Prevalence of food allergies and intolerances documented in electronic health records

Warren W. Acker, MS,[a,b] Joseph M. Plasek, MS,[a,c] Kimberly G. Blumenthal, MD, MSc,[d,e,f,g] Kenneth H. Lai, MA,[h] Maxim Topaz, RN, MA, PhD,[a,d] Diane L. Seger, RPh,[a,h] Foster R. Goss, DO, MMSc,[i] Sarah P. Slight, PhD, MPharm, PGDip,[a,j,k] David W. Bates, MD, MSc,[a,d] and Li Zhou, MD, PhD[a,d,l]

Boston, Mass, Scranton, Pa, Salt Lake City, Utah, Aurora, Colo, and Newcastle upon Tyne, United Kingdom

Background: Food allergy prevalence is reported to be increasing, but epidemiological data using patients' electronic health records (EHRs) remain sparse.

Objective: We sought to determine the prevalence of food allergy and intolerance documented in the EHR allergy module.

Methods: Using allergy data from a large health care organization's EHR between 2000 and 2013, we determined the prevalence of food allergy and intolerance by sex, racial/ethnic group, and allergen group. We examined the prevalence of reactions that were potentially IgE-mediated and anaphylactic. Data were validated using radioallergosorbent test and ImmunoCAP results, when available, for patients with reported peanut allergy.

Results: Among 2.7 million patients, we identified 97,482 patients (3.6%) with 1 or more food allergies or intolerances (mean, 1.4 ± 0.1). The prevalence of food allergy and intolerance was higher in females (4.2% vs 2.9%; $P < .001$) and Asians (4.3% vs 3.6%; $P < .001$). The most common food allergen groups were shellfish (0.9%), fruit or vegetable (0.7%), dairy (0.5%), and peanut (0.5%). Of the 103,659 identified reactions to foods, 48.1% were potentially IgE-mediated (affecting 50.8% of food allergy or intolerance patients) and 15.9% were anaphylactic. About 20% of patients with reported peanut allergy had a radioallergosorbent test/ImmunoCAP performed, of which 57.3% had an IgE level of grade 3 or higher.

Conclusions: Our findings are consistent with previously validated methods for studying food allergy, suggesting that the EHR's allergy module has the potential to be used for clinical and epidemiological research. The spectrum of severity observed with food allergy highlights the critical need for more allergy evaluations. (J Allergy Clin Immunol 2017;■■■:■■■-■■■.)

Key words: *Food hypersensitivity, allergy and immunology, epidemiology, anaphylaxis, prevalence, electronic health records*

Abbreviations used
EHR: Electronic health record
OFC: Oral food challenge
PEAR: Partners' Enterprise-wide Allergy Repository
RAST: Radioallergosorbent test

The prevalence of adverse reactions to food in the United States in 2014 was estimated to be 5% for adults and 8% for children,[1] an increase from 2006 estimates (3% to 4% and 6%, respectively).[2] Reports over the last decade indicate that the incidence of food-induced hospitalizations in the United States increased from 0.6 per 1000 patients to 1.3 per 1000 patients.[3]

However, most studies reporting food allergy epidemiology use cross-sectional surveys, a method often limited by small sample size and selection bias. In addition, many studies focus on a specific food allergen or allergen group, most commonly peanut, tree nut, or shellfish.[4-6] Current electronic health record (EHR) systems in the United States contain an "allergy" module in which health care providers document a patient's adverse reactions to medications, foods, or environmental substances, including reactions reported by the patient or observed clinically. This module must include food allergies to ensure patient safety, especially for hospitalized patients. The EHR allergy module also serves as the only semi-standardized location for allergy documentation between EHRs and enables population-based estimates of food allergy epidemiology.

In this study, we used the EHR allergy module of a large health care system to estimate the prevalence of food allergies and intolerances and associations with sex and racial/ethnic groups. In

From [a]the Division of General Medicine and Primary Care, Brigham and Women's Hospital, Boston; [b]Geisinger Commonwealth School of Medicine, Scranton; [c]the Department of Biomedical Informatics, University of Utah School of Medicine, Salt Lake City; [d]Harvard Medical School, Boston; [e]the Division of Rheumatology, Allergy, and Immunology, Department of Medicine, Massachusetts General Hospital, Boston; [f]Medical Practice Evaluation Center, Department of Medicine, Massachusetts General Hospital, Boston; [g]Edward P. Lawrence Center for Quality and Safety, Massachusetts General Hospital, Boston; [h]Clinical & Quality Analysis, Partners HealthCare System, Boston; [i]the Department of Emergency Medicine, University of Colorado, Aurora; [j]Newcastle University, Newcastle upon Tyne; [k]Newcastle upon Tyne Hospitals NHS Foundation Trust, Newcastle; and [l]Clinical Informatics, Partners eCare, Partners HealthCare System, Boston.

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Corresponding author: Li Zhou, MD, PhD, Partners HealthCare, 399 Revolution Dr, Ste 1315, Somerville, MA 02145. E-mail: lzhou@bwh.harvard.edu.

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addition, we examined the prevalence of specific reactions, including those potentially IgE-mediated and anaphylactic.

METHODS

Setting and data collection

In this study, we used food allergy and intolerance data collected at Partners HealthCare, an integrated health care delivery network in the Greater Boston Area composed of multiple community and specialty hospitals as well as community health centers. Partners HealthCare providers recorded patient food allergies and intolerances in an allergy module of the EHR. Patients' allergy information was integrated and stored in the Partners' Enterprise-wide Allergy Repository (PEAR).[7] In this article, we use the term "food allergies and intolerances" to represent any adverse reaction to food, including allergies, idiosyncratic and pseudoallergic reactions, intolerances, and even food preferences.[8-10] The study population consisted of patients seen at any Partners HealthCare center from January 1, 2000, to December 31, 2013. This study was approved by the Partners HealthCare Human Research Committee.

Food allergy and intolerance information in PEAR included a list of specific allergens (ie, culprit foods), reaction(s) to that allergen, and associated data (date/time this information was recorded and any updated information such as new/different reactions). Patients' demographic information (sex, date of birth, and self-reported racial/ethnic group) was extracted from the Partners HealthCare EHR. As described in a previous study,[10] food allergy and intolerance records were processed by a natural language processing tool to the coded form, negated terms were removed, and food allergens were classified into groups. Classification was based on the Food Allergen Labeling and Consumer Protection Act,[11] cross-sensitivity findings, medical terminologies (eg, Systematized Nomenclature of Medicine – Clinical Terms[12]), recommendations of a multidisciplinary expert panel, and a review of the allergy literature.[10] The final food allergen classification consisted of 19 food substance groups.

Patients' adverse reactions associated with food allergens were captured and classified by reaction type (eg, hives/urticaria and anaphylaxis). These adverse reactions represented both patient self-reported adverse reactions to food and physician-recorded symptoms to food. We defined potentially IgE-mediated reactions as those that included anaphylaxis, shortness of breath, tongue swelling, hives/urticaria, itching, bronchospasm/wheezing, angioedema, and hypotension.[13,14] We classified anaphylactic reactions as only those reactions entered as anaphylaxis by the clinical provider (eg, a patient with reactions of shortness of breath and hives would not have been considered anaphylaxis).

To better understand the validity of food allergy data entered in PEAR, we used specific IgE to peanut by radioallergosorbent test (RAST) from 2000 to 2010 and ImmunoCAP from 2009 to 2013 for all patients reportedly peanut allergic or intolerant.

Data analysis

We determined food allergy and intolerance prevalence to each of the 19 food allergen groups, as well as by sex and racial/ethnic group (white, black, Hispanic, Asian, and "other or unknown"). "Other or unknown" racial/ethnic group included those with more than 1 racial identity and patients whose racial/ethnic group was "not given," "unknown," "refused," or missing. We calculated the prevalence of common (frequency, >1.0%) reactions among patients with 1 or more food allergies or intolerances.

We validated EHR-reported peanut allergies by identifying patients with a documented allergy or intolerance to peanut who had a RAST/ImmunoCAP performed in our health care system, and assessing the grade by IgE level (negative, <0.35 mg/dL; grade 1, 0.35-0.69 mg/dL; grade 2, 0.70-3.49 mg/dL; grade 3, 3.50-17.49 mg/dL; grade 4, 17.50-49.99 mg/dL; grade 5, 50.0-100.0 mg/dL; and grade 6, >100.0 mg/dL). We performed the corollary analysis using only those patients with reported peanut allergies whom we identified as potentially IgE-mediated.

We used chi-square tests to compare documented food allergies and intolerances in each demographic group for all food allergies and intolerances and for each allergen group. For multigroup categories (eg, race), we collapsed each group into binary variables for statistical comparisons. P values were calculated, with $P < .05$ being considered statistically significant. Data were analyzed using SAS statistical software version 9.3 (SAS Inc, Cary, NC).

RESULTS

Description of study population

Our overall study population (ie, the PEAR data set) consisted of 2,714,851 patients of whom 55.2% were females and 44.8% were males. Most of our patients were white (70.5%), followed by Hispanic (6.3%), black (5.7%), and Asian (3.6%).

Prevalence of documented food allergy and intolerance

A total of 132,734 food allergy and intolerance records were documented for 97,482 (3.6%) food-allergic or intolerant patients. On average, patients with food allergy and/or intolerance had 1.4 ± 0.1 food allergen records in PEAR. The most prevalent food allergen groups ($P < .001$) were shellfish (0.9%), fruit or vegetable (0.7%), dairy (0.5%), peanut (0.5%), and tree nut (0.4%) (Table I; see Table E1 in this article's Online Repository at www.jacionline.org).

Female patients were more likely to have a recorded food allergy or intolerance than males, both overall (4.2% vs 2.9%; $P < .001$) and for every food allergen group except peanut (0.4% for females vs 0.5% for males; $P < .001$). Asian patients (4.3%) had a significantly ($P < .001$) higher prevalence compared with other racial/ethnic groups (3.6%), followed by black patients (3.9%), white patients (3.8%), and Hispanic patients (2.8%). Among the 9 most common food allergen groups, Asian patients had significantly higher food allergy and intolerance prevalence for all groups except additives (Asian 0.1% vs non-Asian 0.2%; $P < .001$) and grain (Asian 0.2% vs non-Asian 0.3%; $P < .001$) (Tables I and E1).

Food adverse reactions

Among 132,734 allergy and intolerance records, there were 148,046 documented reactions experienced by 97,482 patients. Seventy percent of the reactions had 1 or more known adverse reaction documented (ie, they were not documented as "unknown"), accounting for 103,659 reactions. On average, patients had 1.2 reactions (when known) for each unique food allergen. A total of 28.3% of patients with a documented food allergy or intolerance had a reaction of hives/urticaria, followed by anaphylaxis (15.9%) and gastrointestinal irritation (11.5%). A total of 50.8% of patients with a food allergy or intolerance had a corresponding documented reaction that was potentially IgE-mediated (Table II).

Peanut allergy and specific IgE

There were 12,946 patients with an allergy or intolerance to peanut, including 7,318 (56.5%) patients with potentially IgE-mediated reactions to peanut. Among all patients with a documented allergy or intolerance to peanut, 2537 (19.6%) had a specific IgE to peanut performed between 2000 and 2013. Of these tests, results were negative (n = 216 [8.5%]), grade 1