Food Allergy Diagnosis and Management

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(Adapted from Uygungil and Sharma 2016)
Objectives

• Overview of Food Allergy Prevalence and Presentation

• Diagnosis:
  • Importance of the history
  • Different types of FA
  • Diagnostic tests
  • Economic impact of FA
  • Interpretation of results and natural history

• Current Management based on NIAID Food Allergy Guidelines
<table>
<thead>
<tr>
<th>Prevalence</th>
<th>Infant/child</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>2.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Egg</td>
<td>1.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Peanut</td>
<td>1%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Tree nuts</td>
<td>0.5%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Fish</td>
<td>0.1%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Shellfish</td>
<td>0.1%</td>
<td>2%</td>
</tr>
<tr>
<td>Wheat, soy</td>
<td>0.4%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Sesame</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Overall</td>
<td>5%</td>
<td>3% to 4%</td>
</tr>
</tbody>
</table>
Prevalence of Food Allergy (FA)

- **8% Children** (2.4% multiple, 3% severe reactions)
  - Cow’s milk 2.2%
  - Peanut 1.8%
  - Tree Nuts 1.7%

- **5% Adults**
  - Shellfish 1.9% (3.1% in Blacks)
  - Fruits 1.6%
  - Vegetables 1.3%

- Overall increase in the rates of FA over time
- IgE sensitization to food (milk, egg, peanut) have remained **stable** over the decades (80s/90s vs 2005-06)

  - Gupta et al. Pediatrics 2011;128:e9-17
  - Sicherer JACI 2014;133:291-307
Risk Factors for FA

- Gender (males in children)
- SES (increased with more affluence)
- Race (Asian and Black children)
- Genetics (Fam Hx)
- Atopy
- Vitamin D
- Dietary fat – omega-3s
- Obesity (inflammatory state)
- Antacids
- Hygiene/Infections
- Microbiome, antibiotic use
- Endocrine disruptors/toxins
- Timing and Route of exposure to foods
- Place of birth
  - US born
  - children of immigrants
  - arriving before age 2y

-Sicherer JACI 2014;133:291-307
-Keet et al JACI 2012;129:169-175.
Food Allergy: The Basics

“An adverse health effect arising from a specific immune response that occurs reproducibly on exposure to a given food.”

Boyce JA et al. J Allergy Clin Immunol 2011
Diagnosis of FA

• You are the front line
• You have a major impact on patient outcomes
  – Prevention of FA
  – Diagnosis of FA
  – Economic burden of FA
• We want to help you to be able to do the right thing in the face of pressures from
  – Family requests/demands
  – Provider satisfaction scores
  – Time constraints
Food Allergy Case 1

• A 4 year old girl eats some mixed nuts at her grandmother’s house for the first time.
• Never had peanut or tree nuts before
• Within 10 minutes develops facial angioedema, total body hives and coughing
• She is given Benadryl at home and brought to your office with resolved symptoms.
• She otherwise eats a full diet
# IgE Mediated Disorders

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Features</th>
<th>Age</th>
<th>Foods</th>
<th>Natural Hx</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaphylaxis</td>
<td>Rapid onset, multiorgan</td>
<td>any</td>
<td>PN, TN, F, SF, Milk, Egg, Wheat, Soy</td>
<td>variable</td>
<td>SPT, specific, IgE, Component resolved diagnostics (CRD)</td>
</tr>
<tr>
<td>Angioedema/urticaria</td>
<td>20% acute 2% chronic</td>
<td>younger</td>
<td></td>
<td></td>
<td>SPT, specific, IgE, Component resolved diagnostics (CRD)</td>
</tr>
<tr>
<td>GI</td>
<td>Immediate vomiting</td>
<td></td>
<td></td>
<td></td>
<td>SPT, specific, IgE, Component resolved diagnostics (CRD)</td>
</tr>
<tr>
<td>Rhinitis, Asthma</td>
<td>Rarely isolated, inhalation</td>
<td>younger</td>
<td>Wheat, egg, seafood</td>
<td></td>
<td>SPT, specific, IgE, Component resolved diagnostics (CRD)</td>
</tr>
<tr>
<td>Oral Allergy</td>
<td>Oral itching, 1% anaphylaxis</td>
<td>Older children/adults</td>
<td>Fruits, vegetables</td>
<td>persists</td>
<td>Prick-prick or no testing</td>
</tr>
<tr>
<td>Delayed Meat Induced</td>
<td>6-8 hour delay rare</td>
<td>α-Gal IgE (CHO moiety)</td>
<td>Wheat, shellfish celery</td>
<td></td>
<td>α-Gal IgE</td>
</tr>
<tr>
<td>Food-exercise induced anaphylaxis</td>
<td>Only within 2 hours of exercise rare</td>
<td></td>
<td>Wheat, shellfish celery</td>
<td>persists</td>
<td>Exercise test SPT, IgE</td>
</tr>
</tbody>
</table>

-adapted from Sicherer JACI 2014;133:291-307
Tolerance to the 10 foods is unknown. Sees allergy 3 months later. Patient avoids 9 foods that she was previously tolerating and peanut. Panel of food specific IgE levels positive to 10/20 foods. Possible peanut/tree nut reaction. Multiple OFC to confirm true FA. Patients undergo repeat testing. Tolerance now to the 10 foods is unknown. Total cost = $3-4K and new FAs. Patient now reacts to 2 new foods that she was previously tolerating.
Possible peanut reaction

You send Peanut and Tree nut IgE only

Patient Avoids Peanut and Tree nuts

Sees Allergy 3 months later

Confirm PN allergy +/- OFC

Follow every year

Normal diet otherwise $300
Case 2

• A 5 month old boy with severe atopic dermatitis covering 80% of his body surfaces.
• His parents think that food allergy is the cause.
• They want to know **all** the foods that he is allergic to
• They have tried “everything” for his skin and nothing is working
Mixed IgE-Cell Mediated

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</thead>
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<tr>
<td><strong>Atopic Dermatitis</strong></td>
<td>Food induced in 35% of moderate-severe</td>
<td>Infants &gt; Children &gt; Adults</td>
<td>Egg, milk</td>
<td>resolves</td>
<td>SPT, IgE</td>
</tr>
<tr>
<td><strong>Eosinophilic GI disease</strong></td>
<td>Biopsy proven eosinophils in GI tissue, dysphagia, reflux, weight loss, impaction</td>
<td>any</td>
<td>Many, milk 70%</td>
<td>persistent</td>
<td>Empiric diets, EGD + Bx, SPT, IgE</td>
</tr>
</tbody>
</table>

-adapted from Sicherer JACI 2014;133:291-307
Natural Hx of AD and FA

• Retrospective chart review 298 patients with possible food triggered AD
• 19% without prior immediate reactions developed new immediate reactions after an initial food elimination diet.
• 30% of these were anaphylaxis
• Cow’s milk and egg most commonly
• Avoidance of a food related to development of a new food allergy
• Unrelated to level of specific IgE or the food

Take home for AD and FA

• Strict elimination diets for children with food-triggered atopic dermatitis should be recommended with caution
• These children may develop IgE-mediated food reactions to foods that could be prevented.
• Topical treatment of AD is essential
• Close follow-up of response to diet elimination versus inclusion
• Future studies of the possibility of keeping small amounts of the offending agent in the diet are needed.
Case 3

• A 6 month old girl who is formula fed has persistent spitting up
• Despite changing formulas, adding rice cereal to bottles and antacid use symptoms continue
• She is now falling off of her growth curve.
# Mixed IgE-Cell Mediated Disorder Features Age Foods Natural Hx Tests

<table>
<thead>
<tr>
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-adapted from Sicherer JACI 2014;133:291-307
Case 4

• A 3 month old breastfed girl has bloody mucousy stools and persistent crying.
• Mom has taken out milk from her diet but the bloody stools persist.
• She wants to know all the foods that her baby is allergic to.
## Non-IgE Mediated

<table>
<thead>
<tr>
<th>Disorder</th>
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<th>Foods</th>
<th>Natural Hx</th>
<th>Tests</th>
</tr>
</thead>
</table>
| **FPIES**                 | *Chronic exposure:* Emesis, diarrhea, poor growth, lethargy  
*Re-exposure:* 1.5-2 h delay in emesis, hypotension, lethargy | Infancy-toddlerhood | Milk and soy, Solids: rice, oat, banana, other solid foods | resolves   | IgE helps with persistence       |
| **Food protein induced proctocolitis** | Mucousy bloody stools in infants             | infancy       | Milk, soy +/-BF        | resolves   | Empiric diet, reintro 6-9 months |
| **Celiac Disease**        | Autoimmune, enteropathy, malabsorption        | any           | Gliadin (wheat, barley, rye) | lifelong   | IgA -TTG, HLA and biopsies      |
| **Heiner Syndrome**       | Rare, pulmonary infiltrates, FTT, anemia      | infancy       | milk                   |            | Milk IgG precipitins             |

Adapted from Sicherer JACI 2014;133:291-307
Case 5

- A 7 mo old girl eats banana and oatmeal for breakfast
- After playing for half an hour, she takes a 1 hour nap
- Wakes up projectile vomiting multiple times and appearing listless and pale
- The same reaction happens a week later with oatmeal and raisins
## Non-IgE Mediated

<table>
<thead>
<tr>
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<th>Natural Hx</th>
<th>Tests</th>
</tr>
</thead>
</table>
| **FPIES** *(Food Protein Induced Enterocolitis)* | *Chronic exposure:* Emesis, diarrhea, poor growth, lethargy  
*Re-exposure:* 1.5-2 h delay in emesis, hypotension, lethargy | Infancy-toddlerhood | Milk and soy, Solids: rice, oat, banana, sweet potato other solid foods | resolves   | IgE helps with persistence |
| **Food protein induced proctocolitis**  | Mucousy bloody stools in infants          | infancy      | Milk, soy +/-BF             | resolves   | Empiric diet, reintro 6-9 months |
| **Celiac Disease**                      | Autoimmune, enteropathy, malabsorption    | any          | Gliadin (wheat, barley, rye)| lifelong   | IgA -TTG, HLA and biopsies   |
| **Heiner Syndrome**                     | Rare, pulmonary infiltrates, FTT, anemia  | infancy      | milk                       |            | Milk IgG precipitins         |

-adapted from Sicherer JACI 2014;133:291-307
Economic Impact of Childhood Food Allergy in the United States

• Overall Economic Cost of Food Allergy: $24.8 Billion

• Direct Medical Costs: $4.3 Billion
  – Clinician visits, ED visits, Hospitalizations

• Costs to Family: $20.5 Billion
  – Lost labor productivity, Out-of-pocket, Opportunity costs

Testing and Diagnosis

- History consistent with IgE-mediated symptoms to a food

  AND

- Positive serum levels of IgE specific to that food protein (“RAST” testing) or positive skin prick testing to food protein

  OR

- Positive double blind placebo controlled oral food challenge (gold standard)

Boyce JA et al. J Allergy Clin Immunol 2011
History

- Symptoms (ever occur without the food?)
- Dose of the triggering food
- Form of the food
  - Does the patient tolerate the food in a different form (heated, baked, cooked, dried)
- Timing of the reaction (minutes, hours, days)
- Other factors: viral illness, exercise, NSAIDs
- Response to medications (Diphenhydramine, Epi)
- Has the patient tolerated the culprit food **SINCE** the original reaction
Pearls and Pitfalls of Diagnosis

• **Pre-test probability is most important**
  – Consider more likely foods for age
  – Consider DDx – lactose intolerance, non-IgE mediated, irritant effects, food poisoning (ie scromboid), gustatory rhinitis, other allergen (ie, medication)

• **Tolerated foods need **not** be tested:**
  – milk, egg, soy, wheat, peanut, tree nuts, fish, shellfish, fruits, vegetables, meats

• **Do not discount a negative test with a convincing history**

-Sicherer JACI 2014;133:291-307
## Cross-Reactivity and Co-Reactivity

Table 1. Natural History of Food Allergy and Cross-Reactivity between Common Food Allergies.

<table>
<thead>
<tr>
<th>Food</th>
<th>Usual Age at Onset</th>
<th>Cross-Reactivity</th>
<th>Usual Age at Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hen’s egg white</td>
<td>6–24 mo</td>
<td>Other avian eggs</td>
<td>7 yr (75% of cases resolve)*</td>
</tr>
<tr>
<td>Cow’s milk</td>
<td>6–12 mo</td>
<td>Goat’s milk, sheep’s milk, buffalo milk</td>
<td>5 yr (76% of cases resolve)*</td>
</tr>
<tr>
<td>Peanuts</td>
<td>6–24 mo</td>
<td>Other legumes, peas, lentils; coreactivity with tree nuts</td>
<td>Persistent (20% of cases resolve by 5 yr)</td>
</tr>
<tr>
<td>Tree nuts</td>
<td>1–7 yr; in adults, onset occurs after cross-reactivity to birch pollen</td>
<td>Other tree nuts; coreactivity with peanuts</td>
<td>Persistent (9% of cases resolve after 5 yr)</td>
</tr>
<tr>
<td>Sesame seeds</td>
<td>6–36 mo</td>
<td>None known; coreactivity with peanuts and tree nuts</td>
<td>Persistent (20% of cases resolve by 7 yr)</td>
</tr>
<tr>
<td>Fish</td>
<td>Late childhood and adulthood</td>
<td>Other fish (low cross-reactivity with tuna and swordfish)</td>
<td>Persistent†</td>
</tr>
<tr>
<td>Shellfish</td>
<td>Adulthood (in 60% of patients with this allergy)</td>
<td>Other shellfish</td>
<td>Persistent</td>
</tr>
<tr>
<td>Wheat‡</td>
<td>6–24 mo</td>
<td>Other grains containing gluten</td>
<td>5 yr (80% of cases resolve)</td>
</tr>
<tr>
<td>Soybeans‡</td>
<td>6–24 mo</td>
<td>Other legumes</td>
<td>2 yr (67% of cases resolve)</td>
</tr>
<tr>
<td>Kiwi</td>
<td>Any age</td>
<td>Banana, avocado, latex</td>
<td>Unknown</td>
</tr>
<tr>
<td>Apples, carrots, and peaches§</td>
<td>Late childhood and adulthood</td>
<td>Birch pollen, other fruits, nuts</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

It might be prudent to test for foods with **high co-reactivity** if not being consumed but generally avoid testing foods that are cross-reactive (exceptions). Lack N Engl J Med 2008;359:1252-60.
Pearls and Pitfalls of Diagnosis

• Positive SPT or food specific IgE indicates *sensitization not clinical allergy*
  – Indiscriminate food testing is poorly informative
  – Leads to unnecessary avoidance
  – Nutritional and growth concerns
  – Cascade of further testing
  – Take care not to “over test”

• Specific IgE levels
  – not correlated to severity
  – trended over time to monitor for persistence/resolution

-Sicherer JACI 2014;133:291-307
Food “Panel” Testing

- Serum IGE testing that includes a predetermined list of foods
- May include foods which the child is eating/tolerating
- Risk for false positive results
- Can present confusing results to ordering providers and families
- Potential for increased costs
- Generally not recommended, instead consider single allergens of concern
Unproven/Experimental Tests

• Intradermal skin test with foods
  – Risk of systemic reactions and death; high false positive rate

• Atopy patch testing with foods
  – No standardized reagents; No significant enhancement in diagnostic accuracy compared with skin prick testing

• Provocation/neutralization, cytotoxic tests, applied kinesiology (muscle response testing), hair analysis, electrodermal testing, food-specific IgG or IgG4 (IgG “RAST”)


Slide adapted from American Academy of Allergy, Asthma, and Immunology.
What About Siblings?

<table>
<thead>
<tr>
<th>Sibling sensitized to:</th>
<th>Any food (n = 642)</th>
<th>Peanut (n = 324)</th>
<th>Tree nut (n = 132)</th>
<th>Milk (n = 217)</th>
<th>Egg (n = 155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any food</td>
<td>53.0 (340)</td>
<td>55.6 (180)</td>
<td>44.7 (59)</td>
<td>51.6 (112)</td>
<td>54.8 (85)</td>
</tr>
<tr>
<td>Peanut</td>
<td>24.6 (158)</td>
<td>22.8 (74)</td>
<td>28.0 (37)</td>
<td>23.5 (51)</td>
<td>31.6 (49)</td>
</tr>
<tr>
<td>Tree nut</td>
<td>16.7 (107)</td>
<td>16.4 (53)</td>
<td>21.2 (28)</td>
<td>15.2 (33)</td>
<td>21.3 (33)</td>
</tr>
<tr>
<td>Milk</td>
<td>35.4 (227)</td>
<td>37.4 (121)</td>
<td>38.6 (51)</td>
<td>27.2 (59)*</td>
<td>31.0 (48)</td>
</tr>
<tr>
<td>Egg</td>
<td>35.1 (225)</td>
<td>35.19 (114)</td>
<td>34.9 (46)</td>
<td>31.8 (69)</td>
<td>38.1 (59)</td>
</tr>
<tr>
<td>Soy</td>
<td>23.1 (148)</td>
<td>21.6 (70)</td>
<td>28.8 (38)</td>
<td>23.5 (51)</td>
<td>28.4 (44)</td>
</tr>
<tr>
<td>Wheat</td>
<td>36.5 (234)</td>
<td>36.7 (119)</td>
<td>43.2 (57)</td>
<td>33.6 (73)</td>
<td>37.4 (58)</td>
</tr>
<tr>
<td>Shellfish</td>
<td>14.8 (95)</td>
<td>14.8 (48)</td>
<td>18.2 (24)</td>
<td>11.5 (25)</td>
<td>15.5 (24)</td>
</tr>
<tr>
<td>Fish</td>
<td>3.9 (25)</td>
<td>4.3 (14)</td>
<td>6.1 (8)</td>
<td>3.2 (7)</td>
<td>2.6 (4)</td>
</tr>
</tbody>
</table>

The asterisk and dagger symbols indicate statistical significance for association between sensitization and index child allergy.

*P < .01.

What About Siblings?

<table>
<thead>
<tr>
<th>Sibling allergic to:</th>
<th>Any food (n = 642)</th>
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<th>Milk (n = 217)</th>
<th>Egg (n = 155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any food</td>
<td>13.6 (87)</td>
<td>11.7 (38)</td>
<td>22.0 (29)†</td>
<td>12.9 (28)</td>
<td>17.4 (27)</td>
</tr>
<tr>
<td>Peanut</td>
<td>3.7 (24)</td>
<td>4.9 (16)</td>
<td>7.6 (10)†</td>
<td>1.8 (4)</td>
<td>3.9 (6)</td>
</tr>
<tr>
<td>Tree nut</td>
<td>1.6 (10)</td>
<td>1.5 (5)</td>
<td>2.3 (3)†</td>
<td>0.9 (2)</td>
<td>0.7 (1)</td>
</tr>
<tr>
<td>Milk</td>
<td>5.9 (38)</td>
<td>4.0 (13)*</td>
<td>6.1 (8)</td>
<td>8.3 (18)</td>
<td>12.3 (19)†</td>
</tr>
<tr>
<td>Egg</td>
<td>4.4 (28)</td>
<td>4.9 (16)</td>
<td>8.3 (11)†</td>
<td>4.6 (10)</td>
<td>5.8 (9)</td>
</tr>
<tr>
<td>Soy</td>
<td>0.9 (6)</td>
<td>0.3 (1)</td>
<td>0.8 (1)</td>
<td>0.9 (2)</td>
<td>1.3 (2)</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.1 (7)</td>
<td>0.9 (3)</td>
<td>0.0 (0)</td>
<td>1.4 (3)</td>
<td>2.6 (4)</td>
</tr>
<tr>
<td>Shellfish</td>
<td>0.2 (1)</td>
<td>0.0 (0)</td>
<td>0.8 (1)</td>
<td>0.0 (0)</td>
<td>0.0 (0)</td>
</tr>
<tr>
<td>Fish</td>
<td>0.0 (0)</td>
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The asterisk and dagger symbols indicate statistical significance for association between sibling clinical allergy and index child allergy.

*P < .05.
†P < .01.

Persistence vs Resolution of IgE-mediated FA

- Higher specific IgE levels
- Larger skin prick test
- Reaction on first exposure
- Atopic Dermatitis Severity

www.cofargroup.org
Risk Factors for More Severe Reactions

- Concomitant asthma (asthma + PN allergy → most fatal)
- Amount ingested
- Food form (cooked, raw, or processed)
- Co-ingestion of other foods (fats, alcohol)
- Age of the patient
- Degree of sensitization at the time of ingestion
- Rapidity of absorption, based on whether
  - The food is taken on an empty stomach
  - The ingestion is associated with exercise
- Lack or delayed administration of epinephrine
- Lack of skin symptoms
- Denial of symptoms
- Reliance on oral antihistamines alone to treat symptoms

-J Allergy Clin Immunol 2010;126:S1-S58.
## Interpretation of Specific IgE

<table>
<thead>
<tr>
<th>Food</th>
<th>Age</th>
<th>50% PPV</th>
<th>95% PPV</th>
<th>SPT mm</th>
<th>Natural Hx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>&lt;1 any</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>60% by 18y if IgE &gt;50</td>
</tr>
<tr>
<td>Egg</td>
<td>1 5</td>
<td>2 2</td>
<td>1.7 6</td>
<td>4mm</td>
<td>Low chance before 18y if IgE &gt;50</td>
</tr>
<tr>
<td>Peanut</td>
<td>1 4 5</td>
<td>2 (clear hx) 34 2.1</td>
<td>8mm</td>
<td>Low chance before 4y if IgE &gt;5 at age 1 -20% by early adulthood</td>
<td></td>
</tr>
<tr>
<td>Tree nut</td>
<td></td>
<td></td>
<td>15</td>
<td></td>
<td>9% by early adulthood, if + to 2+ poor prognosis</td>
</tr>
</tbody>
</table>

Variations in these cut-off values are reported depending on the specific food, study center, population

-Savage et al. JACI In Practice 2016:4:196-203
-J Allergy Clin Immunol 2013;132:874-80
Component Resolved Diagnostics

Commercially available for a number of foods, but used more frequently for:

- Peanut (“uknow” test)
- Tree nuts
- Milk
- Egg

Component Resolved Diagnostics

Risk

Ara h1 Ara h2 Ara h3 Ara h8 Ara h9

Storage proteins

PR-10 LTP

Labile Stabile
NIAID FA Guidelines: Management

• Education families on:
  – Carrying medications at all times
    • 2 epinephrine autoinjectors
    • In purse or bag; not in the car
  – Proper use of medications
  – Preparedness

• Provide a written emergency plan

• Dosing of epinephrine:
  – 0.15 mg for ≤ 25 Kg*
  – 0.3 mg for > 25 kg

• Benadryl dosing: 1-1.5 mg/kg (max 50 mg)

-J Allergy Clin Immunol 2010;126:S1-S58.
FA Guidelines: Management

• Avoidance
  – Label reading, labeling laws, advisory warnings
  – Restaurant precautions – “chef cards”, cross-contact
  – Travel – medication and safe meal preparedness
  – School – written emergency plan, caution with crafts, field trips, mealtimes
  – Home – avoid cross-contact
  – Educate all care givers
  – Vigilance – always have medications ready, medical alert jewelry
  – Avoid home trials
  – Nutritional counseling and growth monitoring
  – Psychological impact – anxiety, bullying, balance in caution

-Sicherer JACI 2014;133:291-307
-J Allergy Clin Immunol 2010;126:S1-S58.
Future Therapies – Allergen Specific

- Allergen Immunotherapy
  - Oral (OIT), Sublingual (SLIT) or percutaneous
  - Food allergen administered slowly, in small but steadily increasing doses, up to a stable daily dose
  - Tolerance desired as opposed to desensitization

- Others?
  - Anti-IgE (omaluzimab)
  - Chinese Herbal Therapy (FAHF-2)
  - Modified allergen protein/peptide vaccines
  - Probiotics
Children’s National Food Allergy Program

- Inaugural FARE (Food Allergy Research and Education) Clinical Network Center of Excellence
- > 1,100 new and > 2,000 returning food-allergic patients treated annually
  - Immediate appointment availability throughout region
- > 500 oral food challenges performed annually
- One of <5 programs in the US to have a dedicated Food Allergy Psychology Program
- Multidisciplinary clinics: Eosinophilic Esophagitis clinic (Allergy/GI/Nutrition)
- NIAID-CNMC Pediatric Allergy Immunology Fellowship Program
- Clinical trials program for novel food allergy immunotherapies