



MOC-CME Review

Management of food allergies and asthma in schools



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Key Messages

- As the prevalence of food allergy and asthma increases, more schools will need to have plans in place to manage students with these allergic disorders.
- Approximately 16% to 18% of food allergy reactions occur in school and include first-time reactions to food allergens.
- There is increased morbidity in children with both coexistent food allergy and asthma. These children have increased risk of hospitalizations, increased use of asthma medications, and fatal anaphylaxis.
- Allergen avoidance reduces the risk of allergic reactions and asthma exacerbations. Severe food allergic reactions are often the result of oral allergen exposures, whereas cutaneous and inhalation exposures are less likely to trigger severe allergic reactions.
- Food allergy, anaphylaxis, and asthma action plans are tools available to help guide treatment of reactions and symptoms in schools.

Instructions

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- Review the target audience, learning objectives and all disclosures.
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- Approximately 4–6 weeks later you will receive an online outcomes assessment regarding your application of this article to your practice. Once you have completed this assessment, you will be eligible to receive MOC Part II credit from the American Board of Allergy and Immunology.

Overall Purpose

Participants will be able to demonstrate increased knowledge of the clinical treatment of allergy/asthma/immunology and how new information can be applied to their own practices.

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Learning Objectives

At the conclusion of this activity, participants should be able to:

- Discuss recommendations for food allergy and asthma management in schools
- Identify resources for optimizing food allergy and asthma management for students

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Target Audience

Physicians involved in providing patient care in the field of allergy/asthma/immunology

Accreditation

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Clinical Vignette

A 5-year-old girl is seen for asthma and food allergies to peanut and tree nuts. Since her last visit, she had one allergic reaction during which she developed hives and wheezing after taking a bite of a muffin cross-contaminated with peanut. This incident was treated with epinephrine. This past winter, she had multiple upper respiratory tract infections that required 2 courses of oral corticosteroids. Her asthma is currently well controlled with daily inhaled fluticasone, with no nighttime awakenings. Her parents report that cat exposure triggers sneezing and coughing, which

resolve with albuterol, oral antihistamine, and removal from the trigger. She starts kindergarten at a new school in the fall, and her parents have many concerns about this transition and how the school will be prepared to manage her food allergies and asthma.

Introduction

Food allergy and asthma are common chronic conditions that affect 8% and 14% of school-aged children, respectively.¹ Food allergy at a young age is a risk factor for persistent, problematic asthma in childhood.² Furthermore, food allergy and asthma

coexist in many children, and these children have an increased risk of fatal or near-fatal anaphylaxis, especially if asthma is poorly controlled.^{3–6}

Because children spend a significant part of their day in school and the number of school-aged children with food allergies and asthma has been increasing, challenges to the management of allergic reactions/anaphylaxis and asthma at school are important concerns.^{7,8} Schools need to be prepared to identify and treat allergic reactions to foods and asthma exacerbations. The current mainstay of food allergy and asthma management focuses on trigger avoidance as well as recognition and prompt treatment of symptoms. In children with asthma and concomitant food allergies, distinguishing between a food allergy reaction and an asthma flare is nuanced and will be further discussed.

Association Between Food Allergy and Asthma

Epidemiologic studies have demonstrated the high rate of concomitant food allergy/sensitization and asthma.^{1,9,10} In a study of children with asthma from the National Cooperative Inner-City Asthma Study, 45% had serologic evidence of IgE-mediated sensitization to at least 1 of 6 of the most common food allergens.⁹ In the National Health and Nutrition Examination Survey (NHANES) study, those with physician-diagnosed asthma, when compared with those without asthma, had an increased prevalence of food sensitization (27.5% compared with 14.9%).¹⁰ A large study of 18,000 asthmatic and 4,000 food allergic students found that 9.3%, of the asthmatic students had food allergy, and conversely 40.1% of the food allergic students had asthma.¹ Thus, many children are affected by both disorders, and it is important to address how to handle both conditions when discussing management at school.

Children with both food allergy and asthma develop their asthma earlier and at a higher prevalence than children without food allergy.³ In a study of 567 children, symptomatic food allergy (defined as a history of reaction with positive test results) was associated with asthma in both younger (<6 years of age) (odds ratio [OR], 5.3; 95% confidence interval [CI], 1.7–16.2) and older children (≥6 years of age) (OR, 4.9; 95% CI, 2.5–9.5).³ This association was even stronger among children with multiple or severe food allergies.³

Greater Burden of Disease in Children With Food Allergy and Asthma

Several studies have found worse asthma morbidity in children with coexisting food allergies compared with those with asthma alone (Table 1).^{10–13} The NHANES study reported that patients with both asthma and food allergy had almost 7 times greater odds of having severe asthma compared with patients with asthma without food allergy.¹⁰ One case-controlled study of children aged 1 to 16 years found that children with life-threatening asthma that required use of ventilatory assistance were more likely to have a history of food allergy than children without non-life-threatening asthma exacerbations (after regression analysis: OR, 5.89; 95% CI, 1.06–32.61).¹³

In addition to higher severity of disease, children with concomitant food allergy and asthma have poorer outcomes and increased healthcare utilization. In the Northeast-based School Inner-City Asthma population, asthma morbidity, pulmonary function, and resource use were compared between children with asthma with food allergies and those without.¹² Children with asthma with food allergy had an increased risk of hospitalization for asthma (OR, 2.35; 95% CI, 1.30–4.24; *P* = .005), and use of controller medication (OR, 1.99; 95% CI, 1.06–3.74; *P* = .03).¹² Those with multiple food allergies independently had a higher risk of hospitalization, asthma-related hospitalization, controller use, and health care practitioner visits.¹²

Table 1

Increased Morbidity in Children With Concomitant Food Allergy and Asthma

Severe asthma ¹⁰
Increased daytime symptoms ¹²
Increased use of systemic steroids ^{9,10,14}
Increased asthma controller use ¹²
Increased hospitalizations and ED visits ^{12,14}
Use of a mechanical ventilator ¹³
Spirometry values: lower FEV ₁ and FEV ₁ /FVC ¹²
Fatal anaphylaxis ^{4,5}
Anaphylactic shock ¹⁵

Abbreviations: ED, emergency department; FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity.

These findings of increased ED visits and systemic corticosteroid use are similar to findings in other US and European cohorts.^{9,10,14}

Having a diagnosis of asthma also worsens the general prognosis for food allergy.² A study of 526,406 patients with asthma and a matched reference cohort without asthma described an incidence of anaphylactic shock of 109.0 per 100,000 person-years in the asthma cohort and 19.9 per 100,000 person-years in the referent cohort.¹⁵ Asthma in this study was associated with a 5.2-fold (95% CI, 4.7- to 5.6-fold) increased risk of anaphylactic shock from food allergies.¹⁵ Similarly, a UK study of individuals aged 10 to 79 years reported a more than doubled incidence of anaphylaxis in individuals with asthma compared with those without asthma, with the most common triggers of anaphylaxis in this population being drugs and food.¹⁶ Asthma has also been identified in other studies as a risk factor for fatal food anaphylaxis, although fatal reactions are rare.

Effect on School-Aged Children

The effect of food allergy and asthma in children of school age is wide. Food allergy reactions can occur anywhere, and approximately 16% to 18% of children with food allergies are reported to have had reactions at school.^{17–19} Up to 25% of students who have an allergic reaction at school are unaware of their risk.²⁰ Most reactions in schools occur in the classroom (79%–83%) and the lunchroom (12%–15%).^{17,18} Other locations of reactions include school field trips, playground, and traveling to and from school on a bus.²⁰

Food allergies also have an effect on school attendance and social engagement. In a study of caregivers of food allergic children, responders indicated that food allergy had an effect on school attendance (34%), parties (68%), and field trips (61%).²¹ In addition, food allergies can affect social activities, such as birthday parties and sleepovers, which may contribute to anxiety and isolation from other children.²¹

Asthma also poses a significant burden on school-aged children.^{22,23} Asthma is the No. 1 reason for school absenteeism and poor school performance, causing 10 million school absences annually.^{8,23} Having asthma, especially poorly controlled, was found to be related to decreased academic achievement (adjusted OR, 1.43; 95% CI, 1.09–1.88) in a study that included 1,715 adolescents who were part of a Swedish population-based birth cohort.²⁴ In school-aged children, increased asthma symptoms were associated with reports of attention-deficit/hyperactivity syndrome symptoms and poor performance on tasks that assessed concentration and attention.²⁵ Poorly controlled asthma may also cause physical limitations on socialization at recess or other activities that require physical exertion.^{26,27}

Bullying is another important issue for children with food allergy and asthma. One study reported that a quarter of food allergic children were the target of bullying, and most of these episodes (82%) occurred in school, with 80% being perpetrated by their classmates. Notably, 21% felt teased or harassed by teachers or school staff.²⁸ A higher percentage of students with asthma, compared with those

Table 2
Food Allergy Management in Schools

Variable	Explanation
Route of administration	
Ingestion	• Primary route of exposure of concern for systemic reactions¹⁸ • Most allergic reactions occur through ingestion¹⁸
Skin contact	• Low risk of severe systemic or respiratory symptoms^{18,48,49}
Inhalation	• Low risk of severe systemic symptoms to exposure to allergens such as peanut^{18,48} • Air sampling studies for peanut have shown no measurable Ara h 1 or Ara h 2^{51,52} • Cooking foods such as milk or fish can produce aerosolized particles that may trigger respiratory symptoms and asthma⁵⁰
Avoidance measures	
Allergen conscious food preparation ^{30,53}	• School staff should be trained to read food advisory labels and identify food allergens • Awareness of common food allergens during food preparation • Prepare food separately for children with food allergies • Clean and sanitize food preparation equipment before and after use to prevent cross-contact (utensils, trays, baking sheets) • Handwashing with soap and water
Awareness of hidden allergens for avoidance	• FALCPA does not apply to prescription and over-the-counter medications, nonfood items (such as personal care items), and raw agricultural food products⁵³ • Craft projects and science experiments: peanut butter craft projects, finger paint (egg), paste (wheat), play dough (wheat), and macaroni (wheat, egg)^{18,30}
Practicing good cleaning techniques	• Emphasis on hand-washing with soap and water or commercial wipes before and after eating^{30,54} • Use soap and water or all-purpose cleaning products on surfaces that come into contact with food^{30,54} • Cleaning with water alone or antibacterial hand sanitizer leaves residual amounts of Ara h 1⁵²
School policies for implementation	• The CDC guidelines provide a framework of evidence based recommendations for management of food allergies in schools³⁰ • Schools have implemented various policies,^{35,36} but the efficacy of these policies is uncertain^{37,38}
Recognition of symptoms	
Performing staff training	• Symptom recognition and preparedness is crucial for timely treatment of food allergy reactions¹⁸ • Nurses and other school staff members are relied on to administer epinephrine⁴⁴ • There is variability on who receives food allergy and anaphylaxis training at schools^{44,46}
Management	
Action plan availability	• Individualized emergency care plans^{22,23,30,31} ◦ Inform school personnel of student's specific allergy triggers ◦ Guide management of allergic reactions ◦ Reviewed annually by health care professionals
Availability of medications and stock epinephrine autoinjectors	• Should be easily accessible and available throughout the school (voluntary guidelines) • The School Access to Emergency Epinephrine Act 2013⁶⁹ ◦ Only 12 states currently require schools to stock epinephrine ◦ Most of the remaining states have laws or guidelines to allow stock epinephrine • Policies are available to guide maintenance and how to secure these medications and increase access in schools⁶⁹
Age-appropriate considerations	• Younger children are more dependent on staff to help avoid allergens and recognize and manage reactions³⁶ • Wearing medical alert bracelets³⁰ • Self-carriage and/or self-administration of epinephrine autoinjectors may be appropriate for some students^{30,36} • Take into account age, maturity, dexterity, and understanding of when and how to use the medication. • Most allergists expect children to be able to carry and self-administer epinephrine by 12–14 years of age⁷¹

Abbreviations: CDC, Centers for Disease Control and Prevention; FALCPA, Food Allergen Labeling and Consumer Protection Act.

without asthma, have also reported bullying in school (15.6% vs 10.2%) and cyberspace (17% vs 11%).²⁹ Therefore, school personnel should be aware that students with food allergy and asthma may be bullied, and these instances should be adequately addressed.

Guidelines for School Management of Food Allergies and Asthma

Because both asthma and food allergy may cause potentially life-threatening reactions, the development of school health management plans is critical. Recommendations for management are summarized for food allergy and asthma in Table 2 and Table 3, respectively. It is imperative for parents to inform their child's school about their child's medical problems, provide appropriate medications when necessary, and directly communicate with responsible individuals, for instance, the teacher and school nurse, to familiarize and educate them about management of food allergy and asthma. Parents play a

role in the education of the school staff, but there are many other sources of guidelines available for school administrators.

Guidance for the management of food allergy and asthma in schools is available from organizations such as the American Academy of Pediatrics (AAP), Centers for Disease Control and Prevention (CDC), and National Heart, Lung, and Blood Institute (NHLBI).^{22,23,30–34} These organizations provide evidence-based recommendations that can be applied to schools and to fit an individual child's needs. However, guidelines that specifically address the management of children who have concomitant food allergy and asthma are lacking.

The CDC voluntary guidelines for food allergy management focus on ensuring the daily management of food allergies in individual children, preparing for food allergy emergencies, providing professional development on food allergies for staff members, and creating a safe and healthy educational environment.³⁰ Additional measures include hand washing before handling or consuming food, not allowing food eating on buses, avoiding the use of materials in class with potential

Table 3
Asthma Management in School

Variable	Explanation
Asthma triggers ^{22,23,57-62}	
Environmental	• Irritants: chalk dust, tobacco smoke, strong odors (markers, pesticides, paints), car exhaust • Allergens: animal dander, dust, cockroach, pests, pollens, food (also through ingestion)
Infectious	• Viral, bacterial infections
Weather	• Increased humidity, cold air, after thunderstorms in pollen season
Physical activity	• Physical education classes, recess, afterschool sports
Prevention	
Avoiding triggers ^{22,23,32}	• Check pollen counts • Reducing allergen levels through a multifaceted home and school intervention plan^{22,55,63-65} ◦ Avoiding clutter ◦ Reducing use of cloth for furnishings and decorations ◦ Pest extermination ◦ Maintaining adequate ventilation ◦ Setting standards for humidity • Enforce rules for outdoor triggers, including no smoking and reducing exposure to car exhaust fumes • Avoidance of being outside during changes in weather that are known to increase asthma exacerbations (ie, increased humidity, cold air) • Limitations on physical exertion (during physical education classes, recess, afterschool sports, etc) if symptoms are not well controlled
Management	
School policies for implementation ^{22,23,32-34}	• Guidelines recommend a healthy school environment is in place to reduce asthma triggers, a school-wide plan for asthma management, and easily accessible medications
Action plan availability ^{22,23,32}	• Necessary for every student with asthma • Individualized by the health care professional and family to help provide guidance to the school in the case of symptom development
Performing staff training	• Updated annually by health care professional • Education materials to help with recognition of symptoms and management are available^{32,33} • School staff may be inadequately prepared^{45,47}
Treatment ^{22,23,32-34}	
Baseline maintenance treatment for students	• Regular use of maintenance inhalers and other asthma/allergy medications • Using short-acting β-agonists before exercise in exercise-induced asthma.
Treatment of acute symptoms	• Use of the student's asthma action plan
Medication availability	• Quick and easy access to albuterol and other rescue medications • Should be easily accessible • The Asthmatic School Children's Treatment and Health Management Act led to legislation in all 50 states enabling the right to self-carry and administer quick-relief inhalers at school • There continues to be efforts to enact laws or guidelines that permit schools to stock and administer unassigned albuterol.
Age-appropriate considerations	• Some students may be able to carry and self-administer their asthma medications ◦ Depends on age, maturity, or development level as well as ability to identify symptoms

allergens, and consideration of designated allergy-friendly seating arrangements.³⁰

Many schools have implemented a variety of policies to reduce food allergen exposures. Some have opted for allergen restrictions at the school or classroom level.^{35,36} Others prohibit food sharing between children or ban outside foods for celebrations.³⁵ The implementation of some of these policies, for example, school-wide bans on common food allergens, remains controversial, and the effect of these policies continues to be unclear. Recent studies have begun to examine the effectiveness of these policies on rates of food allergy reactions. Even in peanut-free schools, unintentional exposures can occur.³⁷ A study evaluating Massachusetts schools reported that peanut-free schools had a higher reported rate of epinephrine administration, whereas those with peanut-free tables had a lower rate of epinephrine use.³⁸ Further research is needed to evaluate the effect of allergen-restrictive policies on improving safety for students with food allergy.

For asthma, the National Asthma Education and Prevention Program and the American Lung Association, along with many other organizations, have guidelines that focus on asthma education and avoidance of common triggers as well as effectively managing asthma in schools.^{22,23,32-34} The NHLBI recommends that schools develop and adopt specific policies on asthma management to empower teachers in supporting students with asthma.²³ These guidelines include

recommendations for teachers to know their role in asthma management, knowing how to access the student's asthma plan, what steps to take in case of an asthma episode, and being aware of and reducing known asthma triggers.^{23,39} A shared message of these guidelines is the call for a multidisciplinary approach that involves parents, school staff, and health care professionals.

Multiple organizations support a school-based asthma management program in which health care professionals and policymakers collaborate with schools to reduce the pediatric asthma burden.^{40,41} The School-Based Asthma Management Program is sponsored by the American Academy of Allergy, Asthma, and Immunology and is developed by the AAP, National Institute of Allergy and Infectious Disease, and multiple professional and school groups.^{40,41} Its goal is to integrate schools into the asthma care team through encouraging partnership among the families, practitioners, and school nurses centered around the child with asthma, the creation and use of asthma management and education plans, and a plan to assess and address asthma triggers at home and in school.⁴⁰ The Toolkit is intended for school nurses, administrators, and practitioners who are interested in implementing school-based asthma management programs at their schools.⁴⁰ School-based health centers are effective in increasing knowledge about the disease, improve disease management, and improve asthma control and thus are promising frameworks for student care.^{42,43}

School Training for Food Allergy and Asthma Management

Symptom recognition and preparedness are crucial for timely treatment of food allergy reactions and asthma exacerbations. One study reported that the first adult to recognize food allergy reactions was the teacher in 59% of cases.¹⁸ Thus, it is beneficial for all school staff to be trained to recognize and treat symptoms. However, available data demonstrate that there is variability in who receives anaphylaxis training at schools and who is permitted to administer emergency medications (epinephrine) for allergic reactions.⁴⁴ Studies have also found that school staff and teachers lack awareness of the policies and procedures of asthma management.^{39,45}

Studies of food allergy management in schools have been emerging in recent years.^{44,46} In a survey of Colorado school nurses, 80% of the school nurse respondents reported that there are staff members within their schools who received anaphylaxis training, but within the schools, only 50% of their staff received training, and 68% reported that training lasted 30 minutes or less.⁴⁴ A total of 10% to 20% of survey responders reported, though, that epinephrine was given at least once by unlicensed staff who may or may not have had training.⁴⁴ A national survey of school nurses similarly reported substantial differences in staff training and anaphylaxis preparedness across the United States.⁴⁶

More studies have examined school staff understanding and training for asthma. In a study of 21 elementary teachers in the Bronx, New York, barriers to proper management of asthma in schools included lack of understanding on how to identify students with asthma, lack of teacher knowledge of asthma management guidelines, lack of comfort with management, inadequate access to asthma medication in school and limited communication among school staff.⁴⁵ In another survey study of 162 school nurses in North Carolina and South Carolina, 45% of the nurses reported having access to age-appropriate asthma education materials, but only 16% reported that their schools implemented asthma education programs, with a statistically significant higher rate of training occurring in urban settings than rural settings.⁴⁷ Future steps should be taken to address these barriers and provide adequate training not only to teachers but also other members of the school staff.

Allergen Avoidance and Considerations in Food Allergy

Allergen avoidance remains the mainstay of food allergy management, with ingestion being the primary route of exposure causing severe allergic reactions.¹⁸ In the US Peanut and Tree Nut Allergy Registry study, 60% of reactions were from ingestion, 24% from skin contact exposures or possible ingestions, and 16% from inhalation or possible skin contact or ingestions.¹⁸ Thus, minimizing the chance of ingestion exposures should be the emphasis concerning food allergen avoidance at school.

Previous studies have found that exposure through skin contact or inhalation to peanut has a low risk of severe systemic symptoms.^{18,35,48–50} In a study of children with a history of peanut allergy, 30 underwent contact and inhalation challenges and none experienced a systemic or respiratory reaction.⁴⁸ Only skin symptoms at the site of peanut butter skin contact were observed.⁴⁸ A larger study examining contact reactions included 281 children, some of whom had systemic reactions at oral food challenge.⁴⁹ Peanut butter was applied directly to the skin for 15 minutes under occlusion.⁴⁹ Localized reactions were seen for 41% of the 330 applications, but no child developed a systemic reaction as a result.⁴⁹ Similarly, air sampling studies with shelling raw and roasted peanuts, pouring peanut flour, and opening peanut butter jars showed no measurable Ara h 1 or Ara h 2.^{51,52} Thus, systemic reactions from skin contact or inhalation are highly unlikely. Heating foods, such as milk or fish, can produce aerosolized particles that may trigger allergic or asthma symptoms in affected individuals who are in proximity to the

cooking area, so it is advisable for allergic students to avoid participation in these activities.⁵⁰

Staff members can also help by routinely reading advisory labels and practicing allergen conscious cooking.^{30,53} Prepackaged food products used in the school should be reviewed for ingredients and advisory labels.³⁰ Schools that prepare foods should provide staff education about safe food preparation and handling practices. Sources of food allergens include meals, snacks, food for celebrations, and even some items used in class activities.¹⁸ Hidden allergens found in craft projects or science experiments have been associated with allergic reactions. In one study, peanut butter craft projects were a common cause for contact (44%) and inhalation (41%) reactions.¹⁸ Other potential sources of hidden allergens include finger paint (egg), paste (wheat), play dough (wheat), and macaroni (wheat and egg).¹⁸ Thus, teachers should be informed of a student's allergies, be aware that allergens could be hidden in certain classroom supplies, and use safe alternatives. Older children can also learn about potential allergen sources and be encouraged to self-advocate as developmentally appropriate because these skills are beneficial outside the school setting.

Efforts to clean surfaces to reduce cross-contact are important interventions.⁵⁴ The CDC guidelines recommend the use of soap and water or all-purpose cleaning sanitizers on surfaces that come into contact with food in the lunchroom, classrooms, and other locations.³⁰ An emphasis on hand-washing with soap and water or commercial wipes before and after eating can further limit the risk for unintentional exposures. Cleaning with water alone or antibacterial hand sanitizer can leave residual amounts of Ara h 1.⁵²

Age is an important factor to take into account when guiding recommendations. As children age, they will gradually share the responsibility of managing their risk of exposure as well as treatment. Younger children, though, have a more limited ability to do so and are highly dependent on adults.³⁶ Younger children are behaviorally at a higher risk of having oral exposures because of their interactions with their environment and tendency to place their hands and objects in their mouths. They are also unable to identify potential allergens or understand allergen avoidance measures and thus in some situations may require more oversight by school staff.

Allergen Avoidance in Asthma

Avoidance of common allergen and nonallergen triggers plays an important role in asthma management.⁵⁵ In schools, substances such as chalk dust, tobacco smoke, and strong odors (markers, pesticides, paints) may provoke symptoms.²³ Common indoor allergens that may trigger symptoms in students with asthma include animal dander, dust, cockroach, and mouse.^{56–61} Changes in weather, for instance, increased humidity, thunderstorms, and cold weather, can also trigger asthma exacerbations; thus, limiting time outside in these weather conditions may be warranted.⁶² Asthma symptoms may also be induced by exercise and participation in physical activity, especially around these aforementioned triggers, which may cause an exacerbation. In students with exercise-induced asthma, a short-acting agonist should be available before and during exercise in case of symptoms and physical activity modified if needed.

Schools, especially in urban areas, are a large source of pest allergen exposure.^{59,60} In inner-city public high schools, mouse allergen was detectable in 81% and cockroach allergen was detected in 71% of the vacuumed dust samples collected.⁶⁰ Classroom pets may be a trigger for some students, but even without classroom pets, exposure to animal allergen is possible. Many studies have found significant exposure to cat and dog allergen in schools, mostly spread through clothing from homes with these animals to the classroom.^{56,57} One study found significantly increased bronchial reactivity to inhaled methacholine in children with asthma with cat and dog sensitivity after

their first week at school.⁵⁸ Cat, dog, and dust mite allergen levels have generally been found in higher levels in classrooms with carpeted and upholstered furniture; avoiding these fixtures may help decrease exposure.^{56,57,61} Addressing pest infestations at school is another important intervention to reduce allergen exposure.

Air pollution and air quality are important factors in asthma control.⁵⁵ In the school setting, pollutant exposures include particulate matter, nitrogen dioxide, ozone, and aerosols.⁵⁵ The Indoor Air Quality Tools for Schools Program created by the Environmental Protection Agency provides recommended actions, such as keeping classroom ventilation units free of clutter, reducing the use of cloth for instance in furnishings, and removing classroom pets that trigger symptoms.⁶³

Robust data are lacking on school-based environmental interventions and health outcomes, and most published studies are small. In a study of Swedish schools, dedicated school clothing and banning pet ownership significantly reduced cat allergen levels.⁶⁴ This approach is not practical, though. Other recent studies have found that repair of air filtration systems and moisture damage in schools led to improvement in mold levels and asthma symptoms.⁶³ The use of high-efficiency particulate air filters in school has also been associated with decreased fungal levels and improvement in peak flow.⁶³ Dust mite encasings, cockroach traps with bait, and allergen reduction at home also have produced improvement in asthma symptoms and control.⁶⁵ A multifaceted approach that combines both home and school interventions through multiple routes appears more effective, and education regarding this should be provided.⁶⁵

Recognition and Treatment of Food Allergy Reactions and Asthma Exacerbations Evaluating Respiratory Symptoms

Discerning between a food allergy reaction and asthma exacerbation can sometimes be challenging. Food allergic reactions may trigger respiratory symptoms, such as shortness of breath, cough, and wheezing, but do not generally present with isolated or chronic respiratory symptoms that are more likely to be present in asthma.⁶⁶ Although respiratory symptoms are known to develop during food allergy reactions, in children with asthma, the estimated prevalence of food allergy–induced asthmatic reactions (isolated respiratory symptoms) is 2% to 9%.^{12,66–68} Although isolated respiratory symptoms are uncommon in food allergy reactions, bronchial reactivity is enhanced and forced expiratory volume in 1 second values are decreased after food challenge.⁶⁸

Food allergy should be investigated in the case of respiratory symptoms that are rapid in onset, if there are other symptoms associated (for instance, urticaria, rhinitis, emesis), and in the setting of a possible food exposure.¹¹ The absence of obvious asthma triggers, such as physical activity, illness, and allergen or pollen exposures and occurrence during these seasons, may indicate greater likelihood for food allergic reaction rather than pure asthma exacerbation.² It is imperative that respiratory symptoms from a food allergy reaction and respiratory symptoms from asthma alone are differentiated because they are managed differently. Food allergy reactions with bronchospasm should be treated promptly with injectable epinephrine rather than relying on inhaled β -agonists and corticosteroids alone.²

Treatment

Patients with both food allergy and asthma are at risk for poor outcomes; thus, both disorders should be well managed and well controlled to prevent potential morbidity and mortality. Individualized emergency care plans that inform school personnel of a student's specific allergy triggers and provide guidance on treatment in case of allergic reactions or asthma exacerbations are

recommended.^{22,23,30–32} Most food allergy emergency action plans have a checkbox for designation of an asthma diagnosis to emphasize the greater risk of severe reactions and anaphylaxis in individuals with asthma. These plans should be provided to the schools along with medications, most importantly epinephrine autoinjectors and β -agonists.²³

One study found that only 50.9% of students with food allergy and 24.3% of students with asthma had a school health management plan on file, and rates were lowest among racial minorities and low-income families.¹ Students with both asthma and food allergies had a higher percentage of having a school health management plan but still only at 56.7%.¹ In addition to having these action plans, parents and school personnel should be comfortable with implementation, and these plans should be reviewed with a physician and updated as necessary yearly.

The CDC also recommends rapid access to epinephrine autoinjectors and that these medications are stored to be available to treat reactions that may occur throughout the school.³⁰ Every student with food allergies should provide an unexpired epinephrine autoinjector for the school year.³⁰ Stock epinephrine is also a source of medication, especially for those who forget their medications, have expired supplies, or have no known prior history of food allergy. Although the School Access to Emergency Epinephrine Act was signed into law in 2013, only 12 states currently require schools to stock epinephrine.⁶⁹ The remaining states, except Hawaii, have laws or guidelines that allow but do not require stock epinephrine.⁶⁹ Many of these policies lack guidance on how to obtain, maintain, or pay for these medications; thus, these decisions are left to the individual schools.³⁶ The aforementioned survey study regarding school medications found that nearly half of the stock epinephrine was donated by a drug company and only 30% were purchased using district funds.⁷⁰ The effect of these stock epinephrine recommendations on food allergy management in schools has not been studied.

The Asthmatic School Children's Treatment and Health Management Act was signed into law in 2004 and led to legislation in all 50 states enabling the right to self-carry and self-administer quick-relief inhalers at school, but rules vary based on the student's age and medication needs.³³ Some students may forget to bring their inhaler to school or lose it. Thus, there continue to be efforts to enact laws or guidelines that permit schools to stock and administer unassigned albuterol. Even without a state law, school districts can establish a protective policy to grant immediate access to asthma medications in school. Resources are available to help parents, school administrators, and health care professionals work together to create policies to stock unassigned bronchodilators in schools.^{22,23,32–34}

For some children, self-carriage and/or self-administration of epinephrine autoinjectors or β -agonists may be appropriate, but this decision should take into account age, maturity, dexterity, and understanding of when and how to use the medication. This determination should be made jointly by the family, health care practitioner, and school. Although there is no specific recommended age, most allergists expect children to be able to carry and self-administer epinephrine by 12 to 14 years of age.⁷¹

Conclusion

Improvement of health and school-related outcomes for children with food allergies and asthma calls for the use of school-based partnerships that focus on integrated care coordination among families, practitioners, and school personnel. This collaborative approach is key to successfully transition children with food allergy and asthma into school. In addition to avoidance of food allergy and asthma triggers, preparedness by the school to recognize and manage symptoms of allergic reactions and asthma exacerbations is of utmost importance. Individual emergency plans provide guidance for schools

tailored to a student's specific needs and having medications available to treat symptoms allows for timely management of reactions and exacerbations. Managing allergic diseases at school is challenging, but there are many resources and guidelines that can provide direction for families, health care professionals, and schools.

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