

# Predictors of hospital admission for food-related allergic reactions that present to the emergency department

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**Background:** Guidelines do not provide specific hospitalization criteria for patients presenting to the emergency department (ED) with food-related allergic reactions.

**Objective:** To determine predictors of hospital admission for ED patients with food-related allergic reactions.

**Methods:** We performed a medical record review at 3 academic centers of patients presenting to the ED for food-related allergic reactions (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes 693.1, 995.0, 995.1, 995.3, 995.7, 995.60–995.69, 558.3, 692.5, and 708.X) between January 1, 2001, and December 31, 2006. We focused on patient demographics, medical history, food triggers, clinical presentation, pre-ED and ED management with a specific focus on epinephrine treatment, and disposition. Predictors of hospital admission were determined using multivariable logistic regression.

**Results:** Through random sampling and appropriate weighting, the 1,112 cases reviewed represented a study cohort of 2,583 patients. Most patients (80%) were discharged from the ED. The age and sex of patients admitted to the hospital and those discharged were similar. Multivariable analysis identified 3 factors associated with a higher likelihood of hospital admission: meeting the criteria for food-related anaphylaxis (odds ratio [OR], 2.31; 95% confidence interval [CI], 1.23–4.33), pre-ED epinephrine treatment (OR, 6.65; 95% CI, 3.04–14.57), and epinephrine treatment within 1 hour of ED triage (OR, 3.78; 95% CI, 1.68–8.50). Patients with food-related allergic reactions triggered by shellfish were less likely to be admitted to the hospital (OR, 0.23; 95% CI, 0.08–0.68).

**Conclusions:** Most patients presenting to the ED with food-related allergic reactions are discharged. Several patient factors were independently associated with hospital admission in ED patients with food-related allergic reactions.

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## INTRODUCTION

Food allergies affect approximately 4% of the US population, and recent studies<sup>1,2</sup> suggest a rising prevalence. Food-related allergic reactions are the leading cause of anaphylactic reactions treated in the emergency department (ED), and it is estimated that there are 150 to 200 food allergy–related deaths in the United States each year.<sup>2,3</sup> Rates of hospitalization for food-related anaphylaxis continue to increase not only in the United States<sup>4</sup> but also in countries such as Australia<sup>5</sup> and the United Kingdom.<sup>6</sup> Specifically, the Centers

for Disease Control and Prevention estimates nearly 10,000 hospitalizations annually for food-related allergy in patients younger than 18 years.<sup>7</sup>

Despite the tremendous burden of ED visits and hospital admissions caused by food-related allergic reactions, little is known regarding factors associated with hospital admission from the ED. Available guidelines do not provide specific hospitalization criteria for this growing patient population. As a result, consensus is lacking on the appropriate observation period, and management of severe food-related allergic reactions presents a significant challenge. We studied the current management of patients presenting to the ED with food-related allergic reactions to better understand the factors associated with hospital admission. Identification of predictive factors could help in developing guidelines and determining who may benefit most from a longer observation period.

## METHODS

### Study Design

This multicenter medical record review was performed as a part of the Multicenter Airway Research Collaboration, a division of the Emergency Medicine Network (<http://www.emnet-usa.org>). This study was an extension of an earlier pilot study.<sup>8</sup> We extended our review to encompass 2001–

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2006 at the EDs of 3 academic hospitals in Boston (Massachusetts General Hospital, Children's Hospital Boston, and Brigham and Women's Hospital). The study was approved by the institutional review boards of all 3 institutions.

We searched for all patients presenting to the ED between January 1, 2001, and December 31, 2006, with a physician-diagnosed, food-related acute allergic reaction using relevant *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis codes.<sup>9</sup> The codes included 995.60 (anaphylactic shock due to unspecified food), 995.61 to 995.69 (anaphylactic shock due to specified food), 995.0 (other anaphylactic shock), 693.1 (dermatitis due to food), 995.7 (adverse food reaction, not otherwise classified), 558.3 (allergic gastroenteritis), and 692.5 (contact dermatitis due to food). In addition, random samplings of codes 995.3 (allergy, unspecified), 995.1 (angioedema), and 708.X (urticaria) were reviewed to identify cases of food-related allergic reactions within these nonspecific allergy codes. All medical records were reviewed by physicians and then by an allergist for accuracy and internal consistency. Cases not consistent with a food-related acute allergic reaction were excluded.

#### Data Collection

Standardized data abstraction forms were used to collect data on patient demographics, medical history, food allergy triggers, clinical presentation, pre-ED and ED treatment (with a specific focus on epinephrine treatment), and disposition.

#### Definitions

A food-related acute allergic reaction was defined as an acute episode of symptoms suggestive of an IgE-mediated reaction in which the onset was temporally related to a known or suspected food allergen. Anaphylaxis was defined based on the diagnostic criteria established by the second symposium of the National Institute of Allergy and Infectious Disease and the Food Allergy and Anaphylaxis Network.<sup>10</sup> Specifically, anaphylaxis was defined as an acute allergic reaction involving 2 or more organ systems or hypotension alone after exposure to a likely food allergen. For consistency with an earlier work,<sup>9</sup> hypotension was defined as a systolic blood pressure less than 100 mm Hg for adults in the ED setting. We examined the impact of using less than 90 mm Hg as the threshold, and it did not materially alter the results (data not shown). For children aged 10 to 17 years, hypotension was defined as a systolic blood pressure less than 90 mm Hg and 70 mm Hg + (age multiplied by 2) for children younger than 10 years.<sup>10</sup>

#### Statistical Analysis

We used a stratified sampling method to reflect the population of patients treated in the ED within each *International Classification of Diseases, Ninth Revision, Clinical Modification* code. Sample weights were assigned to account for unequal probabilities of selection, oversampling, and nonresponse. The weights were applied for analyses using the survey module in Stata version 10.0 (StataCorp LP, College Station, Texas). Data are expressed as mean (SE) and as

proportions with 95% confidence intervals. Factors associated with hospital admission were evaluated using weighted  $\chi^2$  tests and *t* tests. A 2-sided  $P < .05$  was considered statistically significant. Multivariable logistic regression was used to identify independent predictors of hospital admission. The multivariable model was created using a manual stepwise approach. Factors associated with admission at  $P < .2$  were evaluated for inclusion in the multivariable model. Results are presented as odds ratios with 95% confidence intervals.

## RESULTS

During the 6-year study period, we reviewed medical records for 1,112 ED visits for food-related allergic reactions. With appropriate weighting, as described in the "Methods" section, this represented a study cohort of 2,583 patients. Most of these patients (80%) were discharged from the ED. Table 1 presents the demographics and medical history of patients according to admission status, and Table 2 describes their presentation to the ED and initial treatments.

#### Demographics

The age and sex of patients admitted to the hospital and those discharged were similar. Univariate analysis suggested that patients 25 years and older were less likely to be admitted to the hospital, but this result was not significant on multivariable analysis (Table 3). There was a slightly increased percentage of white patients among those admitted to the hospital (51%) compared with those who were discharged (45%), but, again, this unadjusted finding was not significant on multivariable analysis.

#### Medical History

Nearly half of all patients (46%) reported a known allergy to the offending agent, and two-thirds of all patients reported a history of a known allergic problem. Patients admitted to the hospital were more likely to report a history of asthma and atopic dermatitis compared with discharged patients. Admitted patients were also more likely to own an epinephrine autoinjector at the time of their ED presentation compared with discharged patients.

#### Food Allergy Triggers and Setting

Peanuts and tree nuts were the most common triggers in all patients with food-related allergic reactions. Patients reporting a reaction triggered by peanuts or tree nuts were more likely to be admitted to the hospital than discharged, and the opposite was true for patients reporting a reaction to shellfish, fish, and egg. The location of the exposure did not vary significantly between patients who were admitted vs discharged.

#### Clinical Presentation

Patients admitted to the hospital more frequently arrived by ambulance, had quicker onset of allergic symptoms (<1 hour), and presented within a shorter period (<3 hours) since exposure to the causative food. From a clinical perspective, patients admitted to the hospital more commonly presented with symptoms of angioedema, trouble swallowing, shortness

Table 1. Demographics and Medical History of Patients Presenting to the Emergency Department With a Food-Related Allergic Reaction According to Disposition<sup>a</sup>

|                                                | Discharged (n = 2,064) | Admitted (n = 519) | P value |
|------------------------------------------------|------------------------|--------------------|---------|
| <b>Demographic Characteristics</b>             |                        |                    |         |
| Age, mean, y                                   | 22 (20–23)             | 20 (18–22)         | .17     |
| Age ≥18 y                                      | 53 (50–56)             | 46 (41–52)         | .06     |
| Age group, y                                   |                        |                    | .002    |
| <6                                             | 30 (27–33)             | 30 (26–35)         |         |
| 6–11                                           | 10 (7–12)              | 9 (7–11)           |         |
| 12–17                                          | 7 (5–10)               | 14 (11–17)         |         |
| 18–24                                          | 11 (9–14)              | 15 (10–19)         |         |
| ≥25                                            | 42 (38–45)             | 32 (26–38)         |         |
| Female sex                                     | 49 (45–54)             | 54 (49–60)         | .18     |
| Race/ethnicity                                 |                        |                    | .009    |
| White                                          | 45 (41–49)             | 51 (45–57)         |         |
| Black                                          | 24 (20–27)             | 25 (20–31)         |         |
| Hispanic                                       | 13 (10–15)             | 13 (9–16)          |         |
| Asian                                          | 7 (4–9)                | 6 (5–8)            |         |
| Other                                          | 12 (9–15)              | 5 (4–5)            |         |
| <b>Medical History</b>                         |                        |                    |         |
| Known allergy to offending allergen            | 45 (40–49)             | 51 (45–56)         | .09     |
| Known allergic problems                        | 63 (59–67)             | 70 (65–75)         | .04     |
| Asthma                                         | 41 (36–47)             | 52 (45–59)         | .03     |
| Hay fever                                      | 14 (10–18)             | 18 (13–24)         | .19     |
| Atopic dermatitis                              | 16 (13–20)             | 24 (19–30)         | .02     |
| Patient owns EpiPen                            | 31 (27–36)             | 44 (38–50)         | .001    |
| Patient taking any long-term medications       | 40 (35–44)             | 49 (44–55)         | .008    |
| Specific food trigger causing current reaction |                        |                    |         |
| Peanuts                                        | 16 (13–19)             | 23 (19–27)         | .004    |
| Tree nuts                                      | 15 (12–18)             | 23 (18–28)         | .002    |
| Seeds                                          | 2 (1–3)                | 3 (0–6)            | .53     |
| Fruits and vegetables                          | 13 (10–16)             | 11 (7–15)          | .49     |
| Shellfish                                      | 16 (13–20)             | 10 (7–14)          | .02     |
| Fish                                           | 11 (8–13)              | 4 (2–6)            | .001    |
| Milk products                                  | 10 (7–12)              | 11 (7–14)          | .64     |
| Eggs                                           | 6 (4–8)                | 2 (2–3)            | <.001   |
| Wheat                                          | 0.5 (0–1)              | 1 (0–1)            | .47     |
| Other                                          | 25 (21–28)             | 20 (15–25)         | .18     |

<sup>a</sup> Data are given as percentage (95% confidence interval) except where indicated otherwise.

of breath, wheezing, hoarse voice, stridor, and diarrhea. Initial vitals signs did not differ by hospital admission status ( $P > .20$  for all), with 2 possible exceptions. Admitted patients compared with discharged patients had a slightly higher initial heart rate (mean: 106 vs 103 bpm,  $P = .03$ ) and a possibly higher respiratory rate (mean: 23 vs 22 breaths/min,  $P = .13$ ). Patients admitted to the hospital met the criteria for anaphylaxis more frequently than did patients who were discharged.

#### Pre-ED and ED Management

Compared with discharged patients, admitted patients were more likely to receive pre-ED treatments, including epinephrine, antihistamines, corticosteroids and  $\beta$ -agonists. Patients admitted to the hospital were also more likely to receive more than 1 dose of pre-ED epinephrine compared with discharged patients.

#### Predictors of Hospital Admission

Multivariable analysis showed that the presence of symptoms meeting the criteria for anaphylaxis, treatment with epinephrine pre-ED, and treatment with epinephrine within 1 hour of ED triage were associated with an increased likelihood of hospital admission (Table 3). In contrast, multivariable analysis showed that patients presenting with a food-related allergic reaction due to shellfish were less likely to be admitted to the hospital. The other specific food allergy triggers and history of any atopic conditions, including asthma, were not associated with hospital admission on multivariable analysis.

#### DISCUSSION

There are sparse data evaluating the admission decision process in the ED for patients presenting with food-related allergic reactions. This study provides a comprehensive re-

Table 2. Presentation of Patients Treated in the ED With a Food-Related Allergic Reaction According to Disposition<sup>a</sup>

|                                                                          | Discharged (n = 2,064) | Admitted (n = 519) | P value |
|--------------------------------------------------------------------------|------------------------|--------------------|---------|
| Arrived at ED by ambulance                                               | 30 (26–34)             | 45 (40–51)         | <.001   |
| Time since exposure, h                                                   |                        |                    | <.001   |
| <1                                                                       | 24 (20–29)             | 30 (23–37)         |         |
| 1–3                                                                      | 47 (42–52)             | 52 (45–58)         |         |
| 4–6                                                                      | 10 (7–13)              | 13 (10–17)         |         |
| 7–12                                                                     | 3 (1–4)                | 0.5 (0.2–1)        |         |
| >12                                                                      | 17 (13–21)             | 4 (2–6)            |         |
| Onset of symptoms, h                                                     |                        |                    | .02     |
| <1                                                                       | 30 (25–35)             | 36 (29–43)         |         |
| 1–3                                                                      | 44 (39–49)             | 48 (42–55)         |         |
| >3                                                                       | 26 (21–30)             | 16 (12–20)         |         |
| Location of exposure                                                     |                        |                    | .38     |
| Home                                                                     | 53 (48–58)             | 59 (53–65)         |         |
| School/day care                                                          | 9 (6–11)               | 6 (3–9)            |         |
| Work                                                                     | 3 (1–5)                | 4 (2–7)            |         |
| Restaurant                                                               | 26 (22–31)             | 24 (18–30)         |         |
| Other                                                                    | 9 (6–12)               | 7 (5–8)            |         |
| Location immediately before ED arrival                                   |                        |                    | .02     |
| Home                                                                     | 63 (58–68)             | 54 (48–59)         |         |
| School/day care                                                          | 7 (5–10)               | 6 (3–9)            |         |
| Work                                                                     | 3 (1–6)                | 4 (1–6)            |         |
| Restaurant                                                               | 12 (9–16)              | 15 (9–20)          |         |
| Physician office/clinic                                                  | 7 (4–10)               | 7 (5–10)           |         |
| Other                                                                    | 7 (4–10)               | 15 (12–18)         |         |
| Signs and symptoms                                                       |                        |                    |         |
| Skin rash                                                                | 72 (68–75)             | 64 (59–70)         | .03     |
| Itching                                                                  | 46 (42–50)             | 40 (34–45)         | .08     |
| Swelling                                                                 | 48 (44–53)             | 48 (42–53)         | .92     |
| Peripheral edema                                                         | NC                     | 2 (0–4)            | –       |
| Angioedema                                                               | 5 (3–7)                | 18 (13–22)         | <.001   |
| Trouble swallowing                                                       | 15 (12–18)             | 26 (21–31)         | <.001   |
| Trouble breathing/shortness of breath                                    | 27 (23–31)             | 47 (42–53)         | <.001   |
| Wheezing                                                                 | 14 (11–17)             | 32 (28–37)         | <.001   |
| Hoarse voice                                                             | 5 (3–8)                | 10 (7–13)          | .02     |
| Stridor                                                                  | 1 (0.4–2)              | 6 (4–8)            | <.001   |
| Nausea/vomiting                                                          | 14 (11–17)             | 17 (14–21)         | .20     |
| Abdominal pain/cramps                                                    | 5 (3–7)                | 3 (2–4)            | .10     |
| Diarrhea                                                                 | 2 (1–4)                | 1 (0.4–1)          | <.001   |
| Dizziness/fainting                                                       | 3 (2–5)                | 4 (1–7)            | .80     |
| Organ system involvement                                                 |                        |                    |         |
| Respiratory                                                              | 37 (33–67)             | 64 (59–70)         | <.001   |
| Cutaneous                                                                | 93 (90–95)             | 91 (88–94)         | .37     |
| Gastrointestinal                                                         | 30 (26–34)             | 41 (35–46)         | .001    |
| Cardiac                                                                  | 4 (2–6)                | 5 (2–9)            | .48     |
| Anaphylaxis <sup>b</sup>                                                 | 53 (48–57)             | 80 (75–85)         | <.001   |
| Pre-ED treatments (≤3 h before triage)                                   | 50 (46–55)             | 66 (60–71)         | <.001   |
| Epinephrine                                                              | 27 (22–33)             | 57 (50–65)         | <0.001  |
| Benadryl                                                                 | 80 (75–85)             | 80 (73–86)         | .93     |
| Other antihistamines                                                     | 6 (3–8)                | 12 (6–18)          | .04     |
| Corticosteroids                                                          | 5 (2–7)                | 19 (14–23)         | <.001   |
| Intravenous fluids                                                       | 3 (0.3–5)              | 4 (2–5)            | .68     |
| Inhaled β-agonists                                                       | 8 (4–11)               | 21 (16–27)         | <.001   |
| Oxygen                                                                   | NC                     | 3 (2–4)            | NC      |
| Other                                                                    | 4 (1–7)                | 4 (2–7)            | .82     |
| No. of pre-ED epinephrine doses in patients receiving pre-ED epinephrine |                        |                    | .01     |
| 1                                                                        | 99 (99–100)            | 91 (89–92)         |         |
| ≥2                                                                       | 1 (0.3–1)              | 9 (8–11)           |         |
| ED treatment with epinephrine within 1 h of ED triage                    | 7 (5–9)                | 27 (22–32)         | <.001   |

Table 2. (Continued) Presentation of Patients Treated in the ED With a Food-Related Allergic Reaction According to Disposition<sup>a</sup>

|                                                       | Discharged (n = 2,064) | Admitted (n = 519) | P value |
|-------------------------------------------------------|------------------------|--------------------|---------|
| Initial respiratory rate, mean (95% CI), breaths/min  | 22 (21–23)             | 23 (22–23)         | .13     |
| Initial heart rate, mean (95% CI), bpm                | 103 (101–105)          | 106 (104–109)      | .03     |
| Initial systolic blood pressure, mean (95% CI), mm Hg | 123 (121–124)          | 121 (118–123)      | .32     |
| Initial temperature, mean (95% CI), °F                | 98.1 (98.0–98.2)       | 98.0 (97.8–98.1)   | .20     |
| Initial oxygen saturation, mean (95% CI), %           | 98 (98–98)             | 98 (98–99)         | .39     |
| Oxygen saturation on room air                         | 98 (97–99)             | 97 (96–98)         | .39     |

Abbreviations: CI, confidence interval; ED, emergency department; NC, noncalculable (when the number of observations was fewer than 30, robust estimates could not be produced).

<sup>a</sup> Data are given as percentage (95% confidence interval) except where indicated otherwise.

<sup>b</sup> See the “Methods” section for details.

view of the current management of patients with food-related allergic reactions presenting to 3 academic EDs during a 6-year period. To our knowledge, this is the largest study of ED patients with food-related allergic reactions specifically examining factors associated with hospital admission. By studying current practices in several academic EDs, a few novel predictors of hospital admission were identified.

These data suggest that patients who meet symptomatic criteria for anaphylaxis are more likely to be hospitalized. In addition, patients treated with epinephrine pre-ED or within 1 hour of triage were more likely to be admitted to the hospital. Likely, patients who received epinephrine treatment had more severe food-related allergic reactions compared with patients who did not receive epinephrine treatment. On the other hand, it is somewhat surprising that patients who received appropriate treatment with epinephrine had a worse outcome, ie, they were admitted. As noted previously herein, the explanation for this paradoxical finding is probably “confounding by severity.”<sup>11</sup> This type of methodological problem

suggests that demonstration of the benefits of epinephrine will need to look beyond hospital admission (eg, the effect of epinephrine on timing and completeness of symptom relief) because even if patients’ symptoms improve quickly, they may still be admitted for other reasons (ie, concern about a biphasic reaction).

Epinephrine is widely accepted as the most effective treatment for anaphylaxis.<sup>10</sup> Moreover, a delay in the administration of epinephrine is a clear risk factor for poor outcomes.<sup>12–14</sup> Specifically, prompt treatment with epinephrine has been shown to decrease fatalities from food-related anaphylaxis<sup>12–15</sup> and to potentially decrease the risk of a biphasic response.<sup>16</sup> Despite this knowledge, food-related anaphylaxis continues to be inadequately treated.<sup>17,18</sup> In this study, only 41% of patients meeting the criteria for anaphylaxis were treated with epinephrine, indicating that further work is needed for EDs to comply with national guidelines for the management of patients presenting with food-associated anaphylactic reactions. In addition, without clear guidelines for hospital admission in ED patients with food-related allergic reactions, it is even more important that we provide appropriate initial treatment.<sup>10</sup>

These data suggest that of all the specific food allergy triggers evaluated, only patients with reactions to shellfish were less likely to be admitted to the hospital. This is inconsistent with previous data suggesting that shellfish allergies are associated with more severe food-related allergic reactions.<sup>2</sup> The present findings suggest that although shellfish allergy is still a risk factor for food-related allergic reactions, the seriousness of these reactions may not be as well understood compared with other food triggers, such as peanuts or tree nuts. This finding warrants further study in another population of patients with food-related allergic reactions.

Individuals who have both IgE-mediated food allergy and asthma have been reported to be at higher risk for food-related anaphylaxis.<sup>19</sup> Asthma has also previously been associated with the need for multiple doses of epinephrine.<sup>20</sup> The present data suggest that patients with a history of asthma, as well as other allergic diseases, such as atopic dermatitis, are more commonly admitted to the hospital. However, this association was not an independent predictor of hospital admission. Collectively, the data suggest that when ED physicians

Table 3. Multivariable Predictors of Hospital Admission in Patients Presenting to the ED With a Food-Related Allergic Reaction

|                                               | Odds ratio | 95% CI     | P value   |
|-----------------------------------------------|------------|------------|-----------|
| Age group, y                                  |            |            |           |
| <6                                            | 1.00       | Reference  | Reference |
| 6–11                                          | 0.65       | 0.31–1.36  | .25       |
| 12–17                                         | 1.44       | 0.67–3.07  | .35       |
| 18–24                                         | 0.47       | 0.16–1.39  | .17       |
| ≥25                                           | 0.67       | 0.32–1.41  | .29       |
| Female sex                                    | 1.47       | 0.89–2.42  | .13       |
| White race/ethnicity                          | 1.07       | 0.61–1.88  | .81       |
| Asthma                                        | 1.46       | 0.85–2.51  | .17       |
| Peanut trigger                                | 1.10       | 0.59–2.06  | .77       |
| Tree nut trigger                              | 0.84       | 0.43–1.62  | .60       |
| Shellfish trigger                             | 0.23       | 0.08–0.68  | .008      |
| Anaphylaxis <sup>a</sup>                      | 2.31       | 1.23–4.33  | .009      |
| Pre-ED epinephrine treatment                  | 6.65       | 3.04–14.57 | <.001     |
| Epinephrine treatment within 1 h of ED triage | 3.78       | 1.68–8.50  | .001      |

Abbreviations: CI, confidence interval; ED, emergency department.

<sup>a</sup> See the “Methods” section for details.

are evaluating patients with food-related allergic reactions, asking about a history of asthma, or other allergic diseases, is important and relevant, but further studies are needed to determine whether these comorbidities should affect the need for hospital admission or longer observation.

The period of hospital observation after emergency management of a severe allergic reaction has long been a dilemma, and current guidelines do not provide specific criteria for hospitalization. One major concern is the potential development of biphasic anaphylaxis, which ranges in incidence from 1% to 23%.<sup>16,21</sup> In addition, there remains a lack of consistency between studies regarding reliable predictors of biphasic anaphylaxis.<sup>21,22</sup> Some reports recommend 8 hours of hospital observation for all patients presenting to the ED with anaphylaxis,<sup>23</sup> whereas others suggest 24 hours of hospital observation.<sup>16,24</sup> A 24-hour observation period for those who received epinephrine and 12 hours for all other patients has been suggested as a more “reasonable approach.”<sup>25</sup> Although the rate of biphasic reactions was not investigated in the present study, this area needs further investigation to make clearer recommendations regarding appropriate observation times.

We believe that understanding admission decision making in the ED setting is critical as hospitalization rates for food-related anaphylaxis continue to rise.<sup>7</sup> This increase could be related to increased awareness, reporting, and use of specific medical diagnostic codes for food allergy or could represent a real increase in patients experiencing food-allergic reactions.<sup>7</sup> Regardless of the cause of this increase, it remains unclear whether choosing to admit these patients affects their outcome. Note that previous smaller studies<sup>26</sup> have found that most patients admitted to the hospital for observation after anaphylaxis do not receive further treatment. Therefore, we need to better understand who would benefit most from further observation or hospital admission. Further prospective studies to better understand predictors of admission for patients with food-related allergic reactions would help in the development of guidelines to better support physician decision making in the ED.

A potential limitation of this study is reliance on the medical record and the possibility that the documentation was inaccurate or incomplete. Also, these findings may not be generalizable to all EDs because the 3 hospitals evaluated were located in an urban academic setting in Boston. Furthermore, because we did not interview physicians, we cannot assess physician factors that were potentially associated with admission, such as diagnostic uncertainty and psychosocial factors that could affect the decision. Further prospective studies can help us better understand whether treatment decisions have an effect on outcome and develop evidence-based criteria for hospitalization. Last, although we evaluated symptoms at presentation to the ED, analysis of symptoms after appropriate treatment in the ED as predictors of hospital admission merits further investigation.

In summary, food allergy is a growing health care concern, with numerous clinical challenges complicated by severe

allergic reactions requiring ED management and hospitalization. The present study suggests that risk factors for hospital admission in ED patients with food-related allergic reactions are symptoms of anaphylaxis, pre-ED epinephrine treatment, and epinephrine use within 1 hour of ED triage. Conversely, we found that patients with food-related allergic reactions triggered by shellfish were less likely to be admitted to the hospital. Further study and identification of predictors of hospital admissions may help characterize patients at risk who would benefit most from a longer observation period and develop evidence-based guidelines to improve their care.

## REFERENCES

1. Sampson HA. Update on food allergy. *J Allergy Clin Immunol*. 2004;113:805–819; quiz 820.
2. Munoz-Furlong A, Weiss CC. Characteristics of food-allergic patients placing them at risk for a fatal anaphylactic episode. *Curr Allergy Asthma Rep*. 2009;9:57–63.
3. Clark S, Camargo CA Jr. Emergency management of food allergy: systems perspective. *Curr Opin Allergy Clin Immunol*. 2005;5:293–298.
4. Lin RY, Anderson AS, Shah SN, Nurruzzaman F. Increasing anaphylaxis hospitalizations in the first 2 decades of life: New York state, 1990–2006. *Ann Allergy Asthma Immunol*. 2008;101:387–393.
5. Poulos LM, Waters AM, Correll PK, Loblay RH, Marks GB. Trends in hospitalizations for anaphylaxis, angioedema, and urticaria in Australia, 1993–1994 to 2004–2005. *J Allergy Clin Immunol*. 2007;120:878–884.
6. Bohlke K, Davis RL, DeStefano F, et al. Epidemiology of anaphylaxis among children and adolescents enrolled in a health maintenance organization. *J Allergy Clin Immunol*. 2004;113:536–542.
7. Branum AM, Lukacs SL. Food allergy among children in the United States. *Pediatrics*. 2009;124:1549–1555.
8. Oren E, Banerji A, Clark S, Camargo CA Jr. Food-induced anaphylaxis and repeated epinephrine treatments. *Ann Allergy Asthma Immunol*. 2007;99:429–432.
9. Clark S, Gaeta TJ, Kamarthi GS, Camargo CA. ICD-9-CM coding of emergency department visits for food and insect sting allergy. *Ann Epidemiol*. 2006;16:696–700.
10. Sampson HA, Munoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report—second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. *Ann Emerg Med*. 2006;47:373–380.
11. Clark S, Costantino T, Rudnitsky G, Camargo CA Jr. Observational study of intravenous versus oral corticosteroids for acute asthma: an example of confounding by severity. *Acad Emerg Med*. 2005;12:439–445.
12. Bock SA, Munoz-Furlong A, Sampson HA. Further fatalities caused by anaphylactic reactions to food, 2001–2006. *J Allergy Clin Immunol*. 2007;119:1016–1018.
13. Bock SA, Munoz-Furlong A, Sampson HA. Fatalities due to anaphylactic reactions to foods. *J Allergy Clin Immunol*. 2001;107:191–193.
14. Pumphrey RS. Lessons for management of anaphylaxis from a study of fatal reactions. *Clin Exp Allergy*. 2000;30:1144–1150.
15. Pumphrey RS, Gowland MH. Further fatal allergic reactions to food in the United Kingdom, 1999–2006. *J Allergy Clin Immunol*. 2007;119:1018–1019.
16. Tole JW, Lieberman P. Biphasic anaphylaxis: review of incidence, clinical predictors, and observation recommendations. *Immunol Allergy Clin North Am*. 2007;27:309–326, viii.
17. Klein JS, Yocum MW. Underreporting of anaphylaxis in a community emergency room. *J Allergy Clin Immunol*. 1995;95:637–638.
18. Sheikh A, Ten Broek V, Brown SG, Simons FE. H1-antihistamines for the treatment of anaphylaxis: Cochrane systematic review. *Allergy*. 2007;62:830–837.

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19. Shah E, Pongracic J. Food-induced anaphylaxis: who, what, why, and where? *Pediatr Ann*. 2008;37:536–541.
  20. Uguz A, Lack G, Pumphrey R, et al. Allergic reactions in the community: a questionnaire survey of members of the anaphylaxis campaign. *Clin Exp Allergy*. 2005;35:746–750.
  21. Kemp SF. The post-anaphylaxis dilemma: how long is long enough to observe a patient after resolution of symptoms? *Curr Allergy Asthma Rep*. 2008;8:45–48.
  22. Mehr S, Liew WK, Tey D, Tang ML. Clinical predictors for biphasic reactions in children presenting with anaphylaxis. *Clin Exp Allergy*. 2009;39:1390–1396.
  23. Forrest-Hay A, Taylor C, Tochard S. Biphasic anaphylaxis in a UK emergency department. Paper presented at: 2003 Symposium of the Resuscitation Council of the United Kingdom.
  24. Ellis AK, Day JH. Incidence and characteristics of biphasic anaphylaxis: a prospective evaluation of 103 patients. *Ann Allergy Asthma Immunol*. 2007;98:64–69.
  25. Smit DV, Cameron PA, Rainer TH. Anaphylaxis presentations to an emergency department in Hong Kong: incidence and predictors of biphasic reactions. *J Emerg Med*. 2005;28:381–388.
  26. Lee JM, Greenes DS. Biphasic anaphylactic reactions in pediatrics. *Pediatrics*. 2000;106:762–766.

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