The Epidemiology of Food Allergies: What We Know, What We Don’t, and Where We Go from Here

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Ann & Robert H. Lurie Children’s Hospital of Chicago
Introduction: Dr. Ruchi Gupta

- Dr. Ruchi Gupta, is Associate Professor of Pediatrics at the Northwestern University Feinberg School of Medicine's Center for Healthcare Studies and the Ann and Robert H. Lurie Children’s Hospital of Chicago, where she also serves as a clinical attending.

- Dr. Gupta’s research and clinical interests include childhood food allergy and asthma and their management. Dr. Gupta has more than 40 peer-reviewed publications and multiple funded grants.

- As a parent of a child with food allergies, her work has greatly impacted her day-to-day life.
1. Describe the prevalence and variability of pediatric food allergy in the United States

2. Explain a recent study of food-induced hospitalizations among Illinois children

3. Describe the economic impact of food allergy

4. Review the quality of care children with food allergies receive, as perceived by parents

5. Describe the quality of life (QoL) of food allergic children and their families

6. Explain how parental empowerment is related to food-allergy related quality of life
Food Allergy Prevalence
8% of U.S. children have a food allergy
1 in 13 school-aged children, or 2 per classroom
Of those with food allergy, 30% are allergic to multiple foods

Most Common Food Allergens


www.foodallergy.org
## Prevalence – Variability by Age

<table>
<thead>
<tr>
<th></th>
<th>Peanut</th>
<th>Shell-fish</th>
<th>Tree Nut</th>
<th>Milk</th>
<th>Egg</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0 – 2 years</strong> (n=5429)</td>
<td>22%</td>
<td>7%</td>
<td>5%</td>
<td>31%</td>
<td>15%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>3 – 5 years</strong> (n=5910)</td>
<td>30%</td>
<td>12%</td>
<td>14%</td>
<td>22%</td>
<td>13%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>6 – 10 years</strong> (n=9911)</td>
<td>25%</td>
<td>17%</td>
<td>14%</td>
<td>19%</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>11 – 13 years</strong> (n=6716)</td>
<td>28%</td>
<td>20%</td>
<td>15%</td>
<td>17%</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td><strong>≥ 14 years</strong> (n=10 514)</td>
<td>20%</td>
<td>23%</td>
<td>13%</td>
<td>18%</td>
<td>4%</td>
<td>3%</td>
</tr>
</tbody>
</table>


www.foodallergy.org
Prevalence – Variability by Race

- Disparities may exist in etiology and diagnosis
- Odds by race/ethnicity
  - Although Black children reported a higher rate of FA than other groups, they were 25% less likely to be diagnosed

<table>
<thead>
<tr>
<th>Race</th>
<th>Frequency of Food Allergy (%)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>12.78%</td>
<td>(11.04, 14.74)</td>
</tr>
<tr>
<td>Black</td>
<td>14.97%</td>
<td>(13.58, 16.48)</td>
</tr>
<tr>
<td>White</td>
<td>9.04%</td>
<td>(8.68, 9.41)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>8.21%</td>
<td>(7.00, 9.08)</td>
</tr>
<tr>
<td>Multiple/Other</td>
<td>10.24%</td>
<td>(8.76, 11.93)</td>
</tr>
</tbody>
</table>

Prevalence – Variability by Income

- Disparities may exist in etiology and diagnosis
- Odds by income
  - Children of households with <50K had lower rates of having a food allergy and were 46% less likely to be diagnosed

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Frequency of Food Allergy (%)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25K</td>
<td>8.77%</td>
<td>(7.94, 9.68)</td>
</tr>
<tr>
<td>25K – 49,999</td>
<td>9.56%</td>
<td>(8.89, 10.27)</td>
</tr>
<tr>
<td>50K – 99,999</td>
<td>10.46%</td>
<td>(9.90, 11.04)</td>
</tr>
<tr>
<td>100K – 149,999</td>
<td>9.84%</td>
<td>(8.93, 10.83)</td>
</tr>
<tr>
<td>&gt;150K</td>
<td>13.35%</td>
<td>(11.64, 15.27)</td>
</tr>
</tbody>
</table>

Geographic distribution of childhood food allergy in the United States (N = 38,465)

Geographic Variability

Population density corresponds with food allergy prevalence (P<0.0001)


www.foodallergy.org
Food Allergy Hospitalizations
Ambulatory care visits, including emergency department (ED) visits, due to food allergies are on the rise.

Over a 5-year study period (2008-2012), there were a total of 1,690 ED visits due to food induced anaphylaxis among children in Illinois

- 203 (10.7%) resulted in hospitalization

### Rate of ED Visits and Hospitalizations by Race

#### Graph A

- **X-axis:** Year (2008-2012)
- **Y-axis:** Rate per 100,000 children
- **Legend:**
  - Red: Asian
  - Orange: Black
  - Green: White
  - Blue: Hispanic

#### Graph B

- **Average Annual % Change:**
  - Asian: 18.9%
  - Black: 30.2%
  - White: 29.4%
  - Hispanic: 47.1%

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Rate of ED Visits and Hospitalizations by Insurance Type

Most Common Allergens to Cause Hospitalizations

Peanut  Tree nut  Fin fish  Milk

Average Length of Stay: 1.45 days

The Economic Impact of Food Allergy
What if you could purchase a completely effective and safe treatment to eliminate all food allergies for your child that would allow him or her to safely eat all foods. Imagine this treatment was a pill that needed to be taken by your food allergic child once per month.

What is the most you would be willing and able to pay out-of-pocket per month for such a treatment?

### Direct Medical Costs*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Children With Visit, % (SE)</th>
<th>Visits per Child, Mean (SE)</th>
<th>Cost, US $</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visit</td>
</tr>
<tr>
<td>Visits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediatrician</td>
<td>42 (2)</td>
<td>.82 (.05)**</td>
<td>112</td>
</tr>
<tr>
<td>Allergist</td>
<td>41 (2)</td>
<td>.79 (.05)**</td>
<td>175</td>
</tr>
<tr>
<td>Pulmonologist</td>
<td>14 (1)</td>
<td>.07 (.01)**</td>
<td>175</td>
</tr>
<tr>
<td>Nutritionist</td>
<td>17 (1)</td>
<td>.16 (.04)**</td>
<td>100</td>
</tr>
<tr>
<td>Alternative Provider</td>
<td>17 (1)</td>
<td>.23 (.05)**</td>
<td>100</td>
</tr>
<tr>
<td>Emergency Department</td>
<td>13 (1)</td>
<td>.18 (.02)*****</td>
<td>711</td>
</tr>
<tr>
<td>Inpatient Hospitalization Stays</td>
<td>4 (1)</td>
<td>.05 (.01)*****</td>
<td>6269</td>
</tr>
<tr>
<td><strong>Total Direct Medical Costs</strong></td>
<td></td>
<td></td>
<td><strong>724</strong></td>
</tr>
</tbody>
</table>

*Direct medical costs are medical costs borne by the health care system associated with prevention, diagnosis, and treatment of food allergies.

**Source: Hospital Outpatient Prospective Payment System (insert)

***Source: Patel et al (insert here)

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**Gupta RS, Holdford D, Bilaver L, Dyer A, Holl J, Meltzer D. The high economic impact of childhood food allergy in the United States. JAMA Pediatrics Sept 2013 16, published online before print.**
## Out-of-Pocket Costs

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Reporting Cost (SE)</th>
<th>Mean Direct Out-of-Pocket Costs, US$ (SE)</th>
<th>Cost Per Child, US$</th>
<th>Overall Annual Cost (in Millions), US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits to the physician’s office of health clinic (including copays)</td>
<td>52.5 (2.2)</td>
<td>160 (14)</td>
<td>84</td>
<td>499</td>
</tr>
<tr>
<td>Visits to the emergency room (including copays)</td>
<td>16.1 (1.6)</td>
<td>247 (42)</td>
<td>40</td>
<td>235</td>
</tr>
<tr>
<td>Overnight Stays at the hospital</td>
<td>10 (1.4)</td>
<td>411 (182)</td>
<td>41</td>
<td>244</td>
</tr>
<tr>
<td>Travel to and from health care visits (including ambulance use; parking expenses)</td>
<td>27.7 (1.8)</td>
<td>91 (14)</td>
<td>25</td>
<td>149</td>
</tr>
<tr>
<td>Epinephrine injectors</td>
<td>35.9 (1.9)</td>
<td>87 (4)</td>
<td>31</td>
<td>184</td>
</tr>
<tr>
<td>Antihistamines</td>
<td>50.8 (2.2)</td>
<td>62 (4)</td>
<td>32</td>
<td>188</td>
</tr>
<tr>
<td>Other prescription/nonprescription medications</td>
<td>29.3 (1.9)</td>
<td>122 (13)</td>
<td>36</td>
<td>211</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Reporting Cost (SE)</th>
<th>Mean Direct Out-of-Pocket Costs, US$ (SE)</th>
<th>Cost Per Child, US$</th>
<th>Overall Annual Cost (in Millions), US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-traditional medicine</td>
<td>15 (1.6)</td>
<td>123 (30)</td>
<td>19</td>
<td>110</td>
</tr>
<tr>
<td>Costs associated with special diets and allergen-free food</td>
<td>37.7 (2.0)</td>
<td>756 (59)</td>
<td>285</td>
<td><strong>1689</strong></td>
</tr>
<tr>
<td>Additional/change in child care</td>
<td>6.7 (0.8)</td>
<td>2158 (323)</td>
<td>145</td>
<td>857</td>
</tr>
<tr>
<td>Legal guidance</td>
<td>2.3 (0.6)</td>
<td>402 (122)</td>
<td>9</td>
<td>55</td>
</tr>
<tr>
<td>Counseling or mental health services</td>
<td>4.5 (0.7)</td>
<td>571 (123)</td>
<td>26</td>
<td>152</td>
</tr>
<tr>
<td>Special summer camp</td>
<td>3 (0.7)</td>
<td>702 (183)</td>
<td>21</td>
<td>125</td>
</tr>
<tr>
<td>A change in schools was needed due to food allergy</td>
<td>4.2 (0.7)</td>
<td>2611 (497)</td>
<td>110</td>
<td>650</td>
</tr>
<tr>
<td>Other expenses (e.g., cleaning supplies)</td>
<td>9.5 (1.1)</td>
<td>396 (86)</td>
<td>36</td>
<td>216</td>
</tr>
<tr>
<td><strong>Any out-of-pocket costs</strong></td>
<td><strong>74.3 (2.1)</strong></td>
<td><strong>1252 (90)</strong></td>
<td><strong>931</strong></td>
<td><strong>5516</strong></td>
</tr>
</tbody>
</table>

Out-of-pocket costs: medical costs borne by patient associated with the prevention, diagnosis, and treatment of food allergies. Includes all costs associated with protecting the child from exposure to allergens, including special child care arrangements. The out-of-pocket costs exclude the top 1% of reported costs in each category.

# Opportunity Costs*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Reporting, % (SE)</th>
<th>Opportunity, Mean (SE)</th>
<th>Per Child</th>
<th>Overall Annual (in Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice of Career has been restricted</td>
<td>5.7 (0.9)</td>
<td>15 655 (2471)</td>
<td>892</td>
<td>5.3</td>
</tr>
<tr>
<td>A job had to be given up</td>
<td>4.9 (0.7)</td>
<td>29 657 (4151)</td>
<td>1453</td>
<td>8.6</td>
</tr>
<tr>
<td>A job was lost through dismissal</td>
<td>1.9 (0.6)</td>
<td>14 849 (7479)</td>
<td>282</td>
<td>1.7</td>
</tr>
<tr>
<td>A job change was required</td>
<td>2.5 (0.6)</td>
<td>10 605 (3161)</td>
<td>265</td>
<td>1.6</td>
</tr>
<tr>
<td>Any job-related opportunity cost (total amount)**</td>
<td>9.1 (1.0)</td>
<td>32 719 (4166)</td>
<td>2977</td>
<td>17.6</td>
</tr>
<tr>
<td>Any job-related opportunity cost (maximum amount)***</td>
<td>9.1 (1.0)</td>
<td>26 363 (2545)</td>
<td>2399</td>
<td>14.2</td>
</tr>
</tbody>
</table>

*Opportunity cost is the additional cost associated with activities forgone as a result of a child’s food allergy

**All possible responses were used to calculate job-related opportunity cost

***Only the maximum of 4 possible responses was used to calculate job-related opportunity cost

Comparing WTP & Measure of Actual Cost

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (in Billions)</th>
<th>Per Child</th>
<th>Total (in Billions)</th>
<th>Per Child</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WTP</strong></td>
<td><strong>20.8</strong></td>
<td><strong>3504</strong></td>
<td>(15.7-25.7)</td>
<td>(2652-4344)</td>
</tr>
<tr>
<td>Costs borne by families</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Out-of-pocket treatment</td>
<td>5.5</td>
<td>931</td>
<td>(4.7-6.4)</td>
<td>(793-1080)</td>
</tr>
<tr>
<td>Lost labor productivity</td>
<td>0.77</td>
<td>130</td>
<td>(0.53-1.0)</td>
<td>(89-175)</td>
</tr>
<tr>
<td>Opportunity</td>
<td>14.2</td>
<td>2399</td>
<td>(10.5-18.4)</td>
<td>(1771-3104)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20.5</strong></td>
<td><strong>3457</strong></td>
<td><strong>2816-4208</strong></td>
<td></td>
</tr>
<tr>
<td>Reported costs borne by families</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct medical costs</td>
<td>4.3</td>
<td>724</td>
<td>(2.8-6.3)</td>
<td>(472-1063)</td>
</tr>
<tr>
<td>Reported costs</td>
<td><strong>24.8</strong></td>
<td><strong>4184</strong></td>
<td>(20.6-29.4)</td>
<td>(3475-4960)</td>
</tr>
</tbody>
</table>

Economic Impact

Total Annual Cost per Child: $4,184

Total Annual Cost In the U.S.: $24.8 billion

Quality of Care for Children with Food Allergies
Role of the pediatrician
- Pediatricians must be adept at managing food allergies
- Pediatrics are often the only physician children can access
- The average wait time to see an allergist has been found to be as long as 4 months in an urban center

Patient-practitioner relationship
- Food allergies impact physical and emotional health
- Patient-physician relationship is complex in the pediatric setting
- Trusting, communicative relationships have been shown to improve chronic disease management

Overall, parents report high levels of satisfaction and trust in their physicians.

- Treat with courtesy & respect: Allergist 96, Pediatrician 97
- Listened carefully: Allergist 94, Pediatrician 94
- Treated your view w/ respect: Allergist 94, Pediatrician 92
- Concerned for impact on life: Allergist 88, Pediatrician 83

Parental Satisfaction with Care

Parent report of food allergy management


www.foodallergy.org
Fathers were more likely to respond favorably about the care their child received.

Parents of children with food allergies feel cared for and respected by their child’s doctors

Proper management of food allergy by both pediatricians and allergists is critical

Increased education in healthcare settings around recognizing symptoms of an anaphylactic reaction and how and when to use epinephrine auto-injectors is needed

A food allergy action plan and counseling of prognosis are vital for all children with food allergy

Quality of Life in Caregivers of Food Allergic Children
Food Allergy and Quality of Life

- Food allergies impact quality of life (QoL) in variety of domains. These include:
  - Family relationships
  - Finances (discussed above)
  - Social interactions
  - Day care and school

QoL Impact on Families

- 1 in 4 parents report that food allergy causes a strain on their marriage

- Poor quality of life is more likely if the child has:
  - Been to the ED for food allergies in the last year
  - Multiple food allergies
  - Milk of wheat allergies

Many people do not believe that food allergy is a serious problem. This can lead them to resent children with food allergy, especially when their own child is directly affected.

Quality of life among food allergic families varies widely, with one exception:
- Caregivers are consistently troubled by social limitations.

Caregivers of children with food allergy express the greatest concern when it comes to **school and day care**. Ninety percent of schools report enrolling children with food allergy, with half of these schools reporting a food-induced reaction in the past two years.

One in 4 kids have their 1st reaction at school.

Parental Empowerment and Quality of Life
What is the relationship between maternal/paternal empowerment and quality of life among parents of children with food allergy?
Parental Empowerment & QoL – Preliminary Findings

- Mothers are more empowered than fathers to care for their child with food allergy
- Mothers experience worse QoL than fathers, particularly when child has comorbid chronic conditions
- Parents of children with more severe food allergy are more empowered but suffer worse QoL
- Parents of children with peanut, milk, egg, and tree nut allergy report similar degrees of empowerment, yet milk and egg allergy are associated with significantly reduced QoL
- Overall parental empowerment does not appear to predict parental food allergy quality of life

Maternal caregivers of children with food allergy reliably report greater empowerment but lower QoL than paternal caregivers.

Parental concern about lack of control over allergen exposure in child’s social environment is associated with decreased QoL, particularly in mothers.

Traditional empowerment-based interventions focusing on anaphylaxis management and allergen avoidance are not sufficient to improve QoL among caregivers of children with food allergies.

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