



Time Trends in Food Allergy Diagnoses, Epinephrine Orders, and Epinephrine Administrations in New York City Schools

Elizabeth Feuille, MD¹, Cheryl Lawrence, MD², Caroline Volel, MD, MPH³, Scott H. Sicherer, MD¹, and Julie Wang, MD¹

Objectives To assess time trends in food allergy diagnoses, epinephrine autoinjector (EAI) prescriptions, and EAI administrations in the school setting.

Study design In this retrospective study, deidentified student data from the New York City Department of Health and Mental Hygiene, which oversees >1 million students in 1800 schools, were provided to investigators. Data from school years 2007-2008 to 2012-2013 pertaining to diagnoses of food allergy, student-specific EAI orders, and EAI administrations among students in New York City were analyzed for trends over time, via the use of ORs and χ^2 calculation.

Results The prevalences of providing physician documentation of food allergy and EAI orders, and the incidence of EAI administrations, all increased approximately 3-fold over the years of the study. Of 337 EAI administrations, more than one-half used stock EAI, and three-quarters were for students without a student-specific order preceding the incident.

Conclusions The rise in food allergy diagnoses, EAI prescriptions, and EAI administrations suggest either a true increase in allergic disease, increased reporting, and/or, in the case of EAI administrations, increased appropriate use. As the majority of EAI administrations used stock supply, availability of nonstudent-specific stock EAI appears vital to management of anaphylaxis in schools. Collaboration between physicians, families, and schools is needed to identify students at risk for severe allergic reactions and to ensure preparedness and availability of EAI in the event of anaphylaxis. (*J Pediatr* 2017;190:93-9).

Food allergy and anaphylaxis are startlingly common among children in the US. Food allergy is estimated to affect up to 8% of children, more than one-third of whom report having severe reactions.¹ Furthermore, the prevalences of both food allergy and anaphylaxis appear to be increasing.²⁻⁷ The leading cause of anaphylaxis in children is food allergy; other common causes include insect venom hypersensitivity and medication allergy.⁷⁻¹² Anaphylaxis can manifest with difficulty breathing, throat swelling, and decrease in blood pressure, and can, although quite rarely, be fatal.¹³ The potentially life-saving treatment for anaphylaxis is the timely administration of epinephrine.^{14,15} To address this risk for anaphylaxis, standard management for food allergy (and other conditions associated with risk of anaphylaxis) is strict avoidance of the trigger and preparedness at all times with an epinephrine autoinjector (EAI) in case a severe reaction occurs.

With children spending most of their days in school, schools must have a system for identifying at-risk students and ensuring availability of EAI in the event of a severe allergic reaction. Fatal and near-fatal anaphylactic reactions, although rare, do occur in schools; most cases have been associated with delayed administration of epinephrine.^{10,16-19} EAI administration in schools is of particular relevance due to school policy changes regarding EAI stocking and administration, across the country and within New York City (NYC). Historically, EAI could only be administered in school if a student-specific order was on file. The School Access to Emergency Epinephrine Act, enacted in 2013, incentivized most states across the US to mandate stocking of nonstudent-specific epinephrine in schools (<https://www.foodallergy.org/advocacy/epinephrine/map>). In schools under supervision of the NYC Department of Health and Mental Hygiene (DOHMH), stocking of nonstudent-specific EAI has been mandatory since the school year 2005-2006. In addition to continued training of staff in proximity to at-risk students, the NYC DOHMH has increasingly over the past several years offered training in recognition and treatment of anaphylaxis to all school staff.

There are few studies addressing epidemiology of food allergy and anaphylaxis in US schools²⁰⁻²² and fewer providing insight into how this is changing over time.^{21,23} In this report, we describe trends in reporting of physician-diagnosed

From the ¹Division of Pediatric Allergy and Immunology, Jaffe Food Allergy Institute, Icahn School of Medicine at Mount Sinai, New York; ²New York City Department of Health and Mental Hygiene, Queens; and ³Mailman School of Public Health, Columbia University, New York, NY

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DOHMH	Department of Health and Mental Hygiene
EAI	Epinephrine autoinjector
EHR	Electronic health records
MAF	Medication administration form
NYC	New York City

food allergy, student-specific EAI, and EAI use in schools over a 6-year period in the NYC public school system.

Methods

For this retrospective study, NYC DOHMH provided investigators with collated and deidentified student data pertaining to food allergy diagnoses and student-specific physician orders for EAI for school years 2007-2008 to 2012-2013 and EAI administrations for school years 2008-2009 to 2012-2013. These data were extracted from the city-wide electronic health records (EHRs) of the >1 million students in 1800 schools overseen by the NYC DOHMH. Each student's medical diagnoses, prescriptions to be used in and out of school, and administrations of medication in school are documented in the student EHR; further details as to how these are recorded are provided under the subheadings to follow. Schools under supervision of the NYC DOHMH are exclusively urban, with students diverse in race, ethnicity, and socioeconomic status. For this study, grades kindergarten to fifth were considered elementary school, grades 6-8 middle school, and 9-12 high school. This study was approved by the institutional review boards of the Icahn School of Medicine at Mount Sinai and the NYC DOHMH.

Each year, students in the NYC public school system are asked to provide the schools with physician documentation of all medical conditions on a health examination form as well as physician orders for the student's medications on a medication administration form (MAF). Both are completed by the child's healthcare provider and provided to the school health office by the parent. Medical diagnoses (based on the health examination form, MAF, or other physician documentation) as well as physician orders from the MAF, are entered into the student's EHR.

In schools under supervision of the NYC DOHMH, all administrations of medications, including EAI, require mandatory recording in the city-wide EHR. This recording is completed by a school nurse within 24-48 hours of administration of the medication. The indication and the date and time of administration are recorded. For EAI, source of the medication (stock or student-specific) is documented as well. Two 2-packs of EAIs (one junior and one regular) were provided to each school during the study period and were replaced promptly if used. Funding for these EAIs was provided for NYC DOHMH for the school years 2008-2009 and 2009-2010 and by Mylan through the EpiPen4Schools program for the subsequent 3 school years from 2010-2011 to 2012-2013.

Statistical Analyses

Data were analyzed with Microsoft Excel (2010; Microsoft, Redmond, Washington), RStudio (Version 0.99.896 RStudio, Inc, Boston, Massachusetts), and MedCalc Software (MedCalc, Ostend, Belgium) for general descriptive frequencies and for inferential trends using ORs with the mid-P calculation. Differences in proportions between school years were tested with χ^2 analysis.²⁴

Results

Demographics for all students in the NYC public school district are summarized in **Table I**. The total number of students increased each school year from 1 037 560 in 2007-2008 to 1 116 346 in 2012-2013. There were more male than female students (51.3% male). Ethnic/racial distribution was as follows: the majority of students identified as Hispanic (39.4%), followed by black (30.2%), Asian (14.6%), white (14.3%), and other (1.5%). Regarding age distribution, 5.2% were in pre-kindergarten, 43.4% were in elementary school (kindergarten to fifth grade), 21% in middle school (sixth to eighth grade), and 30.3% in high school (ninth to 12th grade). Distribution of students' lunch pricing, which is based on economic status, was as follows: 59.3%, 6.6%, and 28.2% qualified for free, reduced, and full price, respectively; 6.6% had an unknown lunch pricing status.

Reporting of Physician-Diagnosed Food Allergy

The portion of total students in the NYC public school system who provided documentation of physician-diagnosed food allergy increased significantly over the years of the study from 0.39% (N = 4007) in 2007-2008 to 1.43% (N = 15 944) in 2012-2013 (**Figure**, $P < .001$). As shown in **Table I**, the prevalence of reported food allergy was greatest among students in elementary school, who were male, identified as white, and did not qualify for reduced-price or free lunch.

The portion of total students who provided MAFs for EAI increased significantly over the years of the study from 0.26% (N = 2647) in 2007-2008 to 0.74% (N = 8310) in 2012-2013 (**Figure**) ($P < .001$). As with food allergy diagnoses, prevalence of having MAF for EAI was greatest amongst younger students, males, those identifying as white, and those qualifying for full-price lunch (**Table I**).

Indications listed on EAI MAF are summarized in **Table II**. The majority of physician orders for EAI were for either anaphylaxis due to food or food intolerance (79.3%). For orders with a specified culprit food, peanut (64.1%) was most commonly listed. Additional indications included anaphylaxis with unspecified cause (16.8%), asthma (1.6%), bee sting allergy (0.6%), urticaria and/or angioedema (0.6%), and anaphylaxis due to latex (0.4%). The remaining indications (each accounting for <0.1%) included additional atopic conditions and neurologic, hematologic, and immunologic disorders.

In total, over the 6 school years from 2007-2008 to 2012-2013, 48% of those with reported food allergy provided an MAF for EAI, and this percent trended down significantly from 50.1% in 2007-2008 to 46.5% in 2012-2013 (**Table III**) ($P < .001$).

In contrast to the aforementioned data regarding physician-diagnosed food allergy and physician orders for EAI, reporting of EAI administrations was not dependent on parent provision of physician-completed forms to the school health office. Instead, reporting of EAI administrations was completed by school health staff, who are required to document administrations in the city-wide EHR within 24-48 hours of administration.

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