

STATE OF THE ART
ReviewsCarol E. O'Neil, PhD, MPH, LDN, RD, Michael Zanovec, MS,
and Theresa A. Nicklas, DrPHA Review of Food Allergy and
Nutritional Considerations
in the Food-Allergic Adult

Abstract: *In the United States, the prevalence of adults with food allergies is approximately 2% to 3%. Theoretically, any food can cause an allergic reaction; however, some foods are clearly more allergenic than others. In adults, peanuts, tree nuts, finned fish, crustaceans, fruit, and vegetables account for 85% of the food-allergic reactions. Currently, the only ways to manage food allergies are to avoid the allergen and initiate therapy for an allergic reaction if ingestion does occur. The presence of homologous proteins among animal or plant foods and between foods and certain airborne allergens may account for cross-sensitization that may be clinically relevant. For inpatients or outpatients with food allergies, nutrient and fluid requirements are the same as for individuals without food allergies. Since patients with adverse reactions to food may self-restrict intake or have been counseled on food avoidance, it is particularly important to determine dietary adequacy and to provide patients with appropriate food substitutions to provide nutrients that may be missing from a patient's diet. This is of particular concern for individuals with multiple food allergies. Eating away from*

home and traveling also pose special problems for those with food allergies.

Keywords: food allergy; oral allergy syndrome; food allergens; nutrition education

Approximately 20% of the population in the United States alters their diet as a result of a perceived adverse reaction to 1 or more foods.¹

inborn errors of metabolism, or nonreproducible adverse reactions. Other diseases that can be confused with a food allergy include celiac disease, gustatory rhinitis, irritable bowel syndrome, and anorexia nervosa (Table 1).

The information presented in this section is limited to food allergy, which is also known as an IgE-mediated hypersensitivity to food. These reactions occur immediately, that is, within min-

 Approximately 20% of the population in the United States alters their diet as a result of a perceived adverse reaction to 1 or more foods. 

Reactions include food allergies, including those caused by immunoglobulin E (IgE) or mixed IgE-mediated/cell responses and other immunologic reactions to food, including those that are non-IgE- and cell-mediated reactions. Food intolerances include responses to pharmacologic agents or bacterial toxins and nontoxic reactions resulting from enzyme deficiencies,

utes up to 2 hours, after exposure to the food.⁴ If ancillary events, such as exercise, are required to trigger a reaction, the response time can be up to 6 hours.¹⁹ Fatal or near-fatal anaphylactic reactions can be prolonged or biphasic.²⁰ Food-allergic reactions are reproducible and tend to affect the same target organ(s) in an individual.⁴ These include gastrointestinal (eg,

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Table 1.Summary Table of Adverse Food Reactions¹⁻⁴

Food Allergy	
IgE mediated Urticaria Angioedema Acute asthma Anaphylaxis Oral allergy syndrome Food-associated exercise-induced anaphylaxis	Mixed IgE and cell mediated Allergic eosinophilic esophagitis Allergic eosinophilic gastroenteritis Atopic dermatitis Asthma Cell mediated Food protein–induced enterocolitis ^{a,5,6} Food protein–induced proctocolitis ^{a,6,7} Food protein–induced enteropathy ^{a,6} Food-induced pulmonary hemosiderosis (Heiner syndrome) ^{a,8}
Food Intolerance	
Toxic Bacterial food poisoning Biogenic amine (eg, scombroid) fish poisoning ^{9,10} Paralytic shellfish poisoning ¹¹⁻¹³ Heavy metal poisoning Toxins within the food (eg, pufferfish ¹⁴⁻¹⁶ or mushrooms ^{17,18}) Pharmacologic Alcohol Caffeine Histamine and histamine-releasing agents Tyramine	Non-toxic Celiac disease Enzyme deficiency Lactase Fructose Glucose-6 phosphate dehydrogenase Cystic fibrosis Galactosemia, phenylketonuria, and other inborn errors of metabolism Irritable bowel syndrome Pancreatic insufficiency Liver/gallbladder disease Gustatory rhinitis Food aversions Anorexia nervosa

^aUsually in children.

cramping, vomiting, and diarrhea), respiratory (eg, asthma, rhinitis), and cutaneous symptoms (eg, eczema, pruritus, urticaria) and oral allergy syndrome (eg, pruritus and burning of the oral cavity or angioedema of the lips, tongue, or oropharynx). Anaphylaxis is a multisystemic reaction, characterized by hypotension, shock, cramping, diarrhea, vomiting, generalized urticaria, dys-

pnea, wheezing, swelling of the throat, and a feeling of impending doom. Food allergy induces 30 000 cases of anaphylaxis, 2000 hospital admissions, and 200 deaths each year in the United States.²⁰ Any food can elicit anaphylaxis; however, shellfish appears to be the major trigger in adults.²¹ Other foods commonly associated with anaphylactic reactions are peanuts, tree nuts, fin fish,

seeds, and milk.³ Adolescents and young adults with a known sensitivity to peanuts, tree nuts, or seafood appear to be at the greatest risk for developing fatal anaphylaxis.^{22,23}

There is a marked heterogeneity of the prevalence of food allergic responses²⁴; however, in adults, the prevalence is believed to be between 3% and 4% in the United States.^{2,3} The prevalence appears to be increasing¹; this is best documented for peanut,²⁰ sesame,²⁵ and green kiwi,^{26,27} although further studies are needed.²⁴ Reasons for this increasing prevalence are not clear, but they are hypothesized to stem from dietary changes²⁸ or the increased use of antacids.²⁹ Most reports of food allergy have not been confirmed with challenge testing.

Most food allergies develop in childhood, although they can develop at any age. In infants and children, the most common food allergies are to cow's milk (2.5%), egg (1.3%), peanut (0.8%), wheat (0.4%), soy (0.4%), tree nuts (0.2%), finned fish (0.1%), and shellfish (0.1%).¹ Allergies to milk, egg, soy, and wheat usually resolve³⁰; peanut, tree nut, and seafood allergies generally do not.¹ In addition, about 20% of peanut allergies resolve, although they may reoccur.^{31,32} In adolescents and adults, peanuts (0.6%), tree nuts (0.5%), finned fish (0.4%), crustaceans (2%), and fruits and vegetables (5%)^{1,4} account for 85% of the food-allergic reactions.⁴ Currently, the only way to manage food allergies is to avoid the allergen and initiate therapy for an allergic reaction if ingestion does occur.² Severe allergic reactions are medical emergencies.

Food Allergens

Theoretically, any food can cause an allergic reaction; however, some foods are clearly more allergenic than others. The type of protein and epitope configuration (described below), a personal or family history of atopy,³³ and food processing or preparation methods³⁴⁻³⁸ all contribute to the development of food allergies. Individuals must have had a prior exposure to an allergen to have an allergic

reaction, although the original exposure may be occult.

Most food allergens sensitize via the gastrointestinal tract; these are water-soluble glycoproteins 10- to 70-kD in size that are relatively heat, acid, and protease resistant. These allergens are likely to have sequential configuration and include proteins from foods traditionally thought of as allergens, including peanuts, tree nuts, shellfish, finned fish, milk, and eggs. Individual foods can have multiple allergenic epitopes, and not all individuals allergic to the foods have IgE antibodies to all the epitopes.¹ Symptoms resulting from sensitization to these allergens include urticaria, pruritis, and anaphylactic responses.

Other food allergens are heat labile, susceptible to enzymatic degradation, difficult to isolate, and likely to be composed of conformational rather than sequential allergenic epitopes.² Fruits and vegetables that share allergenic epitopes with inhalant pollens are examples (Table 2). Exposure to these allergens in sensitized individuals generally produces oral allergy syndrome, an IgE-mediated hypersensitivity in which the primary sensitization occurs via the respiratory tract to inhaled pollens that cross-react with foods. Individuals sensitized to these allergens develop symptoms in the oral cavity, including pruritus; burning; angioedema of the lips, tongue, or oropharynx; and erythema after ingesting fruits or vegetables with proteins homologous to those in pollen.⁴ When individuals have severe symptoms or react to fruit or vegetables that have been cooked, they may be sensitized to lipid transfer proteins, which suggests allergy to sequential epitopes. Allergic reactions to these proteins have been reported to peach, hazelnut, cherry, apple, and maize.³⁷ Pollen food syndromes³⁹ and the prevalence of plant food allergies have been recently reviewed.⁴²

Similar types of animal and plant proteins account for most food allergens, with plants constituting the majority of food allergens. The presence of homologous proteins among animal or plant foods and between foods and certain airborne allergens may account for

Table 2.

Pollen-Food Oral Allergy Syndrome: Cross-Reactive Pollens and Foods^{4,39-41}

Birch pollen	Apple, apricot, carrot, celery, cherry, hazelnut, nectarine, parsnip, peach, pear, plum, potato
Ragweed pollen	Banana, cucumber, kiwi, melon, zucchini
Mugwort pollen	Carrot, celery, grapes, lychee, mango, and spices including caraway seeds, parsley, fennel seeds, coriander seeds, paprika, garlic, and aniseed

cross-sensitization that may be clinically relevant. Clinically relevant cross-reactivity is more common (>20%) among related fruits (eg, those of the Rosaceae family), tree nuts, mammalian milks, and seafood than among grains and legumes.⁴³ Cross-reactivity among proteins can explain how people can become sensitized to food allergens and have a reaction with no known prior exposure to a food.

Examples of Food Allergens

Tropomyosin. Tropomyosin has been identified as a panallergen in invertebrates^{44,45}; thus, there is a high degree of cross-reactivity among species. Among crustacean-allergic individuals, shrimp,⁴⁶ crab,⁴⁷ crawfish,⁴⁸ and lobster^{48,49} are mediated by tropomyosin; those with proven allergy to any species should therefore be cautious about consuming other species of crustaceans. Allergies to mollusks, including oysters,⁵⁰ scallops,⁴⁷ squid,⁵¹ and snails,⁵² result in part from tropomyosin, but there are other allergens reported.⁵³ Cross-reactivity has been shown using skin prick testing (SPT), in vitro testing (eg, the radioallergosorbent test [RAST]), and challenge testing; however, there are individuals who react to only 1 species.⁵³ It is recommended, however, that individuals allergic to 1 mollusk avoid others—especially those within individual classes, until they can be tested.⁵³ Cross-reactivity between mollusks and crustaceans has been reported but is not well defined^{47,54}; however, individuals allergic to shellfish are often advised to avoid all shellfish.⁵³

Allergenic tropomyosins are found in other invertebrates, including amphipods found in nori,⁵⁵ fish muscle parasites (*Anisakis simplex*),⁵⁶ house dust mites,⁵⁷ and cockroaches.^{57,58} Although the amount of tropomyosin in these species varies, exposure to these sources can lead to production of IgE antibodies and cross-reactivity with seafood,^{57,59-61} although the clinical importance is unclear. Tropomyosins are also found in mammals; however, they are nonallergenic.^{62,63}

Parvalbumin. Parvalbumin is classed as a panallergen for finned fish⁶⁴ and helps explain the high level of cross-reactivity among species.^{65,66} Although studies are limited, it appears that cod, mackerel, herring, and plaice share common allergenic structures.^{64,67} In vitro studies suggest more extensive cross-reactivity.^{65,66} There is apparently a difference in parvalbumin content of dark and light fish muscles.⁶⁸ This may explain why not all fish-allergic individuals are allergic to tuna,⁶⁹ although studies have suggested that some tuna species do not have parvalbumin.⁷⁰ Skin testing is not always adequate for testing for clinical cross-reactivity among finned fish, and subjects with either positive SPT or RAST should be cautious when consuming fish of another species until lack of reactivity can be demonstrated.⁷¹ Parvalbumin is also found in amphibians and is responsible for the several allergic reactions reported to frogs.^{70,72,73}

Bovine IgG. Bovine IgG has been identified as a major cross-reactive

allergen in vertebrate meats, including beef, lamb, and venison, and milk.⁷⁴

Plant food allergens. Plant food allergens are classed into families and superfamilies using structural and functional properties.^{2,75} Many allergens belong to the cupin superfamily (seed storage proteins) or the prolamin superfamily (albumins, nonspecific lipid transfer proteins, α amylase/trypsin inhibitors, and prolamin storage proteins of cereals). The pathogenesis-related proteins (PRs) are a heterogeneous collection of 14 plant protein families; many plant food allergens are homologous to PRs. Pathogenesis-related proteins are responsible for pollen-fruit or latex-fruit cross-reactive syndromes. There are also unrelated families of proteins that are allergenic, such as the profilins, which are highly cross-reactive; IgE from profiling-sensitive individuals binds to a large number of botanically unrelated plants.⁷⁶

Naming Allergens

Purified allergens are named using the first 3 letters of the genus, followed by a single letter of the species name and an Arabic number to indicate the chronology of allergen purification.⁷⁷ Allergens with the number "1" in their name were the first discovered and are not necessarily the most significant clinically. For example, 8 peanut (*Arachis hypogaea*) allergens have been identified that are named Ara h 1 to Ara h 8.^{20,78} A list of food allergen sources is available online through the International Union of Immunological Societies Allergen Nomenclature Subcommittee.⁷⁹

Pathogenesis of IgE-Mediated Food Allergy

In food-allergic individuals, exposure to allergenic epitopes from food proteins causes production of specific IgE antibodies that bind to the surface of tissue-bound mast cells or circulating basophils. Upon subsequent exposure to these allergens, the allergen cross-links the specific IgE antibody, triggering the cells to release potent preformed or newly formed inflammatory mediators that

are activators (eg, histamine, platelet-activating factor, tryptase), spasmogens (eg, histamine, prostaglandin D₄, leukotriene C₄), and chemoattractants (eg, neutrophil chemottractant factor, eosinophil chemotactic factor of anaphylaxis). The actions of these mediators cause the clinical signs and symptoms of food allergy. For example, histamine triggers leakage of fluid from blood vessels into the tissues; in a mild allergic reaction, urticaria results, but in a severe response, blood pressure could drop and if left untreated, death could ensue. Histamine also causes smooth muscle contraction, which leads to bronchospasm.²

In general, individuals with a low threshold (ie, those requiring a low dose of food to trigger the response) are more likely to have a severe reaction.⁸⁰ Characteristics of the allergen affect disease expression: allergens that sensitize via the gastrointestinal tract are more likely to trigger a severe reaction than food allergens that sensitize via the respiratory tract.⁸¹ Target organ sensitivity also affects the outcome; for example, those with asthma have a higher risk of severe anaphylaxis.²³ Once anaphylaxis begins, there is no way to predict how serious it can become.

Allergy Tests

Diagnostic Tests

Diagnosis of food allergy can include a focused medical history, physical examination, SPT, in vitro testing, or food challenge. Weight and body mass index should be obtained for all individuals.

Skin prick testing. SPT is performed by placing a small amount of a standardized allergen solution containing the specific food protein (along with positive and negative controls) on the skin, scratching the skin with a single- or double-tined lancet, and observing whether a wheal and flare response occurs. If the wheal is at least 3 mm larger than that produced by the negative control, the reaction is considered positive, suggesting that an individual has symptomatic reactivity to the protein. Larger wheals (eg, median wheal diameter >8-10 mm) indicate a

greater likelihood of clinical reactivity.⁸² Some have advocated measuring the wheal size in 2 perpendicular diameters and recording the mean (mm) as an area, recorded in mm², using a computer-linked laser reader. Absolute wheal size (mm) can be used to predict clinical reactivity.^{83,84} A positive skin test demonstrates the presence of specific IgE antibodies. SPT with food extracts is very sensitive, but it lacks specificity. The positive predictive value is rarely higher than 50%, whereas the negative predictive accuracy is >95%.⁴ Clinical history should be used in conjunction with SPT since overdiagnosis could occur, resulting in an unnecessarily restricted diet.

Fruits and vegetables may contain both labile and stable allergens. For labile allergens, it may be necessary to use fresh fruit or vegetables in the testing.⁸⁵ In that situation, freshly cut produce is placed on the subject's arm, and the lancet goes immediately through the fruit or vegetable to prick the skin. A caveat when fresh fruit and vegetables are used for SPT is that there is no way to determine the specific allergen content, which can vary depending on the specific species used and on the ripeness of the produce.⁸⁶

If an SPT is negative and there is a convincing history, additional testing, including a physician-supervised food challenge, is necessary to confirm the diagnosis. Care should also be taken when assessing allergens with a high prevalence of cross-reactivity since the presence of specific IgE antibodies may not be clinically relevant.^{87,88}

Radioallergosorbent test. The in vitro RAST detects the presence of food-specific IgE antibodies. The concentration of specific IgE antibody (kU_A/L) can be measured using an ImmunoCAP (Phadia, Uppsala, Sweden) or other product. Unlike the SPT, the RAST carries no risk of an adverse reaction to the individual. Like SPT, increasing levels of specific IgE antibodies are associated with an increased probability of a clinical reaction.¹ When individuals have specific IgE levels exceeding the predictive (diagnostic) level, they are more than 95% likely to experience an allergic reaction upon

Table 3.Diagnostic Food Allergen–Specific IgE Levels Using the CAP FEIA System²

Food	IgE Level, kU _A /L	Positive Predictive Value
Egg	7	98
Dairy	15	95
Peanut	14	100
Fish	20	100
Soybean	30	73
Wheat	26	74
Tree nut	~15	~95

exposure. For some allergens, there are guidelines whereby clinical reactions are likely (Table 3); however, interpretation of in vitro allergy tests remains challenging for many food allergens.

RAST testing may obviate the need for food challenge testing; however, many individuals with detectable food-specific IgE antibodies do not experience clinical reactions upon ingestion of those foods.¹ Thus, if an individual has a convincing history, challenge testing may be needed for a definitive diagnosis.

Challenge testing. Oral food challenges remain the only way to diagnose definitively a food allergy.⁴ In food challenges, individuals are fed sequential, measured amounts of the putative allergen and observed for adverse effects. For the test, the food in question should be withheld for a minimum of 2 weeks prior to the challenge, and the initial dose is typically less than that which usually induces symptoms; specific IgE levels to given foods should also be considered when available.⁸⁹ Intervals between doses are longer than the reported time period between ingestion of the food and adverse reactions. This has been shown to be relatively safe when done as an office procedure,⁹⁰ however, adverse reactions, sometimes severe, have been reported.⁸⁹⁻⁹¹

In open challenges, food is presented in typical servings sizes, such as 1 slice

of bread or 2 tablespoons of peanut butter.⁴ This type of challenge is not blinded and may need to be repeated using the gold standard for diagnosing food allergy: the double-blind, placebo-controlled, food-challenge (DBPCFC).⁹² Unfortunately, these tests also have ambiguities, and there is no consensus about how to interpret the outcome and how to define positive and negative provocations in DBPCFC.⁹³ Efforts are under way to develop standardized methods for DBPCFC⁹⁴; however, it is not clear whether this is a realistic goal.⁹⁵

A variety of unproven allergy tests have been put forth, including use of specific IgG foods accompanied by rotary diets, provocation-neutralization testing and therapy, applied kinesiology followed by acupressure or acupuncture, and changes in cell size upon in vitro exposure of leukocytes to food extract followed by elimination diets or rotary diets. None of these have been shown to be of use in diagnosis of allergic disease.^{96,97}

Nutritional Risk Screen

For inpatients or outpatients with food allergies, nutrient and fluid requirements are the same as for individuals without food allergies. Since individuals with adverse reactions to food may self-restrict intake¹ or have been counseled

on food avoidance,⁴ it is particularly important to determine dietary adequacy and to provide individuals with appropriate food substitutions to supply nutrients that may be missing from the diet. This is of particular concern for individuals with multiple food allergies.

The Joint Commission requires that information about food allergies be placed in an inpatient's chart.⁹⁸ For inpatients in long-term care (LTC) facilities, The Joint Commission standards and elements of performance (EP.17) require that dietary and food allergies be assessed.⁹⁹ In acute care and LTC facilities, it is critical that the food service staff and nursing staff be alerted to any patients with food allergies to avoid cross-contaminating food or utensils or serving the patient these foods. In addition, for patients with food allergies or idiopathic anaphylaxis, a consult with a registered dietitian should assess dietary intake and ensure that the patient is appropriately counseled to avoid food-allergic reactions after discharge. Idiopathic anaphylaxis can result from food allergens to masked or hidden foods, for example, mustard.¹⁰⁰

For the hospitalized patient with food allergy who requires enteral or parenteral nutrition, the nutrition assessment, indications for nutrition support, estimate of nutrition needs, and guidelines for metabolic monitoring are similar to those of the patients without food allergies. A thorough search of the literature failed to find peer-reviewed articles documenting allergic reactions to enteral formulas. Product analysis shows that enteral formulas may contain milk or soy ingredients, so allergic reactions are possible, especially in infants and young children. Milk and soy allergies are among those frequently outgrown; thus, these reactions are less likely to occur in adults.³⁰ If patients receiving enteral nutrition have a history of allergy to proteins found in milk or soy present with symptoms consistent with an allergic response, it is logical to assume that an elemental formula may help. If not, parenteral nutrition may be needed.

Allergic reactions in patients receiving parenteral nutrition have been reported to latex stoppers on lipid preparations,¹⁰¹

vitamin preparations,¹⁰²⁻¹⁰⁴ and soy emulsifiers.^{105,106} Reports in the literature are rare and usually consist of a single case or case series; moreover, some of the reports do not distinguish between an anaphylactic reaction and an anaphylactoid reaction.^{107,108} However rare, allergy to a component of parenteral nutrition remains a possibility, and health care professionals should remain alert and refer patients as needed to a board-certified allergist.

The Nutrition Care Process

Step 1: Nutrition Assessment

Physical Observations

Physical observations are usually unremarkable; however, some adults with food allergies have cutaneous symptoms such as pruritis, atopic dermatitis, urticaria, angioedema, and erythema at the time of the examination. Acute urticaria, which can be caused by a food allergy, may only last a few hours and not be present when an individual is observed for a physical examination. Respiratory responses to allergic food substances may be seen as laryngeal edema, wheezing, and asthma. Gastrointestinal symptoms that may be associated with food allergy include nausea, vomiting, diarrhea, and severe abdominal cramping. These symptoms may not be present when a patient is examined. It is also important to assess patients for possible nutrient deficiencies.

Client History

A diagnosis can often be made using a focused history and physical examination.⁴ It is important to obtain a full history to determine possible causal food(s), quantity of food required to trigger symptoms, temporal association between ingestion and symptoms, concomitant factors needed to trigger a reaction (eg, concomitant exercise, aspirin, and alcohol), whether the food was consumed raw versus cooked,⁴ symptoms following ingestion, consistency of the reaction,^{1,3} and the length of time since the last reaction or the last time the food was ingested.⁴

One element of the diet history that may be overlooked is the association

between consuming specific foods and exercise or physical activity, noting that consumption of the food can occur as long as 6 hours prior to exercise. There is also a report that aspirin,¹⁰⁹ including low-dose aspirin therapy,¹¹⁰ can enhance this reaction. Food-dependent exercise-induced anaphylaxis is rare; however, it has been shown for a variety of foods including celery,¹¹¹ legumes,¹¹² tofu,¹¹³ pistachios,¹¹⁴ and, perhaps the most common reactant, wheat.¹¹⁵ Individuals are asymptomatic unless these elements are combined.¹¹⁶

Diet history/recall/frequency. A diet history should include current intake, as well as historical intake of any foods containing allergens and contact with nonfood items that could contain food allergens. The temporal reactions with the intake of putative food allergens should be determined. A 24-hour recall may not be useful in this situation since it does not provide usual intake.^{117,118} Assessing nutrient intake and dietary adequacy of those with food allergy involves comparing usual intake with their nutritional requirements. This can be done using the MyPyramid Web site¹¹⁹ or nutrient databases.¹²⁰

Nutritional status of individuals can be compromised because of elimination of entire food groups. Dietary inadequacies including essential fatty acid deficiencies,¹²¹ protein/energy,^{122,123} vitamin D- and calcium-deficient rickets,^{124,125} pellagra,¹²⁶ and scurvy¹²⁷ have been reported in food-allergic individuals. Most reports involved children; however, the cases of pellagra and scurvy were found in adults. It is critical when working with subjects with food allergies that they receive appropriate counseling to prevent these deficiency diseases.

If the diet history does not reveal a clear association between food(s) and symptoms, individuals may be asked to keep a food diary/symptom log.⁴ In the diaries, all food, beverages, condiments, and supplements that are consumed are recorded, along with specific brand names of foods eaten, recipes, preparation methods, and the temporal relationship of when a food was consumed and

the onset of symptoms; ancillary activities, including exercise, should also be included. Individuals should also include spices and herbs used in cooking. It is also appropriate to evaluate eating behaviors, such as the number of meals eaten at home versus outside the home, ethnic preferences, use of processed or prepared meals, family support, and literacy level and understanding of diagnosis prior to designing a nutrition intervention. Since most anaphylactic reactions to foods occur away from home, it is important to understand eating patterns.

Since IgE-mediated reactions are usually immediate, it is often possible to determine the food(s) causing the reaction by history or by using food diaries; however, if the results are not clear, additional testing is needed. Often food diaries rule out a suspected food allergen since ingestion is not clearly associated with symptoms.⁴ Food logs can also be used to assess nutrient intake and dietary adequacy as described above. In those with established food allergy, logs can also be used to determine compliance with the diet prescription.

Step 2: Nutrition Diagnosis

A variety of nutrition diagnoses in any of the 3 domains may be appropriate for an individual with food allergies.

Intake. After assessing the food history of a subject, it may become clear that the person has inadequate energy intake, possibly resulting from food avoidance or inadequate vitamin (or mineral) intake, possibly from excluding specific foods from the diet.

Clinical. The client may be underweight because of refusal to eat.

Behavioral. After assessing the food/nutrition history and talking with the client, it may be apparent that the individual verbalizes inaccurate or incomplete information, has no prior knowledge of need for food- and nutrition-related information, or relates concerns about previous attempts to learn information. These nutrition diagnoses would be very applicable to those with food allergy and would be related to an inability to read food

Table 4.

Goals of Nutrition Education for Individuals With Food Allergy

Enable individuals to:
• Define the allergen-free nutrition prescription
• List common foods that contain the allergen
• List foods that are allowed in an allergen-free nutrition prescription
• List nutrient-dense alternative foods that do not contain allergens
• Read a food label and state the risk involved in packaged foods with precautionary labeling
• Be able to identify hidden sources of allergens
• Identify specialty companies that manufacture allergen-free foods in dedicated facilities
• Plan, shop for, and prepare healthy, allergen-free meals at home or in the homes of family and friends (this would include making substitutions in cooking as needed)
• Select appropriate restaurants and interact with wait staff to choose meals that minimize the risk of allergen exposure
• Explain cross-contamination risks and describe steps to take to minimize the risk
• Identify problem-solving avoidance skills
• Describe symptoms of a food-induced allergic reaction and what should be done during a reaction
• Identify online resources for reliable medical information
• Locate and join food allergy support groups to share experiences with other food allergic families

labels, inability to identify situations that could expose them to an allergen, or lack of knowledge about how to design a nutritionally adequate diet without including the food allergen(s).

Step 3: Nutrition Intervention

The nutrition intervention would depend on the nutrition diagnosis. The intervention should include food or nutrient delivery that ensures an allergen-free environment while a patient is in a given facility. Individuals with food allergy have a variety of educational needs that a registered dietitian can help with, including planning a diet that is nutritionally adequate¹²⁸ and how to avoid food allergens¹²⁹ to help prevent anaphylactic reactions.¹³⁰ In a 2-year period, 50% of food-allergic individuals will have an unintentional exposure that leads to an adverse clinical reaction.¹³¹ Thus, the nutrition intervention may include com-

prehensive nutrition education to help individuals identify and avoid possible exposures to allergens after discharge and to improve or maintain dietary adequacy depending on the needs of the client.

Successful avoidance of food allergens depends on appropriate education and an individual's ability to identify the food(s) that caused the reaction(s), ability to recognize cross-reacting allergens, ability (and willingness) to read food labels, ability to inquire about foods at restaurants, and ability to take other actions to prevent exposures (Table 4). Since food allergies can negatively affect the quality of life of individuals,¹³²⁻¹³⁵ it is important that dietitians work closely with them.^{128,136} The general public has a knowledge gap about the definition, symptoms, and prevalence of food allergy,¹³⁷ so providing this information is vital.

Of special importance when working with individuals after discharge is helping them avoid allergens by understanding the food label and including its limitations, identifying hidden allergens, making appropriate choices away from home, and traveling with confidence.

Food labels. Prior to January 1, 2006, a major obstacle to managing food allergies was an inability to identify ingredients that would elicit allergic reactions in sensitized individuals.¹³⁸ The Food Allergen Labeling and Consumer Protection Act of 2004 (Title II of Public Law 108-282)¹³⁹ was designed to help consumers identify immediately foods containing the 8 major food allergens: milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat, and soybeans with their usual or common name (eg, *milk* or *peanuts*). Highly refined oils need not declare their origin, although it is

generally in the product name. Initial studies have shown a high percentage of food-allergic individuals read food labels; however, remaining problems include failure to identify the source of allergens and a failure to alert consumers that a product change had been made.¹⁴⁰ In addition, tree nuts are not defined, not all allergens are listed, and allergens may be hidden in terms such as *natural flavoring* and *spices*. This is of concern since dozens of spices have been reported to cause IgE-mediated hypersensitivity reactions.^{39,141} Although it has been suggested that the new food labels would reduce the number of allergic reactions to food,¹⁴² a newer study suggests that consumers are not heeding the labels.¹⁴³

Sources of hidden allergens. The presence of hidden allergens can be insidious, and exposure is difficult to assess.¹⁴⁴ The first report of adverse reactions to hidden allergens came in 1928 when asthma-like symptoms were reported in 2 peanut-sensitive children when they drank milk from a cow fed peanut plants.¹⁴⁵ Other examples include ingestion of eggs and meat from poultry fed fish flour; spices, especially garlic and mustard, found in a variety of foods¹⁴⁴; and milk or soy proteins found in boiled ham or sausage. Soy has become a particular problem since it is found in so many foods. Gelatin-based additives, including those prepared from fish gelatin, have also caused anaphylactic reactions in exposures ranging from vaccines¹⁴⁶ to marshmallows.¹⁴⁷ Occult exposures such as those described make identifying these allergens challenging and underscore the importance of teaching clients how to contact food manufacturers.

Eating away from home. Anaphylactic reactions to foods are most likely to occur away from home.^{22,148,149} To help individuals avoid food-allergic reactions in these situations, registered dietitians must be especially familiar with cross-reactivity of allergens and hidden allergens in food.¹⁴⁴ Because of the potential severity of the problem, adverse reactions to peanuts have been the best studied.¹⁵⁰ Individuals eating in Asian restaurants, ice cream shops, and

Table 5.

Nutrients to Monitor in Patients Excluding Food Groups From Their Diet

Food Avoided	Monitor Intake of These Nutrients and Supplement Patient as Needed
Fish	Protein, niacin, vitamin B ₆ , vitamin B ₁₂ , vitamin E, phosphorus, and selenium
Shellfish	Zinc, magnesium, copper, and selenium
Eggs	Vitamin D, vitamin B ₁₂ , vitamin B ₆ , pantothenic acid, selenium, riboflavin, and biotin
Dairy	Calcium, vitamin A, vitamin D, riboflavin, pantothenic acid, and phosphorus
Peanuts	Niacin, magnesium, vitamin E, manganese, and chromium
Tree nuts	Vitamin E, magnesium, copper, manganese and phosphorus
Soybeans	Thiamin, riboflavin, vitamin B ₆ , folate, calcium, phosphorus, magnesium, iron, and zinc
Wheat	Thiamin, riboflavin, niacin, iron, selenium, chromium, and fiber
Fruit/vegetables	Vitamin C, folate, beta-carotene, potassium, and fiber

bakeries were the most likely to suffer adverse reactions foods.¹⁵⁰ Individuals need to be instructed on how to ask if the food was used in the recipes served since foods can be hidden in sauces, dressings, or egg rolls and visual identification may be precluded. Other exposures can come from contamination caused by the use of shared cooking or serving equipment, ingestion of food intended for others, food consumed from a buffet, skin contact or inhalation from residual food on tables, peanut shells on the floors, being too close to the cooking of food,^{144,150,151} or through exposure in open-air markets.¹⁵² Foods cooked in oils contaminated by other foods also pose a risk to those eating outside the home.¹⁴⁴

Traveling. Unique aspects to foreign travel include a potential inability to read food labels or to communicate effectively with the wait staff. New food-labeling legislation came into effect

in the European Union in November 2005¹⁵³; however, subjects may not be able to identify allergens in unfamiliar situations. Air travel poses unique challenges: anaphylactic reactions have been reported, principally to peanuts. Individuals generally self-treated the reaction and did not always inform flight personnel.¹⁵⁴

The other principal nutrition intervention for registered dietitians is to ensure that individuals have adequate nutrient intake and dietary adequacy. If they are nutrient deficient, it is important to help them identify foods that can be tolerated to improve nutrient intake. Table 5 suggests possible nutrient inadequacies associated with elimination of foods in the diet.

Food and Feeding Issues

In theory, any food can cause a food allergy; however, 8 foods (milk, eggs, fish, shellfish, tree nuts, peanuts, wheat,

and soybeans) are responsible for most food-induced allergic reactions in the United States.³ Since there is no cure for food allergy, strict food avoidance is the only way to prevent an allergic reaction. Successful avoidance of food allergens relies on educating clients to take appropriate measures, with particular emphasis on determining hidden food allergens and label reading. Whenever foods are restricted from the diet, it is critical to provide guidelines to substitute nutritionally appropriate alternatives for the foods that are excluded from the diet. Table 4 lists specific goals of nutrition education for individuals with food allergy.

Step 4: Monitoring and Evaluation

Depending on the intervention needed, monitoring could include assessing the individual's understanding of and compliance with nutrition education on avoidance of food allergens or whether an individual has maintained or gained weight. If adverse reactions occurred, a review of how they could have been prevented would be important. It may be especially important to monitor some groups closely since adolescents and young adults may partake in risk-taking behavior by purposefully ingesting known allergens.¹⁵⁵

Nutrition Care FAQs

- **Question:** Does the term *hypoallergenic* mean allergen free?
Answer: No. The term *hypo* means "low or below normal," not "free." Cosmetics, soap, shampoo, lotions, and sunscreen products labeled *hypoallergenic* may contain milk, egg, wheat, tree nuts, or other allergens.
- **Question:** Is it safe for a person allergic to one tree nut to consume other species?
Answer: No. Tree nuts can cause severe, potentially fatal reactions,¹⁵⁶ and these can occur upon first exposure to a particular tree nut in subjects allergic to other tree nuts.²² Tree nut allergens are highly cross-reactive,¹⁵⁶⁻¹⁵⁹ multiple allergies to different tree nuts are common,¹⁵⁶ and it can be difficult

to differentiate species, particularly in prepared foods. Generally, the advice given to tree nut-allergic individuals is that all tree nuts should be avoided if they have a documented reaction to one species. The exception would be if it can be established clearly that the subject can tolerate other species and can consume those species without the risk of cross-contamination.¹⁶⁰

- **Question:** Is it safe for a tree nut-allergic person to use nutmeg (*Myristica fragrans*)?

Answer: Yes. Nutmegs are sometimes referred to as tree nuts¹⁵³; however, they are obtained from seeds of a tropical tree. A person allergic to tree nuts can usually safely consume nutmeg. However, nutmeg, and the closely related spice, mace, have been shown to cause positive SPTs and allergic reactions,¹⁶¹ although this does not appear to be a common food allergen.¹⁴¹

- **Question:** Is it safe for tree nut-allergic individuals to consume peanuts (and vice versa)?

Answer: Probably not. The general public often considers peanuts and tree nuts as similar foods; however, peanuts are actually legumes (family Leguminosae), so botanically, they are more closely related to beans and peas than to tree nuts. However, studies have shown there is substantial cross-reactivity among peanuts and tree nuts.^{156,162-164} Because of the potentially severe reaction to both, in the absence of definitive negative challenge testing, it may be prudent for sensitized individuals to refrain from either type of nut.

- **Question:** Is it safe for finned fish-allergic individuals to take fish oil supplements?

Answer: Maybe, although most manufacturers of fish oil supplements recommend against it. Varying amounts of fish protein may remain in fish oils, but the literature is conflicting as to whether these proteins can elicit allergic reactions^{165,166} at this time and if fish oil supplements are safe for fish-allergic individuals. Whether reactions occur likely depends on

individual tolerance and dose. In this case, it is best to consult with a board-certified allergist and the specific manufacturer.

- **Question:** Are oils manufactured from corn, soy beans, peanuts, or tree nuts safe for individuals allergic to these foods?

Answer: Maybe. In individuals allergic to these foods, there is a potential to react to the oil since residual proteins may remain.¹⁶⁷⁻¹⁷¹ The potential for allergic reactions may also depend on processing, since crude oils contain approximately 100 times more protein than refined oils.^{168,169,172} Whether these proteins cause allergic reactions is not clear,¹⁷³⁻¹⁷⁵ but most peanut- or soy-allergic individuals can tolerate highly refined oils.^{168,176} Thresholds to very low levels of protein need to be established for these proteins; however, these studies are lacking, so it is best to consult with a board-certified allergist on a case-specific basis.

- **Question:** Should individuals with corn allergy avoid all products produced from corn?

Answer: Yes. This recommendation is based on a lack of literature detailing the amount of residual protein remaining in corn products and a lack of testing evaluating the allergenicity of these products. These recommendations may change if evidence-based findings regarding these products become available.

- **Question:** Is calcium carbonate safe for individuals with milk allergy?

Answer: Yes. It is a calcium salt used for calcium enrichment and does not contain milk protein.

- **Question:** Is a kosher food labeled *pareve* safe for an individual allergic to milk?

Answer: No. Under Jewish law, a product considered *pareve* or *parve* should not contain milk or meat. However, reactions to *pareve* foods have occurred in exquisitely sensitive milk-allergic individuals.^{177,178} It is always best to contact the kosher certification agency to determine if there is any chance that a food product has milk products.

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