

ORIGINAL ARTICLE

A brief intervention to improve food allergy knowledge among US pediatricians: lessons learned

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Keywords

food allergy; primary care physicians; continuing medical education.

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Abstract

Objective: To evaluate a brief educational tool for pediatricians developed to address known gaps in food allergy knowledge.

Study Design: Pre- and post-assessments were administered to a convenience sample of 61 US pediatricians completing the Food Allergy Comprehension Tool between February and March of 2010. McNemar's and Wilcoxon signed rank tests were used to determine whether clinical knowledge of food allergy and level of comfort in caring for food-allergic children increased significantly after reviewing the tool. Logistic regression models were used to measure the association of participant characteristics with increased knowledge and comfort.

Results: Sixty-one percent of surveyed physicians answered more knowledge questions correctly after reviewing the tool. Significantly more participants correctly indicated that anaphylaxis poses the greatest threat to teenagers rather than young children, and correctly rejected chronic nasal problems as a symptom of food allergy ($p < 0.05$). Comfort in caring for food-allergic children increased significantly on all items post-intervention ($p < 0.05$). Odds of increased knowledge and comfort were significantly higher among pediatricians without previous training in food allergy.

Conclusion: The Food Allergy Comprehension Tool is a rapid way to address known knowledge gaps among pediatricians and to identify areas in need of further intervention. We recommend integration of the tool with current food allergy guidelines.

Food allergy is a growing concern in the United States, affecting an estimated 6–8% of children (1–3). Food allergy may be fatal at a time and place that cannot be predicted and may occur despite perceived allergen avoidance, self-treatment, and medical attention (4). Further, anaphylaxis is most often food-induced (5) and is responsible for substantial morbidity and mortality in the United States (6).

Given the uncertainty and unpredictability of food allergy reactions, prevention is of utmost importance. The pediatrician plays a critical role to this end in the United States, where many pediatricians provide primary care and are therefore often the first and sometimes only line of defense against

childhood food allergy. Pediatricians are frequently relied on by families for an initial diagnosis of food allergy, instruction in the management of food allergy, and evaluation of food allergy over time.

However, significant knowledge gaps and misconceptions in food allergy, have been reported among providers in the United States (7–10). Studies suggest that many pediatricians are unaware of the most common food allergens and are unable to correctly instruct families in the appropriate administration of epinephrine following a food-induced anaphylactic event (7, 10). Perhaps more alarming, a recent review reports that there is no widely practiced gold-standard criteria for the diagnosis of food allergy (11).

Further, physicians have expressed concern regarding their clinical ability to manage and treat food allergy (7). In spite of the stated need, formal training in food allergy is rare in pediatric programs. While several educational tools exist, current resources are not tailored to meet the needs of the busy primary care provider (12–15).

Further effort is needed to equip pediatricians in the provision of care for food-allergic patients. The goal of this study was to evaluate a brief education tool for primary care physicians specifically targeting known misconceptions in food allergy.

Methods

Pre- and post-assessments were administered to a convenience sample of pediatricians completing the Food Allergy Comprehension Tool (FACT) between February and March of 2010. The Institutional Review Boards of Children's Memorial Hospital and Northwestern University in Chicago, IL USA, approved the study protocol. Consent to participate was implicit in completion and return of the FACT.

Development and design

The FACT was developed by pediatricians, pediatric allergists, and health services researchers, with support of an expert panel of leaders in the field. The tool was designed to address common food allergy misconceptions among primary

care physicians previously identified in a study conducted by Gupta et al. (7). Following expert panel review, cognitive interviews (N = 5) were conducted to ensure general understandability and consistency of response using the referenced approach (16).

The FACT is included for the reader in Supplement 1. The tool includes a brief pre- and post-evaluation, three food allergy case studies, and several case-related questions with detailed explanations and references to relevant literature. A sample case study is also included in Fig. 1 for reference.

Study participants

Eligible participants included practicing pediatricians able to complete a web-based version of the FACT in English. Participants were recruited from four Chicago-area practices, a list of graduates from the Children's Memorial Hospital Residency Program, and current members of the Illinois Chapter of the American Academy of Pediatrics via email invitation with a direct link to the tool. Upon completion, a small honorarium was provided to participants.

Outcome measures

Pre- and post-assessments were used to evaluate changes in participant response. Assessments were identical and administered immediately before and after completion of the case

Case 1

Jack is a 26 month old male who returns to your clinic after an ER visit for food allergy. He ate a piece of a granola bar that was produced on a line with peanut and tree nuts. Fifteen minutes later he developed hives on his arms, legs, and trunk. His mother next noticed periorbital edema and wheezing. He was taken to a nearby ER and was treated with IM epinephrine, diphenhydramine, steroids, and one albuterol nebulized treatment. He was observed in the ER and then discharged home that evening. He was sent home with a prescription for an epinephrine auto-injector.

Jack has a history of eczema that is well controlled with topical emollients and occasional topical steroid use. He has no prior history of wheezing. His parents do not report any previous exposure to peanuts. He eats eggs, milk, soy and wheat with no symptoms of food allergy. He has never eaten tree nuts, fish, or shellfish.

1. The parents are concerned about other potential signs of food allergy. Other signs may include:
 - A. Atopic dermatitis
 - B. Chronic nasal congestion
 - C. Acute urticaria
 - D. Both A and C

Explanation to Question 1

There is a wide range of manifestations of food allergy. Food allergy has been reported in up to 35% of patients referred to an allergist or dermatologist for atopic dermatitis. Evaluation should be considered in infants and children with moderate to severe atopic dermatitis or if there is a history of exacerbation when eating specific foods. If food allergy is diagnosed, the atopic dermatitis often improves after dietary elimination of that particular food.

The causes of acute urticaria vary and include infection, drug reaction, and food allergy. Acute urticaria is a common symptom present with food allergy. In contrast, chronic urticaria is very rarely related to food allergy. Food allergy testing is rarely indicated for chronic urticaria since most cases are idiopathic.

Multiple nasopharyngeal symptoms occur with food allergy, including acute rhinitis, but the rhinitis is typically associated with other oropharyngeal symptoms such as pruritus of the throat and angioedema. However, chronic rhinitis is not a manifestation of food allergy.

The correct answer is D, both atopic dermatitis and acute urticaria may be signs of food allergy.

Sources:

1. Burks W. Skin Manifestations of Food Allergy. *Pediatrics* 2003; 111:1617-24.
2. Kulthan K. Prevalence and relevance of the positivity of skin prick testing in patients with chronic urticaria. *J Dermatol* 2008; 35:330–35.

Figure 1 Example of a case study used as part of the Food Allergy Comprehension Tool (FACT) in intervention.

studies. Provider knowledge of food allergy diagnosis, symptoms, triggers, susceptibility, and treatment was evaluated as well as the level of comfort in caring for food-allergic children.

Statistical analysis

Physician's knowledge was dichotomized into correct or incorrect. Level of comfort was measured in five ordinal categories ranging from one (not very comfortable) to five (very comfortable). McNemar's and Wilcoxon's signed rank tests were performed to evaluate significant changes post-FACT in physicians' knowledge of and comfort in caring for children with food allergy, respectively.

Logistic regression models were used to measure the association of physician characteristics with clinical knowledge of food allergy and the physician's level of comfort in caring for food-allergic children. For this analysis, the level of comfort was dichotomized into increased comfort levels post-FACT or unchanged/decreased comfort levels.

All statistical analyses were performed with a type I error of $p < 0.05$, using Stata/SE 12.0 (Stata Corp LP, College Station, TX, USA).

Results

Participant characteristics

A total of 62 pediatricians responded to the web-based FACT. Data from one physician were not used in analyses owing to missing responses, yielding a final sample of 61 participants.

Time in practice was well distributed from one to 47 years. Sixty-four percent of physicians had practiced for more than 10 years. Twenty-three percent had participated in allergy training during residency, but none had fellowship training in allergy.

Knowledge of food allergy

Sixty-one percent of surveyed physicians answered more knowledge questions correctly after reviewing the FACT case studies. Itemized scores for the pre-/post-knowledge questions are presented in Table 1. After reviewing the FACT, significantly more physicians correctly responded to two of the five knowledge questions, indicating that anaphylaxis poses the greatest threat to teenagers rather than young children (77% vs. 51%, $p < 0.01$), and correctly rejected chronic nasal problems as a symptom of food allergy (82% vs. 31%, $p < 0.01$). More physicians also correctly identified the three most common food allergies in children (57% vs. 46%, $p = 0.19$) and selected the correct dose of epinephrine by weight (87% vs. 82%, $p = 0.32$), but not to a degree of statistical significance. Significant improvements in knowledge were observed regardless of how long a provider had been in practice, but odds of improvement were higher among those without formal training in food allergy (Table 2).

Table 1 Pre-/post-knowledge assessment following administration of the Food Allergy Comprehension Tool (N = 61)

Item	Correct responses, % (n)		
	Pre	Post	p-value
Definition and diagnosis			
Positive skin prick test or IgE testing is sufficient for diagnosis (F)	84 (51)	82 (50)	0.81
Symptoms and severity			
Chronic nasal problems are symptoms of FA (F)	31 (19)	82 (50)	<0.01
Triggers and environmental risk			
3 most common childhood FA (egg, milk, peanut)	46 (28)	57 (35)	0.19
Perceptions of susceptibility and prevalence			
Teenagers are at higher risk for fatal FA (T)	51 (31)	77 (47)	<0.01
Treatment and utilization of health care			
Dose of epinephrine, 66-lb child (EpiPen/Twinject, 0.3 mg epinephrine)	82 (50)	87 (53)	0.32

FA, food allergy.

Table 2 Association between participant characteristics and increased knowledge of food allergy following administration of the Food Allergy Comprehension Tool (N = 61)

Item	Odds of increased knowledge, OR (95% CI)	
	Years in practice? >10 vs. ≤10 yr	Allergy training? Yes vs. No
Definition and diagnosis		
Positive skin prick test or IgE testing is sufficient for FA diagnosis (F)	0.5 (0.2, 1.6)	0.3 (0.1, 1.0)
Symptoms and severity		
Chronic nasal problems are symptoms of FA (F)	1.7 (0.6, 5.0)	0.2 (0.1, 0.7)
Triggers and environmental risk		
Three most common childhood FA (egg, milk, peanut)	0.5 (0.2, 1.4)	1.0 (0.4, 2.9)
Perceptions of susceptibility and prevalence		
Teenagers are at higher risk for fatal FA (T)	1.2 (0.4, 3.8)	0.5 (0.2, 1.8)
Treatment and utilization of health care		
Dose of epinephrine, 66-lb child (EpiPen/Twinject, 0.3 mg epinephrine)	0.4 (0.1, 1.6)	0.8 (0.2, 3.6)

FA, food allergy.

Level of comfort in caring for food-allergic children

Seventy-five percent of surveyed physicians reported an increased level of comfort in caring for food-allergic children

after reviewing the FACT case studies. Itemized comfort scores increased significantly on all items post-FACT (Table 3). Increased comfort was observed regardless of how long a provider had been in practice, and among those with or without formal training in food allergy (Table 4).

Discussion

Improving knowledge gaps in the recognition and management of childhood food allergy is vital among pediatricians in primary care. These providers are often the first and sometimes only line of defense against childhood food allergy in the United States. More thorough training is needed in order to keep affected children safe, with careful planning to ensure common misconceptions are adequately addressed. Evaluation of the Food Allergy Comprehension Tool suggests it is one such tool to assess providers' baseline knowledge, rapidly address known misconceptions, and identify areas in need of further intervention.

Past work suggests that primary care providers often struggle to correctly identify food allergy symptoms, understand susceptibility and risk, and advise parents on appropriate treatment (7, 9). After reviewing the FACT, improvements were most marked on items addressing symptoms and susceptibility. Significant increases in knowledge were not detected for three of the five pre-/post-knowledge questions, highlighting areas in need of more intensive intervention. Findings also suggest that the FACT may relieve physicians' previously reported concerns in caring for food-allergic children (7). After completing the case studies, increased comfort in care was observed for all items assessed.

Table 3 Pre-/post-comfort in caring for food-allergic children following administration of the Food Allergy Comprehension Tool (N = 61)

Item	Mean comfort score (s.d.)		
	Pre	Post	p-value
Definition and diagnosis			
Diagnosis of FA	3.89 (0.69)	4.15 (0.73)	<0.001
Knowledge/interpretation of laboratory testing	3.66 (0.75)	3.98 (0.76)	<0.001
Knowledge of oral allergy syndrome	3.31 (1.03)	3.87 (0.76)	<0.001
Symptoms and severity			
Identification of FA symptoms	3.49 (0.91)	4.05 (0.78)	<0.001
Triggers and environmental risk			
Recommended dietary restrictions for children with FA	3.07 (1.03)	4.00 (0.86)	<0.001
Use of epinephrine autoinjector	4.25 (0.87)	4.44 (0.72)	0.026
Counseling of patients/families with FA	3.49 (0.89)	4.03 (0.78)	<0.001

FA, food allergy; S.D., standard deviation.

Scores range from 1 (not very comfortable) to 5 (very comfortable).

Table 4 Association between participant characteristics and increased comfort caring for food-allergic children following administration of the Food Allergy Comprehension Tool (N = 61)

Item	Odds of increased comfort, OR (95% CI)	
	Years in Practice? >10 vs. ≤10 yr	Allergy training? Yes vs. No
Definition and diagnosis		
Diagnosis of FA	1.1 (0.4, 3.3)	1.2 (0.4, 3.5)
Knowledge/interpretation of laboratory testing	1.5 (0.5, 4.4)	0.3 (0.1, 1.0)
Knowledge of oral allergy syndrome	1.7 (0.6, 4.9)	0.5 (0.2, 1.5)
Symptoms and severity		
Identification of FA symptoms	0.7 (0.2, 2.4)	0.4 (0.1, 1.5)
Triggers and environmental risk		
Recommended dietary restrictions for children with FA	0.7 (0.2, 1.9)	0.6 (0.2, 1.6)
Use of epinephrine autoinjector	1.2 (0.3, 4.0)	0.3 (0.1, 1.3)
Counseling of patients/families with FA	1.1 (0.4, 3.0)	0.3 (0.1, 1.0)

FA, food allergy.

Because it is critical to ensure that increased confidence is accompanied by adequate knowledge, administration of the FACT alone is not sufficient to address the care of food-allergic children. Rather, the FACT is a stepping stone to more targeted training where indicated; notably, the tool seems to be particularly helpful to improve knowledge among pediatricians without formal training in allergy.

Interactive case scenarios have been shown to be more effective than didactic lectures in continuing medical education (CME) sessions (17–20). Reports have also demonstrated that web-based CME programs are just as effective as traditional formats, if not better (21–24). Accordingly, the FACT has been accepted as a paper- and web-based CME program at Children's Memorial Hospital in Chicago, IL, and is available for use at other institutions upon request.

The National Institute of Allergy and Infectious Diseases (NIAID) recently published its first official guidelines outlining ideal management practices for children with food allergy (25, 26). This publication offers a unique opportunity to enhance the FACT, a tool designed for use in busy primary care practices. The development of a brief, easy-to-use version of the guidelines would be an excellent complement to this tool. Together, both components hold promise as a practical first step in a food allergy intervention designed to improve food allergy diagnosis, management, and counseling among primary care physicians.

Several limitations to this study should be highlighted. A convenience sample of providers was utilized, making selection bias a concern. Those inclined to participate may have had higher baseline knowledge of food allergy, limiting the detection of significant improvements in knowledge after

reviewing FACT case studies. Small sample size may also have hindered the detection of statistical significance.

Conclusion

The Food Allergy Comprehension Tool is a rapid way to address known knowledge gaps among pediatricians and to identify areas in need of further intervention. The tool proved most effective among providers without formal training in food allergy and may require modification for use in other populations. We recommend integration of the FACT with the recent NIAID food allergy guidelines. If successfully disseminated, this practical tool holds promise as a first step in targeted interventions designed to improve food allergy diagnosis, management, and counseling among primary care physicians. Such interventions are vital to improve the management of childhood food allergy in the United States.

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management, analysis, or interpretation of the data; or in preparation, review, or approval of the manuscript.

Authors contributions

EES made substantial contributions to the study's conception and design, intervention development, acquisition of data, interpretation of data, and drafting of the manuscript. CHL and MWS performed the statistical analysis and participated in data interpretation and drafting of the manuscript. PP made substantial contributions to the study's conception and design, intervention development, and acquisition of data and also provided critical revisions to the manuscript. MRW and JP provided critical input to the study's conceptions and design as well as intervention development and also provided critical revisions to the manuscript. RS conceived of and designed the study, made substantial contributions to intervention development, and provided critical revisions to the manuscript. All authors read and approved the final manuscript.

Financial disclosures

The authors have nothing to disclose.

Conflict of interest

The authors have no conflicts of interest.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Data S1. The Food Allergy Comprehension Tool.

Please note: Wiley-Blackwell are not responsible for the content or functionality of any supporting materials supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

Supplemental Material 1. The Food Allergy Comprehension Tool.

Before reviewing the cases, please complete the following pre-evaluation.

a. How comfortable are you in the following areas of food allergy?

	<u>Not Very Comfortable</u>			<u>Very Comfortable</u>	
Identification of food allergy symptoms	1	2	3	4	5
Diagnosis of food allergy	1	2	3	4	5
Knowledge/interpretation of laboratory testing for food allergy	1	2	3	4	5
Recommended dietary restrictions for children with food allergy	1	2	3	4	5
Use of epinephrine autoinjector	1	2	3	4	5
Knowledge of oral allergy syndrome	1	2	3	4	5
Counseling of patients/families with food allergy	1	2	3	4	5

b. A positive skin prick test or serum specific IgE testing by itself is sufficient for the diagnosis of food allergy.

☐ True ☐ False ☐ I don't know

c. Which of the following are the **three** most common food allergies in children? **Choose 3 answers.**

☐ Milk ☐ Soy ☐ Tomato ☐ Wheat
☐ Egg ☐ Peanut ☐ Seafood ☐ Tree Nuts
☐ Strawberry ☐ Citrus

d. Teenagers are at higher risk of fatality from food-induced anaphylaxis than younger children.

☐ True ☐ False ☐ I don't know

e. Which of the following doses of epinephrine would you prescribe to a child who weighs 30 kg (66 lbs)?

☐ Epipen Jr. or Twinject Jr. (0.15 mg of 1:1000 epinephrine)
☐ Epipen or Twinject (0.3 mg of 1:1000 epinephrine)
☐ Neither of the above
☐ I don't know

f. Chronic nasal symptoms may be a sign of food allergy.

☐ True ☐ False ☐ I don't know

Case 1

Jack is a 26 month old male who returns to your clinic after an ER visit for food allergy. He ate a piece of a granola bar that was produced on a line with peanut and tree nuts. Fifteen minutes later he developed hives on his arms, legs, and trunk. His mother next noticed periorbital edema and wheezing. He was taken to a nearby ER and was treated with IM epinephrine, diphenhydramine, steroids, and one albuterol nebulized treatment. He was observed in the ER and then discharged home that evening. He was sent home with a prescription for an epinephrine auto-injector.

Jack has a history of eczema that is well controlled with topical emollients and occasional topical steroid use. He has no prior history of wheezing. His parents do not report any previous exposure to peanuts. He eats eggs, milk, soy and wheat with no symptoms of food allergy. He has never eaten tree nuts, fish, or shellfish.

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1. The parents are concerned about other potential signs of food allergy. Other signs may include:
 - A. Atopic dermatitis
 - B. Chronic nasal congestion
 - C. Acute urticaria
 - D. Both A and C

Explanation to Question 1

There is a wide range of manifestations of food allergy. Food allergy has been reported in up to 35% of patients referred to an allergist or dermatologist for atopic dermatitis. Evaluation should be considered in infants and children with moderate to severe atopic dermatitis or if there is a history of exacerbation when eating specific foods. If food allergy is diagnosed, the atopic dermatitis often improves after dietary elimination of that particular food.

The causes of acute urticaria vary and include infection, drug reaction, and food allergy. Acute urticaria is a common symptom present with food allergy. In contrast, chronic urticaria is very rarely related to food allergy. Food allergy testing is rarely indicated for chronic urticaria since most cases are idiopathic.

Multiple nasopharyngeal symptoms occur with food allergy, including acute rhinitis, but the rhinitis is typically associated with other oropharyngeal symptoms such as pruritus of the throat and angioedema. However, chronic rhinitis is not a manifestation of food allergy.

The correct answer is D, both atopic dermatitis and acute urticaria may be signs of food allergy.

Sources: 1. Burks W. Skin Manifestations of Food Allergy. *Pediatrics* 2003; 111:1617-24.
2. Kulthan K. Prevalence and relevance of the positivity of skin prick testing in patients with chronic urticaria. *J Dermatol* 2008; 35:330–35.

2. Jack is referred to an allergist for further evaluation. What is the most appropriate testing at this time?

- A. Atopy patch testing
- B. Serum specific IgE testing or skin prick testing
- C. Oral food challenge

Explanation to Question 2

Skin prick testing involves introduction of allergen extracts into the skin. A positive reaction is defined as a wheal at least 3mm greater than the negative control. The negative predictive value is > 95% while the positive predictive value is < 50%; therefore, there are many false positive results. Antihistamines should be discontinued prior to testing. Testing cannot be performed on skin with extensive eczema/rash or in patients with dermatographia. In these patients, serum specific IgE testing may be of use. Serum specific IgE testing is the detection of the serum specific IgE to specific allergens. All positive and negative tests need to be correlated with the patient's clinical history. A positive test alone does not make the diagnosis of clinical food allergy. Rather, it provides evidence of sensitization, i.e., an immunological response.

A double-blind, placebo controlled food challenge is the gold standard for diagnosis of food allergy, though open challenges are generally used in most clinical settings. The patient is given gradually increasing amounts of the suspected food allergen over a time period of hours to a day. The process requires close physician supervision. Patients may benefit from an oral food challenge if they have borderline test results or if a false positive or false negative is suspected based on clinical history. Oral food challenges may prevent unjustified food elimination from the diet.

Atopy patch tests are currently used to diagnose delayed hypersensitivity T-cell mediated reactions such as contact dermatitis. Atopy patch testing for IgE-mediated food allergy is not recommended.

The correct answer is B, serum specific IgE testing or skin prick testing are appropriate *initial* tests for food allergy.

Sources: 1. Sampson H. Update on food allergy. *J Allergy Clin Immunol* 2004; 113:805-19.
2. American College of Allergy, Asthma, & Immunology. Food allergy: a practice parameter. *Ann Allerg Asthma Immunol* 2006; 96:S1-68.

Skin prick testing reveals the following:

Histamine (positive control): 3 mm wheal
Glycerosaline (negative control): 0 mm wheal
Peanut: 7 mm wheal
Walnut: 2 mm wheal
Cashew: 3 mm wheal
Almond: 3 mm wheal
Pecan: 2 mm wheal
Hazelnut: 1mm wheal
Fish: 2 mm wheal

Serum specific IgE testing reveals:

Peanut: 15 kU/L
Walnut: < 0.35 kU/L
Cashew: < 0.35 kU/L
Almond: < 0.35 kU/L
Pecan: < 0.35 kU/L
Hazelnut: < 0.35 kU/L
Fish: < 0.35 kU/L

3. What should you advise the family regarding food avoidance?

- A. Avoid peanuts
- B. Avoid tree nuts
- C. Avoid fish
- D. A and B
- E. A, B and C

Explanation to Question 3

The diagnosis of food allergy is established through clinical history and oral challenge. Skin tests and serum specific IgE provide evidence of sensitization and help determine when a challenge is appropriate.

Patients with large wheals from skin prick testing (SPT) or with high serum specific IgE are likely to have food allergy. For certain foods (e.g., cow's milk, egg, peanut), cutoff values associated with high likelihood for having a reaction have been published. The cutoff value for IgE and wheal diameter is different for each food and is also dependent on the age of the child. The cutoff value is the concentration of specific IgE for a particular food allergen that is 90% predictive of a clinical reaction to the food. Increasing levels of specific IgE and wheal response to SPT beyond the cut-off level correlate with an increased likelihood of having clinical food allergy but not necessarily with reaction severity. **For example, established cutoff values for serum specific IgE testing include:**

Egg (child 3-17 yrs): 7 kU/L
Egg (child ≤ 2 yrs): 2 kU/L
Cow's milk (child 3-17 yrs): 15 kU/L
Cow's milk (child ≤ 2 yrs): 5 kU/L
Peanut (child < 18 yrs): 14 kU/L
Fish (child < 18 yrs): 20 kU/L

Jack is therefore likely to be truly allergic to peanut since his IgE value is over the 14 kU/L cutoff value. Note that Jack was not tested for egg or milk allergy as his parents reported regular consumption of these foods without symptoms of food allergy. If a child is already consuming a food without experiencing a clinical reaction, SPT and IgE testing is not warranted. If for whatever reason testing is conducted and positive results are observed, it is important to stress to the caregiver that the food continue to be consumed on a regular basis. Because testing indicates that the child is sensitized to the allergen, a prolonged absence of the food from the diet could lead to clinical symptoms upon re-exposure.

While there is no cross reaction between peanuts and tree nuts, children allergic to one have an increased risk of allergy to the other. Since peanuts and tree nuts are often processed together, it is often advisable to strictly avoid both peanuts and tree nuts to avoid exposure through cross-contamination.

The correct answer is D, Jack should continue to avoid peanuts and tree nuts.

Sources: 1. Sampson H. Update on food allergy. *J Allergy Clin Immunol* 2004; 113:805-19.
2. American College of Allergy, Asthma, & Immunology. Food allergy: a practice parameter. *Ann Allergy Asthma Immunol* 2006; 96:S1-68.
3. Clark AT, Ewan PW. The development and progression of allergy to multiple nuts at different ages. *Pediatr Allergy Immunol* 2005; 16:507-11.

4. Of the following, which is the proper anticipatory guidance regarding recognition and appropriate management of anaphylaxis?
- A. A dose of anti-histamine can prevent food-induced anaphylaxis
 - B. Epinephrine is the primary treatment for anaphylaxis
 - C. Fatal anaphylactic reactions occur most often in individuals with unknown food allergy

Explanation to Question 4

Fatal and near-fatal anaphylaxis typically occurs in people with known food allergy at locations away from home (such as school). Of note, persons with asthma and teenagers are at a higher risk for fatal reactions. Many people with food allergy do not carry self-injectable epinephrine with them. Food antigens may not be apparent in foods such as cookies or cakes, and even trace amounts of the food or handling of the food can induce anaphylaxis.

Common symptoms of anaphylaxis include dyspnea, urticaria, angioedema, flushing, pruritus, GI symptoms, syncope, and hypotension. Cutaneous symptoms are the most common and occur in over 90% of reported cases but are less common in cases of fatal anaphylaxis. Signs of anaphylaxis typically occur within seconds to minutes after exposure to the allergen, although, rarely, symptoms may occur a few hours later. A late phase reaction may also occur several hours after the initial reaction. Parents should be advised that any child with signs of anaphylaxis needs observation in a healthcare setting for a minimum of 4-6 hours.

Epinephrine should be given at the first sign of anaphylaxis. Epinephrine acts by decreasing vasodilation, edema, and bronchoconstriction. In addition, it suppresses the release of inflammatory mediators from mast cells and basophils. Patients should be taken to the closest hospital even if the symptoms have resolved as they may recur and the patient would then require additional doses of epinephrine.

Antihistamines may control urticaria or other symptoms of anaphylaxis but its use should not be substituted for intramuscular epinephrine. Diphenhydramine and cetirizine can be used in addition to epinephrine but both medications have a slower onset of action and should never be used alone for the treatment of anaphylaxis.

All patients with food allergy should wear a MedicAlert bracelet listing the foods that cause allergic reactions.

The correct answer is B, epinephrine is the primary treatment for anaphylaxis.

Sources: 1. Joint Task Force on Practice Parameters. The diagnosis and management of anaphylaxis: an updated practice parameter. *J Allergy Clin Immunol* 2005; 115:S483-523.

5. Which is the most appropriate instruction regarding use of an epinephrine auto-injector?
- A. Epinephrine is equally efficacious when given either intramuscularly or subcutaneously
 - B. Children should be switched from the 0.15 mg dose to the 0.3 mg dose of epinephrine when they reach 20 kg (44 lbs)
 - C. Epinephrine auto-injectors should be available at all locations in which the child spends an extensive amount of time

Explanation to Question 5

Patients diagnosed with food allergy should carry a self-injectable epinephrine pen and have instructions regarding use. Recommended dosage is 0.15 mg of 1:1000 epinephrine for children weighing 15 to 30 kg (33 to 66 lbs) and 0.3 mg of 1:1000 epinephrine for anyone over 30 kg (66 lbs). Epinephrine should be given intra-muscularly in the thigh as evidence shows more rapid absorption and higher plasma epinephrine levels than with subcutaneous injections or intramuscular injections in the upper arm.

Epinephrine auto-injectors should also be available at home, daycare, and school. Demonstration of the epinephrine auto-injector and written instructions should be provided to the family. An anaphylaxis emergency action plan should be provided to the family, daycare, and school.

Children should be instructed not to share or trade food with others and to notify adults if they eat something that may contain the food to which they are allergic.

The correct answer is C, epinephrine auto-injectors should be available at all locations in which the child spends an extensive amount of time.

Sources: 1. Sicherer SH, Estelle F, Simons R, Section on Allergy and Immunology. Self-injectable epinephrine for first-aid management of anaphylaxis. *Pediatrics* 2007; 119:638-46.

6. The parents want to know if Jack will outgrow his food allergy. Which is the most appropriate statement?
- A. All food allergies are life long
 - B. Most cases of peanut allergy persist into adulthood but there is a small chance that he will develop tolerance
 - C. He is likely to outgrow his peanut allergy

Explanation to Question 6

Peanut, tree nut, shellfish, and fish allergy are often lifelong. For example, less than 10% of patients develop tolerance to tree nuts and, at most, 20% of patients outgrow peanut allergy. There is also a risk of recurrence of allergy, especially among patients who fail to regularly ingest the offending allergen after resolution of their allergy. For example, recurrence of peanut allergy occurs in roughly 8% of patients who experienced resolution. Patients should continue to carry epinephrine until they have demonstrated ongoing tolerance to the offending allergen.

Most children will develop tolerance to milk, egg, soy, and wheat allergy. For example, over 75% of patients will develop tolerance to egg by 7 years of age. Similarly, a majority of children with milk allergy will develop tolerance by 5 years of age.

There is evidence to suggest that regular ingestion of cooked egg in baked products by egg-allergic children or ingestion of extensively heated milk by milk-allergic children may increase the development of tolerance. However, absent an oral challenge, there is no defined method to identify egg/milk-allergic children able to safely consume baked egg/heated milk products. Therefore, strict avoidance of the food allergen is advised until the child has consulted with an allergist.

The correct answer is B, most cases of peanut allergy persist into adulthood but there is a small chance that Jack will develop tolerance.

- Sources:**
1. Wood RA. The natural history of food allergy. *Pediatrics* 2003; 111:1631-37.
 2. Savage JH, Matsui EC, Skripak JM, Wood RA. The natural history of egg allergy. *J Allergy Clin Immunol* 2007; 120:1413-17.
 3. Skripak JM, Wood RA. Peanut and tree nut allergy in childhood. *Pediatr Allergy Immunol* 2008; 19:368-73.
 4. Nowak-Wegrzyn A, Bloom KA, Sicherer SH, et al. Tolerance to extensively heated milk in children with cow's milk allergy. *J Allergy Clin Immunol* 2008; 122:342-7.
 5. Lemon-Mule H, Sampson H., Sicherer SH, et al. Immunologic changes in children with egg allergy ingesting extensively heated egg. *J Allergy Clin Immunol* 2008; 122:977-83.

Case 2

A 17 year old male comes to your office in August because he is concerned that he has a food allergy. After eating bananas, he develops pruritus of his lips and tongue without edema. He has no systemic symptoms after eating bananas. The symptoms resolve with no treatment. He has no history of eczema or asthma. He does have seasonal allergic rhinitis in the late summer for which he takes loratadine with good response.

7. What further testing is needed?
- A. Skin prick testing for banana
 - B. Skin prick testing for pollens
 - C. Skin prick testing for banana and pollens
 - D. No further testing is needed

Explanation to Question 7

Pollen-food allergy syndrome (PFAS), also known as oral allergy syndrome (OAS), is an IgE-mediated reaction that affects the oropharynx. It is thought to occur from the cross-reactivity between proteins present in pollens and those expressed by fruits and vegetables. Patients develop tingling and itching of the lips, tongue and palate when eating certain raw fruits and vegetables. Systemic signs are very rare. Symptoms do not occur when the fruit or vegetable is cooked. Specific fruits and vegetables are associated with certain types of pollen. For example, birch pollen allergy can have cross reactivity with apples, plums, peaches, nectarines, cherries, and almonds. Patients with allergic rhinitis secondary to ragweed pollen may have cross reactivity with melons, bananas, and tomatoes. Grass pollens cross react with melons and kiwi fruit. This syndrome affects up to 50% of adults with allergic rhinitis secondary to pollens.

Pollen-food allergy syndrome can be confirmed through skin prick testing to the fresh foods and pollen, and also with oral food challenges, though oral challenges are rarely necessary.

Symptoms of PFAS can sometimes be controlled with antihistamines. Patients should avoid consumption of the raw food product that produced symptoms but they may continue to eat the specific food if it is cooked. Any patient who has a history of systemic symptoms should strictly avoid the food in all forms and carry an epinephrine auto-injector.

The correct answer is C, skin prick testing for banana and pollens would be appropriate to confirm a diagnosis of pollen-food allergy syndrome.

Sources: 1. Tatachar P, Kumar S. Food-induced anaphylaxis and oral allergy syndrome. *Pediatr Rev* 2008; 29:e23-27.

Case 3

A 16 year old female presents to your office for a well-child exam. She has a history of peanut allergy but admits that she does not carry her epinephrine autoinjector. She feels that she is always careful in avoiding food with peanuts.

8. What advice would you give this patient regarding her risk of fatal anaphylaxis?
- A. Adolescents are at a lower risk for fatal anaphylaxis than younger children, but she should still carry her epinephrine autoinjector with her at all times to be safe
 - B. Foods may be unknowingly contaminated with peanuts and therefore having an epinephrine auto-injector is critical at all times
 - C. Because she is careful in screening for peanut products in food, her risk of anaphylaxis is low

Explanation to Question 8

Teenagers are at higher risk for fatal food-induced anaphylaxis than younger children. In fact, recent data suggest that the dose provoking symptoms in peanut-allergic patients decreases with age, which may in part contribute to the observed difference in risk. Studies have also shown that adolescents have poor understanding of when food allergy reactions are severe and when epinephrine is indicated. Accidental exposure to peanuts and tree nuts are very common and has been reported to be as high as 48%. In addition, 54% of adolescents admit to purposefully eating potentially unsafe food.

The correct answer is B, foods may be unknowingly contaminated with peanuts and therefore having an epinephrine auto-injector is critical at all times.

Sources: 1. Sampson M, Muñoz-Furlong A, Sicherer S. Risk-taking and coping strategies of adolescents and young adults with food allergy. *J Allergy Clin Immunol* 2006; 117:1440-45.
2. van der Zee T, Dubois A, Kerkhof M, van der Heide S, Vlieg-Boerstra B. The eliciting dose of peanut in double blind, placebo-controlled food challenges decreases with increasing age and specific IgE level in children and young adults. *J Allergy Clin Immunol* 2011; 128:1031-36.

9. Which of the following food allergies are more common in adults than children?

- A. Shellfish
- B. Egg
- C. Peanut

Explanation to Question 9

The most common food allergies in children are milk, egg, and peanut. The most common food allergies in adults are shellfish, peanut, and tree nut. This reflects the fact that most children outgrow their milk and egg allergies. Although peanut allergy is the second most common food allergy in adults it is still more common in children, affecting 0.8% of young children (0-5 yrs). Only 0.1% of young children have shellfish allergy while it affects 2% of adults. Allergies to tree nuts and fruits are also more prevalent among adolescents and adults than children.

The correct answer is A, shellfish allergy is more common in adults than children.

Sources: 1. Kandyil RM, Davis CM. Shellfish allergy in children. *Pediatr Allergy Immunol* 2009; 20:408–14.
2. Sampson, H. Update on food allergy. *J Allergy Clin Immunol* 2004; 113:805-19.

Please tell us about yourself.

In what year did you complete your residency? _____

Do you have any fellowship training in allergy?

☐ Yes

☐ No

Did you participate in a formal allergy rotation during residency?

☐ Yes

☐ No

Do you feel this exercise was helpful? What would you change?