

## **Food Allergy Treatment Value: Child Caregiver and Patient Perspectives**

### **Conflicts of Interest**

Sanaz Eftekhari, Hannah Jaffee, and Melanie Carver are employed by the Asthma and Allergy Foundation of America (AAFA), a non-profit patient organization, which has received food allergy-related funding from Aimmune, DBV Technologies, Genentech, kaléo, Mylan, Pfizer and PhRMA.

### **Financial Support**

This work was funded by Pharmaceutical Research and Manufacturers of America (PhRMA) Foundation, Washington, DC.

## Abstract

**Background:** Food allergy is a major health problem that significantly impacts quality of life (QoL). There is growing focus to evaluate food allergy related QoL and treatment value beyond the clinical effectiveness perspective by engaging patients and caregivers. We aimed to identify and prioritize outcomes important to food allergy parents of children and patients allergic to milk, egg, and/or peanut, to guide comparative effectiveness research (CER) that focuses on evaluating food allergy treatment decisions.

**Methods:** We conducted a modified 3-round Delphi study to identify and derive consensus on priority treatment outcomes for parents of children and adult patients with diagnosed allergies to at least one of three major allergenic foods (milk, egg, and peanut) from across the United States.

**Results:** Round 1 yielded 44 statements for round 2, and 39 statements reached the agreement level for round 3 ranking. Statements were organized under 4 sections: 1) food allergy problems, 2) treatment experiences, 3) important treatment outcomes, and 4) value of different treatment options.

**Conclusion:** Food allergy parents and patients face several social, psychological, medical, healthcare, financial, food selection, and awareness challenges. The areas of consensus on important treatment outcomes revealed shared priority for reducing the risk of potentially fatal allergic reactions and having reliable treatments. The most valued treatment options reflect hope for permanent cure and fear of serious allergic reactions.

**Key words:** Food allergy, Food hypersensitivity, Caregivers, Quality of Life, Comparative Effectiveness Research, Delphi Technique.

33 **Key message:** We identified and prioritized: 1) food allergy treatment outcomes, and 2) value of  
34 different treatment options to food allergy patients and parents. Our results inform comparative  
35 effectiveness research that evaluates food allergy treatment outcomes and value.

## Introduction

Food allergy is a global health problem affecting about 8% of children and 5% of adults worldwide with higher and steadily rising prevalence in developed countries.<sup>1</sup> In the United States, it is estimated that 7.6% of children and 10.8% of adults have food allergy.<sup>2,3</sup> Among the American children, the most prevalent food allergens are peanut (2.2%) followed by milk (1.9%) and shellfish (1.3%); while egg allergy affects 0.9%. About 39.9% of children with food allergy have multiple allergies to different types of food. Around 42.0% of allergic American children experienced a severe food allergy reaction at least once in their life, and 19.0% visited the emergency department due to a life-threatening allergic reaction in the prior year.<sup>2</sup>

Food allergy is a chronic condition that significantly impacts quality of life (QoL), and can be fatal.<sup>4</sup> The impact of food allergy on young children is higher than other age groups with repercussions on 1) the child's own perception of the condition, 2) parents' proxy perception of their child's illness, 3) the child caregiver experience, and 4) parents' and families' day-to-day life.<sup>5</sup> Thus, the societal, psychological, and economic burdens of food allergy impact multiple stakeholders including patients, parents and caregivers, schools and childcare facilities, workplaces, healthcare systems, and the food industry.<sup>6</sup>

On comparing food allergy QoL in the United States vs. Europe, a population-based study used the Food Allergy Quality of Life Questionnaire-Parent Form (FAQLQ-PF) found that American parents of food-allergic children had higher clinical impact and lower QoL in comparison to their European counterparts. In both groups, the impact increased with the child's age and the number of food allergies.<sup>7</sup>

The benefit of food allergy treatments does not come without financial costs and adverse events. For example, the Institute for Clinical and Economic Review found in 2019 satisfactory

59 desensitization effectiveness of two oral immunotherapies (OIT) for peanut allergy. However,  
60 the annual cost–effectiveness limits of these two therapies were \$1,508 and \$2,369, and their  
61 adverse events included systematic allergic reactions, need for epinephrine, and other side effects  
62 leading to discontinuation of therapy.<sup>9</sup>

63         Universally, there is a growing focus on Patient-Centered Outcomes Research (PCOR)  
64 that helps patients and caregivers make informed healthcare decisions and incorporates their  
65 opinions in assessing healthcare options’ value. To support this research direction, the United  
66 States Patient-Centered Outcomes Research Institute (PCORI) funds more research investigating  
67 comparative effectiveness research (CER) from the patients and caregivers’ perspectives.<sup>10</sup>  
68 Particularly for food allergy, there is an urgent need to evaluate QoL and treatment value beyond  
69 the clinical effectiveness perspective via engaging patients and caregivers to add their insights of  
70 the psychological, societal, and economic aspects of the problem.<sup>11</sup> Food allergy QoL assessment  
71 tools have been using food allergy QoL surveys <sup>7,12,13</sup>, however; there are no specific food allergy  
72 treatment value measures guided by food allergy patients and caregivers’ experiences,  
73 challenges, needs, and desired outcomes.<sup>5,11</sup> To develop these guided food allergy specific  
74 measures, PCOR is needed to evaluate and prioritize outcomes important to patients and  
75 caregivers.<sup>14</sup> In turn, the prioritized treatment outcomes can guide CER that generates evidence  
76 on comparing the benefits and harms of alternative food allergy treatments for better informed  
77 individual and population level decisions.<sup>15</sup>

78         In order to guide CER that focuses on evaluating food allergy treatment decisions, we  
79 conducted a modified 3-round Delphi study to identify and derive consensus on priority  
80 treatment outcomes and value of different treatment options for parents of children and adults  
81 with food allergy.

## Methods

### Study Design

We conducted a modified 3-round Delphi study to identify and derive consensus on priority treatment outcomes and value of different treatment options for parents of children and adults with food allergy to milk, egg, and/or peanut. The Delphi technique is a multi-round survey process used to seek opinions and develop consensus among a defined group of subject matter experts about controversial or limited evidence topics.<sup>16</sup> Specifically, rank-ordering techniques have been identified as one of the most reliable and valid instruments for measuring food allergy related QoL.<sup>5</sup>

### Study Participants

For purposes of this study, patient and caregiver experience with food allergy was considered the primary inclusion criteria as panelists were considered experts based on real-world experience.<sup>17</sup> The Asthma and Allergy Foundation of America (AAFA), a national non-profit patient advocacy organization, identified and assembled a panel of parents of children with food allergy and adult patients from its national advocacy and support national network across the United States. The panelists were assembled from 3 major food allergy groups: milk, egg, and peanut; to capture a wide range of experiences and opinions. Panelists were invited and communicated via emails throughout the Delphi process. We aimed to recruit 10-15 panelists from each of the 3 allergy groups to capture a wide range of opinions and judgments and balance group dynamics. We targeted a response rate of at least 80% for each round, thus a round was not considered complete for analysis until the 80% threshold was reached.

### Data Collection

Between January and March 2020, we used Qualtrics® software (Qualtrics, Provo, UT, USA) to collect the panelists' anonymous responses to the 3-round survey. Round 1 included a brief demographic survey followed by open-ended questions on 1) problems encountered by food allergy patients or parents, 2) food allergy treatment experience, 3) important food allergy treatment outcomes, and 4) value of effective food allergy treatment.

## **Data Analysis**

We analyzed round 1 using NVivo 12® software following the grounded theory and a stepwise thematic analysis. Two researchers (JM and MA) independently coded the responses then grouped them into conceptual themes to develop round 2 statements supported with examples from the panelists' round 1 responses. Round 2 statement were provided against 4-point Likert-scale agreement rating in addition to a space for general comments. We sought an agreement (Agree and Strongly Agree) percentage of  $\geq 75$  to be determined a consensus for inclusion in the final round. Round 3 asked the panelists to rank consensus statements according to their importance. We assessed round 3 mean rankings and levels of agreement among the panelists using Kendall's coefficient of concordance in Microsoft Excel®.

## **Results**

Forty-five panelists participated in the first round of our survey (Table 1). Forty of these panelists responded to each of the second and third rounds (88.9%). An overview of the Delphi process is presented in Figure 1.

Round 1 yielded 44 statements for round 2 organized under 4 sections: 1) food allergy problems, 2) treatment experiences, 3) important treatment outcomes, and 4) value of treatment and the quantitative value of different treatment options.

Thirty-nine statements reached the targeted agreement level ranging between 77.5% and 100% (Table 2). On quantifying the value of different treatment options, the order of these options according to their average scores is 1) permanently cures food allergy, 2) reduces the risk of serious anaphylaxis, 3) reduces the risk of accidental exposure to small quantities of the allergen, 4) increases food options for patients, 5) allows a food allergy patient to participate in social activities with less fear, 6) allows a food allergy patient to have less anxiety about food, 7) reduces the risk of mild or moderate allergic reactions (Table 3).

In round 3, concordance assessment showed that the ranking for food allergy treatment values had the highest level of consensus ( $W=0.4$ ), while the lowest consensus was found in ranking the two statements on food allergy awareness ( $W=0.002$ ) (Table 4).

## Discussion

We engaged parents of children with food allergy and adult patients in a 3-round Delphi panel survey to identify and prioritize important food allergy outcomes and valued treatments to guide future CER (Figure 2). Two key findings emerged from this study. First, food allergy parents and patients face several challenges revolving around social, psychological, medical, healthcare, financial, food selection, and awareness problems. Second, our panel agreed that the current treatments for food allergy are unsatisfactory, offer limited options, and are inconvenient. The areas of consensus and ranking of important treatment outcomes revealed are reducing the risk of fatal allergic reactions and having reliable treatments. The most valued treatment options reflect hope for permanent cure and fear of serious allergic reactions.

Overall, our panel identification and enumeration of different social challenges confirm their importance and echo the findings of two previous surveys on the social challenges of food allergy.<sup>13,18</sup> Our panel ranked these social challenges putting “eating at restaurants” on the top of



the list. A previous survey supports this prioritization, where 53% of food allergy families reported leaving a restaurant in the middle of dining, and 89% avoided certain restaurants.<sup>18</sup> This finding can be relevant to the fact that no formal training on food allergy is required for restaurant employees who learn about the problem during on-job ad hoc training.<sup>19</sup>

The second social challenge, school or childcare services, has been found in a previous study as a leading factor for food allergy parents to become a school volunteer or attend a school field trip for close monitoring of their child (61% and 69% of survey respondents), change their child's school (25% of respondents), or even decide to homeschool (18% of respondents).<sup>18</sup> Social isolation, our panel's third rank, was discussed in two previous surveys where families in the first survey reported experiencing social isolation and limited social activities in different ways<sup>18</sup>, while the second survey identified social limitation was the only consistent factor for food allergy implications according to food allergy caregivers.<sup>13</sup> The fourth challenge was travel which was previously reported in different ways: canceling vacation plans (57% of respondents) and avoiding airline travel (43% of respondents).<sup>18</sup>

Final ranking of psychological challenges put the anxiety experienced by parents of allergic children above the anxiety of adult patients. One interpretation could be the higher percentage of food allergy parents in our panel (93.3% are either parents or both parents and patients). The higher ranking of parents' anxiety is consistent with a study that revealed mothers of food allergy children have higher anxiety and stress levels in comparison to mothers of asthmatic children and control groups. In that study, anxiety and stress were related to history of anaphylaxis, parents' continuous stress about their children, and the effects of food allergy on the family relations and financial conditions.<sup>20</sup> This finding supports the inclusion of caregiver

171 burden or other spillover effects observed when evaluating the comparative cost-effectiveness of  
172 any interventions in food allergy.

173         The ranking of medical challenges showed that severe and moderate allergic reactions are  
174 agreed on and prioritized, and may reflect the adaptation to mild reactions. Providers' inadequate  
175 training on food allergy was ranked first in the healthcare challenges and could be attributed to  
176 the first-round examples of prescribing medication that contain allergens, lack of awareness  
177 about advanced or curative treatments for allergy, and delayed diagnosis by non-specialists.  
178 Unavailability of necessary medications such as pediatrics epinephrine autoinjector and properly  
179 stored autoinjector also presented significant challenges.

180         The panel agreed that several costs are challenging to food allergy patients and parents  
181 including food, pharmacy, medical, and non-healthcare costs related to vacations and special  
182 child-care. Food costs received the highest rank and confirms previous findings that showed  
183 allergy-safe food is priced higher than regular food resulting in higher financial burden on food  
184 allergy families.<sup>18</sup> In the same line, our panel agreed on other food related challenges including  
185 finding and preparing safe food, and interference with the family diet. When considering the  
186 economic value of potential interventions for food allergy patients, costs outside of the typical  
187 "health system" frequently covered by health insurance may need to be considered.

188         Our panel agreement on pharmacy and medical costs is not surprising; several qualitative  
189 and quantitative studies report higher costs of food allergy medications and added costs of  
190 medical visits due to food allergy, including emergency room visits.<sup>18,21</sup> Additionally, it is  
191 estimated that the annual direct medical costs attributed to pediatric food allergy is \$4.3 billion.<sup>22</sup>

192         Food allergy awareness was prioritized by our panel which agreed on the challenges of  
193 lack of awareness among school and childcare employees, and family and friends. School

personnel awareness is a challenge reported elsewhere; a study conducted with public elementary schools found that 52% relied on parents to educate school personnel on their children food allergy, 16% only had written individual emergency plans for food allergy, 11% had no methods for educating their staff on food allergy, and 9% posted food service notices.<sup>23</sup> Educational strategies to improve food allergy awareness may help reduce the fear parents face when they leave their children at school or at daycare, but complex educational interventions may be difficult to assess.

Diagnostic tests and reaching definite allergy diagnosis were agreed upon as major challenges. Panelists elaborated on these challenges by discussing diagnostic tests' contraindications, inaccuracy, delayed results, and delayed allergic reactions to some of these tests. These findings are not surprising as accurate diagnosis, and consequently prevalence estimates, of food allergies remains a challenge due to the nature of the current diagnostic tests.<sup>24</sup>

Our panel agreed that the current treatments for food allergy are unsatisfactory, offer limited options, and are inconvenient. Agreement and ranking of important treatment outcomes revealed that reducing the risk of anaphylaxis is the top priority followed by the reliability of food allergy treatments. Interestingly, the order of different treatment options' value in round 2 differed from their final ranking in round 3. However, the two treatment options: "permanently cures the allergy" and "reducing the risk of serious anaphylaxis" had the highest mean values (98.2 +/-5.82, and 96.0 +/-10.98) in round 2 and ranked first and second in round 3.

This study confirms previous findings that food allergy patients and caregivers experience various health and economic burdens frequently outside standard healthcare services (e.g. food, special childcare, travel).<sup>22,25,26</sup> Our study further demonstrates the potential spillover effects experienced by caregivers of young children with food allergies. In pediatric economic

217 evaluations, incorporating family spillover effects and health outcomes is substantial and makes  
218 health interventions more cost-effective.<sup>27</sup> In the case of food allergy, our panel rated parental  
219 anxiety as an important psychological consideration. To our knowledge, the economic burden  
220 specific to these parental health effects attributable to pediatric food allergy have not been  
221 evaluated.

Our study has some limitations. First, since we included mainly parents of allergic children and very few adult patients, the two different experiences may have impacted the homogeneity of our panel. Second, although we included a relatively large and geographically diverse national sample of food allergy patients and caregivers, the Delphi panel selection was purposeful and not intended to be completely representative but rather diverse enough to capture all salient themes. The third limitation is specific to the Delphi technique which lacks in-person discussions among the panelists. In-person discussions may produce more interactive and reassessed ideas and perspectives.

230 **Acknowledgement**

231 The authors would like to thank the panelists for their invaluable inputs.

## References

1. Sicherer SH, Sampson HA. Food allergy: Epidemiology, pathogenesis, diagnosis, and treatment. *J Allergy Clin Immunol*. 2014;133(2):291-307.e5. doi:10.1016/j.jaci.2013.11.020
2. Gupta RS, Warren CM, Smith BM, et al. The public health impact of parent-reported childhood food allergies in the United States. *Pediatrics*. 2018;142(6). doi:10.1542/peds.2018-1235
3. Gupta RS, Warren CM, Smith BM, et al. Prevalence and Severity of Food Allergies Among US Adults. *JAMA Netw open*. 2019;2(1):e185630. doi:10.1001/jamanetworkopen.2018.5630
4. Sicherer SH, Sampson HA. Food allergy. *J Allergy Clin Immunol*. 2010;125(2 SUPPL. 2). doi:10.1016/j.jaci.2009.08.028
5. Greenhawt M. Food allergy quality of life and living with food allergy. *Curr Opin Allergy Clin Immunol*. 2016;16(3):284-290. doi:10.1097/ACI.0000000000000271
6. Dyer A, Negris O, Gupta R, Bilaver L. Food allergy: how expensive are they? *Curr Opin Allergy Clin Immunol*. 2020;20(2):188-193. doi:10.1097/ACI.0000000000000622
7. DunnGalvin A, Koman E, Raver E, et al. An Examination of the Food Allergy Quality of Life Questionnaire Performance in a Countrywide American Sample of Children: Cross-Cultural Differences in Age and Impact in the United States and Europe. *J Allergy Clin Immunol Pract*. 2017;5(2):363-368.e2. doi:10.1016/j.jaip.2016.09.049
8. Miller J, Blackman AC, Wang HT, et al. Quality of life in food allergic children: Results from 174 quality-of-life patient questionnaires. *Ann Allergy, Asthma Immunol*. 2020;124(4):379-384. doi:10.1016/j.anai.2019.12.021

- 255 9. Tice JA, Guzauskas GF, Hansen RN, et al. The effectiveness and value of oral  
 256 immunotherapy and Viaskin peanut for peanut allergy a summary from the Institute for  
 257 Clinical and Economic Review's California Technology Assessment Forum. *J Manag*  
 258 *Care Spec Pharm*. 2020;26(5):620-623. doi:10.18553/jmcp.2020.26.5.620
- 259 10. Patient-Centered Outcomes Research Institute. Our Programs.  
 260 <https://www.pcori.org/about-us/our-programs>. Published 2017. Accessed December 20,  
 261 2020.
- 262 11. Polk BI, Dinakar C. Patient-Centered Outcomes in Food Allergy. *Curr Allergy Asthma*  
 263 *Rep*. 2017;17(6). doi:10.1007/s11882-017-0708-z
- 264 12. Allen CW, Bidarkar MS, Vannunen SA, Campbell DE. Factors impacting parental burden  
 265 in food-allergic children. *J Paediatr Child Health*. 2015;51(7):696-698.  
 266 doi:10.1111/jpc.12794
- 267 13. Springston EE, Smith B, Shulruff J, Pongratic J, Holl J, Gupta RS. Variations in quality  
 268 of life among caregivers of food allergic children. *Ann Allergy, Asthma Immunol*.  
 269 2010;105(4). doi:10.1016/j.anai.2010.08.003
- 270 14. Frank L, Basch E, Selby J V. The PCORI perspective on patient-centered outcomes  
 271 research. *JAMA - J Am Med Assoc*. 2014;312(15):1513-1514.  
 272 doi:10.1001/jama.2014.11100
- 273 15. Sox HC. Defining comparative effectiveness research the importance of getting it right.  
 274 *Med Care*. 2010;48(6 SUPPL.). doi:10.1097/MLR.0b013e3181da3709
- 275 16. Jorm AF. Using the Delphi expert consensus method in mental health research. *Aust N Z J*  
 276 *Psychiatry*. 2015;49(10):887-897. doi:10.1177/0004867415600891
- 277 17. Mattingly TJ, Slejko JF, Perfetto EM, Kottiril S, Mullins CD. What Matters Most for

- 278 Treatment Decisions in Hepatitis C: Effectiveness, Costs, and Altruism. *Patient*.  
 279 2019;12(6):631-638. doi:10.1007/s40271-019-00378-7
- 280 18. Asthma and Allergy Foundation of America. *My Life With Food Allergy Report*.  
 281 Arlington, VA; 2019.
- 282 19. Bureau of Labor Statistics. Food and Beverage Serving and Related Workers.  
 283 Occupational Outlook Handbook.  
 284 [https://www.bls.gov/ooh/food-preparation-and-serving/food-and-beverage-serving-and-](https://www.bls.gov/ooh/food-preparation-and-serving/food-and-beverage-serving-and-related-workers.htm)  
 285 [related-workers.htm](https://www.bls.gov/ooh/food-preparation-and-serving/food-and-beverage-serving-and-related-workers.htm). Published 2019. Accessed May 20, 2020.
- 286 20. Lau GY, Patel N, Umasunthar T, et al. Anxiety and stress in mothers of food-allergic  
 287 children. *Pediatr Allergy Immunol*. 2014;25(3):236-242. doi:10.1111/pai.12203
- 288 21. Protudjer JLP, Jansson SA, Heibert Arnlind M, et al. Household costs associated with  
 289 objectively diagnosed allergy to staple foods in children and adolescents. *J Allergy Clin*  
 290 *Immunol Pract*. 2015;3(1):68-75. doi:10.1016/j.jaip.2014.09.021
- 291 22. Gupta R, Holdford D, Bilaver L, Dyer A, Holl JL, Meltzer D. The economic impact of  
 292 childhood food allergy in the United States. *JAMA Pediatr*. 2013;167(11):1026-1031.  
 293 doi:10.1001/jamapediatrics.2013.2376
- 294 23. Rhim GS, McMorris MS. School readiness for children with food allergies. *Ann Allergy,*  
 295 *Asthma Immunol*. 2001;86(2):172-176. doi:10.1016/s1081-1206(10)62687-7
- 296 24. Renz H, Allen KJ, Sicherer SH, et al. Food allergy. *Nat Rev Dis Prim*. 2018;4.  
 297 doi:10.1038/nrdp.2017.98
- 298 25. Bilaver LA, Chadha AS, Doshi P, O'Dwyer L, Gupta RS. Economic burden of food  
 299 allergy: A systematic review. *Ann Allergy, Asthma Immunol*. 2019;122(4):373-380.e1.  
 300 doi:10.1016/j.anai.2019.01.014

- 301 26. Cummings AJ, Knibb RC, King RM, Lucas JS. The psychosocial impact of food allergy  
302 and food hypersensitivity in children, adolescents and their families: A review. *Allergy*  
303 *Eur J Allergy Clin Immunol.* 2010;65(8):933-945. doi:10.1111/j.1398-9995.2010.02342.x
- 304 27. Lavelle TA, D'Cruz BN, Mohit B, et al. Family Spillover Effects in Pediatric Cost-Utility  
305 Analyses. *Appl Health Econ Health Policy.* 2019;17(2):163-174. doi:10.1007/s40258-018-  
306 0436-0



307 **Table 1. Characteristics of Participants in a Delphi Panel on the Value of Treatment for**  
 308 **Food Allergy (n=45)**

<b>Mean age* (+/-SD)</b>		40.93 (+/-7.13)	
<b>Variable</b>	<b>Level</b>	<b>Frequency</b>	<b>Percentage</b>
<b>State of Residency</b>	Massachusetts	5	11.1%
	California	4	8.9%
	North Carolina	4	8.9%
	Florida	3	6.7%
	Pennsylvania	3	6.7%
	District of Columbia	2	4.4%
	Maryland	2	4.4%
	Missouri	2	4.4%
	New York	2	4.4%
	Ohio	2	4.4%
	Texas	2	4.4%
	Virginia	2	4.4%
	Arkansas	1	2.2%
	Alabama	1	2.2%
	Connecticut	1	2.2%
	Illinois	1	2.2%
	Minnesota	1	2.2%
	Nebraska	1	2.2%
	New Jersey	1	2.2%
	Nevada	1	2.2%
	Oregon	1	2.2%
	Tennessee	1	2.2%
	Washington	1	2.2%
	Wisconsin	1	2.2%

<b>Gender</b>	Female	42	93.3%
	Male	3	6.7%
<b>Relation to food allergy</b>	Parent of a child with food allergy	37	82.2%
	Both Patient and Parent of a child with food allergy	5	11.1%
	Patient with food allergy	3	6.7%
<b>Type of food allergy</b>	Peanut allergy	13	28.9%
	Milk allergy	2	4.4%
	Egg allergy	3	6.7%
	Peanut and milk allergy	2	4.4%
	Peanut and egg allergy	9	20.0%
	Milk and egg allergy	5	11.1%
	Peanut, milk, and egg allergy	11	24.4%

\*One participant did not report her age.

309  
310

311 Table 2. Levels of Agreement on Round 2 Statements of a Delphi Panel on the Value of Treatment for Food Allergy

Topic	Statement and Examples*	Agreement Percentage
<b>Social Activities</b> “Patients with food allergy experience problems with...”	...travel.” (Examples include extra planning required, barriers or limitations to travel, difficulty finding travel options that can cater to a food allergy patient’s needs.)	97.50%
	... eating or dining at restaurants.” (Examples include restricted eating options, inability to eat full ingredients of offered meals, cross contamination during food handling, restaurants hosting social events do not allow outside food.)	97.50%
	... social isolation.” (Examples include child feeling ‘left out’ of group activities, inability to attend birthday parties or other activities with friends like ball games or movies at movie theaters, unable to attend summer camps, forced to eat at a separate table from friends.)	87.50%
	... support from school or childcare services.” (Examples include inadequate supervision and attention to allergic children.)	80.00%
<b>Psychological Problems</b>	“ <u>Parents</u> of children with food allergy experience anxiety on daily basis.” (Examples include fear of child having allergic reactions; preparing safe food alternatives; and responding to allergic children questions about allergy consequences.)	97.40%
	“ <u>Patients</u> with food allergy experience anxiety on daily basis.” (Examples include fear of allergic reactions, accidental exposure, and cross contamination; preparing safe food alternatives.)	89.70%
	“Parents of children with food allergy experience the feeling of guilt.” (Examples include wondering if taking antibiotics during late pregnancy that lead to the child food allergy.)	56.4%**
<b>Medical Problems</b> “Patients with food allergy experience problems...”	... as moderate allergic reactions.” (Examples include skin rashes and blisters, itchiness, running nose, sore throat, swelling of the eyes and lips, nausea, diarrhea, sleeplessness.)	92.50%
	... as severe anaphylaxis reactions.”	90.00%

	<i>(Examples include delayed or unexpected anaphylactic reaction; rapid shortness of breath; severe tongue or throat swelling.)</i>	
	... with growth.” <i>(Examples include: A child with small stature as a result of food allergy and food avoidance.)</i>	67.5%**
	... with eating disorders.” <i>(Examples include: Potential anorexia after a traumatic experience with food.)</i>	47.5%**
<b>Healthcare Problems</b> “Patients with food allergy experience problems with...	... providers not being adequately trained or educated on food allergy.” <i>(Examples include prescribing medications that contain allergens, lack of awareness about advanced or curative treatments for allergy, non-specialists who delay allergy diagnosis.)</i>	87.50%
	... ensuring an epinephrine autoinjector or other necessary medication or device is available.” <i>(Examples include finding epinephrine autoinjector for children, properly stored epinephrine autoinjector.)</i>	82.50%
	... scheduling, accessing an appropriately trained provider, or managing all appointments.” <i>(Examples include keeping current on all appointments, securing free time for OIT weekly treatment, scheduling appointments after each other like pediatrician before allergy specialists, preparing medical records for school.)</i>	67.5%**
	... providers not taking their allergy seriously.” <i>(Examples include emergency room providers prescribe Benadryl instead of Epinephrine autoinjector for severe reactions.)</i>	65.0%**
<b>Financial Problems</b> “Patients with food allergy experience problems with...	... pharmacy costs.” <i>(Examples include costs for epinephrine autoinjectors, OIT, antihistamines.)</i>	92.50%
	... food costs.” <i>(Examples include expensive allergen friendly food in grocery stores and restaurants.)</i>	90.00%
	... medical costs.” <i>(Examples include doctor’s appointments, emergency room visits, urgent</i>	87.50%

	<i>care.)</i>	
	... non-health care costs.” <i>(Examples include extra expenses relating to vacations, child-care.)</i>	77.50%
<b>Food Selection</b> “Patients with food allergy experience problems with...	... finding safe food.” <i>(Examples include need to call the manufacturer to see if product is safe.)</i>	95.00%
	... impacting the rest of the family’s diet.” <i>(Examples include balancing the needs of the patient with his or her siblings.)</i>	92.50%
	... food preparation.” <i>(Examples include: Spending additional time to prepare all meals, additional time learning new recipes, planning meals.)</i>	89.70%
<b>Food Allergy Awareness</b> “Patients with food allergy experience problems with...	... family and friends being aware of their needs.” <i>(Examples include others not taking allergy seriously, not understanding cross contamination, not aware how to use Epinephrine autoinjector or other allergy medications.)</i>	95.00%
	... school or childcare employees being aware of their needs.” <i>(Examples include providing allergic food to children, lack of training on how to use epinephrine autoinjector when needed.)</i>	85.00%
<b>Food Allergy Diagnosis</b> “Patients with food allergy experience problems with...	... food allergy diagnostic tests.” <i>(Examples include limited tests that patients can’t do due to contraindications, inaccurate tests, tests that cause delayed allergic reactions.)</i>	80.00%
	... reaching definite allergy diagnosis.” <i>(Examples include babies with allergy who don’t have typical symptoms, some physicians don’t allow babies to take some tests below certain ages, allergy diagnosis takes long time.)</i>	77.50%
<b>Food Allergy Treatment</b> “Patients with food allergy experience...	... inconvenient treatment experience.” <i>(Examples include carrying epinephrine autoinjector and inhalers all time, rest periods required for OIT.)</i>	90.0%
	... limited treatment options.” <i>(Examples include ineffective treatments for infants and young children, having Eosinophilic esophagitis (EoE) makes patients ineligible to take</i>	90.0%

	<i>OIT, better treatments are not located everywhere.)</i>	
	... unsatisfactory treatments.” <i>(Examples include there is no preventive treatment and avoidance is the only way for prevention, treatments respond only to allergic reaction and there is no curative treatment available.)</i>	85.0%
<b>Important Treatment Outcomes</b>	“Treatments that lessen the risk of anaphylaxis (a potentially life-threatening allergic reaction) are important to food allergy patients.”	100.00%
	“Treatments that lessen the risk of moderate allergic reactions (like skin rash, itching, and sore throat) are important to food allergy patients.”	100.00%
	“Treatments that lessen the risk of cross contamination or accidental exposure to little amounts of allergens are important to food allergy patients.”	97.50%
	“Treatments that have been thoroughly investigated in clinical trials are important to food allergy patients.” <i>(Examples include OIT that have been well-investigated without drop-outs due to side-effects during the clinical trial.)</i>	97.50%
	“Convenient treatments are important to food allergy patients.” <i>(Examples include treatments that does not cause pain, easy to administer by anyone like a family member or a caregiver, doesn't require rest period.)</i>	97.50%
	“Reliable treatments (work every time without doubt) are important to food allergy patients.”	97.50%
	“Treatments that improves tolerance to allergic food are important to food allergy patients.” <i>(Examples include ability to eat small amounts of egg or milk, make small amounts of allergic food not life-threatening, enables more dietary options.)</i>	95.00%
	“Treatments with less side-effects are important to food allergy patients.”	95.00%
<b>Value of Different Treatments</b>	reduce the risk of serious anaphylaxis (a potentially life-threatening allergic reaction)	97.50%
	increases the food options for food allergy patients	97.50%
	would allow food allergy patients to participate in social activities with less fear	97.50%

	permanently cures the allergy	95.00%
	reduce the risk of mild or moderate allergic reactions (e.g. skin rash, itching, runny nose, mild swelling)	95.00%
	reduce the risk of a reaction to accidental exposure of small quantities of the allergen	95.00%
	does not cure the allergy but allows food allergy patients to have less anxiety about food	92.50%

312 *\*Round 2 examples were rephrased from the panelists' responses in round 1.*

313 *\*\*Failed to reach agreement, which was defined as a concurrence of 75% or more for the responses agree or strongly agree (5*

314 *statements out of 44 statements).*

315 **Table 3. Rating of Round 2 Statements on Different Food Allergy Treatments Values (0 = No value at all, 100 = Maximum**  
 316 **value or priceless)**

<b>Food allergy treatment that...</b>	<b>Mean value (+/- SD)</b>
... permanently cures food allergy	98.2 (+/-5.82)
... reduces the risk of serious anaphylaxis	96.0 (+/-10.98)
... reduces the risk of accidental exposure to small quantities of the allergen	88.3 (+/-15.08)
... increases the food options for a patient	85.7 (+/-19.17)
... would allow food allergy patient to participate in social activities with less fear	84.0 (+/-20.16)
... allows food allergy patient to have less anxiety about food	82.8 (+/-17.82)
... reduces the risk of mild or moderate allergic reactions	81.2 (+/-19.01)

317

318



319 Table 4. Final Rankings of Statements of a Delphi Panel on the Value of Treatment for Food Allergy

Topic	Item/Characteristic	Rank	Mean (+/-SD)	W*
<b>Social Activities</b>	Eating or dining at restaurants	1	2.2 (+/-1.02)	0.07
	Support from school or childcare services	2	2.2 (+/-1.2)	
	Social Isolation	3	2.5 (+/-1.09)	
	Travel	4	3.0 (+/-0.97)	
<b>Psychological</b>	Parent's anxiety	1	1.2 (+/-0.42)	0.3
	Patient's anxiety	2	1.8 (+/-0.42)	
<b>Medical</b>	Severe anaphylaxis reactions	1	1.4 (+/-0.49)	0.02
	Moderate allergic reactions	2	1.6 (+/-0.49)	
<b>Healthcare</b>	Providers' inadequate training on food allergy	1	1.3 (+/-0.46)	0.2
	Availability of necessary food allergy medications or devices	2	1.7 (+/-0.46)	
<b>Financial</b>	Food costs	1	1.9 (+/- 0.96)	0.2
	Pharmacy costs	2	2.4 (+/- 1.12)	
	Medical costs	3	2.5 (+/-1.03)	
	Non-health care costs	4	3.3 (+/- 0.90)	
<b>Food Selection</b>	Finding safe food	1	1.4 (+/- 0.66)	0.3
	Food preparation	2	2.2 (+/- 0.63)	
	Impacting the rest of the family's diet	3	2.4 (+/- 0.77)	
<b>Food Allergy Awareness</b>	School or childcare employees	1	1.5 (+/- 0.50)	0.002
	Family and friends	2	1.5 (+/- 0.50)	
<b>Food Allergy Diagnosis</b>	Diagnostic tests	1	1.4 (+/- 0.48)	0.09
	Reaching definite allergy diagnosis	2	1.7 (+/- 48)	
<b>Food Allergy Treatment</b>	Unsatisfactory treatments	1	1.9 (+/- 0.75)	0.02
	Limited treatment options	2	2.0 (+/- 84)	
	Inconvenient treatment experience	3	2.2 (+/- 83)	
<b>Important Treatment Outcomes</b>	Reducing the risk of anaphylaxis (a potentially life-threatening allergic reaction)	1	2.0 (+/- 1.41)	0.3
	Reliable treatments	2	4.0 (+/- 2.42)	
	Reducing the risk of mild or moderate allergic	3	4.3 (+/- 1.85)	

	reactions			
	Reducing the risk of cross contamination or accidental exposure to small quantities of the allergen	4	4.4 (+/- 1.93)	
	Improving tolerance to allergic food	5	4.6 (+/- 2.07)	
	Reducing side-effects	6	5.4 (+/- 1.80)	
	Thoroughly investigated in clinical trials	7	5.4 (+/- 2.00)	
	Convenient treatments	8	6.1 (+/- 2.15)	
<b>Value of Different Treatments</b>	Permanently cures the allergy	1	2.0 (+/- 1.82)	0.4
	Reducing the risk of serious anaphylaxis	2	2.4 (+/- 1.24)	
	Reducing anxiety about food	3	3.8 (+/- 1.53)	
	Reducing the risk of a reaction to accidental exposure of small quantities of the allergen	4	4.6 (+/- 1.58)	
	Reducing the risk of mild or moderate allergic reactions	5	4.6 (+/- 1.61)	
	Increasing food options for food allergy patients	6	5.2 (+/- 1.56)	
	Allowing food allergy patients to participate in social activities with less fear	7	5.6 (+/- 1.43)	

\*Kendall's coefficient ( $W$ ) calculated to evaluate confidence in ranks

320  
321

322

323 **Figures' legends**

324 Figure 1. Overview of Delphi Process

325 Figure 2. Panelists' Important Treatment Outcomes and Most Valued Treatments

326