

Original Study

Food-induced Anaphylaxis Among Commercially Insured US Adults: Patient Concordance with Postdischarge Care Guidelines

Pamela B. Landsman-Blumberg, DrPH^a, Wenhui Wei, PhD^b, Damon Douglas, PharmD^c, David M. Smith, PhD^a, Sunday Clark, MPH, ScD^d, and Carlos A. Camargo, Jr, MD, DrPH^e *Palm Harbor, Fla; Bridgewater, NJ; New York, NY; Boston, Mass*

What is already known about this topic? Prior studies investigated physician adherence with US national guidelines for patients after an emergency department visit and/or hospitalization for food-induced anaphylaxis and found rates of suboptimal epinephrine autoinjector prescription and specialist referral.

What does this article add to our knowledge? This retrospective study of health care claims of US adults with food-induced anaphylaxis found that receipt of food-induced anaphylaxis postdischarge care was low; 54% of adult patients filled epinephrine autoinjector prescriptions, and 22% visited an allergist/immunologist.

How does this study impact current management guidelines? Results of this analysis indicate the need for increased physician and patient education to improve patient concordance with recommended postdischarge anaphylaxis care and investigation of patient barriers to seeking such care, especially by visiting an allergist/immunologist.

BACKGROUND: Food-induced anaphylaxis is a potentially life-threatening condition that frequently results in emergency department (ED) visits and/or hospitalization. Little

information is available on patient compliance with recommended postdischarge anaphylaxis care.

OBJECTIVE: To describe patient characteristics, concordance with recommended postdischarge care, and risk of repeated events among adults with an initial ED visit and/or hospitalization for food-induced anaphylaxis.

METHODS: In this retrospective study of health care claims, adults with an ED visit and/or hospitalization for food-induced anaphylaxis were identified from the 2002-2008 Truven Health MarketScan Databases by using an expanded International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis code algorithm. The first identified ED visit and/or hospitalization was the index event. Data from patients with continuous medical and prescription coverage for ≥ 1 year before and after the index event were retained for analysis. Analyses included baseline demographic and clinical characteristics, postdischarge epinephrine autoinjector (EAI) prescription fills and allergist/immunologist visits, and repeated events in the 1-year postindex period.

RESULTS: Patients ($n = 1370$) had a mean (SD) age of 44 ± 15 years, 58% were women. Most (86%) were seen in the ED and/or discharged from the ED. Within 1 year after discharge, 54% of adults had filled ≥ 1 EAI prescription (71% within 1 week) and 22% had ≥ 1 allergist/immunologist visit (53% within 4 weeks). Overall, 73 patients (5%) had evidence of a subsequent anaphylaxis-related ED visit and/or hospitalization 1 year after discharge.

CONCLUSION: Concordance with recommended postdischarge anaphylaxis care was low among adults with food-induced anaphylaxis. Within 1 year after discharge, 54% of patients filled an EAI prescription and 22% consulted an allergist/immunologist. © 2013 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol: In Practice 2013;■:■-■)

^aXcenda, Palm Harbor, Fla

^bSanofi US, Bridgewater, NJ

^cMemorial Sloan Kettering Cancer Center, New York, NY (previously fellow at Rutgers, The State University of New Jersey, Newark, NJ, and on assignment at Sanofi US until 2011)

^dDepartment of Emergency Medicine, Weill Cornell Medical College, New York, NY

^eDepartment of Emergency Medicine, and Division of Rheumatology, Allergy and Immunology, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, Mass

Supported by Sanofi US.

Conflicts of interest: P. B. Landsman-Blumberg has received a consulting fee or honoraria from Thomson-Reuters Healthcare (now Truven Health Analytics), has consultant arrangements with Thomson-Reuters Healthcare (now Truven Health Analytics), and owns stock in Merck & Co Inc. W. Wei is an employee of and has stock and/or stock options in Sanofi US. D. Douglas was an employee of Sanofi when engaged in the research. D. M. Smith is employed by Thomson-Reuters Healthcare. C. A. Camargo, Jr, has received a consulting fee or honoraria from Sanofi-Aventis and has consultant arrangements with Dey (Mylan) and Sanofi-Aventis. S. Clark declares no relevant conflicts of interest.

Received for publication November 22, 2012; revised June 25, 2013; accepted for publication July 10, 2013.

Available online ■■

Cite this article as: Landsman-Blumberg PB, Wenhui W, Douglas D, Smith DM, Clark S, Camargo CA Jr. Food-induced anaphylaxis among commercially insured US adults: Patient concordance with postdischarge care guidelines. J Allergy Clin Immunol: In Practice. <http://dx.doi.org/10.1016/j.jaip.2013.07.003>.

Corresponding author: Carlos A. Camargo, Jr, MD, DrPH, EMNet Coordinating Center, Massachusetts General Hospital, 326 Cambridge St, Suite 410, Boston, MA 02114. E-mail: ccamargo@partners.org.

2213-2198/\$36.00

© 2013 American Academy of Allergy, Asthma & Immunology

<http://dx.doi.org/10.1016/j.jaip.2013.07.003>

*Abbreviations used**EAI- Epinephrine autoinjector**ED- Emergency department**ICD-9-CM- International Classification of Diseases, Ninth**Revision, Clinical Modification**SD- Standard deviation*

Key words: Food-induced anaphylaxis; Postdischarge care; Epinephrine autoinjector; Allergist; Immunologist; Prescription; Concordance; Emergency department; Hospitalization; Treatment guidelines

Food-induced anaphylaxis is a potentially life-threatening systemic allergic reaction, which frequently results in emergency department (ED) visits and/or hospitalization. In the United States, 1%-2% of adults are affected by food allergy,¹ and it is estimated that there are 203,000 ED visits for acute food-related allergic reactions and nearly 90,000 ED visits for food-related anaphylaxis annually.² Adults (aged ≥ 18 years) account for approximately 62% or 126,000 of these ED visits annually. The economic burden (direct and indirect) of food allergies and anaphylaxis in the United States was estimated at nearly half a billion dollars in 2007.¹

After an ED visit and/or hospitalization for anaphylaxis, US national guidelines recommend that patients be prescribed an epinephrine autoinjector (EAI), receive education about allergen avoidance, and recognize the symptoms of anaphylaxis and how to use an EAI, receive an anaphylaxis emergency action plan, and are referred to an allergist/immunologist.³⁻⁸ Chart review studies of adults with food-induced anaphylaxis seen in the ED have reported low physician compliance with these guidelines.^{9,10} For patients with food-induced allergic reactions, the frequency of EAI prescription receipt was reported to be 16%-39%, and the frequency of referral to an allergist/immunologist was 12%-18%.^{11,12} The rates were slightly higher for patients considered to have food-induced anaphylaxis, with 22%-44% who received an EAI prescription, and 13%-21% were being referred for follow-up.^{11,12} Concordance with the guidelines was better among patients discharged from the hospital: 59% were prescribed an EAI, and 35% were referred to an allergist/immunologist.¹¹ However, these studies did not evaluate patient compliance with recommended postdischarge care. Moreover, data about repeated events are limited. One study at a community-based specialist practice in Australia reported that approximately 8% of patients with anaphylaxis (all triggers) experienced a subsequent anaphylaxis-related event during the following year.¹³

This retrospective study of health care claims for a large population of commercially insured US adults examined patient concordance with recommended postdischarge care, and the rate of a repeated event over 1 year of follow-up among a cohort with an ED visit or hospitalization for food-induced anaphylaxis. The data presented are descriptive in nature. The specific study objectives were the following: (a) to describe the demographic and clinical characteristics of adult patients with an initial ED visit or hospital stay for food-induced anaphylaxis, (b) to describe characteristics of the initial event, (c) to estimate the rate of recommended postevent anaphylaxis preventive care sought and

received by patients (defined as filling an EAI prescription and visiting an allergist/immunologist) within 1 year, and (d) to estimate the proportion of patients having a subsequent anaphylaxis-related ED visit or hospitalization in the 1-year postdischarge period.

METHODS

Data source

The 2001-2009 Truven Health MarketScan Commercial and Medicare Supplemental Databases (Truven, Ann Arbor, Mich) were used. These databases provide access to fully adjudicated inpatient and outpatient medical claims, as well as outpatient prescription drug claims, for > 43 million privately insured individuals annually. Individuals are enrolled in more than 100 health plans, including a variety of fee-for-service and managed-care designs. The population includes persons with employer-sponsored health insurance for themselves and their dependents, and includes individuals aged > 65 years old with Medicare supplemental insurance. Detailed cost, use, and outcomes data for health care services received in both inpatient and outpatient settings are available. The medical claims, outpatient prescription drug claims, and person-level enrollment data are linked by unique enrollee identifiers. The MarketScan Databases are fully compliant with the letter and spirit of the Health Insurance Portability and Accountability Act of 1996. The study included de-identified administrative claims data, and, therefore, institutional review board review and approval were not required.

Patient selection

Adults (aged ≥ 18 years) were selected if they had an ED visit or hospitalization during the study period (January 1, 2002, to December 31, 2008) for anaphylaxis and classified as having food-induced events based on Method I or Method II of the Harduar-Morano algorithm¹⁴ and had continuous medical and prescription coverage for ≥ 1 year before (preindex) and ≥ 1 year after (postindex) the date of the initial ED visit or hospital discharge (index date) (see Table E1 in this article's Online Repository at www.jaci-inpractice.org). Patients admitted to the hospital through the ED were captured in the hospitalized cohort. Patients who were immunocompromised and with a diagnosis of AIDS or cancer, or who had organ transplantation during the preindex period, and those with sepsis at index were excluded (Table E1).

Demographic and clinical characteristics

Characteristics such as age, sex, US Census region, and health-plan type were extracted from the claim for the index event. Urbanicity or rurality, as defined by Urban Influence Codes,¹⁵ were assigned based on the county of residence of the patient as recorded on the index claim. Median household income was estimated by matching the ZIP code of the patient's residence with that of the 2000 US Census.

Clinical characteristics were collected in the preindex period. The Deyo adaptation of the Charlson Comorbidity Index and individual comorbid conditions were based on specific International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. Preindex prescription fills for EAIs were identified by National Drug Code numbers recorded on individual prescription claims, and allergist/immunologist visits were identified by physician specialty as coded on the preindex outpatient medical claims.

Characteristics of the index event

Cardiorespiratory failure and subsequent interventions were identified on the index hospital facility and professional claims for an inpatient stay were identified by using ICD-9-CM, Current Procedural Terminology, and Healthcare Common Procedure Coding System codes. Inpatient measures that also included intensive care unit stay, length of hospitalization, and discharge destination were identified by using facility and admission summary claims data for the index hospital stay. Costs for the ED and hospital index events are represented by the total reimbursed amount for all providers of care associated with the event, including patient copayment and coinsurance deductibles, any coordination of benefits amount, and the amount paid by the insurer. All costs were inflated to 2008 US dollars by using the medical component of the Consumer Price Index.

Postindex outcomes

Prescription EAI fills and allergist/immunologist visits in the postindex period were identified as in the preindex period. These data were recorded on individual prescription and medical claims and, therefore, captured care sought by the patient and covered by the insurer. In addition, the time to first EAI prescription fill, number of fills, time to first allergist/immunologist visit, and the number of visits in the postindex period were determined. Patients with ≥ 1 subsequent anaphylaxis event and treated as an inpatient or in the ED were identified by using the same methods (I and II) as those used to identify index events. The second hospitalization was considered an extension of an index hospital event if the discharge destination on the index claim indicated transfer to another facility, and the admission date on the second hospital claim was the same as the discharge date of the index event.

Statistical analyses

Medical and prescription drug claim histories were examined as described earlier. Mean (SD) was used to summarize continuous measures, whereas median (interquartile range) were used when continuous measures had skewed distributions. Count and percentage were used for categorical measures. For reporting the outcomes of the index event, events were stratified by their location: the ED or hospital. No statistical comparisons were made. Analyses were conducted by using SAS version 9.2 software (SAS Institute Inc, Cary, NC).

RESULTS

Patient demographics and clinical characteristics

After applying the selection criteria (Table E1), 2379 patients were identified with food-induced anaphylaxis, of whom 1370 (58%) were aged ≥ 18 years. Among these adult patients, 95% were identified by using single diagnosis codes (Method I) and 5% by the expanded diagnosis algorithm (Method II). Baseline demographic and select clinical characteristics are shown in Table I. The mean age of patients was 44 years, and more than half were women (58%). Patients resided across the United States, with most (84%) living in metropolitan counties. Patients were enrolled in a variety of health plans along the continuum of managed care. The mean Charlson Comorbidity Index score was 0.4, with 22% of patients with a score of 1, and 4% with a score of >2 . The number of patients with any allergy-related comorbidity (ie, asthma, allergic rhinitis, eczema) was 321 (23%). The most common allergy-related comorbidities were asthma and

TABLE I. Baseline demographics and clinical characteristics of 1370 adults with food-induced anaphylaxis

Variable	Patients (n = 1370)
Women, no. (%)	798 (58)
Age, (y), mean (SD)	44 $\pm$ 15
Age group, no. (%)	
18–34 y	384 (28)
35–54 y	672 (49)
55–64 y	219 (16)
≥ 65 y	95 (7)
Payer, no. (%)	
Commercial	1274 (93)
Medicare	96 (7)
Insurance plan type, no. (%)	
Fee for service	161 (12)
Health maintenance organization	302 (22)
Point of service plan	199 (15)
Preferred and/or exclusive provider organization	674 (49)
Other or unknown	34 (2)
Geographic region, no. (%)	
Northeast	189 (14)
Midwest	343 (25)
South	557 (41)
West	272 (20)
Other	9 (1)
Urban Influence Code, no. (%)	
Metropolitan counties	1146 (84)
Non-metropolitan counties	215 (16)
Unknown	9 (0.7)
Income, \$, mean (SD)	50,665 $\pm$ 19,601
Comorbidities of interest, no. (%)	
Allergic rhinitis	180 (13)
Asthma	179 (13)
Cardiovascular disease	174 (13)
Chronic obstructive pulmonary disease	31 (2)
Depression	116 (9)
Eczema	15 (1)
Hypertension	291 (21)
Personal history of allergy	19 (1)
Psychiatric disease	172 (13)
Stroke	10 (1)
Thyroid disease	76 (6)

allergic rhinitis, both found in 13% of patients. In the preindex period, 13% of patients had ≥ 1 EAI prescription fill and 7% had ≥ 1 allergist/immunologist visits.

Index event characteristics

Characteristics of the index event are shown in Table II. Most patients (86%) were treated in the ED and discharged from the ED. Evidence of cardiorespiratory failure was noted on 16% of hospital facility and provider claims. Cardiorespiratory or resuscitative interventions were indicated on 6% of hospital-related claims.

For hospitalized patients, the mean (SD) length of stay was 2.3 $\pm$ 3.1 days (median, 1 day; interquartile range, 1–2 days) and 49% spent time in the intensive care unit. The majority of

TABLE II. Characteristics related to the index event in 1370 adults with food-induced anaphylaxis

Outcome	ED (n = 1180)	Hospital (n = 190)
Cardiorespiratory failure, no. (%) [*]	N/A	30 (16)
Acute respiratory failure		16
Respiratory arrest		2
Hypotension		13
Cardiac arrest		1
Use of cardiorespiratory and/or resuscitative interventions among patients with cardiorespiratory failure, no. (%) [*]	N/A	12 (6)
Endotracheal intubation		4
Continuous invasive mechanical ventilation		8
Laryngoscopy and/or tracheostomy		2
Cardiopulmonary resuscitation		0
Cost of index event, \$		
Mean (SD)	1414 ± 1423	7340 ± 11,306
Median (IQR)	1052 (612–1757)	4349 (2846–7112)

IQR, Interquartile range; N/A, not applicable.

^{*}Represents the count of unique patients; therefore, the total does not necessarily equal the sum of individual conditions.

patients were discharged home (90%), whereas 2% were transferred to another hospital or other acute care facility, and 1% were transferred to an intermediate care or skilled nursing facility; the remaining 7% of patients were discharged to an unidentified location. The mean total index event costs in 2008 US dollars were \$1415 (median, \$1052) for ED visits and \$7340 (median, \$4349) for hospital stays.

Postdischarge care

Within the first year postindex period, 54% of adults with food-induced anaphylaxis filled or refilled ≥ 1 EAI prescription (Table III); 60% had 1 prescription fill, and 40% had ≥ 2 fills. Among the patients who filled an EAI prescription, 71% did so within 1 week of discharge (Figure 1, A). The mean (SD) time to the first EAI fill was 29 ± 69 days, and the median was 2 days. At the first fill, 64% of patients received 1 EAI and 36% received 2 EAI. Within 1-year postindex period, 22% of adults with food-induced anaphylaxis had evidence of ≥ 1 allergist/immunologist visit (Table III). Of these, 53% had their first visit within 4 weeks of discharge (Figure 1, B). The mean (SD) time to the first visit was 61 ± 82 days, and the median was 25 days. Patients with ≥ 1 visit to an allergist/immunologist had on average 2.4 ± 2.0 visits to these specialists.

Excluding adults who filled an EAI prescription or an allergist/immunologist visit in the preindex period, 52% of the remaining adults filled or refilled ≥ 1 EAI prescription within the 1-year post-index period and 18% had evidence of ≥ 1 allergist/immunologist visit. The mean (SD) time to the first EAI fill and to the first allergist/immunologist visit were 22 ± 59 days and 54 ± 78 days, respectively.

Subsequent anaphylaxis events

During the postindex period, a total of 73 patients (5%) had evidence of another ED visit (82%) or hospitalization (18%) for

TABLE III. Postindex period (within 1 y) anaphylaxis care in 1370 adults with food-induced anaphylaxis

Variable	Patients (n = 1370)
EAI prescription fills, no. (%)	
Adults with ≥ 1 fill	746 (54)
No. fills	
0	624 (46)
1	573 (42)
≥ 2	173 (13)
No. EAIs received at first fill	
1	480 (64)
2	266 (36)
Days to first fill, mean (SD)	29 ± 69
Allergist/immunologist visits	
Adults with ≥ 1 visit, no. (%)	296 (22)
No. visits, mean (SD)	2.4 ± 2.0
Days to first visit, mean (SD)	61 ± 82
Subsequent anaphylaxis-related events	
Adults with a subsequent event, no. (%)	73 (5)
Days to first subsequent event, mean (SD)	90 ± 109

anaphylaxis. The mean (SD) time to this subsequent event was 90 ± 109 days, and the median time was 53 days (interquartile range, 1–155 days). The proportions of patients with events over the days, weeks, and months in the postindex period are shown in Figure 2. When events that occurred within 7 days of the discharge data were excluded (events likely to be late manifestations of the original event), the number of patients with evidence of a subsequent event was 42 (3%), and the mean (SD) time to the subsequent ED visit or hospitalization was 155 ± 102 days.

DISCUSSION

The recommended course of care for a patient with anaphylaxis who is discharged from the ED or hospital includes a prescription for an EAI and referral to a specialist.^{3,4} Whereas previous studies evaluated if patients received a prescription for an EAI and/or referral to a specialist upon discharge,^{11,12,16} no published studies were identified that evaluated if patients fill or refill an EAI prescription and/or visit a specialist after discharge and, if so, when. This study presents novel descriptive data of patient concordance with recommended care after an ED visit or hospitalization among adults with food-induced anaphylaxis.

In this large cohort of adults with food-induced anaphylaxis, 86% of adults were identified on the basis of an ED visit versus a hospital stay. The patients were enrolled in a variety of health plans across the United States and were covered by employer-sponsored medical and prescription insurance. As expected, the current study population was older (mean age, 43 years) than identified previously (mean age range, 29–36 years)^{11,12} because other studies included children in the food-induced anaphylaxis patient populations. The mean age of all patients (adults and children) enrolled in the MarketScan Databases in 2008 was 34 years, and 75% were aged ≥ 18 years. Food-induced anaphylaxis is frequently associated with other atopic manifestations; the rate of atopic comorbidities (ie, allergic rhinitis, eczema, asthma) was 23% in this adult population. It may be that the proportion of patients with atopic comorbidities is underestimated in this

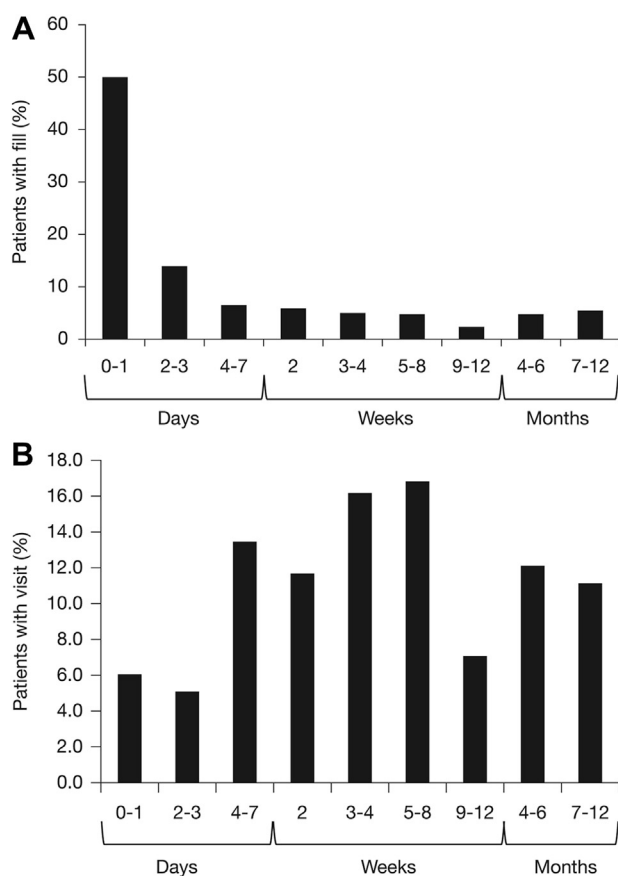


FIGURE 1. **A**, Time to first epinephrine autoinjector prescription fill within 1 year after discharge in 746 adults who filled ≥ 1 prescription. **B**, Time to first allergist/immunologist visit within 1 year after discharge in 296 adults who had ≥ 1 visit.

study. The preperiod was 1 year in length, and patients whose condition was managed with over-the-counter treatments may not have had a health care visit related to the condition within this time frame. In addition, prescription claims were not examined because many of the associated medications are approved for treatment of other indications. Finally, unless the atopic condition was “active” or directly related to the anaphylaxis event, physicians and coding staff were likely to not code these chronic conditions.

In the current study, suboptimal patient concordance with recommended postdischarge care was found, particularly for visiting an allergist/immunologist. After discharge from the ED or hospital, 54% of patients filled an EAI prescription, whereas only 22% visited an allergist/immunologist. Patients with an EAI available before their index event may have opted to not fill or refill their prescription after the anaphylaxis event because 13% of patients were identified as having already filled an EAI prescription in the prior year. More patients visited an allergist/immunologist in the year after the index event than in the year before the event (22% vs 7%). In addition, although a majority of patients who filled a prescription did so within 1 week of discharge (71%), the numbers thereafter were similar to the number of patients who visited an allergist/immunologist within the same time period (Figure 1). Therefore, it is possible that these patients

either received an EAI prescription or were encouraged to fill their prescription by the allergist/immunologist.

Previous studies of patients discharged from the ED with food-induced acute allergic reactions reported that 22%–44% of patients received an EAI prescription, and 13%–21% were referred to an allergist^{11,12}; proportions for those discharged from the hospital were 59% for receipt of an EAI prescription and 39% for specialist referral.¹¹ In the current study, patients with EAI fills and allergist/immunologist visits were 54% and 22%, respectively. Moreover, these percentages represent patients’ receipt of care, the likely result of complying with postdischarge recommendations as opposed to patients who received such recommendations. However, patients in this study are all enrolled in employer-sponsored prescription plans, and 61% are enrolled in health plans that did not require referrals to specialists; therefore, this population may have fewer barriers to obtaining subsequent care than the average patient with food-induced anaphylaxis seen in an ED or admitted to the hospital in the United States who may or may not have been insured.^{11,12}

The proportion of patients with a subsequent anaphylaxis-related ED visit or hospitalization within 1 year after discharge was lower (5%) than previously reported for all anaphylaxis triggers (8%).¹³ It is possible that the rate of subsequent anaphylaxis-related events is actually lower than reported. As shown, a large proportion of patients were identified with another event within 1–2 days of the index discharge. Medical claims are derived for the purposes of financial reimbursement to providers of care; therefore, it is not possible to confirm if these were events independent of the first event or in some way a continuation of care related to the index event. If events that occur within 7 days of the discharge data are excluded, then the proportion of patients with a subsequent event is reduced to 3%. Conversely, the low rate of subsequent events could reflect the short duration of follow-up (1 year). Although events that occur more than 1 year after discharge are important, they were not included in this study of postdischarge care for several reasons, including (1) the availability of additional longitudinal data for only a subset of study patients, and (2) EAI require replacement every year, which may or may not be linked to the receipt of postanaphylaxis discharge care. Nevertheless, analysis of these data suggests that, despite poor concordance with recommended postdischarge anaphylaxis care, most patients with food-induced anaphylaxis do not experience a recurrent event within 1 year after discharge. In addition, once an adult patient learns what food type caused the severe reaction, he or she may become more diligent in avoiding further exposure. Taken together, this raises difficult questions regarding how to encourage better guideline concordance in both adult patients with food-induced anaphylaxis and their care providers.

To determine the impact, if any, of adhering to the recommended preventive care, it would be useful to know if the patients with a subsequent event were among those who did not receive the recommended care. This care includes not just an EAI prescription fill and a visit with an allergist/immunologist but also education about the use of an EAI and an anaphylaxis emergency care plan.^{5–8} Due to the limited number of subsequent events in this study, the association between receiving preventive medical care through (1) availability of an EAI and (2) evaluation by a specialist, and having a second anaphylaxis event could not be evaluated. The receipt of recommended care may reduce the severity of a subsequent event, therefore, reducing the

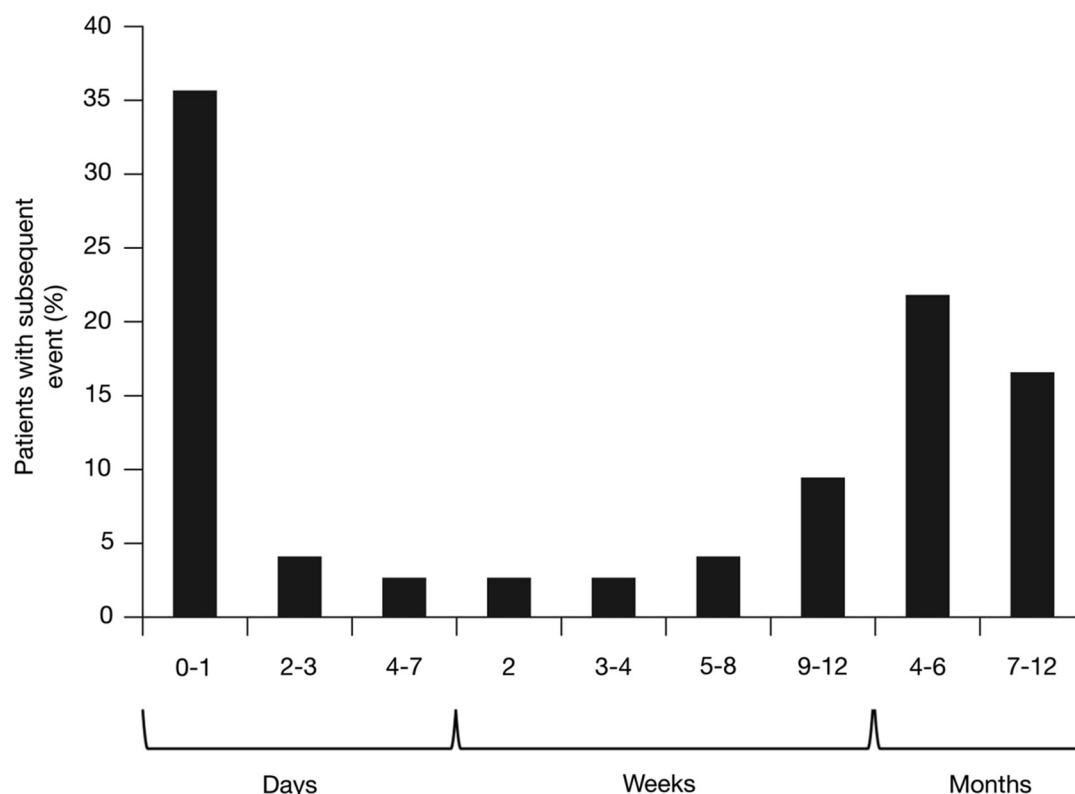


FIGURE 2. Time to first subsequent anaphylaxis event in the 1 year after discharge period in 73 adults who had ≥ 1 subsequent event.

need for an ED visit or hospitalization. A potentially important caveat to these results is that we did not assess recurrent anaphylaxis events that did not result in an ED visit or hospitalization. Although we do not think that the addition of these events would materially change our conclusion, this possibility merits further study.

There are additional limitations of this analysis that should be considered when interpreting the data. The study population comprised patients with employer-sponsored commercial and Medicare supplemental insurance who were residing in the United States. Therefore, the results are not generalizable to non-commercially insured or uninsured populations. Also, because the patients were required to have a minimum of 12 months continuous enrollment after their index event, survival bias was introduced. However, according to the low mortality rate from anaphylaxis ($<1\%$) reported in the literature,^{17,18} this bias is expected to be minimal and not affect the characterization of this food-induced anaphylaxis population. In addition, although the use of ICD-9-CM codes to identify anaphylaxis events could result in an underestimation of the true number of events in the database, the majority of anaphylaxis ICD-9-CM codes related to allergic reactions are specific to food triggers, which limits the possibility of underestimation. In addition, this likelihood was minimized by including an algorithm by using a combination of codes indicative of the signs and symptoms of anaphylaxis¹⁴ that lead to an increase in study sample size of 5% (68 patients). Finally, the study methodology does not allow a distinction to be made between the failure of the medical staff to provide appropriate discharge advice and the failure of the patient to follow advice that was given, which would require different study designs and data sources.

The proportion of patients with EAI fills (54%) and allergist/immunologist visits (22%) in the current study was suboptimal. This study, although descriptive in nature, includes much new information regarding the demographic and clinical characteristics of patients with food-induced anaphylaxis and care sought after a food-induced anaphylaxis event. However, predictors of having an EAI fill and visiting an allergist could help further explain these findings and identify barriers to receipt of such care. Ideally, prospective studies that begin with physician-patient encounters at discharge for food-induced anaphylaxis or retrospective studies that capture both the delivery (eg, writing a prescription) and receipt (eg, filling an EAI prescription) of recommended care such as through electronic medical records linked to prescription claims, are needed to identify to whom and where further education be provided. In addition, given the low rate of subsequent events, further studies are needed to estimate the impact of receiving or not receiving all components, both medical and educational, of recommended postanaphylaxis discharge care on the likelihood of experiencing a subsequent anaphylaxis event.

Acknowledgment

The authors received editorial and writing support in the preparation of this manuscript from Pieter van Bokhoven, PhD, of Excerpta Medica, funded by Sanofi US.

REFERENCES

1. Patel DA, Holdford DA, Edwards E, Carroll NV. Estimating the economic burden of food-induced allergic reactions and anaphylaxis in the United States. *J Allergy Clin Immunol* 2011;128:110-5.

2. Clark S, Espinola J, Rudders SA, Banerji A, Camargo CA Jr. Frequency of US emergency department visits for food-related acute allergic reactions. *J Allergy Clin Immunol* 2011;127:682-3.
3. Joint Task Force on Practice Parameters; American Academy of Allergy, Asthma and Immunology; American College of Allergy, Asthma and Immunology; Joint Council of Allergy, Asthma and Immunology. The diagnosis and management of anaphylaxis: an updated practice parameter. *J Allergy Clin Immunol* 2005;115(suppl 2):S483-523.
4. Lieberman P, Nicklas RA, Oppenheimer J, Kemp SF, Lang DM, Bernstein DI, et al. The diagnosis and management of anaphylaxis practice parameter: 2010 update. *J Allergy Clin Immunol* 2010;126:477-80.
5. Anaphylaxis in schools and other childcare settings. AAAAI Board of Directors. American Academy of Allergy, Asthma and Immunology. *J Allergy Clin Immunol* 1998;102:173-6.
6. Simons FE. Anaphylaxis, killer allergy: long-term management in the community. *J Allergy Clin Immunol* 2006;117:367-77.
7. National Institute of Allergy and Infectious Diseases. Guidelines for the diagnosis and management of food allergy in the United States. Summary of the NIAID-Sponsored Expert Panel Report. December 2010. Available from: <http://www.niaid.nih.gov/topics/foodallergy/clinical/documents/faguidelinesxecsummary.pdf>. Accessed July 27, 2013.
8. National Institute of Allergy and Infectious Diseases. Guidelines for the diagnosis and management of food allergy in the United States. May 2011. Available from: <http://www.niaid.nih.gov/topics/foodallergy/clinical/documents/faguidelinespatient.pdf>. Accessed July 27, 2013.
9. Clark S, Camargo CA Jr. Emergency management of food allergy: systems perspective. *Curr Opin Allergy Clin Immunol* 2005;5:293-8.
10. Campbell RL, Luke A, Weaver AL, St Sauver JL, Bergstralh EJ, Li JT, et al. Prescription for self-injectable epinephrine and follow-up referral in emergency department patients with anaphylaxis. *Ann Allergy Asthma Immunol* 2008;101:631-6.
11. Banerji A, Rudders SA, Corel B, Garth AM, Clark S, Camargo CA Jr. Repeat epinephrine treatments for food-related allergic reactions that present to the emergency department. *Allergy Asthma Proc* 2010;31:308-16.
12. Clark S, Bock SA, Gaeta TJ, Brenner BE, Cydulka RK, Camargo CA, et al. Multicenter study of emergency department visits for food allergies. *J Allergy Clin Immunol* 2004;113:347-52.
13. Mullins RJ. Anaphylaxis: risk factors for recurrence. *Clin Exp Allergy* 2003;33:1033-40.
14. Harduar-Morano L, Simon MR, Watkins S, Blackmore C. Algorithm for the diagnosis of anaphylaxis and its validation using population-based data on emergency department visits for anaphylaxis in Florida. *J Allergy Clin Immunol* 2010;126:98-104.
15. Larson SL, Freishman JA. Rural-urban differences in usual source of care and ambulatory service use: analyses of national data using urban influence codes. *Med Care* 2003;41(suppl):III65-74.
16. Campbell RL, Hagan JB, Li JT, Vukov SC, Kanthala AR, Smith VD, et al. Anaphylaxis in emergency department patients 50 or 65 years or older. *Ann Allergy Asthma Immunol* 2011;106:401-6.
17. Mulla ZD, Simon MR. Hospitalizations for anaphylaxis in Florida: epidemiologic analysis of a population-based dataset. *Int Arch Allergy Immunol* 2007;144:128-36.
18. Sampson HA. Anaphylaxis and emergency treatment. *Pediatrics* 2003;111:1601-8.

TABLE E1. Patient selection criteria

Selection criteria
Patients with an emergency department visit or hospitalization for food-induced anaphylaxis (Method I or Method II) between January 1, 2002, and December 31, 2008
18 y of age and older at the index event
12-mo continuous enrollment in the pre- and postindex periods
Patients in the 12-mo preindex period without evidence of (exclusion factors)
AIDS (ICD-9-CM 042)
Cancer (ICD-9-CM 140.x-209.x)
Organ transplant (ICD-9-CM V42.0-42.9) or complication (ICD-9-CM 996.8x)
Patients without evidence of sepsis during the index emergency department visit or hospitalization (ICD-9-CM 995.91, 995.92)