Analysis of food-allergic and anaphylactic events in the National Electronic Injury Surveillance System

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Background: The National Electronic Injury Surveillance System (NEISS) captures a nationally representative probability sample from hospital emergency departments (EDs) in the United States.
Objective: Emergency department data from NEISS were analyzed to assess the magnitude and severity of adverse events attributable to food allergies.
Methods: Emergency department events describing food-related allergic symptomatology were identified from 34 participating EDs from August 1 to September 30, 2003.
Results: Extrapolation of NEISS event data predicts a total of 20,821 hospital ED visits, 2333 visits for anaphylaxis, and 520 hospitalizations caused by food allergy in the United States during the 2-month study period. The median age was 26 years; 24% of visits involved children ≤5 years old. Shellfish was the most frequently implicated food in persons ≥6 years old, whereas children ≤5 years old experienced more events from eggs, fruit, peanuts, and tree nuts. There were no reported deaths. Review of medical records found that only 19% of patients received epinephrine, and, using criteria established by a 2005 anaphylaxis symposium, 57% of likely anaphylactic events did not have an ED diagnosis of anaphylaxis.
Conclusion: Analysis of NEISS data may be a useful tool for assessing the magnitude and severity of food-allergic events. A criteria-based review of medical records suggests underdiagnosis of anaphylactic events in EDs.
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Key words: *Anaphylaxis, food allergy, emergency department, surveillance/epidemiology*

Abbreviations used
AS: Anaphylaxis Symposium
CFSAN: Center for Food Safety and Applied Nutrition
CPSC: Consumer Product Safety Commission
ED: Emergency department
ICD-9: International Classification of Diseases, Ninth Revision
NEISS: National Electronic Injury Surveillance System

Food allergy is a recognized public health problem. With reported prevalence on the increase, it is also a leading cause of anaphylactic events treated in hospital emergency departments (EDs).[1] Despite these observations, nationally representative data on ED visits or other surveillance data that would be necessary to estimate the frequency of food allergy–related morbidity occurring in the US population are sparse. Accurate estimates of the magnitude and severity of food-related adverse events over time in the US population are important because they provide a basis for monitoring changes in the prevalence of food allergy–related events caused by consumer behaviors and/or other public health measures.

The Food and Drug Administration Center for Food Safety and Applied Nutrition (CFSAN) collects adverse event reports caused by CFSAN-regulated products, such as conventional foods, infant formula, dietary supplements, food and color additives, and cosmetics, directly from consumers and health care practitioners through the CFSAN Adverse Events Reporting System. This surveillance system, however, is passive and may not capture serious adverse events, such as those requiring medical intervention. As a result, to get a better estimate of the incidence of food-related allergic reactions in the United States than what CFSAN Adverse Events Reporting System data would allow, we used data from the National Electronic Injury Surveillance System (NEISS), which is an active surveillance system maintained by the Consumer Product Safety Commission (CPSC) designed to ascertain consumer product–related adverse events presenting to EDs in the United States.[2] The results we present here were derived from a 2-month pilot program with CPSC designed to estimate the incidence of food-allergic reactions presenting to EDs in the United States.

METHODS

The NEISS Database

The NEISS currently collects data from 98 hospital EDs geographically dispersed throughout the US that have a minimum of 6 beds and that provide 24-hour emergency services, excluding psychiatric and penal institutions. On the basis of NEISS sample design and implementation,[2,3] the data ascertained by the system represent a stratified probability sample that can be weighted to produce national estimates of the number of adverse events treated in US EDs.[3]

In this pilot study, we used 2 months of ED data collected from 34 of the 98 NEISS sites in the United States to calculate national estimates and variances of food-related allergic reactions.[3] CPSC provided CFSAN with an electronic database of all redacted ED reports generated by adverse events to food products. Most, but not all, ED reports had accompanying hard copy medical

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records. For the purposes of this study, a food-related event was defined as any single report of illness or injury attended to in a NEISS ED for which a food was identified as the cause of the event.

Identification/characterization of food-allergic events

In addition to reporting the offending food item, each food-related report listed 1 or more identifiable symptoms in an abbreviated comment field. Because no diagnostic codes for food allergy were documented in the reports, we identified possible food-allergic events from the comment fields using specific symptom key words (Table I) from the medical literature marking the possible presence of food-allergic reactions, including anaphylaxis.[4-7] We defined an ED report as a *food-allergic event* if specific key words were present and there was mention in the report of a "food-allergic reaction." In addition, ED reports were food-allergic events if 1 or more symptom key words were identified, the onset of symptoms occurred within 4 hours after eating a food (unless a rash was present), and there was no mention in the report that the event was caused by food spoilage, food poisoning, medication use, acute gastrointestinal infection or underlying gastrointestinal disease, or any other underlying chronic medical condition.

For each food-allergic event, we collected demographic information (age, sex, and race), the ED diagnosis (eg, anaphylaxis), and the outcome (ie, hospitalization or death). For those food-allergic events for which medical records were available, we collected details pertaining to the period between consumption of the alleged offending food and onset of symptoms, medical/allergy history, physical examination findings, and treatment rendered in the ED. On the basis of findings from the ED report and medical records, when available, food-allergic events were classified in terms of severity as being *anaphylaxis*, *multisystem*, or *single system*.

The anaphylaxis category included all events in which "anaphylaxis" was explicitly stated in the ED reports without medical records or that met 2005 Anaphylaxis Symposium (AS) criteria for anaphylaxis[8] after medical record review. To meet these criteria in either scenario, the medical record had to document multisystemic symptoms or "hypotension" alone in temporal association of food consumption. In addition, for events in which multisystemic ED records were not sufficiently descriptive, documentation of a previous history of food allergy or sensitization was used as the definitive inclusion measure. ED events that did not meet these specific criteria were classified into the other symptom severity categories on the basis of whether the reported symptoms involved $\geq$2 organ systems (multisystem category) or just 1 organ system (single system category). Organ systems were defined as cutaneous, gastrointestinal, respiratory, and cardiovascular.[9] Specific medications (eg, epinephrine, histamine, and glucocorticoids) used or administered during each food-allergic event were also evaluated as a measure of clinical severity.

Foods

Implicated foods were classified into various general categories, such as fruits, dairy products, bakery products, and meat/poultry. Where possible, foods were characterized more specifically as, for example, "peanuts," "tree nuts," "fish," "eggs," and "soy"; in other words, as major food allergens in the Food Allergen Labeling and Consumer Protection Act of 2004.[4] The category "shellfish" included all crustacean or molluscan shellfish. Records that implicated an unspecified seafood product were characterized as "seafood." Multiple component food items typically served hot (eg, pizza, enchiladas, tacos, egg rolls, and fast food) were placed in a "combined food" category. The "miscellaneous food" category included items that were few in number and did not have a common category (eg, nonfruit beverages, rice, baby food, noodles, and infant formula). When more than 1 food item was reported, a category designated as "several products listed" was used. Events in which a specific food was not listed (ie, reports of eating simply "lunch," "dinner," and so forth) were recorded as "unknown."

Comparison of childhood and adult events

Because a higher prevalence of food allergies has been documented in young children compared with adults,[9-11] we used 4 age groups ($\leq$12 months, 13 months to $\leq$5 years, 6 to $\leq$18 years, and >19 years) to explore age-related differences in food-allergic events. The pediatric age groups were based on developmental milestones with regard to feeding and food allergy. Whereas the first age milestone (12 months) represented the transition from breast-feeding to initial introduction of dietary allergens,[11] the second age milestone (5 years) represented an age by which most children appear to outgrow their food allergies from infancy.[10,12]

TABLE I. Allergic symptom key words for NEISS database event searches

Flush/flushing	Nausea	Dizziness, lightheadedness
Erythema (redness)	Vomiting	Loss of consciousness
Rash (eczema)	Diarrhea	Syncope (fainting)
Urticaria (hives)	Abdominal pain/cramps	Hypotension, low blood pressure
Angioedema (edema, swelling)	Voice hoarseness	Shock
Pruritus (itch)	Choke/choking	Distress (respiratory, cardiac)
Dry/dryness	Stridor	Tachycardia
Tear/tearing	Cough	Arrhythmia
Congestion	Wheeze/bronchospasm	Uterine contractions
Runniness	Chest pain	Anaphylaxis
Sneezing	Dyspnea (difficult or shortness of breath)	Allergy
Tight/tightness	Tachypnea (rapid breathing)	Allergic reaction

Statistical analysis

All relevant clinical data from the ED reports were entered into an EpiInfo database (EpiInfo Version 3.2.2.; Centers for Disease Control and Prevention). Data were analyzed by using SAS (SAS Systems for Windows v 9.1.2, SAS Institute Inc, Cary, NC). The SAS procedure PROC SURVEYFREQ was used to compute the various estimated weighted frequencies and their corresponding proportions with the sample design variables and weights provided by NEISS.[3] Weighted frequencies were based on 34 of 98 hospitals in NEISS. NEISS weights have been adjusted yearly to reflect changes in the most recent sampling frame of US hospitals. Using NEISS weighted data, we extrapolated our findings to produce national estimates of the incidence of food-allergic events presenting to EDs each year. Ninety-five percent CIs were calculated around the nationwide estimates.

RESULTS

Overall, a total of 1161 food-related events were ascertained by NEISS from 34 participating EDs for the period August 1 through September 30, 2003. Although a total of 806 (69 %) events were accompanied by 1 or more key words that suggested a possible allergic etiology, only 173 (15%) met the criteria to be considered food-allergic events, 118 of which reported "allergy" or "allergic reaction," and 141 of which had accompanying medical records. The excluded events comprised 419 events that were primarily gastrointestinal in nature (ie, "nausea," "vomiting," "diarrhea," and/or "pain/cramping") and associated with food poisoning, spoilage, or viral gastroenteritis; all 156 events that were "choking" in nature involved mechanical obstruction; 46 cardiovascular events (ie, "chest pain," "tachycardia," and so forth), including all 7 "hypotension" events, predominantly caused by medication or caffeine toxicity or an underlying disease cause; and 12 events for various other reasons. On the basis of our finding that 173 food-allergic events occurred during the study period, we estimate that a total of 20,821 (95% CI, 13,438-28,203) ED visits occurred nationally because of food allergies during the 2-month period (Table II).

TABLE II. Demographic characteristics and selected* implicated foods reported for 173† ED food-allergic events in NEISS

	Unweighted frequency (n = 173)	Weighted frequency (weighted %); [95% CI for percents]
Events with medical records	141	17,881 (86%)
Events without medical records	32	2940 (14%)
Total events	173	20,821
Age		
≤12 mo	15	443 (2%); [0.6, 4]
13 mo to 5 y	26	2614 (13%); [7, 18]
6 to 18 y	28	2529 (12%); [7, 17]
>18 y	104	15,235 (73%); [68, 79]
Sex		
Male	66	7623 (37%); [28, 45]
Female	107	13,198 (63%); [55, 72]
Race		
White	83	12,027 (58%); [39, 76]
Black	26	2797 (13%); [3, 24]
Other	23	1840 (9%); [0.1, 18]
Unknown	41	4157 (20%); [4, 35]
Foods		
Shellfish	36	5068 (24%); [19, 29]
Fruit	20	2397 (12%); [5, 18]
Combined foods (ie, pizza, taco)	18	2276 (11%); [3, 18]
Several foods simultaneously	14	1828 (9%); [4, 14]
Miscellaneous (ie, baby food, rice)	13	1073 (5%); [1, 9]
Peanuts	12	1416 (7%); [0.2, 13]
Tree nuts	11	921 (4%); [0.14, 9]

*Not shown are food categories with unweighted frequency <10: fish, seafood (7 each); candy or chocolate, eggs, vegetables (5 each), bakery products, "unknown" food (4 each), soy, meat or poultry, dairy, snack products (3 each).
†Corresponding to 20,821 estimated nationwide ED visits.

Persons with food-allergic events ranged in age from 1 month to 86 years (median, 26 years). The majority of reported events occurred in white persons (58%) and female subjects (63%). Food-allergic events most often involved shellfish (24% of events), fruits (12%), and "combined food" items (11%). The shellfish category (36 events) predominantly included crustacean shellfish, including shrimp (23 events), crab (8), lobster (1), shrimp and scallops (1), and simply shellfish (3). The most commonly reported fruit was peach (5 events) and tree nut was cashew (4 events). There were 4 events in which the causative food was unknown.

Sixty percent of the reported food-allergic events occurred among adults and 24% among children ≤5 years of age. The implicated foods tended to differ by age group (Fig 1). Events in children ≤12 months most often involved miscellaneous items, eggs, and fruit, whereas events in children age 13 months to 5 years most often involved peanuts, tree nuts, and fruit. Children age 6 to 18 years had a food reactivity profile similar to adults, with shellfish and combination foods implicated most often. Interestingly, very few reactions were noted solely to milk/dairy products in persons ≤5 years of age, and only 1 infant food-allergic event was reportedly a result of infant formula (brand not specified).

Symptoms

Review of ED medical records of 141 food-allergic events revealed that the majority of symptoms were skin-related (67%) followed by the respiratory (19%), gastrointestinal (9%), and cardiovascular (5%) systems (Table III). Although more than 1 symptom was reported in 117 of 141 (83%) food-allergic events, in 64 (55%) of these events, only a single organ system was involved.

For 60 (43%) of 141 events, information was available regarding the time interval between consumption of the offending food and onset of symptoms. Among these, 84% entailed reactions occurring within 1 hour (median time <15 minutes), 9% within 1 to 4 hours, and 5% (with rash-related symptoms) >4 hours after consumption. For 35 (25%) of 141 events, there was a history of a previous reaction with the same food item that brought the person to the ED; for 40 (23%) events, it was specifically stated that there was no history of food allergy.

Anaphylaxis events

Ten (6%) of 173 food-allergic events had a diagnosis of anaphylaxis. Of these, 8 were among the 141 ED reports with accompanying medical records; all had multisystemic complaints, and all met AS criteria.[8] A review of the remaining 133 medical records identified 45 events with multisystemic signs and symptoms, 13 of which met the AS criteria for anaphylaxis. Of note, none of the 141 records reported hypotension, or other blood pressure abnormality, as a sign. Therefore, food-related anaphylaxis was described in a total of 23 events (Table IV), representing 13% of all ED food-allergic events. On the basis of this incidence, we estimate that approximately 2333 (95% CI, 1710-2956) ED visits caused by food-related anaphylaxis occurred nationwide during the 2-month study period. Events meeting AS criteria, but without a diagnosis of anaphylaxis, accounted for 13 (57%) of the 23 anaphylactic events, and 13 (10%) of 133 reviewed ED records.

With regard to food-allergic events involving anaphylaxis, 10 (43%) of 23 events involved children or teenagers. Also, 19 (83%) of 23 events involved a food or food category containing a major food allergen identified by the Food Allergen Labeling and Consumer Protection Act of 2004. The foods implicated most often included seafood (fish or shellfish; n = 8) and nuts (peanut or tree nut; n = 7).

Medication use

Epinephrine was administered in 27 (19%) of 141 events, 4 of 5 hospital admissions, and 13 (62%) of 21 anaphylactic events. Corticosteroids were administered during 92 (65%) of 141 events, including 20 of 21 anaphylactic events. Antihistamines were used in 122 (87%) of 141 events, including 18 of 21 anaphylactic events.

Hospitalizations and death

There were no documented events of death at any ED visit during the reporting period. Eight hospitalized events were identified; based on this incidence, we estimate that there were 520 (95% CI, 94-947) hospitalizations nationwide caused by food-allergic events during the study period. Foods implicated in the 8 hospitalized events were seafood (2), nuts (2), ice cream (1), cream soup (1), lemon (1), and salmon or cranberries (1). Five of the 8 hospitalized events were consistent with a diagnosis of anaphylaxis (explicitly stated by an ED diagnosis and/or

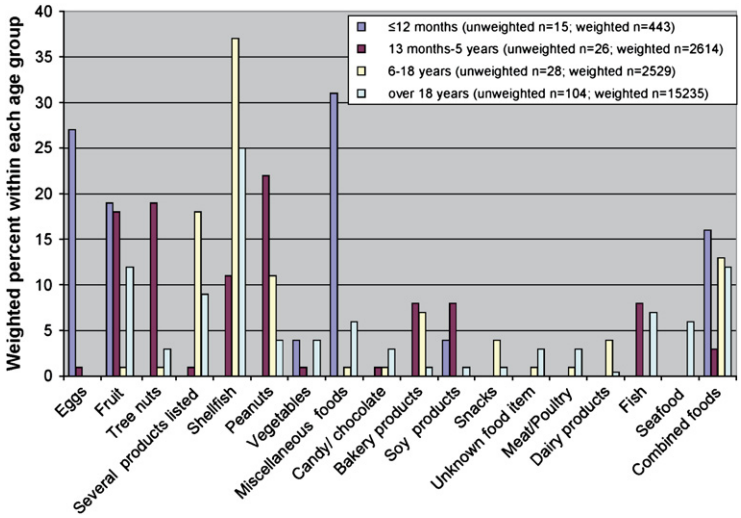


FIG 1. Foods and corresponding age groups implicated in ED food-allergic events (unweighted, n = 173; weighted, n = 20,821). Graphic representation of weighted percentages of events within each age group related to specific food categories.

consistent with anaphylaxis by AS criteria); from this incidence, we estimate 418 (95% CI, 0-871) hospitalizations for food-related anaphylaxis nationwide over the 2-month period. The remaining 3 hospitalized events reported isolated symptoms of "wheezing" (2 events) and "syncope" (1).

DISCUSSION

Accurate assessment of the nature and incidence of severe food allergy—related reactions is needed for monitoring the public health effect of food allergy and for focusing resources on important preventative strategies. It is evident that many severe food-allergic reactions, including anaphylaxis, present to EDs. Thus, NEISS data, which are made up of nationally representative ED information on consumer product–associated injuries, can be used to obtain clinically and epidemiologically relevant information on serious food-allergic reactions.

The NEISS-reported food-allergic events most often involved consumption of shellfish, fruits, and nuts. Our finding that 60% of events occurred among adults and mostly white females is consistent with national food allergy data[9] and, in particular, with a multicenter ED study by Clark et al,[13] who identified food-allergic events at 21 EDs in 9 US states and 4 Canadian provinces over a period of 1 year. In our study, as well as that by Clark et al,[13] the majority of patients received antihistamines and corticosteroids, whereas epinephrine was used far less often (in 19% and 16% of visits, respectively). Thus, even though food allergy management guidelines underscore the importance of epinephrine in these scenarios,[1,14] the NEISS findings reaffirm the relatively infrequent use of epinephrine for food-allergic reactions presenting to US EDs.[13]

On the basis of our findings, we estimate that 20,821 ED visits for food-allergic reactions occurred nationwide during the 2-month study period. On the basis of raw number of events, however, this estimate is approximately 1/5 that produced by Clark et al[13] over comparative periods. A number of factors related to the design and conduct of the 2 studies may account for this difference, including study duration (2 months vs 1 year), geographic distribution of EDs sampled, and differences in the methodology of identifying food-allergic events. Whereas Clark et al[13] performed a retrospective review of ED International Classification of Diseases, Ninth Revision (ICD-9) codes to identify cases, we used a method that relied on a combination of key word symptoms (Table I) and specific secondary criteria, a method that may have excluded food-allergic events as a result of incomplete or nondescriptive ED records. This limitation of our study may explain the relative dearth of cases of food-allergic events exhibiting gastrointestinal symptoms. Whereas previous

TABLE III. Food allergy–related symptoms and/or clinical signs,* by organ system, reported in 141 ED medical records of food-allergic events in NEISS

Organ system	Unweighted frequency (unweighted %) (n = 141)
Skin	
Rash	78 (55)
Facial swelling (swelling of face, tongue, eyes, oral cavity)	67 (48)
Pruritus (itching)	62 (44)
Urticaria (hives)	54 (38)
Edema, general	5 (4)
Tingling lips	5 (4)
Gastrointestinal	
Vomiting	16 (11)
Nausea	14 (10)
Diarrhea	5 (4)
Respiratory	
Dyspnea (difficulty breathing, shortness of breath)	41 (29)
Laryngeal edema (swelling of throat/uvula, throat tightness)	21 (15)
Tachypnea (rapid breathing)	18 (13)
Cardiovascular	
Tachycardia (rapid heart rate)	16 (11)
Dizziness/lightheadedness	6 (5)
Syncope	4 (3)

*Symptoms and signs not mutually exclusive.

TABLE IV. Selected characteristics of all anaphylactic events from 173* ED food-allergic events in NEISS

Age (y)	Sex	Reported foods	Epinephrine administered	Hospital admission	Previous episode of food allergy	Identification of anaphylactic events
2	Female	Cashews	Yes	No	Unknown	AS criteria
4	Male	Gummy candy	No	No	Unknown	Medical record
4	Female	Macadamia nuts	Unknown	Yes	Unknown	Electronic record
5	Male	Orange juice	Yes	No	Unknown	Medical record
6	Male	Peanut butter	No	No	Yes	AS criteria
10	Female	Cheese/butter sandwich	No	No	Yes	AS criteria
12	Male	Ramen noodles	Yes	No	Unknown	AS criteria
13	Male	Nuts	Unknown	Yes	Unknown	Electronic record
17	Male	Chocolate peanut butter cake	Yes	No	Yes	AS criteria
18	Female	Cream soup	Yes	Yes	Unknown	Medical record
19	Male	Nut cookie	No	No	Yes	AS criteria
19	Female	Chocolate	Yes	No	Yes	AS criteria
27	Female	Shrimp	Yes	No	Yes	Medical record
30	Female	Salmon, cranberries	Yes	Yes	No	AS criteria
31	Female	Nuts	No	No	Yes	AS criteria
32	Female	Peanuts	Yes	No	Yes	Medical record
33	Female	Crab cake	No	No	Unknown	AS criteria
39	Female	Chocolate peanuts	Yes	No	Yes	AS criteria
41	Female	Fish	Yes	No	Yes	Medical record
45	Female	Crab	No	No	Yes	AS criteria
55	Female	Shrimp	Yes	No	No	Medical record
57	Male	Shrimp	No	No	Yes	AS criteria
66	Male	Seafood	Yes	Yes	Yes	Medical record

*Corresponding to 20,821 estimated nationwide ED visits.

studies of food anaphylactic reactions[15] or challenges[16] have reported gastrointestinal symptoms in approximately 40% of patients, such symptoms were reported in only 4% to 11% of food-allergic events identified in our study. Thus, it is likely that some of the events excluded by our methodology were, in fact, food allergic events. The ICD-9 identification approach, on the other hand, may overestimate events caused by IgE-mediated food allergies because many nonallergic adverse food reactions, such as food intolerances, may be reported as food allergies.[17] Future studies to validate our study's symptom key word list (and other diagnostic criteria) as an epidemiologic tool for identifying serious food-allergic events will likely need to compare the overall specificity and sensitivity of tools with other established diagnostic criteria, such as the ICD-9 codes. Because we found that certain key words (such as the gastrointestinal and cardiovascular terms) in our study are poorly specific for food-allergic events, these studies may also help establish a targeted key word list that is more effective for future analyses of NEISS or other adverse event databases.

Estimates of the incidence of food-related anaphylaxis in the United States have varied. The results of a literature review, for example, estimated that 1080 Americans experience food-related anaphylaxis each year.[18] A retrospective population-based cohort in residents of Olmstead, Minn, found an annual incidence and occurrence rate of food-related anaphylaxis, defined by a multisystemic symptom-based method, of 7.6 and 10.8 cases per 100,000 person-years, respectively.[1,19] Applying these calculations to US food allergy prevalence estimates, it is estimated that 30,000 food-related anaphylactic reactions are treated in EDs per year, with 2000 hospitalizations and 150 deaths.[1] For a 2-month study period, extrapolation of NEISS data predicts 2333 ED visits and 418 hospitalizations for food-related anaphylaxis. These NEISS sample data cannot estimate number of deaths, because none were identified.

With regard to frequency of anaphylactic events, it is observed that only 13% of total events from NEISS data were identified as anaphylaxis compared with 51% of the events in the study by Clark et al.[13] Again, an explanation for this apparent difference in event frequency may lie in the diagnostic criteria used. Whereas the study by Clark et al[13] determined anaphylaxis on the basis of involvement of 2 or more organ systems or systolic blood pressure <100 mm Hg, our study focused on more restrictive 2005 AS diagnostic criteria that required medical record documentation of multiorgan or severe cardiorespiratory system involvement in temporal association with food consumption. Also, in a number of events without clearly descriptive summaries, an important criterion was a history of food allergy or sensitization. This latter criterion is not a mandatory prerequisite of the AS criteria but rather reflects our study's objective to identify events as specific as possible to support a diagnosis of anaphylaxis. Based on these criterion, though, a number of anaphylactic events representing individuals with reactions after first-known exposure to a food, as seen in most children with peanut allergy,[5] may have been missed. When applying the criteria of Clark et al[13] to the NEISS data, 53 (38%) of 141 eligible events reported multisystem symptoms and would have been diagnosed as anaphylaxis.

There were no ED deaths caused by foods identified by NEISS over the study period. Likewise, Clark et al[13] failed to identify deaths in EDs in their study conducted over an even longer period. Because NEISS only collects data in which the person dies in the ED as opposed to deaths reported in transit or after admission to the hospital, this finding does not exclude the possibility that fatal reactions presented to NEISS EDs. However, this finding, coupled with the observation that most deaths caused by food allergies occur outside the home[20-22] and potentially remote from emergency care system services as well, reinforces the difficulties of estimating number of food allergy–related deaths by an ED surveillance system.

When assessing food-allergic events among various age groups, our analysis of the NEISS data reconfirmed previous observations of a larger percentage of ED events occurring in adults compared with children[23]; however, it also found that a significant percentage of reactions (24%) still occurred in infants and young children. Unexpectedly, there were relatively few food allergic events to such common dietary allergens as dairy and soy in this young population.[14] One explanation could be that allergic events to these foods in infants present with mostly gastrointestinal symptoms and were excluded by the study criteria. On the other hand, a large percentage of events were found to be related to fruits. Although fruits are not considered to be major food allergens, they have been identified as important causes of food anaphylaxis presentations in both children and adults,[15,24] and a recent US questionnaire of self-reported allergies identified fruits and vegetables to be the most prevalent cause of food allergies.[25]

Another important finding from our analysis of the NEISS data is the relative underdiagnosis of anaphylaxis in ED events meeting anaphylaxis criteria. In this study, fewer than half (43%) of events meeting anaphylaxis criteria were reported as such in ED charts. At least 1 other study has documented underestimation of the true incidence of severe food-allergic reactions in EDs by the sole use of ED diagnosis codes for anaphylaxis or food-allergic reactions.[17] From an epidemiologic standpoint, this finding suggests the need for improved public health education strategies to train health care professionals to properly define, identify, and code for anaphylaxis.

In conclusion, the CPSC and CFSAN's pilot study of the NEISS data provided useful information for estimating the magnitude and severity of food allergic events seen in US EDs, and results were comparable to previous epidemiologic studies on the subject. The NEISS is an established, ongoing surveillance system that can be used to capture real-time, nationally representative ED event data. This study shows that NEISS is a potentially valuable resource for obtaining serious adverse event information related to CFSAN-regulated products and may serve as a future surveillance strategy for evaluating the effect of public health programs on the prevalence of food-allergic events over time.

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Clinical implications: Accurate assessment of severe food allergy-related events is important in monitoring the public health impact of food allergies. NEISS data provide useful information for assessing serious health consequences caused by food allergens in the United States.

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