1.93)
Generalized flushing	1.37 (1.05–1.78)
Swollen extremities	2.10 (1.41–3.11)
Generalized pruritus	1.35 (1.02–1.78)
Mucosal symptoms	
Having at least one mucosal symptom	2.45 (1.70–3.54)
Angioedema	3.27 (2.49–4.30)
Eye symptoms	1.38 (1.06–1.80)
Dysphagia	2.93 (2.17–3.96)
Choking sensation	2.55 (1.87–3.47)
Respiratory symptoms	
Having at least one respiratory symptom	2.54 (1.75–3.68)
Dysphonia	2.17 (1.57–3.00)
Cough	1.84 (1.41–2.40)
Dyspnea	2.79 (2.08–3.74)
Chest tightness	2.74 (1.79–4.20)
Noisy breathing	2.18 (1.67–2.85)
Cyanosis	2.38 (1.55–3.63)
Wheezing	2.35 (1.77–3.11)
Cardiovascular symptoms	
Having at least one cardiovascular symptom	2.35 (1.79–3.08)
Chest pain	4.40 (1.34–14.39)
Dizziness	1.84 (1.12–3.00)
Syncope	1.88 (1.02–3.47)
Diaphoresis	1.62 (1.03–2.53)
Palpitations	2.39 (1.17–4.92)
Confusion and mental status changes	2.02 (1.26–3.26)
Hypotension	2.43 (1.59–3.73)
Tachycardia	3.86 (2.56–5.82)

*OR was calculated using binary logistic regression.

than one-quarter (19.1%) were given anaphylaxis emergency medical plans. About one-third of anaphylactic reactions were prescribed steroids (31.8%) and antihistamines (39.7%). About one-tenth were prescribed bronchodilators (13.0%). Of patients treated with epinephrine, less than half were prescribed epinephrine auto-injectors (47.1%) (Table 5).

Discussion

In this study, we examined the management of anaphylaxis in a group of patients at significant risk for under-diagnosis and treatment – children with first-time reactions that require medical evaluation before food allergies are formally diagnosed. Our results suggest that anaphylaxis is under-recognized and under-treated in patients without a prior food allergy diagnosis. Only one-third of reported likely anaphylaxis cases were administered epinephrine. Post-treatment, only one-third of patients with likely anaphylaxis were prescribed epinephrine auto-injectors, and less than half were referred to allergists. More than half of patients treated with epinephrine were not prescribed epinephrine auto-injectors.

Our findings support prior studies suggesting that food-induced anaphylaxis is often poorly recognized and under-treated (17–23). Our findings again support a need for more direct education regarding the broad diagnostic criteria of anaphylaxis, given that the presentation can be subtle, lack cutaneous symptoms, and not always be associated with cardiovascular collapse. In a prior study of fatal and near-fatal anaphylaxis cases in children, cutaneous symptoms and signs were less common in food-induced anaphylaxis deaths compared with those who survived (24). Many of the symptoms and signs of anaphylaxis can be non-specific or misleading, such as confusion, presyncope, collapse, or abdominal pain, all of which carry broad differential diagnoses. Anaphylaxis may be mistaken for an asthma exacerbation if signs of cutaneous symptoms are overlooked, and/or if signs of cardiovascular involvement are misattributed to side effects of bronchodilator treatment. Anaphylaxis is likely under-diagnosed for these and a variety of other reasons (7, 19, 25–27). Under-recognition and subsequent under-treatment of food-related anaphylaxis may be particularly pronounced in the pediatric population, especially in children presenting with their first episode of anaphylaxis. Previous reports show that a large proportion of anaphylactic reactions had no previous history of anaphylaxis or food allergies (22, 28).

Recognition of the variable and atypical presentations of anaphylaxis is critical to providing frontline therapy with intramuscular epinephrine, as well as reducing overreliance on less-effective adjunctive medications as primary therapies, such as antihistamines and glucocorticoids. Timely administration of epinephrine is the only intervention that has been shown to effectively treat the severity of the allergic reactions (29, 30). Several case studies have implicated the failure of rapid administration of epinephrine as a consistent finding in anaphylaxis deaths (24, 31–37). Prior studies show that the use of epinephrine is not consistent in both children and adults and that physician knowledge of anaphylaxis management guidelines is inadequate (20–22, 28, 38). Prompt, early

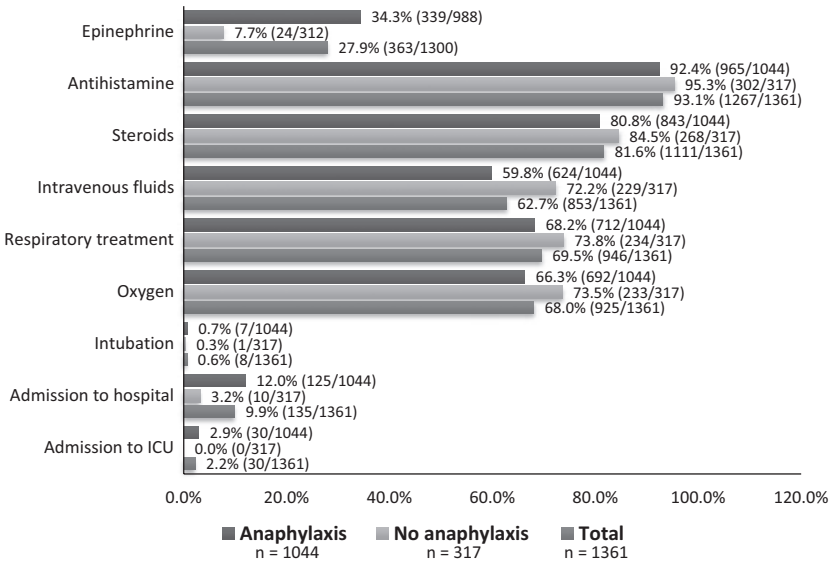

Figure 2 Medications, treatments and interventions provided to patients of food-related allergic reactions with and without anaphylaxis (n = 1361).

Table 5 Discharge care and instructions provided to patients with food-related anaphylaxis and those given epinephrine (treated as anaphylaxis)

Discharge care and instructions	Anaphylaxis n (%)	Given epinephrine n (%)
Total, n (%)	988 (76.0)	363 (27.9)
Given anaphylaxis emergency action plan	199 (19.1)	98 (27.0)
Educated about biphasic reactions	204 (19.5)	125 (34.4)
Allergy referral	442 (42.3)	152 (41.9)
Prescribed epinephrine auto-injectors	344 (33.0)	171 (47.1)
Given epinephrine auto-injectors	78 (7.5)	36 (9.9)
Trained to use epinephrine auto-injectors	174 (16.7)	77 (21.2)
Prescribed steroids	332 (31.8)	185 (51.0)
Prescribed antihistamines	414 (39.7)	152 (41.9)
Prescribed bronchodilators	136 (13.0)	56 (15.4)

administration of epinephrine is a potentially modifiable factor in improving anaphylaxis survival.

In an effort to identify potential areas for educational and therapeutic improvement, we identified risk factors for undertreatment with epinephrine. Milk and egg allergies are more common in infants and young children, and fatal milk allergies affect mostly children (9, 10, 24, 32, 34, 39, 40). However, our study found that infancy, milk and egg triggers, and reported gastrointestinal symptoms were independently associated with anaphylaxis under-recognition and treatment. Factors in our data set associated with an increased likelihood of receiving epinephrine – asthma, and peanut and tree nut allergies – correspond with well-established risk factors for food-induced anaphylaxis and fatality (6, 24, 31–36, 39, 41).

There are several limitations of this study. Foremost, this is a self-reported study assessing parental interpretation of a reaction and its associated factors. However, studies of this nature are routinely conducted as it is a practical and useful way to assess food allergy in a large population. Another notable limitation inherent to survey studies is recall bias. We recognize that parents have varying levels of medical knowledge and may not acknowledge certain medications, treatments, or counseling provided especially under exigent circumstances. To limit recall errors, we provided choices for uncertainty. These responses were not included in proportion estimates. With these acknowledged limits, a large proportion of cases were identified as highly likely for food-induced anaphylaxis, using the NIAID/FAAN criteria. Some of this may be explained by participation bias from respondents who had a more severe event that they are less likely to overlook or that may have been their motivation to take such a survey. We have consistently labeled the reaction as 'likely' or 'highly likely' for anaphylaxis, because we did not assess these patients directly, and are relying on parental report of what occurred, to account for biases in using these criteria. However, we highlight that such reports are no different from taking a history in the office of a past event, which one also would not have been able to assess. Additionally, prior less severe reactions may have been self-treated and therefore missed as the initial presentation of food allergy. A separate analysis was performed limiting highly likely anaphylaxis to those reactions that occurred within 1–2 h (we included all cases in this analysis); the proportion estimates of likely anaphylaxis cases and epinephrine treatment did not significantly change. Because of this selection bias and intrinsic survey study design, we acknowledge that the incidence of

anaphylaxis in first-time food-induced allergic reactions requiring medical care cannot be gathered from this study.

The parental survey design allowed for study beyond emergency department management (to which retrospective chart review designs were limited), but also included management by other medical professionals often not part of the medical record. It is clear from our study that emergency departments were not the only location where initial anaphylaxis cases presented. About 8% of epinephrine administration in anaphylaxis occurred in primary care physician offices. Only about half of epinephrine administration in anaphylaxis occurred in the emergency departments. In fact, the median time to reported epinephrine administration was shorter in primary care offices than in emergency departments.

We examined the management of first-time food-related reactions in children without prior diagnoses of food allergies using a parental survey study design and found that anaphylaxis is under-recognized and under-treated. In this study, only one-third of reported likely anaphylaxis cases were administered epinephrine. These findings suggest that the clinical presentation of a patient experiencing anaphylaxis is often poorly recognized and that improved education and awareness is necessary to raise the standard response to anaphylaxis at all provider levels.

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