Food Challenges in the Office

Why Challenge?

- Confirm a questionable allergic reaction to food
- Evaluate for resolution of a food allergy
- Unclear significance of a positive skin or blood test
Double-blind, placebo-controlled food challenge (DBPCFC) as an office procedure: A manual

- “There is now enough experience with the use of double-blind, placebo-controlled, food challenge (DBPCFC) to recommend its use as an office procedure for most patients complaining of adverse reactions to foods...
- For those foods to which challenges are positive, longitudinal evaluation with repeated challenge at appropriate intervals help to determine whether or not the problem will resolve over a period of time.”
Open Food Challenge

- Most cost and time efficient form of challenge but most subject to bias
- Unmasked and unblinded feeding of food in natural form
- Appropriate when objective symptoms are anticipated and concern for bias is low
- Typically used in office setting
- Negative rules out allergy
- Risk of false positive
  - Feel patient/family out on how far to push subjective symptom:
    - Patient/family may be comfortable avoiding
    - Potentially repeat challenge blinded

Factors to consider in deciding to challenge

- Patient’s history
  - Medical history
  - History of reaction to food
- SPT size and food-specific IgE levels
- Nutritional importance of the food
- Quality of life factors associated with avoidance
  - Low dose food challenges or contact challenges can alleviate anxiety and help with school planning
### CUTOFF VALUES
For Food Challenges

<table>
<thead>
<tr>
<th>Food</th>
<th>&gt;50% React</th>
<th>&gt;95% react</th>
<th>&gt;95% (&lt; age 1-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>IgE 2 kU/L</td>
<td>IgE 15 kU/L</td>
<td>IgE 5 kU/L</td>
</tr>
<tr>
<td></td>
<td>SPT 8 mm</td>
<td>SPT 6 mm</td>
<td></td>
</tr>
<tr>
<td>Egg</td>
<td>IgE 2 kU/L</td>
<td>IgE 7 kU/L</td>
<td>IgE 2 kU/L</td>
</tr>
<tr>
<td></td>
<td>SPT 7 mm</td>
<td>SPT 5 mm</td>
<td></td>
</tr>
<tr>
<td>Peanut</td>
<td>IgE 2 kU/L (history)</td>
<td>IgE 14 kU/L</td>
<td>SPT 8 mm</td>
</tr>
<tr>
<td></td>
<td>IgE 5 kU/L (no history)</td>
<td>Infant Australian population</td>
<td>SPT 4 mm</td>
</tr>
<tr>
<td>Fish</td>
<td>IgE 20 kU/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walnut</td>
<td>IgE 18 kU/L</td>
<td></td>
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</tbody>
</table>


### Peanut cutoffs
Whole vs Ara h 2

<table>
<thead>
<tr>
<th>IgE</th>
<th>Threshold, kU/L</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>PPV</th>
<th>NPV</th>
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</thead>
<tbody>
<tr>
<td>Whole peanut</td>
<td>0.10</td>
<td>100.00</td>
<td>56.00</td>
<td>0.77</td>
<td>1.00</td>
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<td></td>
<td>0.35</td>
<td>97.22</td>
<td>72.00</td>
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<td>0.95</td>
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<td>94.44</td>
<td>76.00</td>
<td>0.85</td>
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<td></td>
<td>1.00</td>
<td>86.11</td>
<td>84.00</td>
<td>0.89</td>
<td>0.81</td>
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<td></td>
<td>5.00</td>
<td>63.89</td>
<td>100.00</td>
<td>1.00</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>15.00</td>
<td>36.11</td>
<td>100.00</td>
<td>1.00</td>
<td>0.52</td>
</tr>
<tr>
<td>Ara h 2</td>
<td>0.10</td>
<td>94.44</td>
<td>96.00</td>
<td>0.97</td>
<td>0.92</td>
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<td>1.00</td>
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<td>1.00</td>
<td>0.66</td>
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<tr>
<td></td>
<td>5.00</td>
<td>38.89</td>
<td>100.00</td>
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<td>0.53</td>
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<tr>
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<td>15.00</td>
<td>25.00</td>
<td>100.00</td>
<td>1.00</td>
<td>0.48</td>
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</table>
**Supplies**

<table>
<thead>
<tr>
<th>FOOD PREPARATION</th>
<th>TREATMENT*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave for heating food</td>
<td>Epinephrine (calculate dose)</td>
</tr>
<tr>
<td>Measuring cups and spoons</td>
<td>Antihistamine</td>
</tr>
<tr>
<td>Gram Scale</td>
<td>Albuterol</td>
</tr>
<tr>
<td>Disposable plates and utensils</td>
<td>Oxygen and supplies</td>
</tr>
<tr>
<td>Mortar and pestle</td>
<td>IV fluids</td>
</tr>
<tr>
<td>Preparation area free from other food</td>
<td>FPIES: Pedialyte and Ondansetron**</td>
</tr>
</tbody>
</table>

*Same emergency equipment for immunotherapy  
**International consensus setting should have immediate access to IVF JACI 139 2017

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**Challenge food**

- Brought from home by family
- Preferably single ingredient foods without risk of cross-contact
  - Can have family shell nuts at home
- Heating can change allergenicity
  - Least cooked/processed form should be challenged
    - Form that will be introduced at home
      - Steak vs ground beef
      - Fresh fruits and vegetables
      - Raw vs cooked seafood
      - Fresh vs canned tuna
Challenge to multiple foods

- Can challenge two foods in one day with a 2 hours break in between (as long as history is not of delayed reaction to the food)
- Can challenge cross-reactive foods together (seafood, tree nuts) either mixed or sequentially
  - Almond/hazelnut
  - Pistachio/cashew
  - Pecan/walnut
  - Crustacean shellfish (shrimp, crab, lobster)
  - Mollusk (oyster, scallop, clam, mussel)

Dosing Schedule

- Total dose is administered in graduated increments
  - Lowers risk of reaction
  - Identify lowest provoking dose
- Every 15-20 minutes
  - Most acute reactions occur in this time period
  - Adjust based on history
- Followed by open feeding with age appropriate serving
Challenge doses

- Total dose
  - 8-10 g dry food
  - 16-20 g meat or fish
  - 100 ml wet food
  - Should correspond with a serving (1 egg, 150 ml milk)
- Initial dose
  - 0.1-1% total dose
  - Lower than expected threshold dose if known
- Escalation
  - Graded challenge: double or semi logarithmic increase
  - 3, 10, 30, 100, 300, 1000, 3000 mg of food protein
  - Milk (cow’s or soy): .1 ml, .3 ml, .9 ml, 3 ml, 9 ml, 30 ml, 90 ml

Nowak-Wegrzyn et al JACI 2009

Portion Size

- Milk/dairy
  - 6-8 oz milk or infant formula
  - ¼-1 cup yogurt or cottage cheese
  - ½-1 oz hard cheese
- Soy/legumes
  - ¼-1 cup soy beverage
  - ¼-1 cup tofu
  - ¼-1 cup cooked beans (kidney, pinto, chickpeas, lentils)
- Egg
  - 1 slice of French toast (1 egg per 1 slice of bread)
  - 1 hard boiled or scrambled egg
- Grains (rice, corn, wheat, rye, barley, oat)
  - ½-1 cup pasta/rice
  - ½-1 oz cereal
  - ½-1 slice bread, muffin or roll
- Meats/Seafood
  - 2-3 oz cooked lean meat/poultry
  - 2-3 oz cooked fish
  - Shellfish 2-3 oz shellfish
- Peanut
  - 2 tablespoons peanut butter (30 g)
- Tree nuts
  - 30-40 g crushed tree nuts = 25-30 pieces
- Seeds
  - 10-15 g seeds = 1-2 teaspoons seeds

*Depending on the age of the patient, adjustment of portion size is recommended

Nowak-Wegrzyn et al JACI 2009
Example dosing schemes

- May use flours and powders (wheat flour, peanut flour, soy flour, egg powder, skim milk powder)
  - Allows precise measurements of pure food without fats to decrease absorption
  - Needs to be followed with serving of food in form that will be served
- Peanut butter
  - 1/64 tsp, 1/32 tsp, 1/16 tsp, 1/8 tsp, ¼ tsp, ½ tsp, 1 tsp, 2 tsp, 1 Tbsp
- Egg (French toast, scrambled, hard boiled)
  - Divide into 8 pieces then:
    - ¼ (=1/32), ½, ¾, 1, 1 ½, 1 ¾, 2 ¼ (can serve yolk last with hard boiled egg)
- Wheat
  - 1 slice wheat bread (divided as with egg)
  - Wheat Chex (1/2 cup)
- Other foods
  - Look at nutrition label for serving size and protein content
  - Work backwards with gradually increasing amounts starting with a dose unexpected to cause a reaction

Patient preparation

- Documental of informed consent
  - Review risks, benefits, outcome, implications of positive or negative challenge
  - Advise timing, potential for additional hours if positive reaction
- Patient must be in good health at the time
  - Allergic rhinitis, asthma, atopic dermatitis under control
  - Should not have medical condition that anaphylaxis or treatment would pose significant risk (cardiac, pregnancy)
  - Should not have any illness with symptoms that could confuse interpretation
- Discontinue medications that may interfere with results or treatment of anaphylaxis
  - Antihistamines (same timing as skin test instructions)
  - Short acting bronchodilator
  - NSAIDS, ACE inhibitors, antacids can increase reactivity
  - B-Blockers
- Food should be eliminated for at least 2 weeks

Nowak-Wegrzyn et al JACI 2009
Patient Preparation

- Should not eat prior to challenge
  - Fasting enhances absorption of food
  - Light meal if needed in young children
- Parents should have provisions to keep child entertained
- Bring change of clothes in the event of vomiting (parent and child)
- Bring familiar cups, plates, utensils for child
- Bring flavorings and other food for picky eaters
  - Chocolate syrup
  - Ketchup
  - Maple syrup
  - Crackers
  - Apples
- Confirm family has epinephrine autoinjector with them

Challenge Procedure

- Baseline
  - Vital signs (RR, HR, BP)
  - Spirometry, especially asthmatics
- Calculate epinephrine dose, consider drawing up for higher risk challenges (or use autoinjector)
- Flow sheet to record dose, time, signs and symptoms, treatment
  - Include weight and calculated medication dosages
- Patient should be supervised by a physician and nurse throughout procedure
  - Supervising physician should be available in office
  - Patient should be re-examined before each dose
  - Food residue should be wiped off to avoid contact reaction
Symptoms during challenge

- Examine oropharynx, chest, skin with any signs of reaction
- Measure vital signs
- Spirometry if respiratory symptoms (lags behind clinical symptoms)
- With subjective symptoms (throat, mouth, skin itch; nausea, abdominal pain) observe for a period to allow resolution before administering subsequent dose
- Challenge should be stopped with objective symptoms
  - Transient perioral hives from contact, or vomiting with anxiety/distaste may not need to stop
  - Treatment is based on symptoms (mild vs anaphylaxis)
- Vitals every 15 minutes (or less) and every 30-60 minutes after resolution
- Depending on severity, patient may need to be transported to ER
Discharge

- Negative challenge
  - 1-2 hours of observation for immediate-type reactions
  - 4 hours for FPIES
  - Food should be regularly ingested at home

- Positive challenge
  - Observe patient after symptoms have resolved with treatment for the duration based on clinical judgement
  - 2-4 hours after resolution for immediate-type reactions and 6 hours for FPIES usually recommended
  - Biphasic reactions rare after food challenges, but review action plan and way to contact physician on call

8-year-old with peanut allergy

- Hives and facial swelling with peanut butter cracker at 3 years of age
  - Eating Nutella (hazelnut) and drinking almond milk
- Skin test positive to peanut
  - Advised to avoid peanut and all tree nuts
- Age age 5 tested to peanut and tree nuts
  - Positive to peanut, cashew and pistachio
**Current options in the management of nut allergy**

<table>
<thead>
<tr>
<th>Options</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid index nut</td>
<td>No other safe option</td>
<td></td>
</tr>
</tbody>
</table>
| Avoid all nuts, including clinically tolerated nuts | • Decreases the risk of accidental reactions due to cross-contamination  
• Easier avoidance of all nuts than specific ones | • Extensive dietary restriction possibly decreasing the quality of life 
• Possibly increased risk of becoming allergic to nuts previously tolerated |
| Continue eating nuts previously tolerated, and introduce nuts likely to be tolerated after OFC | • Tailored avoidance diet may increase quality of life 
• Possibly decreases the risk of also becoming allergic to these nuts | • Increases the risk of accidental reactions due to cross-contamination, or confusion in identifying nuts 
• Possibly increases the risk of becoming allergic to these nuts |
50% NPV with Tree Nut Sensitization or Tree Nut Allergy (to other TN)

Couch et al Annals of Allergy, Asthma & Immunology 2017 118, 591-96
### Tree nuts/Peanut

<table>
<thead>
<tr>
<th>Nut</th>
<th>Nuts per 1 oz serving</th>
<th>Grams Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almond</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>Brazil nut</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Cashew</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Hazelnut</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Macadamia</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Pecan</td>
<td>19 halves</td>
<td>3</td>
</tr>
<tr>
<td>Pine Nut</td>
<td>167 (&lt;1/4 cup)</td>
<td>4</td>
</tr>
<tr>
<td>Pistachio</td>
<td>49</td>
<td>6</td>
</tr>
<tr>
<td>Walnut</td>
<td>14 Halves</td>
<td>4</td>
</tr>
<tr>
<td>Peanut</td>
<td>32</td>
<td>8</td>
</tr>
</tbody>
</table>

USDA National Nutrient Database

### ImmunoCAP Nut components

![Image of nut components](image-url)
Extensively heated milk and egg

- 70-75% of egg and milk allergic children tolerate milk or egg in a baked good (such as a muffin)
- Tolerance to baked milk and egg precedes tolerance to unheated milk and egg
- Baked milk-tolerant children have milder allergy than baked milk-reactive children
- Baked egg-tolerant children tend to develop tolerance more quickly
- Incorporating baked milk and egg to diet appears to accelerate tolerance


Suggested Cut-off Values

- **Baked Milk**
  - Casein IgE < 5 kUA/L
  - Cow’s Milk IgE < 5-10 kUA/L
  - Casein <0.35 kUA/L 100% NPV
  - CM Skin test < 5-7 mm 100% NPV
  - CM Skin test >15 50-100% PPV

- **Baked Egg**
  - Egg white IgE 1.23-7.38 kUA/L
  - Egg white skin test 8-11 mm
  - Ovomucoid IgE 0-4.4 kUA/L

Leonard et al *JACI* in Practice January-February 2015
Baked Egg and Baked Milk Challenges

- Recipe provided by office for parents to prepare
- Challenge dose is usually 1 muffin
- Milk: each muffin contains 1.3 oz/g milk (1 cup per 6 muffins)
- Egg: each muffin contains 1/3 egg (2 grams or 2 eggs per 6 muffins)
- Divide muffin in 8 and administer 1/8 muffin every 15 minutes
- Accelerated schedule: 1/8 muffin, 1/8 muffin, ¼ muffin, 1/2 muffin

Egg Muffin
Jaffe

- 1 cup flour (or flour substitute)
- ¼ tsp salt
- 2 Tbsp of rice milk (or soy milk, cow’s milk, almond milk)
- 1 tsp baking powder
- ¼ tsp cinnamon
- 2 eggs
- ½ cup sugar
- ¼ cup corn oil
- ½ tsp vanilla
- 1 cup ripe banana or apple

Preheat oven 350°F, 30-35 minutes, combine dry ingredients and mix with wet ingredients. Pour in 6 prepared muffin cups and bake for 30 minutes.
Simple Egg Muffin

- Jiffy Muffin Mix
- 2 eggs instead of 1
- Yield 6 muffins
- Bake 350°F 30 minutes

Baked Milk Muffin Jaffe

- 1 cup cow’s milk
- 2 Tbsp canola oil
- 1 tsp vanilla
- 1 egg or 1 ½ tsp egg replacer (e.g. Ener-G brand)
- 1 ¼ cup flour
- ½ cup sugar
- ¼ tsp salt
- 2 tsp baking soda
- Preheat oven to 350°F. Combine dry ingredients and mix with wet ingredients. Pour into muffin cups and bake for 30-35 minutes, or until golden brown and firm to the touch. Yields 6-12 muffins (dose 1-2 muffins)
Banana Milk Recipe

- 2 cups flour
- 2/3 nonfat dry milk powder (1/3 dry milk = 1 cup milk)
- 2 teaspoons baking powder
- 1/2 teaspoon cinnamon
- 2 eggs (or substitute if egg allergic)
- 2 cups (about 4 medium) mashed ripe bananas
- 1 cup sugar
- ½ cup vegetable oil
- Preheat oven to 350°F. Grease 12 muffin tins. In medium bowl, stir together flour, dry milk, baking powder and cinnamon. In large bowl, beat eggs, bananas, sugar and vegetable oil. Gradually add flour mixture. Spoon into prepared pan. Bake for 30 minutes or until wooden pick inserted near center comes out clean. Dose will be 1 muffin.

Baked Milk with Cake Mix

- Yellow Cake Mix
- Replace water with 1 cup milk PLUS 1/3 cup dried milk powder (mix the powdered milk into the cup of wet milk)
- 1/3 cup Vegetable Oil
- 3 large eggs or egg-replacer equivalent
- Preheat oven to 350°F. Place 24 baking cups in cupcake tins. BLEND dry mix, milk, milk powder, oil and eggs (or egg replacer) in large bowl at low speed until moistened (about 30 seconds). BEAT at medium speed for 2 minutes. POUR batter in pans. BAKE for 18-21 minutes or until toothpick inserted in center comes out clean. COOL in pan on wire rack for 15 minutes. Dose will be 2 muffins.
Baked Egg Diet Instructions

Your child MAY NOW EAT the following:

- Store-bought baked products with egg/egg ingredients listed as the third ingredient or further down the list of ingredients.
- Home-baked products that have no more than one third of a baked egg per serving. For example, a recipe that has 2 eggs/batch of a recipe that yields 6 servings.
- All baked products must be baked throughout and not wet or soggy in the middle.

Your child SHOULD CONTINUE TO AVOID unbaked egg and egg-based foods such as the following:

- Caesar salad dressing
- Custard
- Eggs in any form such as hard- or soft-boiled, scrambled, or poached
- Egg noodles
- French toast/pancakes
- Homemade waffles
- Frosting containing egg
- Ice cream
- Mayonnaise
- Quiche

Leonard et al JACI in Practice January-February 2015

Baked Milk Diet Instructions

Your child MAY NOW EAT the following:

- Store-bought baked products with CM/CM ingredient listed as the third ingredient or further down the list of ingredients.
- Home-baked products that have no more than one-sixth cup of CM per baked milk serving. For example, a recipe that has 1 cup CM per batch of a recipe that yields 6 servings.
- Remember to check store-bought products and ingredients on the basis of your child's food allergies to avoid a reaction to other allergens.
- All baked products must be baked throughout and not wet or soggy in the middle.

Your child SHOULD CONTINUE TO AVOID unbaked milk and CM-based foods such as the following:

- Baked products with CM listed as first or second ingredient
- Products that may have a CM ingredient that has not been baked such as a CM ingredient containing frosting on a cookie or cupcake or a cheese flavoring on a cracker that may not have been baked (eg, flavorings may be applied topically after the product is baked)
- Milk chocolate chips that will melt during baking but not "bake." Please continue to use CM-free chocolate chips
- Regular milk or dairy in any form including whole, low-fat, nonfat, or skim CM, lactose-free products, dry milk powder, yogurt, sour cream, butter, hard and soft cheeses, ice cream/sherbet, butter, etc
- Frostings with a CM ingredient
- French toast/pancakes
- Homemade waffles
- Cooked milk products that are not baked such as puddings

Leonard et al JACI in Practice January-February 2015
Baked Cheese

- After 6-12 months of baked milk ingestion can offer a baked cheese challenge
- Amy’s pizza cooked 425°F 13 minutes
- Serving is 1/3 pizza

INFANTS

- In the LEAP study, high risk infants (egg allergy, eczema) had a decreased rate of peanut allergy if introduced between 4-11 months
- 2016 NIAID recommendations include supervised open feeding or graded food challenge in high risk infants with 3-8 mm peanut skin test
Infant preparation

- Light meal (1/2 normal size) may be given 2 hours before challenge
- Schedule challenge at normal meal time
- Do not schedule at nap time
- LEAP
  - 3.9 g cumulative if skin test positive
  - 2 g open feeding if skin test negative
- Texture:
  - Liquids and soft purees by 4-6 months
  - Thicker purees and foods that dissolve between 7-9 months
  - Verify what textures is tolerated at home
- Oral aversion
  - Food preference vs allergy
  - Parents should provide different food options

Emergency Medications for Infants

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine (1:1000 concentration)</td>
<td>0.01 mg/kg IM in the mid-outer thigh in health care settings OR 0.15 mg autoinjector IM in the mid-outer thigh in community settings</td>
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<tr>
<td>Albuterol nebulization</td>
<td>0.15 mg/kg every 20 min × 3 doses (minimum of 2.5 mg per dose) over 5-15 min</td>
</tr>
<tr>
<td>Albuterol MDI inhalation</td>
<td>2 puffs, 90 mcg/puff, with face mask</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0-10 L/min via face mask</td>
</tr>
<tr>
<td>Diphenhydramine</td>
<td>1.25 mg/kg/dose IM/IV</td>
</tr>
<tr>
<td>Cetirizine</td>
<td>2.5 mg PO</td>
</tr>
<tr>
<td>Normal saline (0.9% isotonic solution or lactated ringers)</td>
<td>20 mL/kg/dose administered over 5 min</td>
</tr>
<tr>
<td>Steroids</td>
<td>Prednisolone 1 mg/kg PO OR Solu-Medrol 1 mg/kg IV</td>
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</table>
Anaphylaxis in infants

<table>
<thead>
<tr>
<th>Age</th>
<th>Vitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>When is it hypotension?</td>
<td>Systolic blood pressure (mm Hg)</td>
</tr>
<tr>
<td>Infants (1-12 mo)</td>
<td>&lt;70</td>
</tr>
<tr>
<td>1-10 y</td>
<td>(Age × 2) + 70</td>
</tr>
<tr>
<td>When is it tachypnea?</td>
<td>Respiratory rate</td>
</tr>
<tr>
<td>2-12 mo</td>
<td>≥50 breaths/min</td>
</tr>
<tr>
<td>1-4 y</td>
<td>≥40 breaths/min</td>
</tr>
<tr>
<td>When is it tachycardia?</td>
<td>Heart rate</td>
</tr>
<tr>
<td>&lt;2 y</td>
<td>&gt;160 beats/min</td>
</tr>
</tbody>
</table>

General Instructions:
There are 5 incremental doses in the observed challenge. Doses may be given 15 to 20 minutes apart. Observe for symptoms of reactivity before giving the subsequent dose.

The measurement of a “level” measuring teaspoon used in this protocol is recommended over the measurement of a “rounded” teaspoon used in Du Toit et al to promote consistency and ease of measurement. The peanut protein content is however similar.

Option 1 Instructions:
1. Measure peanut butter dose 1.
2. Add measured dose 1 previously tolerated infant puree fruit or vegetable to the measured peanut butter dose. Stir until well blended.
3. May adjust the infant puree amount to achieve desired consistency.
4. Label dose 1.
5. Repeat steps 1-3 for doses 2-5; labeling the finished dose with the appropriate dose number.
6. Feed dose 1 and observe for symptoms of reactivity for 15-20 minutes.
7. If no symptoms, repeat with doses 2-5 observing for symptoms of reactivity for 15-20 minutes between each dose.

<table>
<thead>
<tr>
<th>Dose</th>
<th>Peanut butter (teaspoon)*</th>
<th>Equivalent weight (g), (Peanut protein content (g))</th>
<th>Puréed fruit or vegetable volume (teaspoon)</th>
<th>Total volume (teaspoons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/8</td>
<td>0.67 (0.15)</td>
<td>1/2</td>
<td>5/8</td>
</tr>
<tr>
<td>2</td>
<td>1/4</td>
<td>1.33 (0.29)</td>
<td>3/8</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1/2</td>
<td>2.67 (0.59)</td>
<td>1</td>
<td>1 1/2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>5.33 (1.17)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1 1/2</td>
<td>8 (1.76)</td>
<td>4</td>
<td>5 1/2</td>
</tr>
</tbody>
</table>

*Total protein: 3.96 g

Bird et al JACI in Practice 2016
OPTION 3: (smash) Thinned Peanut Butter Recipe (3.98 g protein)

Option 3 instructions:
1. Measure peanut butter dose 1.
2. Slowly and measured dose 1 half water and stir until peanut butter is dissolved, thinned
and smooth on both.
3. May adjust water volume or addition previously tolerated infant to achieve desired
consistency.
4. Label dose 1.
5. Repeat steps 1-2 for doses 2-5, labeling the finished dose with the appropriate dose
number.
6. Look at the thickness of the thinned peanut butter before serving. It should no
longer be hot.
7. Feed dose 1 and observe for symptoms of reactivity for 15-20 minutes.
8. If no symptoms appear, repeat with doses numbers 2-5 observing for symptoms of reactivity
for 15-20 minutes between each dose.

<table>
<thead>
<tr>
<th>Dose</th>
<th>Peanut butter (teaspoons)</th>
<th>Equivalent weight (g) (Peanut protein content)</th>
<th>Volume of hot water (teaspoons)</th>
<th>Total volume (teaspoons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/8</td>
<td>0.13 (1.35)</td>
<td>1/8</td>
<td>1/8</td>
</tr>
<tr>
<td>1</td>
<td>1/4</td>
<td>0.27 (2.70)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>3</td>
<td>3/4</td>
<td>0.81 (8.10)</td>
<td>3/4</td>
<td>3/4</td>
</tr>
<tr>
<td>4</td>
<td>4/4</td>
<td>1.26 (12.60)</td>
<td>4/4</td>
<td>4/4</td>
</tr>
<tr>
<td>5</td>
<td>5/4</td>
<td>1.71 (17.10)</td>
<td>5/4</td>
<td>5/4</td>
</tr>
<tr>
<td>Total protein: 3.98 g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OPTION 4: (pre-mix) Thinned Peanut Butter Recipe (3.88 g protein)

Option 4 instructions:
1. Measure the thinned peanut butter dose 1.
2. Slowly add the thinned peanut butter and stir until peanut butter is dissolved, thinned
and well blended. You may increase or decrease the volume of water to achieve desired
consistency. Note: Increasing the amount of water may increase the difficulty of getting through
the entire protocol with a pooling today.
3. Label dose 1.
4. Repeat steps 1-3 for doses 2-5, labeling the finished dose with the appropriate dose
number.
5. Look at the thickness of the thinned Bamba solution before serving. It should no
longer be hot.
6. Feed dose 1 to infant and observe for symptoms of reactivity for 15-20 minutes.
7. If no symptoms appear, repeat with doses numbers 2-5 observing for symptoms of reactivity
for 15-20 minutes between each dose.

<table>
<thead>
<tr>
<th>Dose</th>
<th>Bamba dose (sticks)</th>
<th>Equivalent weight (g) (Peanut protein content)</th>
<th>Volume of hot water (teaspoons)</th>
<th>Total volume (teaspoons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.83 (0.83)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2.43 (2.43)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>4.05 (4.05)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>8.1 (8.1)</td>
<td>3/4</td>
<td>3/4</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>17.01 (17.01)</td>
<td>6/4</td>
<td>6/4</td>
</tr>
<tr>
<td>Total protein: 3.9 g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OPTION 4: Bamba peanut snack (Osem) (3.9 g peanut protein)

Option 4 instructions:
1. Measure Bamba sticks for dose 1.
2. Prepare the first dose:
   a. Slowly add hot water to measured Bamba and stir until peanut solution is
dissolved, thinned, and well blended. You may increase or decrease the
water volume to achieve desired consistency.
3. Label dose 1.
4. Repeat steps 1-3 for the remaining doses 2 through 5, labeling the finished dose with
the appropriate dose number.
5. Check the final temperature of the thinned Bamba solution before serving. It should
no longer be hot.
6. Feed dose 1 to infant and observe for symptoms of reactivity for 15-20 minutes.
7. If no symptoms appear, repeat with doses numbers 2-5 observing for symptoms of reactivity
for 15-20 minutes between each dose.

<table>
<thead>
<tr>
<th>Dose</th>
<th>Bamba dose (sticks)</th>
<th>Equivalent weight (g) (Peanut protein content)</th>
<th>Volume of hot water (teaspoons)</th>
<th>Total volume (teaspoons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.83 (0.83)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2.43 (2.43)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>4.05 (4.05)</td>
<td>1/4</td>
<td>1/4</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>8.1 (8.1)</td>
<td>3/4</td>
<td>3/4</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>17.01 (17.01)</td>
<td>6/4</td>
<td>6/4</td>
</tr>
<tr>
<td>Total protein: 3.9 g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interpreting challenge

- Because infants are nonverbal, results may be equivocal
- Subtle symptoms:
  - Ear picking
  - Tongue rubbing
  - Hand in mouth
  - Neck scratching
  - Irritability
  - Clinging to caregiver
  - Inconsolable crying
  - Somnolence
- LEAP study experience
  - Predominantly skin symptoms
  - No wheeze or hypotension
  - Epinephrine not required

Infant peanut challenge outcome

- Infant ingests full amount without reaction
  - 6 g divided three times per week (5 tsp peanut butter, 2 bags Bamba)
- Infant ingests more than half (completes dose 3) but refuses remainder without reaction
  - Give equivalent amount at home and increase to 2 g if tolerated
- Infant only completes dose 1 and 2
  - Inconclusive, continue to avoid and repeat challenge at another time
- Infant reacts
  - Review avoidance
  - Action Plan
  - Epinephrine Rx
Resources

Standardizing double-blind, placebo-controlled oral food challenges: American Academy of Allergy, Asthma & Immunology-European Academy of Allergy and Clinical Immunology PRACTALL consensus report

Food allergy: A practice parameter update - 2014

Work Group report: Oral food challenge testing

Baked Milk- and Egg-Containing Diet in the Management of Milk and Egg Allergy

Conducting an Oral Food Challenge to Peanut in an Infant