

Concordance with Recommended Postdischarge Care Guidelines among Children with Food-Induced Anaphylaxis

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Objective To describe patient characteristics, concordance with recommended postdischarge care, and risk of repeat events within a cohort of children discharged from an emergency department (ED) or hospital for food-induced anaphylaxis in the US.

Study design Children (aged <18 years) with an ED visit/hospitalization for food-induced anaphylaxis were identified from the 2002-2008 Truven Health MarketScan databases using an expanded *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis code algorithm. The initial identified ED visit/hospitalization was the index event. Claims data for the children with continuous medical and prescription coverage for ≥ 1 year before and after the index event were evaluated. Analyses included the rates of 1-year postdischarge epinephrine autoinjector (EAI) prescription fills, allergist/immunologist visits, and repeat events.

Results The study cohort comprised 1009 patients with an average age of 7 years, including 58% males, 27% with a history of asthma, and 90% discharged from an ED. Within 1 year postdischarge, 83% had an EAI prescription fill (69% within 1 week postdischarge), 43% had a specialist visit (51% within 4 weeks postdischarge), and 6.4% had evidence of another anaphylaxis-related ED visit/hospitalization.

Conclusion Among children with food-induced anaphylaxis, within 1 year postdischarge from the ED or hospital, concordance was higher for EAI prescription fills than for allergist/immunologist visits. Subsequent ED visits/hospital stays for anaphylactic events were low. More research is needed to identify barriers between recommendations and physician/patient behaviors, as well as the impact of not following the recommendations on patient outcomes and healthcare costs. (*J Pediatr* 2014; ■: ■-■).

Food-induced anaphylaxis is a potentially life-threatening systemic allergic reaction that frequently results in emergency department (ED) visits and/or hospitalizations. In the US, approximately 3 million children (3.9% of children) had a reported food allergy in 2007.¹ Among both adults and children, there are 203 000 ED visits annually for acute food-related allergic reactions, of which 90 000 are for food-related anaphylaxis.² Children (aged <18 years) account for approximately 38% (77 000) of the ED visits for food-related allergic reactions annually.²

US national guidelines recommend that after an ED visit/hospitalization for anaphylaxis, patients should be prescribed an epinephrine autoinjector (EAI); receive education about avoiding allergens, recognizing the symptoms of anaphylaxis, and using an EAI; be given an anaphylaxis emergency action plan; and be referred to an allergist/immunologist.³⁻⁹

Retrospective studies of children with food-induced anaphylaxis have found that concordance with these guidelines varies depending on the severity of the allergic reaction and whether the patient is admitted to the hospital. In children with a food-induced allergic reaction, reported frequencies of EAI prescription receipt and allergist referral after discharge from the ED were 43% and 22%, respectively.¹⁰ Among children considered to have food-induced anaphylaxis, reported frequencies ranged from 51% to 63% for receipt of an EAI prescription and from 24% to 33% for referrals for specialist follow-up.^{10,11} Among children discharged from the hospital, 94% were prescribed an EAI and 69% were referred to an allergist.¹⁰ Although the foregoing studies assessed physician compliance with the recommendations, they did not measure patient compliance with these instructions.

The risk of recurrent anaphylaxis is reportedly higher in food-induced anaphylaxis than for other triggers.^{12,13} In a study that followed children for a mean of 7 years, the rate of recurrent anaphylaxis was 30% overall and 39% for food-induced anaphylaxis.¹³

In the present retrospective study of healthcare claims for a large population of commercially insured children in the US with food-induced anaphylaxis discharged from an ED or hospital, we examined patient concordance with

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EAI	Epinephrine autoinjector
ED	Emergency department
ICD-9-CM	<i>International Classification of Diseases, Ninth Revision, Clinical Modification</i>

recommended postdischarge care and the rate of a repeat event over 1 year of follow-up.

Methods

As part of a larger population study, data were obtained from the 2001-2009 Truven Health MarketScan Commercial and Medicare supplemental databases. These databases provide access to fully adjudicated annual inpatient and outpatient medical claims, as well as outpatient prescription drug claims for >43 million privately insured individuals in the US. Data are derived from >100 health plans, including various fee-for-service and managed-care designs. Detailed cost, use, and outcomes data for healthcare services received in both inpatient and outpatient settings are available. The medical claims, outpatient prescription (retail and mail order) 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. Because the study used only deidentified patient records and did not involve the collection, use, or transmittal of individually identifiable data, Institutional Review Board approval was not required.

The children selected for this study were aged <18 years and had an ED visit or hospitalization during the study period (January 1, 2002, to December 31, 2008) for food-induced anaphylaxis based on method I (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM] codes specifically indicating anaphylaxis) or method II (ICD-9-CM algorithm based on the National Institute of Allergy and Infectious Diseases and Food Allergy and Anaphylaxis Network definitions of anaphylaxis) of the Harduar-Morano algorithm.¹⁴ The selected children had continuous medical and prescription coverage for ≥ 1 year before (preindex) and after (postindex) the date of the initial ED visit or hospital discharge (index date). Patients admitted to the hospital through the ED were captured in the hospitalized cohort. Immunocompromised patients with a diagnosis of AIDS, cancer, or organ transplantation during the preindex period, as well as those with sepsis at index, were excluded from our analysis.

Data on 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 Code,¹⁵ was assigned based on the county of residence, and median household income was estimated by matching the ZIP code of the patient's residence with that of the 2000 US Census. Individual comorbid conditions were identified using ICD-9-CM codes from preindex medical claims. Preindex prescription fills for EAI were identified using the National Drug Code numbers recorded on individual prescription claims (retail and mail order) and preindex allergist/immunologist visits were identified by physician specialty, as coded on the preindex outpatient medical claims.

Variables measured in patients with an index ED visit included cardiorespiratory failure and subsequent interventions identified on the index ED claim or hospital facility/professional claim for an inpatient stay using ICD-9-CM, Current

Procedural Terminology, and Healthcare Common Procedure Coding System Level II codes. Inpatient measures, including intensive care unit stay, length of hospital stay, and discharge destination, were identified on the facility and admission summary claims 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 copayment and coinsurance deductibles, any coordination of benefits amount, and the amount paid by the insurer. All costs were inflated to 2008 US dollars using the medical component of the Consumer Price Index.

Prescription EAI fills and allergist/immunologist visits in the postindex period were identified as for the preindex period. These data were recorded on individual prescription and medical claims and thus capture care sought by the patient and covered by the insurer. In addition, time to first EAI prescription fill, number of fills, time to first allergist/immunologist visit, and number of visits in the postindex period were determined. Patients with ≥ 1 subsequent anaphylaxis events and treatment as an inpatient or in an ED were identified using the same methods (methods I and II) as used to identify index events. A 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 if 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 above. Data are reported as mean $\pm$ SD to summarize continuous measures, as median (IQR) for continuous measures with skewed distributions, and as number (%) for categorical measures. Outcomes of index events were stratified by the index place of service, ED or hospital. Analyses were performed with SAS version 9.2 (SAS Institute, Cary, North Carolina).

Results

After the selection criteria were applied, 43% of the children (1009 of 2322) treated for anaphylaxis in the ED or hospital were assigned a code for food-induced anaphylaxis. Among these children, 97% were identified using single diagnosis codes (method I), and 3% were identified using the expanded diagnosis algorithm (method II). The children were enrolled in a variety of health plans, and 58% were male (Table). Patients resided across the US, with the majority (92%) living in metropolitan counties. Overall, 27% of the patients had a history of asthma, 18% had a history of allergic rhinitis, 12% had a history of eczema, and 4.2% had a "personal history" of allergy. In addition, in the preindex period, 35% of patients had a claim for ≥ 1 EAI prescription fill, and 19% had ≥ 1 visit to an allergist/immunologist.

Index Event Characteristics

Most patients (90%) were treated in and discharged from the ED. Hypotension was listed on 1 ED patient's claim, but the

Table. Baseline demographics and clinical characteristics of children with food allergy (n = 1009)

Variable	Value*
Male sex, n (%)	587 (58)
Age, y, mean $\pm$ SD	7 $\pm$ 5.5
Age group, n (%)	
0-5 y	518 (51)
6-11 y	202 (20)
12-17 y	289 (29)
Insurance plan type, n (%)	
Health Maintenance Organization	257 (26)
Point of Service Plan	156 (16)
Preferred Provider Organization	470 (47)
Other	126 (13)
Geographic region, n (%)	
Northeast	223 (22)
Midwest	241 (24)
South	350 (35)
West	186 (18)
Other	9 (0.9)
Urban Influence Code, n (%)	
Metropolitan counties	924 (92)
Nonmetropolitan counties adjacent to metropolitan areas	76 (7.5)
Unknown	9 (0.9)
Income, US\$, mean $\pm$ SD	58 751 $\pm$ 21 641

*Percentages do not always sum to 100% owing to rounding to the nearest integer.

patient did not require cardiorespiratory or resuscitative interventions. Acute respiratory arrest was indicated on hospital facility and provider claims for 9 patients, 6 of whom had evidence of cardiorespiratory or resuscitative interventions.

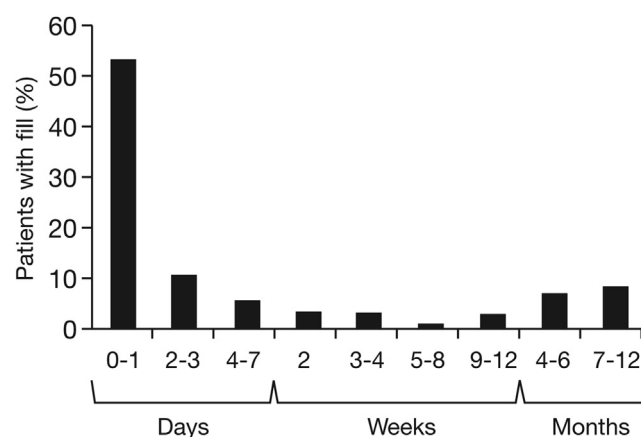
For the 105 patients (10%) who were hospitalized, the mean $\pm$ SD length of stay was 1.4 $\pm$ 1.3 days (median, 1 day; IQR, 1-1 day), and 26% of patients spent time in the intensive care unit. The vast majority of these patients were discharged home (91%), whereas 2.2% were transferred to another acute care, intermediate care, or skilled nursing facility. The remaining patients were discharged to an unidentified location.

The mean total index event cost in 2008 US dollars was \$1266 $\pm$ \$1129 for ED visits and \$4984 $\pm$ \$5813 for hospital stays. The median total index event costs were \$974 (IQR, \$540-\$1596) for ED visits and \$3483 (IQR, \$2373-\$5175) for hospital stays.

Postindex Period Care

Within the first postindex year, 83% of children with food-induced anaphylaxis had a fill or refill of ≥ 1 EAI prescription, and of these, approximately one-half had ≥ 2 prescription fills on different dates. In addition, at the first fill, 42% of patients received 1 EAI and 58% received 2 EAI. Among the patients with a postindex EAI prescription fill, 69% received the fill within 1 week postdischarge (Figure 1). The median time to the first EAI prescription fill was 1 day (IQR, 1-19 days), and the mean time to this first EAI prescription fill was 38 $\pm$ 82 days.

Within the 1-year postindex period, 43% of the children with food-induced anaphylaxis had evidence of ≥ 1 allergist/immunologist visit, approximately one-half of which occurred within 4 weeks postdischarge (Figure 2). The

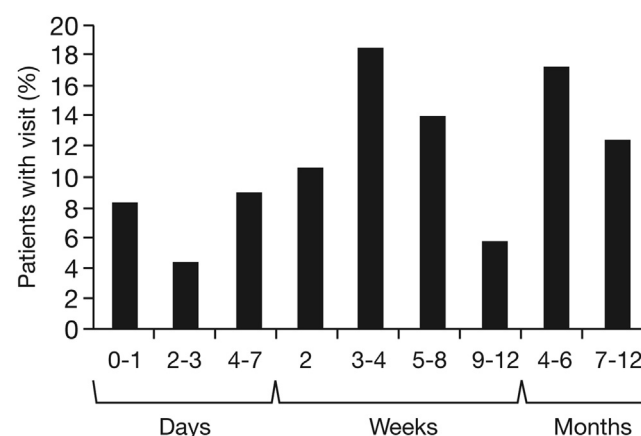
**Figure 1.** Time to first EAI prescription fill within 1-year postdischarge in 833 children who filled ≥ 1 prescription.

mean time to this first visit was 69 $\pm$ 86 days, and the median time was 28 days (IQR, 10-103 days). In addition, patients with a specialist visit had a mean of 2.0 $\pm$ 1.6 allergist/immunologist visits in the first year postdischarge.

Excluding those children who filled an EAI prescription or had an allergist/immunologist visit in the preindex period, 81% of the children with food-induced anaphylaxis filled or refilled ≥ 1 EAI prescription within 1 year postindex, and 39% had evidence of ≥ 1 allergist/immunologist visits. The mean time to the first EAI fill was 19 $\pm$ 60 days, and the median time was 1 day (IQR, 0-3 days). The mean time to the first allergist/immunologist visit was 64 $\pm$ 84 days, and the median time was 25 days (IQR, 12-87 days).

Subsequent Events

A total of 65 children (6.4%) had evidence of another ED visit (n = 64) or hospitalization (n = 1) for anaphylaxis during the 1-year postindex period. The mean time to this subsequent

**Figure 2.** Time to first allergist/immunologist visit within 1-year postdischarge in 435 children who had ≥ 1 visit.

ED visit or hospitalization was 75 ± 109 days, and the median time was 6 days (IQR, 1-359 days). For patients with a subsequent event, **Figure 3** (available at www.jpeds.com) shows the proportion with events over the days, weeks, and months postindex. After excluding events occurring within 7 days of the discharge data (events likely to be late manifestations of the original event), 32 patients (3%) had evidence of a subsequent event. The mean time to the subsequent ED visit or hospitalization was 151 ± 114 days, and the median time was 130 days (IQR, 50-232 days).

Discussion

This is a retrospective claims study presenting descriptive data on patient concordance with recommended care following an ED visit or hospitalization in children with food-induced anaphylaxis. Receipt of care was recorded on individual prescription and medical claims and thus represents anaphylaxis care sought by the patient and covered by the insurer. In this large cohort of children, 90% were identified on the basis of an ED visit (vs hospitalization). Within 1 year postdischarge, 83% of children filled an EAI prescription and 43% visited an allergist/immunologist. During this period, 6.4% of children had a subsequent anaphylactic event.

Studies report an increasing incidence of anaphylaxis worldwide, particularly food-induced anaphylaxis.¹⁶ The recommended course of care in a patient with anaphylaxis discharged from the ED or hospital includes a prescription for an EAI and referral to a specialist.³⁻⁵ Although previous studies have examined whether children discharged from the ED or hospital received a prescription for an EAI or referral to a specialist on discharge,^{10,11} we know of no published studies evaluating whether these children or their caregivers filled or refilled an EAI prescription or visited a specialist postdischarge. This is important, as illustrated by a previous study of 46 children with food-induced anaphylaxis that found that only 39% of children prescribed an EAI at the initial evaluation still had a readily available EAI after a mean of 7 years.¹³ Further research is needed to distinguish between the failure of medical staff to provide appropriate discharge advice and the failure of the patient to follow the advice received. Nonetheless, it remains incumbent on the physician/medical staff to be aware of the guidelines and to educate the patient/caregiver on allergen avoidance and EAI use, as well as on the importance of filling the prescription and having the EAI available for emergency use.

In this large cohort of children, there was good concordance with recommended post-discharge care for filling an EAI prescription (83% of patients), but low concordance for visiting an allergist/immunologist (43% of patients). As 35% of patients were identified as having an EAI prescription fill in the year before their index event, parents may have opted to not fill or refill the prescription postindex as an EAI may have still been available for use. Out-of-pocket costs may also have prevented some of the 27% of patients from getting a postindex EAI. For those patients with an EAI prescription fill, the median out-of-pocket expenditure was \$29 (IQR, \$21-\$46). Co-

payments and formulary status for patients not filling a prescription are not available in the database. Similarly, as guidelines strongly recommend referral to an allergist/immunologist, particularly if one is not already involved,³⁻⁵ parents of children who had previously visited an allergist/immunologist (19% in the year before their index event) may have opted not to schedule another visit. Previous studies of children discharged from the ED with food-induced anaphylaxis reported that 51%-63% of patients received an EAI prescription and 24%-33% were referred to an allergist^{10,11}; proportions for those discharged from the hospital were 94% and 69% for receipt of an EAI prescription and specialist referral, respectively.¹⁰ For patients who may want to visit a specialist, potential barriers include limited availability of services (eg, lack of pediatric specialists in some communities) and health plans requiring preauthorization from the primary care physician to obtain a specialist referral.^{11,17}

Note that all of the children in this study were enrolled in employer-sponsored prescription plans, and 52% were enrolled in a health plan not requiring specialist referrals. Thus, this population may have fewer barriers to obtaining subsequent care than the average child with food-induced anaphylaxis seen in an ED or admitted to a hospital in the US. Yet even with fewer barriers, specialist visits in the year after the anaphylaxis events were still found in only 43% of the population.

Data on subsequent anaphylaxis events in children with food-induced anaphylaxis are limited. In one study, the rate of recurrent anaphylaxis over a 7-year follow-up period was 30% overall and 39% for children with food-induced anaphylaxis, for an annual recurrence rate of 5.6%.¹³ This rate is similar to the 6.4% rate in our patients with subsequent anaphylaxis-related ED visits/hospitalizations in the first year postindex. It is possible that this rate of subsequent anaphylaxis-related events is an overestimate of the true recurrence rate, however. As shown, a large proportion of patients experienced another event within 1-2 days of the index discharge. Medical claims are derived for the purposes of financial reimbursement to care providers, and thus it is not possible to confirm whether these were events independent of the first event.

To determine the impact, if any, of adhering to the recommended preventative care measures, it would be useful to know whether children with a subsequent event were among those who did not receive the recommended care, and whether they differed from those with subsequent events who did receive recommended care. This care includes not only an EAI prescription fill and a visit with an allergist/immunologist, but also the other components of recommended care, such as receipt of education on the use of an EAI and an anaphylaxis emergency care plan.⁶⁻⁹ The receipt of recommended care may reduce the severity of a subsequent event, thereby reducing the need for an ED visit or hospitalization. However, owing to the limited number of patients in this study with evidence of ED or hospital care for subsequent anaphylaxis events, we could not evaluate the association between receiving preventive medical care (through the

availability of an EAI or evaluation by a specialist) and experiencing a second anaphylaxis event. An important caveat to our results is that we did not assess for recurrent anaphylaxis events not resulting in an ED visit or hospitalization.

Some additional limitations should be considered when interpreting our results. First, the study population comprised US children enrolled mainly in employer-sponsored commercial insurance plans. The majority of the US population is covered by employer-sponsored medical and prescription insurance,¹⁸ and, consequently, the Market-Scan databases represent a wide variety of nationally representative employed patients and their dependents, but nonetheless are not representative of food-induced anaphylaxis patients seen in the hospital or ED. Second, patients were required to have a minimum of 12 months of continuous enrollment after their index event, and thus survival bias might have been introduced. However, given the low mortality rate from anaphylaxis in children reported in the literature (2%),^{19,20} the bias is expected to be minimal and to not affect the characterization of this food-induced anaphylaxis population. Finally, although the use of the ICD-9-CM codes available 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, limiting the possibility of misclassification and underestimation. This likelihood was further minimized by using an algorithm that includes a combination of codes indicative of the signs and symptoms of anaphylaxis,¹⁴ thereby increasing the study sample size by 2.5%.

Although patient compliance with postdischarge recommendations for EAI prescription fills and allergist/immunologist visits exceeded the previously reported physician compliance, there remains much room for improvement. This study is descriptive in nature, and further studies are needed to identify potential barriers of adherence to recommended postanaphylaxis discharge care by both physicians and patients, to identify predictors of having an EAI fill and visiting an allergist, and to estimate the impact of receiving recommended care on the likelihood of experiencing a subsequent anaphylaxis event in children with food-induced anaphylaxis. In addition, cost-benefit analyses of alternative attainment strategies of an EAI outside of the current prescription and fill process, such as provision of an EAI on discharge from the ED or hospital, should be undertaken. ■

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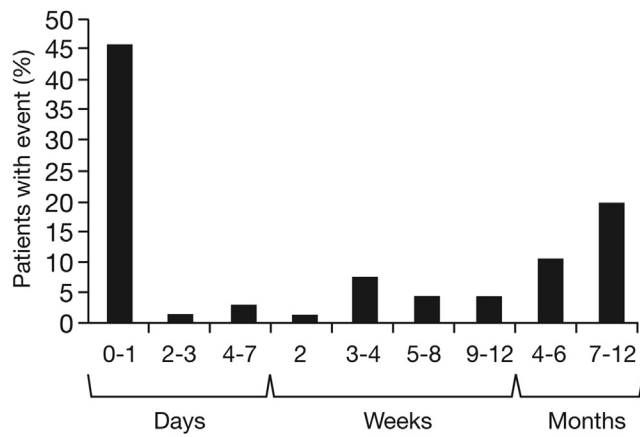


Figure 3. Time to first subsequent anaphylaxis event in the 1-year postdischarge period in 65 children who had ≥ 1 subsequent event.