Immunoglobulin E–Mediated Food Allergies

Why Differentiate From Other Adverse Food Reactions?

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This second article on food allergies focuses on food allergic reactions involving specific immunoglobulin E (IgE) mechanism within the immune system. An IgE-mediated food allergy diagnosis requires both the sensitization (positive test) and the clinical signs and symptoms consistent with IgE-mediated food allergy response. Having the confirmed diagnosis and management plan is crucial because the signs and symptoms appear rapidly after every ingestion of a food with the potential to progress in severity to a life-threatening situation, anaphylaxis. A clear understanding of what constitutes a food allergy, specifically an IgE-mediated food allergy, will facilitate clear communication among healthcare professionals, patients and caregivers, and those in the public.
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An adverse food reaction has been broadly defined[1,2] as any unpleasant reaction after ingestion of food. This statement is both true and vague; however, the 2 large categories of adverse food reactions have specific distinctions. The general public often uses the term *food allergy* loosely to refer to all types of adverse food reactions, which causes confusion about how to obtain an accurate diagnosis and how to properly manage the condition. This article series focuses on the medical condition of food allergies—not food intolerances, which are adverse food reactions that do not elicit an immune system response. *Food allergy* refers specifically to a reproducible adverse health reaction after a specific immune response upon exposure to a food.[3] Food allergy reactions may be further categorized within the immune system as involving a specific immunoglobulin E (IgE) mediated mechanism, immunologic but non–IgE-mediated mechanisms (non-IgE), or a combination of both IgE and non–IgE-mediated mechanisms (Figure 1). Cell-mediated food allergy reactions, also known as allergic contact dermatitis, are localized, delayed reactions after topical contact exposure to a food allergen or other irritants.[4] Many adverse food reaction resources and references do not often address in detail cell-mediated allergic reactions possibly due to allergic contact dermatitis often being treated as a dermatological condition. Many foods, food additives, and spices, as well as nonfood substances such as medication, fragrances, or metals, may cause immunologic and nonimmunologic skin reactions.[5–7] As allergic contact dermatitis has many potentials irritants, not only food, it will not be discussed further in this series. This second article in the series on food allergy focuses specifically on IgE-mediated food allergies, highlighting how IgE-mediated food allergy are defined, the potential to prevent IgE food allergy development, the classic triggers as well as signs and symptoms of IgE-mediated food allergy reactions, and how to identify anaphylaxis. Finally, resources that support healthcare professionals as well as patients and caregivers are also provided.

WHAT ARE THE DEFINING CHARACTERISTICS OF IGE-MEDIATED ALLERGY?

An IgE-mediated food allergy is defined as a reproducible adverse reaction after exposure to a specific antibody, IgE, which triggers an immune response to a specific food.[8] It is possible for individuals to produce detectible IgE without clinical symptoms. In this case, the individual may exhibit a positive result on a skin prick or serum blood test used to indicate sensitization, yet not be truly allergic.[9] An IgE-mediated food allergy diagnosis requires both the sensitization (positive test) and the clinical signs and symptoms consistent with IgE-mediated food allergy response.[3] These 2 characteristics are based on the pathophysiology of IgE-mediated food allergies.

Pathophysiology

The pathophysiology of an IgE-mediated food allergy reaction is clearly understood. Upon exposure to a specific food protein, sensitization may be initiated when the protein binds to IgE receptors on mast cells and basophil cells. Upon reexposure to the protein, this sensitization may eventually lead to the release of chemical mediators, such

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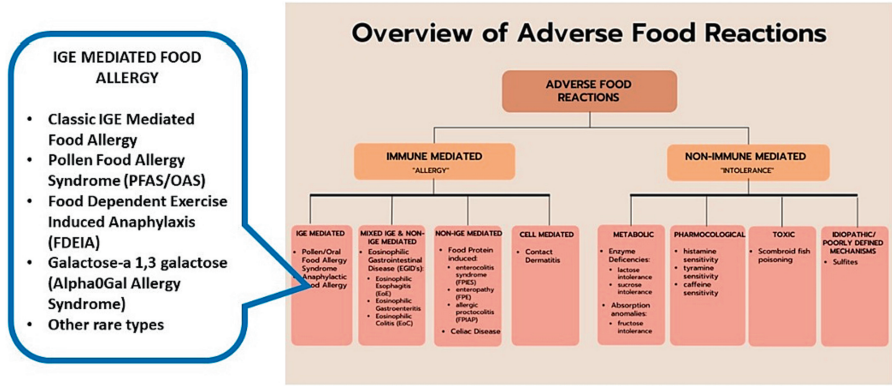

FIGURE 1. Focus on immunoglobulin E (IgE)-mediated food allergy from an overview of adverse food reactions.

as histamines, that produce the clinical signs and symptoms of an acute allergic reaction.[10,11]

What is less clear is which factors influence the development of an IgE-mediated food allergy, why exposure initiates sensitization in some individuals and not others, and why this exposure leads to the release of chemical mediators and signs and symptoms in some individuals and not others.

It was once thought that sensitization began upon the first known ingestion of the food; however, evidence now supports the theory that IgE-mediated food allergy sensitization may begin by exposure to food protein not only via the gut but also through the skin or the respiratory tract. Skin exposure—particularly when the skin is broken, as in moderate to severe eczema—can trigger sensitization, which precedes clinical reaction.[10] The dual-allergen exposure hypothesis (Table 1) theorizes that tolerance to a food is more likely to develop when the protein uptake is established regularly via the intestinal epithelial barrier. There is strong evidence to support this theory for peanuts and moderate evidence that supports this theory for eggs.[13] In the consensus report entitled "Finding a Path to Safety in Food Allergy," the National Academies of Sciences, Engineering, and Medicine[17] reviewed the available evidence related to theories being researched and variations by allergen, nutrient, or practice.

The Atopic March

The atopic march refers to a series of allergic disorders that are often seen together and develop progressively in patients with atopy. The order of progression is typically atopic dermatitis, IgE-mediated food allergy, asthma, and allergic rhinitis.[19] Atopic dermatitis is a risk factor for the development of both food allergen sensitization and IgE food allergy diagnosis.[20]

SIGNS AND SYMPTOMS: TRIGGERS, TIMING, REPRODUCIBILITY, AND SPECIAL CONSIDERATIONS

An IgE-mediated food allergy is suspected if IgE food allergy symptoms present rapidly after every ingestion of any particular food containing the allergen. The connection between food allergy symptoms and consumption of one of the 9 more common IgE-mediated food allergens (discussed next) is usually explored first. IgE-mediated food allergy reactions are unpredictable and stand apart from other adverse food reactions in another important way: their potential for symptoms to progress to anaphylaxis and death. Because of its severity, anaphylaxis is discussed separately from other signs and symptoms (see "Special Considerations").

Food and Nutrition History: Triggers That Provoke Investigation

Although any food protein may elicit an IgE-mediated food allergy response, the allergens found in the following "big nine" foods are most commonly responsible for food allergy in the United States: cow's milk, peanuts, tree nuts, hen's egg, shellfish, fin fish, soy, wheat (not to be confused with gluten, a protein found in wheat), and sesame. Most allergic reactions are highly allergen specific; however, some food allergens share cross-reactivity, which results when the allergens share a similar protein structure.[21] Cross-reactivity reactions are more commonly seen in specific tree-nut combinations (e.g., cashew and pistachio, or walnut and pecan), cow's milk and other mammalian milks such as goat, shellfish species, some species of fin fish, and, most recently, chia and sesame seeds.[9,21–23]

Timing of Reaction

The timing of a reaction is one of the signs and symptoms that indicate which type of adverse food reaction is occurring in IgE-mediated food allergy. IgE-mediated food allergy reactions occur quickly, within minutes or up to within 2 hours. If a reaction occurs outside this time window, with the exception of the IgE-mediated food allergies listed in Table 2, then it is highly unlikely to be an IgE-mediated food allergy, and further investigation is warranted. It is important to explore the timing of a reaction, as patients may not realize when it initially began. Because of high variability in the sequence, severity, and type of

TABLE 1 Summary of Hypotheses Related to Risk of Food Allergy Development

Theory	Key Points	Evidence[a]
Dual-allergen exposure hypothesis	Cutaneous (skin) exposure via allergen particles in household dust before oral (gut) exposure promotes sensitization to allergens, which then leads to food allergy development.	Strong evidence for early oral introduction of *peanut* (Note that in 1 study,[12] atopic dermatitis or skin barrier impairment was associated with an increased risk for likelihood of peanut allergy development.)
		Moderate evidence for early oral introduction of *egg*[b]
		Limited evidence regarding risk of delayed oral exposure for other allergens
Exclusive breastfeeding	Exclusive breastfeeding beyond the first 3–4 mo of life does not prevent food allergy development.[13]	Limited evidence
Hygiene hypothesis	Reduced exposure to microbes in the environment causes changes to the microbiome. Development and establishment of the microbiome is thought to be influenced by the diversity of microbial exposure, including type of delivery (vaginal vs cesarean), antibiotic use, exposure to animals (pets), and prebiotic/probiotic use during pregnancy, lactation, and/or infancy.	Limited evidence
Allergen avoidance hypothesis	Avoiding allergens from maternal diet during pregnancy, lactation, or formula will prevent development of food allergy in infants.	Limited evidence
Nutritional immunomodulation hypothesis	Low levels of specific nutrients that impact the immune system such as omega-3, folate, vitamin D, or antioxidants impact the risk of food allergy development.	Limited evidence
Examples of other speculative hypotheses		
Obesity or overweight theory	Inflammation may play a role in development.	Grade not assignable
Food additives theory	Food additives may negatively impact the immune system.	Grade not assignable
GMO theory	GMOs may splice allergens into previously nonallergenic food and impact food allergy (development or management).[14]	Grade not assignable

Abbreviation: GMO, genetically modified organism.

Data were derived from Leonard,[13] Sicherer and Sampson,[15] and Lodge et al.[16]

[a]Unless otherwise specified, the evidence is defined according to the National Academies of Sciences, Engineering, and Medicine report, "Finding a Path to Safety in Food Allergy."[17] *Strong evidence* is defined as a conclusion statement substantiated by a large, high-quality, and/or consistent body of evidence. *Moderate evidence* is defined as a conclusion statement substantiated by sufficient evidence. *Limited evidence* is defined as a conclusion statement substantiated by insufficient evidence. For *grade not assignable*, a conclusion statement cannot be drawn because of lack of evidence, or the availability of evidence has serious methodological concerns.

[b]Evidence level was upgraded from limited to moderate based on a 2016 systematic review and meta-analysis.[18]

reaction, the assessment process must fully explore symptoms that may have gone unnoticed when they initially began.

Reproducibility of Reactions

Table 2 reviews the clinical signs and symptoms specific to IgE-mediated food allergy. Another factor that sets these symptoms apart from other adverse food reactions is that they are reproducible upon every exposure to the offending food. However, it is important to note that reaction timing, symptom severity, and even the sequence of symptom development can vary widely even for the same individual.[8]

IgE-mediated food allergy reaction timing, symptom severity, and even the sequence of symptom development can vary widely even for the same individual.

Special Considerations Regarding Identifying an IgE-Mediated Food Allergy Reaction

Because symptoms of IgE-mediated food allergy reaction may vary each time, even within the same individual, the importance of being able to identify an anaphylactic reaction is imperative. Although symptoms may appear obvious during some reactions, they may equally seem minor and less obvious during others. Cutaneous symptoms such as hives or swelling are present in most reactions; however, they are not present in approximately 20% of anaphylactic reactions.[8,24] IgE-mediated food allergy are rapid, reproducible with every ingestion of the allergen, and have the potential to progress to anaphylaxis.

Identifying Anaphylaxis

Anaphylaxis is the culmination of several IgE-mediated food allergy symptoms across more than 1 body system or independent acute compromise of the cardiovascular or respiratory system that may lead to death. Anaphylaxis diagnostic criteria involve the compromise of one or more of these organ systems: cutaneous, cardiac, or respiratory. The National Institute of Allergy and Infectious Diseases and the Food Allergy and Anaphylaxis Network have provided the most detailed diagnostic criteria.[28] Although the definition of anaphylaxis may vary slightly in the literature, the most succinct description defines anaphylaxis as "a serious allergic reaction that is rapid in onset and may cause death."[3] The term *anaphylaxis paradox* applies to individuals who develop resolution of anaphylaxis despite not using the appropriate treatment, epinephrine, and the reason is not well understood.[29] Nevertheless, delayed administration of epinephrine is a risk factor for fatal anaphylaxis, making the benefit of rapid administration of epinephrine well recognized.

Time is an essential factor for treating anaphylaxis and for achieving positive outcomes and fatality prevention.[30] Although rare, fatal food allergy reactions have occurred. Food allergy anaphylactic fatality may occur very quickly—for example, onset of symptoms within 30 minutes and progression to death within an hour.[24] Most fatal cases reported in Varshney and Pongracic[24] did not exhibit a previously severe reaction, occurred outside the home, and lacked accessibility to epinephrine; the most commonly implicated allergens were peanuts, tree nuts, and shellfish. There is no exact pattern to an anaphylactic reaction, which can make anaphylaxis challenging to identify. Individuals with an IgE-mediated food allergy diagnosis should remain vigilant and act quickly if anaphylaxis is suspected.

HOW IS IGE-MEDIATED FOOD ALLERGY DIAGNOSED?

Adverse food reactions have overlapping signs and symptoms, and so a physician-confirmed diagnosis is important for both clinical management and immediate treatment of IgE-mediated food allergy reactions (Figure 2). Laboratory tests are used to support or exclude diagnosis of IgE-mediated food allergy but are not diagnostic by themselves. Table 3 identifies the differences between the 3 validated diagnostic tests used to support IgE-mediated food allergy diagnosis, including the skin prick test, serum food-specific IgE, and oral food challenge. Oral food challenges are considered the standard criterion for diagnosis of IgE-mediated food allergy; however, their risk to the patient, validity of medical history, and other supporting diagnostic test results should be considered when determining whether an oral food challenge is necessary. Oral food challenges carry the risk of anaphylaxis, and they should not be undertaken without safety considerations in place and discussion between the patient and the physician to review the risks and benefits.[31]

Oral food challenge is the criterion standard for IgE-mediated food allergies, but its benefits may be outweighed by the risk involved.

Pediatric food allergy diagnosis is particularly important, given the implications that food restriction may have on growth, development, quality of life, and potential for development of IgE-mediated food allergy.[25,32] Unnecessary elimination of foods may inadvertently result in IgE-mediated allergy in 2 ways. Eliminating the food for an extended period where there is previous oral/gut exposure may prompt the development of an IgE-mediated food allergy when that same food is reintroduced.[33] A second consequence of eliminating, or delayed introduction of, a food from an infant's diet may lead to the first exposure through the cutaneous (skin) epithelial barrier, which has a different mechanism than the gastrointestinal (gut) epithelial barrier mechanism that leads to food sensitization and potential subsequent IgE-mediated food allergy.[19,32] The dual-allergen exposure hypothesis supports this theory, and the third article in this series on non–IgE-mediated food allergy will review the elimination

TABLE 2 Factors in Assessment IgE-mediated Food Allergy

Factors	Symptoms and Distinguishing Features
Timing	Immediate to within 2 h
Amount of allergen	Trace or cross-contact exposure may trigger a reaction.
Occurrence	Reproducible with every exposure, from direct ingestion or cross-contact
Clinical presentation of common symptoms	May occur concurrently or one at a time and may be mild or severe. Examples are as follows: • Cutaneous: redness, itching, hives, rash, swelling • Ocular: red, watery, itching, swollen • Upper respiratory: sneezing, itching, runny or congested nose, hoarseness, short dry cough, swelling of the throat • Lower respiratory: wheezing, coughing, tightness of the chest, difficulty breathing, shortness of breath • Gastrointestinal: swelling of the lips and/or tongue, oral itching, abdominal pain, reflux, nausea, vomiting, diarrhea • Cardiovascular[a]: increased or decreased heart rate, dizziness, hypotension, fainting • Others: sense of impending doom, uterine contractions • Anaphylaxis[a]
Test used to support diagnosis	• Skin prick tests[b] • Serum IgE levels[b] • Component-resolved diagnostic tests[c] • Oral food challenge

Abbreviation: IgE, immunoglobulin E.

Data were derived from the National Academy of Sciences, Engineering, and Medicine[17]; Varshney and Pongracic[24]; Stukus and Mikhail[25]; Hearrell and Anagnostou[26]; and Nguyen and Heath[27]

[a]Diagnostic criteria involve acute illness of one or more of the following systems: cutaneous, cardiac (more often in adult fatalities), or respiratory (more often in pediatric fatalities).

[b]Not diagnostic alone; may indicate sensitization, not a true allergy.

[c]Component-resolved diagnostic tests measure specific IgE of individual proteins within an allergen with the goal of increasing specificity in IgE diagnosis based on the understanding that different proteins within an allergen cause a more potent reaction.[17]

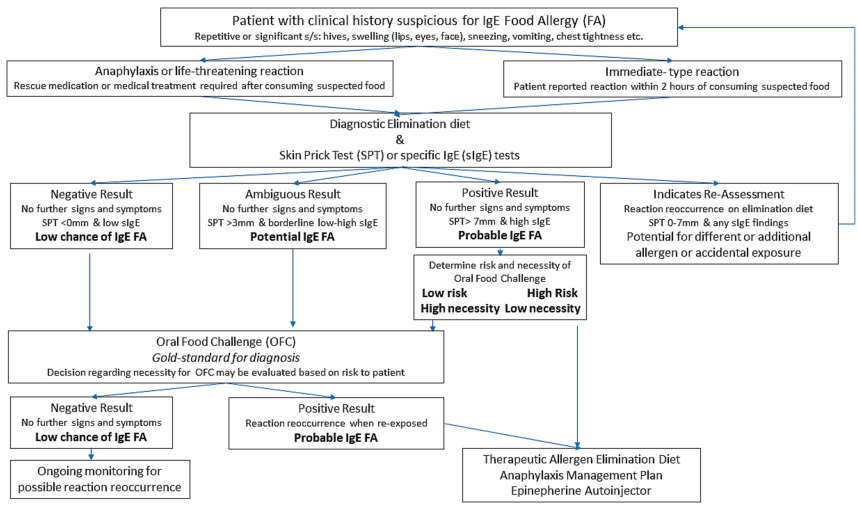

FIGURE 2. Algorithm for the diagnosis of food allergy.[30] IgE, immunoglobulin E.

TABLE 3 Differences Among Food-Specific IgE Diagnostic Tests

	Skin Prick Testing	Serum Food-Specific IgE	Oral Food Challenge
Sensitivity	High	High	High
Specificity	Low	Low	High
Medications that may interfere with results	• Antihistamines • Tricyclic antidepressants • H_2 histamine blockers • Long-term corticosteroids (>2 wk)	None	• Antihistamines • Tricyclic antidepressants • H_2 histamine blockers • Long-term corticosteroids (>2 wk)
Adverse effect	• Localized pruritis, discomfort • Very low risk for anaphylaxis	• No risk for allergic reaction • Localized trauma from venipuncture	• Risk for allergic reaction or anaphylaxis varies based on history and allergy test results
Timing of results	15-20 min	Hours to days, depending on laboratory	Immediate to within 3 h

Abbreviation: IgE, immunoglobulin E.
Reprinted with permission from Stukus and Mikhail.[25]

of food allergens and development of sensitization in more depth.

Diagnosing Different Types of IgE-Mediated Food Allergies

Several IgE-mediated food allergy diagnoses differ in onset, timing, trigger co-factors, or other unique features apart from the classic IgE-mediated food allergy presentation. These diagnoses are identified by the unique features listed in Table 4.

HOW IS IGE-MEDIATED FOOD ALLERGY PREVENTED OR MANAGED?

Prevention of IgE-Mediated Food Allergies

Several factors may influence the risk of IgE-mediated food allergy development, including genetics, atopic dermatitis, and environment. Evidence supporting the dual-allergen exposure hypothesis indicates that early oral introduction of peanut is recommended, especially in high-risk populations.[8] To prevent the serious, potentially lifelong chronic disease that is food allergy, pediatricians play a pivotal role through their ability to educate patients and encourage implementation of recommended guidelines.[8] The Learning Early About Peanut Allergy study[39] led the National Institute of Allergy and Infectious Diseases[40] to establish new guidelines supporting early introduction of peanuts, with strong evidence showing a reduction in peanut allergy development in high-risk populations. Previous recommendations to delay introduction of potential food allergens with the goal of preventing IgE-mediated food allergy are no longer supported by current evidence.[8,41] In fact, increasing evidence supports early introduction of food allergens, between the age of 4 and 6 months,[8,17,42] with the goal of preventing the development of IgE-mediated food allergy, especially for populations considered to be at a high risk. Although many prevention strategies require further investigation, it is clear that it is no longer necessary to delay introduction of allergenic foods.[8,17] To feel more comfortable introducing potentially allergenic foods, parents, especially those of high-risk infants, may want to discuss the order and protocol for introducing food allergens with their pediatrician or allergist. The order, frequency, dose, and protocol for introducing allergens are continuing to evolve with developing literature, and a shared decision-making approach between physician and family is important. The article "Practical Challenges and Considerations for Early Introduction of Potential Food Allergens for Prevention of Food Allergy"[43] is linked in the Resources section (Table 5) for those looking to gain more knowledge.

Rather than delay the introduction of common food allergens, early introduction of peanuts in high-risk populations is now advised.

Management of IgE-Mediated Food Allergies: Avoid Exposure and Treat Anaphylaxis

Once an individual is given a diagnosis of IgE-mediated food allergy, it is very important to have a physician-provided medical emergency action plan that has clear, written instructions for rapid identification of symptoms and management of food allergy reactions. These action plans should be understood by all patients and caregivers and reviewed

TABLE 4 Other IgE-Mediated Food Allergies

Diagnosis	Identifying Features
Adult-onset IgE FA	• IgE-mediated food allergy that exhibits classic IgE FA symptoms however, onset is in adulthood. • Foods not consumed for many years, often not since childhood, may develop into IgE allergy; however, it may also occur with foods that have been consumed.[34] • Previously established atopy may be correlated with IgE allergy.[32] • Most common trigger is shellfish.
Pollen food allergy syndrome[a]	• Subtype of IgE FA caused by sensitization to pollen, which cross-reacts with plant foods • Diagnosed predominantly in adolescents and adults; on the rise in children • Allergen triggers: raw fruits, vegetables, nuts, legumes (beans and peanuts), herbs, and spices; allergens usually tolerated when cooked or processed • Triggers are plant based and vary based on geographical region in relation to pollen produced; may be elevated seasonally • Symptoms: predominantly mild swelling, itching, or burning of the oropharynx; rarely leads to anaphylaxis (2% of cases)
Food-dependent exercise-induced anaphylaxis[26]	• Subtype of IgE FA Food + Exercise = Anaphylaxis • More commonly seen in adolescents and young adults • Common triggers: wheat, shellfish, and nuts, although may be any food • In rare cases, exercise after any food causes anaphylaxis (exercise-induced anaphylaxis). • Ingestion of an allergen, typically within 2-4 h before exercise, triggers anaphylaxis • Usually vigorous exercise; however, level of exertion and reaction are not predictable • Co-factors may influence severity of reaction (alcohol, NSAIDs, etc)
Galactose-α-1,3-galactose (alpha-gal syndrome)	• Subtype of IgE FA mammalian meat allergy • Tick bites are the primary cause. • Reactions are often delayed 2-6 h after ingestion of mammalian meat (beef, pork, lamb), with some patients also reacting to dairy. Derivatives such as gelatin must also be avoided for a minority of cases. • Allergy may be transient if patients avoid further tick bites or may worsen with subsequent tick bites. • Impacted by geography, with most US-based cases occurring in the south, eastern, and central parts of the country, within the range of the lone star tick
Other rare IgE-mediated food allergy diagnoses[b]	• Pork-cat syndrome[35]: primary sensitization to cat causes subsequent allergic reaction after ingestion of pork[36] • Bird-egg syndrome: primary sensitization may occur during interaction with birds (pet or others) via the respiratory tract and results in an allergy to poultry and eggs[37] • Pancake anaphylaxis[38] (oral dust mite allergy): anaphylaxis occurs after consuming dust mite–contaminated food

Abbreviations: IgE, immunoglobulin E; IgE FA, IgE-mediated food allergy; NSAID, nonsteroidal anti-inflammatory drug.
Data were derived from Gupta,[8] Sampson et al,[9] the National Academy of Sciences, Engineering, and Medicine,[17] Varshney and Pongracic,[24] Nguyen and Heath.[27]
[a]Also called oral allergy syndrome.
[b]Potentially anaphylactic.

regularly. Many templates can be found online, and several are listed later in this article (see "Resources"). The number 1 goal of IgE-mediated food allergy management is to avoid the food. A registered dietitian nutritionist trained in food allergies can provide in-depth nutrition education and counseling that supports patient and family understanding and compliance with avoiding all forms of the food allergen. If accidental ingestion occurs, the next important step is to quickly and appropriately treat the reactions that occur.

Remember "EPI first, EPI fast" when treating anaphylaxis.

Preparedness to Treat Anaphylaxis

As discussed previously, 1 key symptom specific to IgE-mediated food allergy anaphylaxis, which can be life-threatening. It is important to first have the knowledge to

TABLE 5 IgE Relevant Resources and Support Tools for Healthcare Professionals, Patients and Caregivers, and the Community

Topic	Resource
Healthcare professionals	
General	Gupta[8]: *Pediatric Food Allergy: A Clinical Guide*
	National Institute of Allergy and Infectious Diseases: Addendum Guidelines for the Prevention of Peanut Allergy
	National Institute for Health and Care Excellence: Clinical Guideline: Food Allergy in the Under 19s: Assessment and Diagnosis (2018 update)
	European Academy of Allergy and Clinical Immunology (EAACI): Pediatric and Adult Diet History Tools (development of a standardized diet history tool to support the diagnosis of food allergy, found in "additional files")
	EAACI: Guideline: Preventing the Development of Food Allergy in Infants and Young Children (2020 Update)
	EAACI: Food Allergy and Anaphylaxis Guidelines: Diagnosis and Management of Food Allergy (2014)
	American Academy of Allergy, Asthma, and Immunology: Guidelines on Food allergy, Anaphylaxis, and Prevention of Food Allergy
	American Academy of Pediatrics (AAP): Guidance on Completing a Written Allergy and Anaphylaxis Emergency Plan
Food allergen introduction	Practical Challenges and Considerations for Early Introduction of Potential Food Allergens for Prevention of Food Allergy

(continues)

TABLE 5 IgE Relevant Resources and Support Tools for Healthcare Professionals, Patients and Caregivers, and the Community, Continued

Topic	Resource
Food allergy and anaphylaxis emergency care plan templates	Food Allergy Research and Education (FARE): Food Allergy & Anaphylaxis Emergency Care Plan
	AAP: Allergy and Anaphylaxis Emergency Plan
	New York State Office of Child and Family Services: Individual Allergy and Anaphylaxis Emergency Plan
	Food Allergy Canada: Anaphylaxis Emergency Plan
Allergy websites	Food Allergy and Anaphylaxis Connection Team
	Kids with Food Allergies (KFA)
	Allergic Living
	FARE
Patients and caregivers	
General	Center for Food Allergy and Asthma Research (CFAAR): Food Allergy Workbook and Passport
	FARE: Food Allergy Chef Cards (multiple languages, good for home or abroad)
Schools	US Centers for Disease Control and Prevention (CDC): Voluntary Guidelines for Managing Food Allergies in Schools and Early Care and Education Programs
	CDC: Toolkit with PowerPoint Presentations for Administrators and Staff (individual presentations)
	KFA: Food Allergy 504 Plan
	Northwestern University: Navigating College with Food Allergies and Restrictions

(continues)

TABLE 5 IgE Relevant Resources and Support Tools for Healthcare Professionals, Patients and Caregivers, and the Community, Continued

Topic	Resource
Social support	Food Allergy Counselor (psychosocial resource hub for the allergy community and healthcare providers supporting them)
	FARE: Teen Talks (social support specifically for the high-risk population aged 11-22 y; Child Chats are also available for children aged 8-10 y)
	FARE: Find a Community Support Group
	CFAAR: Ambassador Program (for teens)
Community	
Food pantry for special diets	Food Equality Initiative
Food pantry resources	FARE: Food Banks and Soup Kitchens
	KFA: What to Do If You Can't Afford Epinephrine Auto-Injectors
Food allergy fatality	Wyatt's Teal Team

Abbreviation: IgE, immunoglobulin E.

identify when an individual is experiencing anaphylaxis (Figure 3) and then to properly treat it. Epinephrine is the only approved treatment for anaphylactic reactions,[20,30] regardless of the setting. There are no contraindications for using epinephrine to treat suspected anaphylaxis.[26] Antihistamines are not indicated to treat anaphylaxis, but they should be used as recommended in the individual's management plan.[26] Access to emergency epinephrine is vitally important to those with food allergies. A previous study found that 24% of reported epinephrine use for life-threatening food allergy reactions in the school setting occurred in cases in which there was not a previously established diagnosis of food allergy.[45] Some factors that may increase the risk of fatal anaphylaxis due to food allergy include engaging in risk-taking behaviors (observed more often in adolescents and young adults), having poorly controlled asthma, and having a history of food allergy anaphylaxis. Groups at a high risk for fatality should receive education and monitoring, and special resources available for these individuals are provided in Table 5. Although fatalities are rare, the main risk factors for fatality are delayed or no administration of epinephrine and belonging to a high-risk population.[30]

EMERGING THERAPIES

Several promising therapies are aimed at achieving desensitization in IgE-mediated food allergy. The terms *desensitization* is used to describe an increase in the amount of food allergen required to elicit a clinical reaction. S*ustained unresponsiveness* is maintaining desensitization after discontinuing regular consumption of the food allergen.[21] Oral immunotherapy, epicutaneous immunotherapy, and sublingual immunotherapy are the most commonly studied and used.[46] Determining whether or which food allergy therapy is the right course of action for a patient is a shared decision-making process between the patient or caregiver and the physician, because quality of life during these therapies is impacted to varying degrees based on individual circumstances. Because desensitization therapies are not a cure, IgE-mediated food allergy symptoms can reemerge at any time if treatment is discontinued. Other new therapies being researched, such as biologics that intended to interfere with food allergy cell receptors,[47] suggest a possible shift in future goals for food allergy therapy from management toward sustained tolerance.

QUALITY OF LIFE FOR INDIVIDUALS WITH FOOD ALLERGIES

IgE-mediated food allergy is a chronic health condition that is known to be associated with increased stress and anxiety among patients and caregivers.[8,17,48] A balance must be struck between participating in social life and maintaining vigilance in constant allergen avoidance. New mental health resources, including a growing body of food allergy–educated mental health professionals and support groups, are available to support patients and caregivers (Table 5).

IGE-RELEVANT RESOURCES

Because the field of food allergies is rapidly evolving, it is also important for healthcare professionals to have access to readily available resources. Table 5 includes IgE-mediated food allergy specific resources, such as clinical references, management tools, quality-of-life tools, and a food allergy fatality resource, for healthcare professionals to help them better understand and support their roles in IgE-mediated food allergy.

PUTTING THE PIECES TOGETHER: WHAT SETS IGE FOOD ALLERGY APART

The importance of achieving common understanding of what constitutes a food allergy, specifically an IgE-mediated food allergy, will facilitate clear communication among

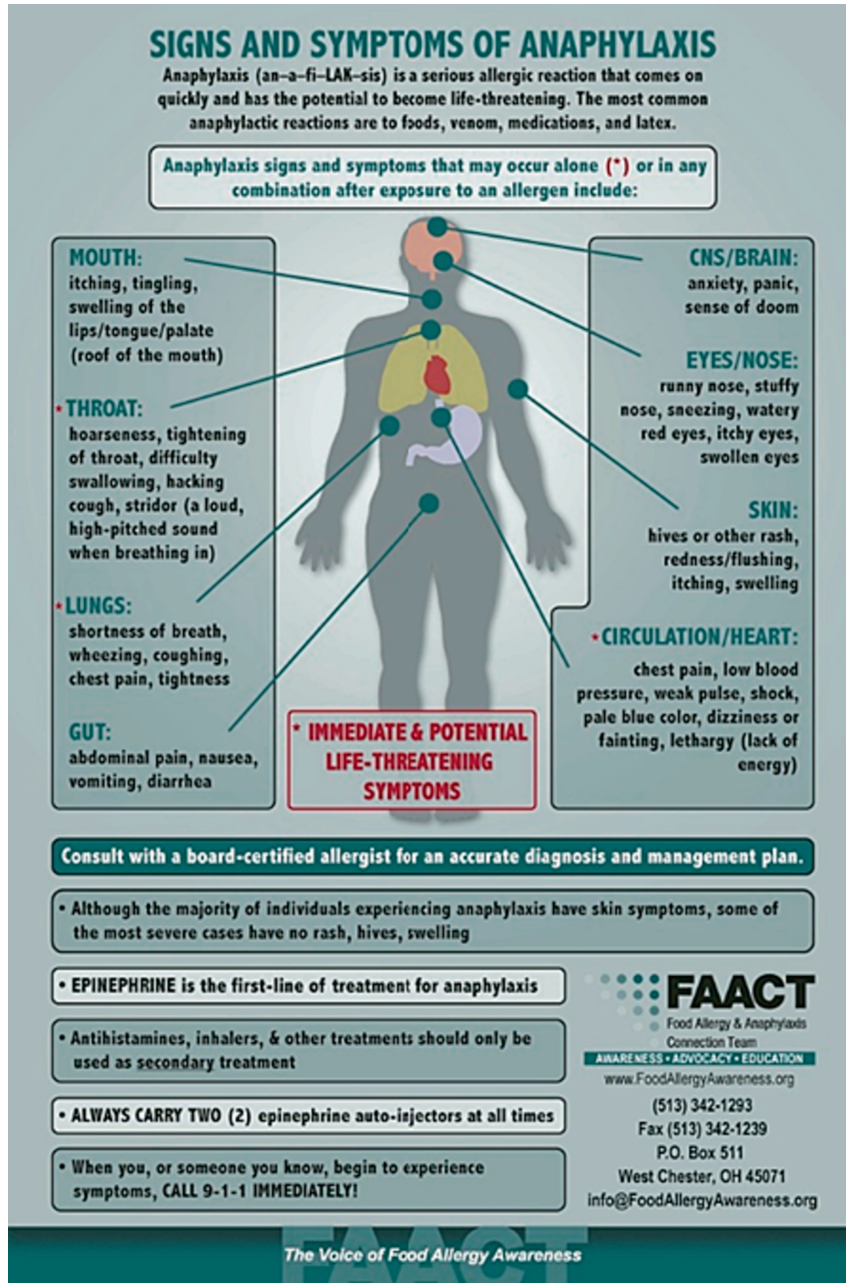

FIGURE 3. Signs and symptoms of anaphylaxis.[30] The Food Allergy and Anaphylaxis Connection Team (FAACT) shares this poster as a free download resource for families and the community.[44]

healthcare professionals, patients and caregivers, and those in the public that provide goods and services to individuals with food allergies. Increased knowledge among healthcare professionals as well as patients and caregivers regarding current and emerging prevention approaches may provide insight into early childhood healthcare decisions aimed at preventing food allergy development in high-risk patients, such as when and how to introduce potential food allergens and/or select emerging allergy prevention treatments. Current research supports the benefits of early introduction of allergenic foods such as peanuts and eggs, and it is no longer recommended to withhold introduction of these foods.[13] Understanding the various signs and symptoms and timing associated with a true food allergy will inform the patient of when they need to see their healthcare provider and what information will be needed for evaluation of the potential diagnosis of a food allergy. Knowing about the various steps in the food allergy diagnostic process and the key data used to make decisions can facilitate the healthcare provider as they decide whether they will need to refer a patient to a food allergy specialist.

Foundational education for patients and caregivers is essential for effective prevention, treatment, and management of IgE-mediated food allergies.

Understanding the varying signs and symptoms of an anaphylactic reaction and the vital importance of having a well-described and well-understood management plan and the medications needed (eg, an epi pen or epinephrine) will be essential for patient or caregiver preparedness in case an anaphylactic emergency occurs. Because the number 1 goal for managing a diagnosed food allergy is avoidance of the food allergen, a clearer understanding by the public in general and correct use of the term *food allergy* by patients and caregivers will guide service providers in making the appropriate modifications in products and services and help minimize accidental exposure. Specifically, restaurants, food manufacturers, schools, day care facilities, and other places where food is provided need to be knowledgeable about food allergy constraints, cross-contamination, hidden sources of food allergens, and emergency treatment.

The stress and reduced quality of life that families living with IgE-mediated food allergies experience are significant, but resources are available to alleviate the burden. Many resources exist and are continually being updated to support both healthcare professionals and patients and caregivers as they identify, diagnose, and manage IgE-mediated food allergies.

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