

Management of Peanut Allergy



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Date of Original Release: February 1, 2019. Credit may be obtained for these courses until January 31, 2020.

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Overall Purpose/Goal: To provide excellent reviews on key aspects of allergic disease to those who research, treat, or manage allergic disease.

Target Audience: Physicians and researchers within the field of allergic disease.

Accreditation/Provider Statements and Credit Designation: The American Academy of Allergy, Asthma & Immunology (AAAAI) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians. The AAAAI designates this journal-based CME activity for 1.00 *AMA PRA Category 1 Credit*TM. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

List of Design Committee Members: Carina Venter, PhD, RD, Scott H. Sicherer, MD, and Matthew Greenhawt, MD, MBA, MSc (authors); Michael Schatz, MD, MS (editor)

Learning objectives:

1. To counsel patients on peanut allergy management including label reading, casual exposure, cross-contact with allergens, and use of emergency medication.

2. To discuss peanut allergy management related to travel and eating away from home.

3. To discuss the psychosocial issues of peanut allergy.

Recognition of Commercial Support: This CME has not received external commercial support.

Disclosure of Relevant Financial Relationships with Commercial Interests: C. Venter has received honorariums for lectures provided for Danone, Mead Johnson, Nestle, and Abbott Laboratories; and received research support from ThermoFisher. S. H. Sicherer reports royalty payments from UpToDate and from Johns Hopkins University Press; grants to his institution from the National Institute of Allergy and Infectious Diseases, from Food Allergy Research and Education, and from HAL Allergy; and personal fees from the American Academy of Allergy, Asthma and Immunology (Deputy Editor of *Journal of Allergy and Clinical Immunology: In Practice*), outside of the submitted work. M. Greenhawt is supported by grant #5K08HS024599-02 from the Agency for Healthcare Quality and Research; is an expert panel and coordinating committee member of the National Institute of Allergy and Infectious Diseases sponsored Guidelines for Peanut Allergy Prevention; has served as a consultant for the Canadian Transportation Agency, Thermo Fisher, Intrimmune, and Aimmune Therapeutics; is a member of physician/medical advisory boards for Aimmune Therapeutics, DBV Technologies, Nutricia, Kaleo Pharmaceutical, Nestle, and Monsanto; is a member of the scientific advisory council for the National Peanut Board; has received honorarium for lectures from Thermo Fisher, Before Brands, multiple state allergy societies, the American College of Allergy Asthma and Immunology, and the European Academy of Allergy and Clinical Immunology; is an associate editor for the *Annals of Allergy, Asthma, and Immunology*; and is a member of the Joint Taskforce on Allergy Practice Parameters. M. Schatz declares no relevant conflicts of interest.

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No funding was received for this work.

Conflicts of interest: C. Venter has received honorariums for lectures provided for Danone, Mead Johnson, Nestle, and Abbott Laboratories; and received research support from ThermoFisher. S. H. Sicherer reports royalty payments from UpToDate and from Johns Hopkins University Press; grants to his institution from the National Institute of Allergy and Infectious Diseases, from Food Allergy Research and Education, and from HAL Allergy; and personal fees from the American Academy of Allergy, Asthma and Immunology (Deputy Editor of *Journal of Allergy and Clinical Immunology: In Practice*), outside of the submitted work. M. Greenhawt is supported by grant #5K08HS024599-02 from the Agency for Healthcare Quality and Research; is an expert panel and coordinating committee member of the National Institute of Allergy and Infectious Diseases

sponsored Guidelines for Peanut Allergy Prevention; has served as a consultant for the Canadian Transportation Agency, Thermo Fisher, Intrimmune, and Aimmune Therapeutics; is a member of physician/medical advisory boards for Aimmune Therapeutics, DBV Technologies, Nutricia, Kaleo Pharmaceutical, Nestle, and Monsanto; is a member of the scientific advisory council for the National Peanut Board; has received honorarium for lectures from Thermo Fisher, Before Brands, multiple state allergy societies, the American College of Allergy Asthma and Immunology, and the European Academy of Allergy and Clinical Immunology; is an associate editor for the *Annals of Allergy, Asthma, and Immunology*; and is a member of the Joint Taskforce on Allergy Practice Parameters.

Received for publication September 13, 2018; revised October 22, 2018; accepted for publication October 23, 2018.

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2213-2198

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<https://doi.org/10.1016/j.jaip.2018.10.043>

*Abbreviations used**ADA- Americans with Disabilities Act**ED- Eliciting dose**EU- European Union**FALCPA- Food Allergen Labeling and Consumer Protection Act of 2004**FDA- Food and Drug Administration**PAL- Precautionary allergen labeling**QoL- Quality of life*

Peanut allergy is a growing public health concern in westernized countries. Peanut allergy is characterized as an often severe and lifelong allergy, which can have detrimental effects on quality of life and trigger anxiety. Although multiple therapeutic options are emerging, the focus of current management strategies is strict peanut avoidance and carriage of self-injectable epinephrine. The greatest risk of reacting to peanut comes from direct ingestion, whereas casual skin contact or airborne exposure is highly unlikely to provoke significant symptoms. Patients and families must be educated about how to best execute strict peanut avoidance through careful label reading as well as how to understand and address likely and unlikely risk with regard to peanut exposure in public, in particular when dining outside of the home and for children attending school or child care. This review discusses the risk of exposure in public such as at school or on an airplane and how such risk can be abated, situations and scenarios when dining out of the house that may pose more risks than others, the essentials of US and EU label reading laws with particular emphasis on precautionary labeling and the risk implied by such, quality of life and psychosocial issues that may affect the peanut allergic individual and family, and a discussion of how risk may differ and evolve based on the patient's age. © 2018 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2019;7:345-55)

Key words: *Peanut allergy; Peanut allergy management; Food allergy; Anaphylaxis; Epinephrine; Epinephrine auto-injector; Food allergy labeling; Allergen avoidance; Quality of life*

Food allergies, including peanut allergy, appear to have increased in prevalence over the past 20 years, though comparable data from the same population over time are scarce.¹ Food allergy, particularly peanut allergy, is becoming an important public health concern due to the large population of affected children, estimated to range between 1.4% and 4.5%.¹ The approach to peanut allergy includes a careful diagnosis, consideration of emerging therapies, and prevention strategies, which are topics of other reviews in this issue.²⁻⁴ However, it is important to recognize that peanut allergy may affect quality of life (QoL),⁵⁻¹⁰ and successful management should include counseling by health care professionals to address the day-to-day issues faced by patients and families to lessen burdens and promote health and safety. This includes counseling that may be individualized for each patient. This review includes information on counseling about the risks of ingestion versus casual skin/air exposure, how to read and interpret food labels, managing peanut allergy away from home, lifestyle and emotional issues, as well as the recognition and treatment of allergic reactions and

anaphylaxis. Management regarding foods that may cross-react with peanut, and co-allergies are discussed in another review in this issue.¹¹ The goal is to provide information to aid the health care professional in productive counseling of patients and families.

MANAGEMENT OF PEANUT ALLERGY IN PUBLIC VENUES

Inside of the home, label reading and care about cross-contact/cross-contamination are key management strategies. However, patients and families have less control outside of the home, an issue that can lead to significant anxiety. Management of food allergy, including peanut, in schools has been addressed elsewhere.¹²⁻¹⁴ Some concerns for allergic reactions when outside of the home involve exposure to potential allergens during travel and when dining outside of the home, whereas the other concern may involve casual exposure, as described above. Regarding remediation of environmental peanut exposure, there are published studies demonstrating that peanut dust does not become airborne and pose an inhalational risk, dust and smeared peanut butter can be readily abated from surfaces with common cleaning methods, and peanut butter removed from skin with the use of soap and water (but not alcohol gel sanitizers).^{15,16}

Banning/restricting peanut from public venues is controversial, unproven in efficacy in reducing risk,⁷ and in fact may provide a false sense of security given that such restrictions may not be enforceable.^{8,9} In a recent Massachusetts school study, peanut-free schools were no less likely than those permitting peanut to have a student require epinephrine for an allergic reaction, though peanut-free tables were associated with a significant decrease.¹⁷ It is also of note that bans may not be universally supported by all parents of allergic children.¹⁸

Restaurants

Management of peanut allergy in restaurants can be challenging. Research on how often this occurs is limited by lack of a prospective study and a heavy reliance on older, self-reported data that may not reflect more recent changes in awareness patterns among consumers and dining establishments. In a registry of 5149 persons with peanut or tree nut allergy, 13.7% self-reported a reaction occurring in a restaurant.¹⁹ In a substudy of registry participants with restaurant reactions, 129 subjects/parental surrogates described circumstances of 156 food establishment reactions.²⁰ Themes regarding the circumstances of reactions included dessert foods (43% of reactions), and foods from Asian restaurants (19%), ice cream shops (14%), and bakeries (13%). For 78% of these reported reactions, someone in the establishment knew that peanut or tree nut was an ingredient, and in half of these reactions, the trigger was a hidden ingredient that would not have been visually identifiable by the patron. About half of the reactions were reported to have occurred when the consumer had not specifically disclosed the allergy to the server.

Reactions attributable to foodservice staff may occur because restaurant personnel may not have a good understanding of allergen management for lack of universal training, a problem at the onset of the modern wave of peanut allergy that has been a focus of education and advocacy efforts. In a 2017 survey of 278 US restaurant managers, fewer than half of the responding personnel were trained in food allergy awareness for food preparation,²¹ although training programs are available and emerging,

TABLE I. Clinical pearls to improve safety for restaurants/food establishments

Study observation	Management advice for patients
High-risk establishments include ice cream parlors, bakeries, Asian food	Avoid high-risk establishments or use additional instructions to staff to reduce risk. Have food prepared specifically for patient, taking into consideration cross-contact and hidden ingredients
Desserts, sauces are higher risk	Avoid unless safety can be confirmed
Restaurant personnel are often not educated about food allergy	Educate while informing. For example, instead of saying: "I cannot have peanut I am allergic," consider: "I have a severe peanut allergy and a small amount can make me sick. You cannot chop nuts and my food together, you cannot remove peanuts from my food, a vanilla milkshake would cause me a reaction if the same mixer made peanut ones, frying/cooking food does not remove peanut protein, and if peanut is a minor or secret ingredient in a food I can get sick." This additional information addresses cross-contact, hidden ingredients, and common misconceptions
Poor communication	Encourage patients to inform about allergy at each encounter, and to provide education. Identify a proper person to provide information; this may be wait staff, chef, and/or manager. Suggest proper communication among staff so that chain of information about the food is reliable. Gauge responsiveness of food establishment staff and option to leave if not comfortable. Parents should encourage and supervise young children so that they gain confidence and accuracy in alerting restaurant staff

TABLE II. Clinical pearls regarding casual exposure

Misconception or concern	Management advice for patients
Being near peanut butter can trigger a reaction	• Emphasize that ingestion is the primary trigger for significant reactions • Inform that peanut protein does not aerosolize in significant amounts from peanut butter or undisturbed peanuts
Being touched by peanut can trigger a reaction	• Describe results of studies on these topics to emphasize the low risk • Emphasize ingestion as the primary trigger of significant reactions • Describe that contact reactions may lead to no symptoms or localized ones such as a rash that often resolves when the area is washed off (exception may be direct eye exposure that could swell the eyelids)
A kiss can trigger a reaction	• Describe results of studies on these topics to emphasize the low risk • Discuss casual vs open-mouth/passionate kissing risks • Describe means to reduce the risk when passionate kissing is the concern (eg, partner avoids the food for at least several hours followed by ingestion of safe foods)
Peanut dust and/or vapors cause airborne reactions	• Describe and reassure that studies have consistently demonstrated that peanut dust does not remain airborne. Detail that peanut butter vapors contain no intact protein, and that what is being smelled is a volatile organic compound that has been shown not to provoke a reaction when inhaled even at close proximity

and were exceptionally limited in number at the time of this survey.²² In surveys of restaurant managers, staff, and chefs,²³⁻²⁶ respondents have noted potentially dangerous misperceptions about safety including that a small amount of allergen is safe for consumption, that heat destroys all allergens, or that removing nuts from a finished meal was safe, despite stated familiarity with food allergy. Another consideration that may complicate effective training is the difficulty with both kitchen staff turnover and language barriers among staff. A number of clinical pearls for education of patients about avoidance in these circumstances are described in [Table I](#).

Casual exposure

Label reading and most of the management strategies described in this review address ingestion exposures. Casual exposure refers to nondirect ingestion exposures. This may include proximity to peanut (concern of "airborne" exposure), skin contact, or kissing or unnoticed/unintended "contaminated" hand/skin contact. Casual contact poses a minimal risk of

provoking an allergic reaction itself, but if a contaminated (unwashed) hand comes in contact with the mouth or mucus membrane, that may lead to unintended/unnoticed ingestion that could provoke a reaction in sufficient quantity (as this would constitute ingestion). Importantly, casual exposure to peanut butter through either inhalation of peanut butter vapors or direct application to the skin has not been shown to trigger reactions. Simonte et al²⁷ studied 30 peanut allergic children, using double-blind methods to evaluate 10 minutes of inhalation exposure to peanut butter (surface area, 16 cm²) and 1 minute of skin contact (pea-sized amount of peanut butter). There were no reactions (except minimal skin response at the site of contact for 33%, also noted in controls). Wainstein et al²⁸ tested 281 peanut allergic children with a large skin exposure to peanut butter, 1 g with contact for 15 minutes, also with no systemic symptoms. Although "airborne" (eg, inhalational) reactions have been reported, the mechanism as to how these may occur has not been substantiated, and this is not considered a likely pathway for reactivity. Studies attempting to assay peanut proteins from air

samples in proximity to peanut butter, shelling peanuts, disturbing peanut shells, and other ambient circumstances have consistently failed to detect peanut or measure amounts above the limit of detection on highly sensitive probes.^{15,16,29,30} Peanut dust does fall to surfaces below where peanut is being eaten or shelled, and that area must be wiped down to prevent having unnoticed/unintended hand-to-mouth contact, as mentioned. However, dust and even smeared peanut butter on surfaces has been consistently shown to be readily abatable using a number of products. The allergist should keep in mind that these evidence-based findings may still not mitigate parental concerns that proximity or casual exposure may provoke a reaction. Anxiety regarding being in proximity of peanut may be ameliorated substantially by counseling or by demonstration of lack of reactivity through proximity exposure challenge.³¹ Although skin exposure/proximity to peanut is unlikely to trigger a significant reaction, it may make more sense to avoid certain situations such as using craft project with peanut butter with young children who may not be able to avoid hand-to-mouth contact. More nuanced, personalized management and solutions may be needed in situations where there is a risk that the fear/anxiety of exposure in these situations may serve as a barrier to a child's lifestyle or education.

Kissing may represent casual (kiss on the cheek) or ingestion (kiss on the mouth) contact. A few case reports have detailed allergic reactions attributable to mouth-to-mouth kissing.³²⁻³⁴ The ingestion of peanut can result in detectable amounts of protein in the saliva, though how potent these amounts are remains unclear and research is limited in this specific area. Maloney et al³⁵ had subjects ingest 2 tablespoons of peanut butter and evaluated various modalities such as brushing, rinsing, and chewing gum, to reduce the residual peanut protein in their saliva. Although all of the interventions reduced salivary peanut, waiting several hours after the peanut ingestion followed by a peanut-free meal was the most effective approach. **Table II** provides advice that an allergist can use to counsel patients/families to address concerns about casual exposure to peanut.

Travel

Travel, domestically or internationally, raises potential issues regarding food avoidance and choosing suitable foods. Families with peanut allergy traveling to an area where their native language is not spoken should be advised to have materials that can alert restaurants about the allergy in the local native language, such as translation cards. While an option and preference for some, finding lodging with a kitchen to prepare all one's meals is not likely necessary for isolated peanut allergy but may be an important option if there are multiple food allergies. Having safe nonperishable food items on hand for an emergency or while in-transit is advisable. Calling ahead to hotels and restaurants to ensure a safe meal can be obtained may reduce later concerns. Advising patients to bring extra emergency medications, insurance information, written plans, knowing how to activate emergency services (ambulance), are all also advisable. In terms of peanut allergy, patient traveling from the United States to Europe may need to be informed about lupine cross-reactions and foods containing lupine in Europe as it is much more widely used than in the United States.³⁶ However, most peanut allergic individuals are not lupine allergic.¹¹ Foods containing lupine in Europe may include pies, certain breads, and pastries in particular.

Flying may raise additional potential concern to those with peanut allergy. There is no evidence that it is unsafe to fly with a peanut allergy, or that the risk of an in-flight reaction is greater than that of a ground-based one occurring outside an aircraft, and the majority of peanut allergic patients who do fly are presumed to do so without incident. However, the experience of flying with a peanut allergy can be anxiety provoking, and many may choose to avoid air travel. One particular concern is that there is a risk that in a cabin where peanut is distributed and/or consumed, peanut dust may circulate and be inhaled. In flight, self-reported reactions have been reported.³⁷⁻⁴⁰ These studies are important, but are limited as they rely on self-report of a reaction, where it is difficult to substantiate the likely route and mechanism of exposure, or to a lesser extent if a true IgE-mediated reaction occurred (eg, vs something else mimicking an allergic reaction, such as vocal cord dysfunction, stress-induced urticaria, etc.). **Table E1** (available in this article's Online Repository at www.jaci-inpractice.org) details the key findings of the known in-flight allergy studies, which highlights a few particular concerns. The first is that based on the symptoms being self-reported, severe reactions (even anaphylaxis) have been reported and epinephrine appears to be underutilized to treat these reactions based on reported symptomatology in accordance with current management principles. The second is that flight crews are often not notified of a reaction occurring.³⁷⁻⁴⁰ Several self-management strategies have been identified that passengers themselves can take to help decrease the risk of reporting an in-flight reaction.⁴⁰ These are detailed in **Table E2**, available in this article's Online Repository at www.jaci-inpractice.org. We specifically highlight the recommendation to wipe the tray table, given recent evidence that has shown that detectable levels of allergen were noted when unwiped tray tables were assayed during a flight.³⁰ As detailed earlier, the risk of significant reactions from casual exposure appears to be minimal, but attention to hand-to-mouth transfer of particulate on tray tables and avoiding snacks that contain peanut while on board are concerns.

The Air Carrier Access Act of 1986 covers all domestic and most international flights. In terms of food allergy, the act implies that other travelers will not be required to cover the cost of any disabilities, epinephrine at a 1:1000 dose must be available on board but can only be administered if directed by an on-board or ground-based doctor, and medical certificates are not required to bring prescribed epinephrine autoinjectors on board.⁴¹ Currently, airlines have their own individual guidance on handling peanut allergies during flights, which is highly variable by airline, and has been the subject of criticism.⁴² No airline can guarantee a peanut-free flight or control what passengers consume on board, and the degree to which passengers are granted accommodations may be subject to differential legal interpretation and implementation by individual cabin crews. One area of concern is the legal authority of the pilot under the Air Carrier Act to refuse boarding or deplane someone with an identified medical risk deemed significant enough to pose a potential risk of diversion or danger to the passenger. This has resulted in multiple high-profile cases of food allergic travelers being refused boarding after disclosing the presence of a very severe food allergy to the crew, and some families have reported this as an act of discrimination by the airline in violation of the newly broadened Americans with Disabilities Act (ADA) (claiming that this was secondary to their having peanut allergy).

TABLE III. Clinical pearls regarding air travel

Misconception or concern	Practical advice to patients
There is a risk of inhaling peanut on an airplane and reacting to it	Studies have shown that peanut does not circulate in the air and this is not a likely route of exposure. Peanut dust on unwashed surfaces that becomes inadvertently ingested, or false presumption that a food is safe that actually contains peanuts are the 2 most likely sources of potential peanut exposure in flight
Only nut-free flights are safe	Use a commercial wipe to clean the seating area, in particular the tray well
Once the airline has been contacted about the food allergen, the food is safe to consume	It is recommended that food allergic individuals do not consume airline-provided food, and bring their own source
Airlines do not carry epinephrine	Passengers should travel with their own supply of self-injectable epinephrine, which is readily accessible in flight. Although airlines do carry epinephrine in their on-board medical kit, this may require an on-board medical provider or contact with ground-based providers to access, which may result in delay
Someone with a food allergy cannot be denied boarding based on his or her medical condition	Although the federal disability law was broadened in 2011 pertaining to multiple medical conditions including food allergy, it is uncertain how this is applied given potentially conflicting statutes (averting potential medical risk as assessed by the pilot under the Air Carrier Act of 1986 vs nondiscriminatory policy to deny boarding on the sole basis of a food allergy)

It is not clear how the stipulations of the pilot's right to assess a passenger's medical risk to fly under the Air Carrier Act are to be balanced by the rights potentially afforded in these situations by the ADA in the setting of the disclosure of the presence of a food allergy, so that food allergic fliers are not consistently refused boarding just because they have an allergy.⁴³ The contract of carriage to which every passenger agrees to when they purchase a ticket does not allow those with peanut allergies to take legal action against those who may discriminate against them. A passenger can file a complaint with a Complaint Resolution Officer or with the Department of Transportation.⁴⁴

In terms of labeling of allergens in food served on airlines, airlines in the United States, similar to railroads and other transportation, are managed by the Interstate Travel Program, which is enforced by the Food and Drug Administration (FDA).⁴⁵ Food allergen labeling of nonpackaged foods served on airplanes is not currently enforced and still being finalized for flights departing from the United States. In contrast, European Union (EU) food labeling laws⁴⁶ require that for flights leaving from the EU or United Kingdom, allergens must either be listed on the packaging, menu, recipe, ticket, or available from a crew member.

Table III describes practical advice for flying with a peanut allergy.

Label reading

Label reading is an essential skill to allergen avoidance. Unlike milk or egg, extensively heating peanut does not manipulate peanut epitope binding for the better, allowing "baked" tolerance.⁴⁷ Although some evidence may suggest that boiling rather than roasting raw peanut may reduce allergenicity,⁴⁸ this is still theoretical, and therefore all forms of peanut should be strictly avoided. Accidental peanut exposure is not uncommon, despite appropriate dietary education regarding avoidance—in 1 study, 50% of peanut allergic children reported accidental ingestion over a median period of 5 years.⁴⁹

Patients and families require education about appropriate peanut avoidance, which should include detailed counseling in label reading to avoid peanut protein in packaged foods.⁵⁰ A

registered dietician can be of great benefit to help families with these issues. Families should be advised regarding reading product labels carefully, to recognize how peanut could be labeled, and to be made aware that labels may change frequently and to always verify the ingredients with each item, even if they have previously eaten it safely.⁵⁰ With label reading, there should be consideration given to variability or variation in patient/family health literacy/numeracy, reading skills, and ability to understand food labels and the allergen risk they pose.^{13,51}

Labeling laws differ across the world and patients should be informed about the labeling laws pertaining to the particular country.⁵² However, all countries with labeling laws include peanut in those regulations. In the United States, the Food Allergen Labeling and Consumer Protection Act of 2004 (FALCPA) mandates that any packaged food product for sale in the United States must contain a clear list of ingredients derived from 8 major food allergens (milk, egg, soybean, wheat, peanut, tree nuts, fish, crustacean shellfish) on the label. The FALCPA law is applicable to conventional food products, dietary supplements, infant formulas, and medical foods. This excludes made-to-order food, meat, poultry, processed eggs, and other foods covered under the US Department of Agriculture (generally fresh fruits and vegetables), as well as alcohol and tobacco products. Therefore, FALCPA does not cover foods produced in restaurants even if they are placed in a wrapper or container after the order was placed. Peanut needs to be clearly indicated on the label using 1 of 3 different methods:⁵³

1. Using the allergen's common name, in this case peanut, in the ingredient list.
2. Using the word "Contains," usually underneath the ingredient list, followed by peanut—for example, "Contains peanut."
3. In the ingredient list in parentheses, for example, flour (peanut, wheat).

Highly refined peanut oil is exempt from the FALCPA allergen labeling law, but unrefined peanut oil (cold-pressed, expelled, or extruded peanut oil—sometimes called gourmet oils) needs to be clearly identified.⁵⁴ In reality however, very few (if

TABLE IV. Comparison of the US and EU labeling laws

Food allergen labelling criteria	FALCPA	EU food allergen labeling
Food allergens indicated	Using the allergen's name or in parenthesis	Using the allergen's name and in bold or italic
Use of the "contains" box	Allowed	Not allowed
PAL regulated, standardized, and quantified	No	No
Covers prepacked food	Yes	Yes
Covers food sold in restaurants and cafes	No	Yes
Peanut oil	Covers only cold/expeller pressed/unrefined peanut oil as highly refined peanut oil is not considered allergenic in the USA	Covers all types of peanut oil

EU, European Union; FALCPA, Food Allergen Labeling and Consumer Protection Act of 2004; PAL, precautionary allergen labeling.

TABLE V. Common labeling misconceptions

Misconception or concern	Practical advice for patients
Risk of contamination can be stratified based on the PAL terminology used	The exact PAL term on the food label cannot be used to stratify risk
Once a food with PAL is tolerated, it is always safe to eat	There may be batch-to-batch differences in the level of contamination of the same product
Risk of contamination is the same for all foods	Food at the highest risk of contamination are thought to include chocolate candies, cookies/biscuits, cereal/trail bars, nut mixes, baked goods/baking mixes, confectionary, and ice cream with chocolate candies from the EU at a much higher risk of contamination than the USA
All patients should avoid all products bearing PAL at all times	Although there is clearly not a zero risk of reaction of consuming these foods, patients should be informed of the ambiguity of using these PAL terms and of foods at the highest risk of contamination. The decision of whether these foods are eaten or avoided should be based on the discussion between the physician and family/patient

EU, European Union; PAL, precautionary allergen labeling.

any) products define the type of peanut oil used in the product. Data have shown that highly refined peanut oil is probably safe for peanut allergic individuals to consume, though many may prefer not to do so, and it may be advisable to counsel against this when the refinement of the oil cannot be verified.⁵⁵

Some companies may use additional phrases such as "peanut-free," but these are not regulated by the FDA. Precautionary allergen labeling (PAL), including phrases such as "may contain," "might contain," "may contain traces," "produced in factory with," "produced on the same line," or other declarations of shared equipment processing are present on many commercial food labels advising consumers that the potential cross-contact/contamination with peanut may have occurred during manufacturing (or, in a legal sense, that the 100% absence of said allergen cannot be guaranteed, adding more confusion to the term). The use of these terms is voluntary and often confusing; risk stratification based on the particular term used on the food label is not possible at present given these terms have variable meaning.⁵⁶ Ford et al⁵⁶ tested peanut contamination in a range of products, with or without PAL statements, including baking mixes, chocolate candies, nonchocolate candies, cookies, salty snacks, cereals, pasta, and pancake mixes. Of these, only 3 of 68 chocolate candies and 2 of 11 nonchocolate candies contained peanut. Taking serving size into account, only 1 of the 5 products contained enough peanut to elicit a reaction. None of the products with no PAL contained detectable levels of peanuts versus 4.5% of those with a PAL. A recent review by Brough et al⁵⁷ summarized studies reporting detectable levels of peanut in 0.9% to 25% products carrying a PAL from different

countries around the world, chocolate candies from Europe posing the highest risk of being contaminated with particularly hazelnut. These authors concluded that foods highest at risk of being contaminated with peanut include chocolate candies, cookies/biscuits, cereal/trail bars, nut mixes, baked goods/baking mixes, confectionary, and ice cream.

In general, products with PAL may have different levels of allergen present ranging from no detectable allergen to amounts that could trigger reactions in very sensitive individuals.⁵⁸ Food producers are guided to use these terms only when they consider a product to be truly at risk of peanut contamination. The US FDA advises that advisory food labels "should not be used as a substitute for adhering to current good manufacturing practices and must be truthful and not misleading."⁵⁴ The absence of any PAL also does not indicate that there is no risk of contamination, though it does indicate that there is no known ingredient under FALCPA.

In Europe and the United Kingdom, EU, legislation (2014) stipulates that 14 major allergens must be clearly declared on food labels (European Food Information to Consumers Regulation No. 1169/2011), including peanut.⁴⁶ Peanut must be highlighted on the label by using bold or italics. Both refined and unrefined peanut oil need to be clearly indicated on the food label.⁵⁹ Separate "contains" boxes or statements indicating the presence of the allergen (peanut) are not allowed. EU regulations also apply to nonpackaged food, including in restaurants and cafes that must have the allergen information available in the printed or verbal form.⁴⁶ In the EU as in the United States, PAL is not a legal requirement, risk and level of contamination vary,

TABLE VI. Age-based recommendations for peanut allergy management

Age of child	Recommendation
All ages	• Maintain self-injectable epinephrine and a food allergy action plan • Train others who are in frequent contact with the child to use self-injectable epinephrine • Strict peanut avoidance • Educate persons who prepare the child's food regarding cross-contact and safe food preparation • Reduce risk taking
Infant	• Education of caregivers • Recognition of symptoms of a reaction unique to infants • Keeping potential allergens out of reach of "curious" hands
Toddler	• Consider medical alert jewelry • Extra education of caretakers, playgroups, daycare/preschool, etc. • Management of impulse control to prevent grabbing • Learning to not share and accept food from strangers/nontrusted sources • Introduction of teaching the child to ask if the food contains his or her allergen • Introduction of teaching the child that he/she is allergic • Introduction of teaching the child about how to use a self-injectable epinephrine device and when such use would be indicated (eg, when symptoms develop)
Grade school	• Education regarding not sharing food • Consider medical alert jewelry • Introduction and continued mastery of label reading • Continuation of impulse control and asking about allergen content • Introduction and continued mastery of alerting others regarding allergy • Awareness and counseling regarding potential for bullying • Mastery of use of self-injectable epinephrine and encouraging self-carry of a device • Introduction to reducing risk-taking behaviors • Introduction of the transition of responsibility from adult caretaker to the child
Teen/adolescent	• Awareness and reduction of risk-taking behavior • Dating partner awareness of the allergy • Self-advocacy in social/public situations • Continued alerting others regarding allergy • Consider medical alert jewelry • Continue and complete the transition of responsibility of care to child • Discuss concerns about alcohol use reducing vigilance and enhancing reactions
College and beyond	• Awareness and reduction of risk-taking behavior • Dating partner awareness of the allergy • Self-advocacy in social/public situations • Continued alerting others regarding allergy • Consider medical alert jewelry • Alerting others to the presence of allergen • Establishing safe food preparation • Assuming full responsibility for one's medical care • Advocating for rights within the workplace • Discuss concerns about alcohol use reducing vigilance and enhancing reactions • Discuss concerns about use of illicit drugs reducing vigilance and enhancing reactions

and products without any PAL are not guaranteed to be safe.⁶⁰ Table IV compares US and EU regulations on labeling.

With the advent of stricter labeling laws, investigators in Europe and elsewhere have been exploring theorized "threshold" doses, defined by an eliciting dose (ED) of allergen at which a particular percentage of the population allergic to that allergen would react. For peanut, several studies have validated that the approximate dose where 5% or less of the peanut allergic population would be expected to have objective symptoms is between 1.5 and 1.95 mg of peanut protein.⁶¹⁻⁶³ A recent multinational study validated that those tolerant to a "one shot" challenge of 1.5 mg of peanut had

significant improvement of QoL, and additional economic modeling has shown that encouraging a 1.5 mg "one shot" in-office challenge versus advising strict avoidance of peanut PAL products was a highly cost-effective alternative,⁶¹⁻⁶⁴ in particular, given the boost such dietary liberation had on QoL. In Australia, this has been taken a step further. The VITALTM (Voluntary Incidental Trace Allergen Labeling) tool was developed and grades the level of risk of allergen contamination and better clarify PAL.⁵⁶ This system is currently used only in Australia, and guides food manufacturers about the use of PAL on foods based on the concentration of allergen likely to cause a reaction in the most sensitive 1% of

food allergy sufferers (ED01, which for peanut is 0.03 mg [0.002–0.37 mg]).⁶⁵ Various challenges are encountered by the food industry as summarized by Venter et al,⁵¹ the most important challenge dealing with setting threshold levels for all allergens, relevant to all population and how to implement and convey these messages. Table V describes common misconceptions and corrective counseling regarding allergen labeling.

QoL AND PSYCHOSOCIAL ISSUES

QoL among those with food allergy, both the affected individuals and their family members, has been documented to be potentially poor.⁶⁶ Comparatively, in one of the earliest food allergy QoL studies, children with peanut allergy were shown to have worse QoL than those with type I diabetes or juvenile rheumatoid arthritis.^{5,67} Interestingly, although QoL can be poor in food allergy, QoL has been shown to be (relatively) worse in milk and egg allergy than peanut, possibly owing to a greater ubiquity of these foods in the diet and difficulty of ongoing avoidance.^{9,10} Moreover, QoL among caregivers of food allergic children (including peanut allergy) is also highly dependent on the parental self-perception of the child's allergy, past history of a severe reaction, and how that reaction was treated.^{9,10} Empowerment and self-efficacy, related though distinct concepts to QoL, have also been shown to be better in caregivers of peanut allergic children than milk or egg allergic children.⁶⁸ Although peanut may have less impact in some ways than other foods, it is highly important for care providers to recognize the potential that peanut allergy can have a strong negative impact on affected families, and how this allergy can increase anxiety, alter socialization, and affect how a family may go about their day-to-day life. However, each individual and family may be differentially affected. It is also important to keep in mind that depending on whom you assess—parent's life, child's life, or parent's impression of the child's life—QoL can differ and parents have been noted in food allergy (and other illnesses) to overestimate the deficit in their child compared with what the child himself or herself may report. The use of both food challenge and oral immunotherapy (OIT) (in selected studies, with more likely beneficial data anticipated from recent phase III OIT trials as well as epicutaneous immunotherapy [EPIT] trials) may help improve QoL, though there remain very limited other interventions.^{69–73}

Bullying is another issue that providers should be aware of. A few studies have noted that children with food allergy, including peanut allergy, have reported being the target of bullying because of their food allergy.^{74–78} Anecdotal reports have also noted that some children have also reported that peers have tried to force feed or involuntarily expose them to peanut (eg, smearing, switching food).⁷⁹ Data on this from studies are emerging, but this is a problem being recognized as a potential growing issue. It is unclear if this is a distinct trend specific to food allergy or part of a larger growing trend of increased bullying among children.^{78,80} Parents may not be aware of the bullying, and if they are, rectifying the problem by alerting the school can result in decreased bullying and improved QoL. Therefore, including a discussion of bullying with families managing peanut allergy is advisable.

Epinephrine

Recognition of an allergic reaction/anaphylaxis and prompt and appropriate use of epinephrine is a key to peanut allergy

management.⁸¹ Symptoms of a peanut allergy can be highly variable from one reaction to another.⁸² Although some may have had a mild past reaction, that is not a reliable predictor of a future reaction, and therefore anyone with a peanut allergy should be given a prescription for self-injectable epinephrine, as well as training in how to use the device and a written action plan.^{81,83} Epinephrine is first-line treatment for severe reactions, but can be used to treat any symptom, and there is little downside to using it safely even if there is doubt to the severity of the reaction.^{84–87} Epinephrine can readily reverse any symptom of an allergic reaction (if its use is timed appropriately), unlike antihistamines that have limited efficacy against respiratory and circulatory/cardiovascular effects. Indications for epinephrine use are robustly reviewed elsewhere.^{81,84} It is of note that a recent cost-effective analysis showed no health or economic benefit for a recent trend of “pre-emptive” administration of epinephrine (inject for known allergen exposure even in the absence of symptoms), though some experts recommend this and some action plans provide an option for this.⁶⁴

Families may be very concerned about fatality, though food allergy fatalities are exceptionally rare, and almost always are associated with delay or absence of appropriate treatment.^{88–90} A review of national mortality statistics has noted that fewer than 150 fatalities were attributed to food allergy over a 10-year time period, though this does not rule out the possibility that some may have occurred that were not noted in these data. It is important to keep in mind that to many patients, the rarity of this outcome occurring is of no consequence and this is a very present fear for them on a daily basis, even obscuring other activities that one does daily that may in fact have much higher risks of fatality. Thus, such discussions need to be handled delicately, with empathy and sensitivity in one's day-to-day conversations with patients and families.

MANAGEMENT OF PEANUT ALLERGY BY AGE: KEY CONSIDERATIONS

Table VI details considerations for management by age. Although there are many commonalities of managing peanut allergy that occurs independent of age, like with any childhood illness, age often dictates certain aspects of management. General principles for managing peanut allergy applicable to any age include avoidance of ingestion of peanut-containing items, being prescribed and carrying self-injectable epinephrine, not taking risks with exposure, and having a written action plan if there is a symptomatic peanut exposure.⁸² However, for infants and toddlers, additional considerations such as training of extended caregivers (eg, grandparents, nanny/sitter), identification of more subtle signs of a reaction (withdrawal, cessation of play, clinginess), and understanding how a child in distress may present with limited verbal abilities, and keeping peanut products out of reach of “curious” hands and minds are important considerations.⁹¹ Issues like enrichment classes and playgroups also may pose additional challenges. For the school-aged child, having a clear treatment plan that the school (including the student's teachers, nurse, and layperson staff) can implement is of the utmost importance, as is maximizing self-protective behavior like avoiding sharing of items, strict hand and surface washing, and finding some compromise about where the student can sit at lunch and what can be used in class activities/celebrations.^{92–94} Playdates and out of school activities may play a large role in

this age group, so extending epinephrine and allergy awareness training to coaches, instructors, or other families who may regularly supervise the individual is important. For the adolescent and teen, risk-taking behavior is a large issue (both for food allergy and non-food allergy-related considerations), and parents and providers need to regularly counsel the allergic individual about not taking risks such as dabbling with unknown or unlabeled foods, always carrying epinephrine, and promptly treating reactions. Many of these issues can be extended to the college-aged individual, with additional considerations of notifying food preparers of one's allergy, and notifying close campus contacts (including health services, roommates, and close friends).⁹⁵⁻⁹⁸ For the peanut allergic adult, similar guidance should be heeded about risk taking and notifying others of their allergy. These needs also need to be balanced within the workplace, and with families. It is important to counsel parents or soon-to-be parents that peanut allergy is not thought to be directly heritable in a child, and to not delay early introduction of peanut in their offspring.⁹⁹

CONCLUSIONS

Peanut allergy is one of the most common food allergies in children and adults. Until there is a curative therapy, management will require attention to dietary avoidance and recognition and management of allergic reactions and anaphylaxis. This review provides guidance on how the physician and other health care providers may approach management issues in counseling with their patients. However, more studies are needed on determining the most effective management strategies, how best to approach management while improving QoL, and how management approaches may need revision as noncurative therapies emerge.

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ONLINE REPOSITORY

TABLE E1. Comparison of patient and reaction characteristics of passenger reported allergic reactions to peanut, tree nut, and sesame seed occurring on commercial aircraft

Study	N	Age	Peanut	Inhalation	Contact	Ingestion	Severe	Epinephrine	Antihistamine
Sicherer (1999) ^{E1}	42	6 mo-50 y	35 (83.3%)	14 (33.3%)	7 (16%)	14 (33%)	5 (12%)	6 (14.3%)	28 (66.7%)
Comstock (2007) ^{E2}	41	2-50 y	30 (71%)	26 (58%)	4 (9%)	15 (33%)	36 (88%)	4 (9.7%)	15 (36.5%)
Greenhawt (2009) ^{E3}	150	6 mo-60 y	96 (64.1%)	73 (48.6%)	42 (27.9%)	24 (15.7%)	50 (33.3%)	15 (10%)	115 (77%)
Greenhawt (2013) ^{E4}	347	3 mo-50 y	239 (69.5%)	155 (44.7%)	114 (32.9%)	45 (13%)	Not calculated	46 (13.3%)	297 (85.6%)
		Comorbid asthma	Respiratory	Cardiovascular	Skin	GI	Notified crew	Prenotified airline	Had own medication
Sicherer (1999) ^{E1}		17 (40%)	11 (31.4%)	0	15 (43%)	2 (6%)	14 (33%)	17 (40%)	27 (64.3%)
Comstock (2007) ^{E2}		28 (68%)	NA	NA	NA	NA	12 (29%)	NA	12 (38%)
Greenhawt (2009) ^{E3}		74 (53%)	42 (28%)	2 (1.4%)	84 (56%)	11 (7.5%)	67 (44%)	96 (63%)	115 (76%)
Greenhawt (2013) ^{E4}		Not reported	287 (82.7%)	77 (22.2%)	290 (83.6%)	84 (24.2%)	177 (51%)	193 (55.5%)	309 (88.9%)

GI, Gastrointestinal; NA, not available.

TABLE E2. Adjusted risk-reduction odds associated with reported passenger accommodations

Lower odds of reaction	Odds ratio (95% CI)	No association	Odds ratio (95% CI)
Make any request	0.32 (0.19-0.54)	Preboarding	0.81 (0.55-1.19)
Request buffer zone	0.64 (0.44-0.94)	Sit in particular seat/section	0.62 (0.36-1.08)
Request announcement to not eat peanut/nut items	0.67 (0.46-0.96)	Not distribute peanut/nut containing snacks	0.78 (0.56-1.08)
Request peanut/nut-free meal	0.43 (0.28-0.65)	Wipe seat belt	0.85 (0.61-1.2)
Wipe tray table	0.61 (0.44-0.86)	Wipe seat back	0.8 (0.57-1.12)
Bring own food	0.19 (0.13-0.27)	Wipe arm rest	0.73 (0.52-1.03)
Avoid use of airline blanket/pillow	0.67 (0.48-0.94)	Wipe common surfaces	0.76 (0.52-1.13)

Odds ratio (OR): odds of an event occurring/odds of the event not occurring. OR > 1 indicates increased chance, OR < 1 a reduced chance. OR of 1 indicates no increased or decreased chance.

95% confidence interval (95% CI)—a range of values between which, with 95% probability, the true value is expected to fall.

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