

# The relationship of allergen-specific IgE levels and oral food challenge outcome

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**Background:** Oral food challenges remain the gold standard for the diagnosis of food allergy. However, clear clinical and laboratory guidelines have not been firmly established to determine when oral challenges should be performed.

**Objective:** We sought to determine the value of food-specific IgE levels in predicting challenge outcome.

**Methods:** A retrospective chart review of 604 food challenges in 391 children was performed. All children had food-specific IgE levels measured by means of CAP-RAST before challenge. Data were analyzed to determine the relationship between food-specific IgE levels and challenge outcome, as well as the relationship between other clinical parameters and challenge outcome.

**Results:** Forty-five percent of milk challenges were passed compared with 57% for egg, 59% for peanut, 67% for wheat, and 72% for soy. Specific IgE levels were higher among patients who failed challenges than among those who passed ( $P \leq .03$  for each food). When seeking a specific IgE level at which a 50% pass rate could be expected, a cutoff level of 2 kUA/L was determined for milk, egg, and peanut. Data were less clear for wheat and soy. Coexistent eczema or asthma was associated with failed egg challenges, but other atopic disease was otherwise not associated with challenge outcome.

**Conclusions:** Allergen-specific IgE concentrations to milk, egg, and peanut and, to a lesser extent, wheat and soy serve as useful predictors of challenge outcome and should be considered when selecting patients for oral challenge to these foods. (*J Allergy Clin Immunol* 2004;114:144-9.)

**Key words:** Food allergy, food-specific IgE concentrations, oral food challenges, CAP-RAST

Food allergy is extremely common, affecting up to 8% of children and 2% of adolescents and adults.<sup>1-6</sup> The diagnosis of food allergy remains a common clinical problem, with the only truly accurate test being the double-blind, placebo-controlled food challenge. Although food challenges remain the gold standard for diagnosis, they are difficult to perform and might cause significant allergic reactions. In clinical practice it is reasonable to offer food challenges when the benefit of passing the challenge outweighs the risk of the challenge. This risk-benefit ratio is particularly important for major

## Abbreviation used

PPV: Positive predictive value

food allergens, such as milk, egg, and wheat, because avoidance of these foods can pose significant nutritional risks.

Although diagnostic measures, such as skin prick tests and RASTs, are commonly used to aid in the decision-making process, there are significant limitations to these diagnostic tools. Skin testing to foods has a high negative predictive value but an overall positive predictive value (PPV) of only 50%.<sup>7-9</sup> While a negative skin test response can be very useful in ruling out food allergy, a positive skin test response is much less helpful in deciding when a patient should undergo challenge. Food-specific IgE levels are also often used, and 2 previous studies by Sampson and coworkers<sup>10,11</sup> established the 90% and 95% PPVs for milk, egg, peanut, and fish. Although these values are extremely useful in determining when a patient's food-specific IgE level is so high that a challenge is unnecessary, guidelines to help determine when an IgE level is low enough to warrant challenge have not been as well defined. This study was therefore performed to assess the value of food-specific IgE levels in predicting the likelihood that patients with presumed milk, egg, peanut, soy, or wheat allergy have acquired oral tolerance or might have been given an incorrect diagnosis because of a false-positive test result.

## METHODS

### Study population

The study population includes patients who underwent an oral food challenge to milk, egg, peanut, soy, and/or wheat at the Johns Hopkins Pediatric Allergy Clinic. Virtually all patients were referred from primary- and secondary-care settings specifically for the evaluation and treatment of food allergy. Challenges were performed when oral tolerance was suspected on the basis of the lack of any reaction to the suspect food within the preceding 12 months and, for most patients, when the food-specific IgE level was less than 0.35 kUA/L or approached one fourth of the previously established 95% PPV for milk, egg, and peanut or one fourth the 50% and 75% PPVs established for soy and wheat, respectively. Some patients were challenged at higher IgE levels if clinically indicated. Although most patients had a clear history of reacting to the suspect food, some had been given diagnoses solely on the basis of positive skin test response or food-specific IgE levels, and others had a less clear history of

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reaction, such as a worsening of atopic dermatitis with exposure to that food.

### Oral challenges

Open oral food challenges were used, and all of the challenges were conducted by the same nurse practitioner and physician. Over a 90-minute period, patients received increasing doses of the food allergen as tolerated for a total dose of 4 g of food protein for children younger than 5 years and 8 g for children 5 years of age or older. Challenges were carried out by using an age-appropriate food or powdered protein camouflaged with juice, infant formula, or other moist food, such as applesauce. Doses were given in increments of 5%, 10%, 15%, 20%, 25%, and 25% of the total challenge every 15 minutes. Challenges were terminated at the first signs of clinical reactivity. Eighty repeat challenges were carried out in children who had previously had a failed challenge to the same food. These repeat challenges were performed when oral tolerance was again thought to have developed after a period of continued avoidance. Many patients also had challenges to more than one food.

### Laboratory studies

Serum samples were analyzed before challenge for food-specific IgE antibodies by using the Pharmacia CAP System FEIA (Pharmacia & Upjohn Diagnostics, Uppsala, Sweden).

### Statistical methods

Statistical analyses were performed by using STATA SE 8.0 (College Station, Tex). Continuous variables, such as allergen-specific IgE levels, were not normally distributed and were therefore compared with the Mann-Whitney *U* test. Proportions were compared with the  $\chi^2$  test. The Cuzick test for trend was used to assess the pass rates across strata of IgE levels for each food. Cutoffs for strata of IgE levels were based on previously published findings<sup>11</sup> and distribution of the underlying data. Positive and negative predictive values of passing a food challenge were calculated on the basis of the prevalence rate of passing a food challenge in the study population. A *P* value of less than .05 was considered to be statistically significant.

## RESULTS

Six hundred four challenges were carried out in 391 patients. Two hundred sixty-seven (68%) participants were male, the median age at first challenge was 4.8 years (range, 0.9-43 years, with 8 patients  $\geq$ 18 years), and 90% were white. A history of other atopic disease was common, with 58% having eczema, 48% having asthma, 43% having allergic rhinitis, and 77% having allergy to more than one food (Table I).

Challenge pass rates, median ages, and specific IgE levels at the time of challenge are presented in Table II. When all challenges were considered (*n* = 604), the median age was 5.3 years, and the overall pass rate was 57%. In the failed challenges urticaria or other skin manifestations occurred in 77% of patients, gastrointestinal symptoms occurred in 43%, upper respiratory symptoms occurred in 24%, and lower respiratory symptoms occurred in 26%, with 60% of reactions involving 2 or more systems. Tables III through VII describe the number of patients who passed food challenges at specific IgE cutoff levels for each food. For each food, patients were divided into 2 groups on the basis

TABLE I. Demographics of the study population

| Characteristic      | Study population (n = 391) |
|---------------------|----------------------------|
| Male sex            | 267 (68%)                  |
| Median age (y)*     | 4.8                        |
| Race                |                            |
| White               | 353 (90%)                  |
| African-American    | 25 (7%)                    |
| Other               | 13 (3%)                    |
| Atopic history*     |                            |
| Eczema†             | 221 (58%)                  |
| Asthma†             | 184 (48%)                  |
| Rhinitis†           | 165 (43%)                  |
| Allergy to >1 food† | 295 (77%)                  |

\*On the basis of the date of first challenge for those patients undergoing more than one challenge.

†Data are missing for some participants.

of their reaction history. The first group, denoted as group 1, consisted of patients who had a clear history of an allergic reaction or who had previously failed a challenge to that food. The second group, denoted as group 2, consisted of patients who were avoiding that food solely on the basis of the finding of a positive test response (food-specific IgE measurement or skin prick test) or patients who had an unclear history of reaction, such as worsening atopic dermatitis. Some patients had insufficient documentation of their reaction history and were not included in the analyses presented in Tables III through VII.

One hundred sixty-six milk challenges were performed, with 45% of the challenges passed (Table II). Those who passed the milk challenge had a median IgE level of 0.9 kUA/L compared with 2.0 kUA/L in those who failed (*P* < .001). For those with a clear history of a prior milk reaction (Table III), there was a statistically significant trend (*P* < .01) of increasing challenge failure with increasing milk-specific IgE levels, with 68% of patients passing the challenge with an IgE level of less than 0.35 kUA/L, 45% passing with levels between 0.35 and 2 kUA/L, 38% passing with levels between 2 and 3 kUA/L, and only 16% passing with a level greater than 3 kUA/L. When both groups were combined, 53% of patients with a milk-specific IgE level of less than 2 passed their challenge (*P* < .01 for trend).

Of the 138 egg challenges, 57% passed with median IgE levels of 0.94 kUA/L for all patients, 0.7 kUA/L for those who passed and 1.2 kUA/L for those who failed (*P* = .02, passed vs failed). Patients were more likely to fail the challenge as the egg-specific IgE level increased, and this trend was observed for both groups, as well as for the entire group (*P* = .05, Table IV). When the egg-specific IgE level was less than 0.35 kUA/L, 67% of patients in group 1 and 60% in group 2 passed the challenge. Pass rates were 63% and 80% for groups 1 and 2 if the IgE level was 0.36 to 1 kUA/L, 49% and 54% when the level was 1 to 2 kUA/L, and 41% and 38% when the level was greater than 2 kUA/L. When the 2 groups were combined, 60% passed the challenge when the egg-specific IgE level was less than 2 kUA/L.

**TABLE II.** Pass rate, median age, and median food-specific IgE results for the 391 children who underwent 604 challenges

|                          | Median age (y)* | Passed | Median IgE level, all* | Median IgE level, fail* | Median IgE level, pass* | P value† |
|--------------------------|-----------------|--------|------------------------|-------------------------|-------------------------|----------|
| All challenges (n = 604) | 5.3             | 57%    | —                      | —                       | —                       | —        |
| Milk (n = 166)           | 5.3             | 45%    | 1.34                   | 2.0                     | 0.9                     | <.001    |
| Egg (n = 138)            | 5.6             | 57%    | 0.94                   | 1.2                     | 0.7                     | .024     |
| Peanut (n = 173)         | 5.6             | 59%    | 1.13                   | 1.9                     | 0.5                     | <.001    |
| Wheat (n = 46)           | 4.2             | 67%    | 8.63                   | 19.6                    | 4.6                     | .011     |
| Soy (n = 81)             | 4.4             | 72%    | 3.88                   | 9.3                     | 3.2                     | .030     |

\*Median age and food-specific IgE results are based on data at the time of the challenge.

†P value for the comparison of median IgE results between those who passed and failed challenges.

**TABLE III.** Milk challenges by specific IgE cutoff level (n = 159)

| IgE level  | Group 1 (n = 153) |          | Group 2 (n = 6) |          |
|------------|-------------------|----------|-----------------|----------|
|            | Total             | Passed   | Total           | Passed   |
| <0.35      | 34                | 23 (68%) | 2               | 1 (50%)  |
| 0.36 to <2 | 56                | 25 (45%) | 2               | 1 (50%)  |
| 2 to 3     | 32                | 12 (38%) | 0               | 0        |
| >3         | 31                | 5 (16%)  | 2               | 2 (100%) |

Group 1 had a clear history of a previous reaction, and group 2 had an unclear history or a positive test response only.

P < .01 for trend for whole group, P < .01 for trend for group 1, and P = .29 for trend for group 2.

For the 173 peanut challenges, 59% passed, and the medians for those who passed or failed were 0.5 kUA/L and 1.9 kUA/L, respectively ( $P < .001$ ). For patients with a clear history of a peanut reaction (Table V), the trend for increasing failure rate with increasing peanut-specific IgE level was statistically significant ( $P < .01$ ), with 76% of patients passing the challenge with an IgE level of less than 0.35 kUA/L, 44% passing with a level between 0.36 and 2 kUA/L, 40% passing with a level between 2 and 4.9 kUA/L, and none passing with a level greater than 5 kUA/L. For those patients without a clear reaction history, 88% of patients passed with a negative peanut-specific IgE level of less than 0.35 kUA/L, 71% passed with a level of 0.36 to 2 kUA/L, 33% passed with a level of 2 to 4.9 kUA/L, and 77% passed with a level greater than 5 kUA/L.

For the 46 wheat challenges, 67% passed, and the medians for those who passed or failed were 4.6 and 19.6 kUA/L, respectively ( $P = .01$ ). All patients with a wheat-specific IgE level of less than 0.35 kUA/L passed their challenge, regardless of reaction history (Table VI). In group 1, 73% passed when the IgE level was 0.36 to 10 kUA/L, 33% passed with levels between 10 and 20 kUA/L, and 56% passed with a level of greater than 20 kUA/L. In group 2, 100% passed with levels between 0.36 and 10 kUA/L, 50% passed with levels between 10 and 20 kUA/L, and 40% passed with a level greater than 20 kUA/L. The trend of failing the wheat challenge with increasing IgE level was statistically significant for group 2 ( $P = .03$ ), as well as for the total group ( $P = .01$ ).

For the 81 soy challenges, 72% passed, and the medians for those who passed or failed were 3.2 and 9.3 kUA/L, respectively ( $P = .03$ ). Results for soy challenges are

presented in Table VII. For group 1, 78% passed when the IgE level was less than 0.35 kUA/L, 77% passed when the level was between 0.36 and 5 kUA/L, 56% passed when the level was between 5 and 15 kUA/L, and 67% passed when the IgE level was greater than 15 kUA/L. In group 2 pass rates were 100%, 89%, 50%, and 67% when the IgE levels were less than 0.35 kUA/L, 0.36 to 5 kUA/L, 5 to 15 kUA/L, and greater than 15 kUA/L, respectively. There was no statistically significant trend for increasing failure rates with increasing soy-specific IgE levels.

Table VIII describes the relationship of other atopic diseases and challenge outcomes, with the results based on data gathered at the time of the first challenge for those participants who had more than one challenge to the same food. Patients were significantly less likely to pass their egg challenges if they had a diagnosis of eczema ( $P < .01$ ) or asthma ( $P < .01$ ) at the time of challenge. The presence of other atopic diseases and challenge outcome were not related for any other foods.

## DISCUSSION

Because food challenges cannot be practically used in every patient with suspected food allergy, clear guidelines to assist both clinicians and patients in the food challenge decision-making process would be a tremendous asset. The current study explores the relationship between food-specific IgE levels and challenge outcome and supports the concept that IgE levels can be a useful laboratory measure to help to determine when a food challenge should be considered. Until recently, the utility of food-specific IgE levels for this purpose was unclear. In 1997, Sampson and coworkers<sup>10,11</sup> published the first of 2 studies that proposed 90% and 95% PPVs for milk, egg, and peanut IgE levels and 50% to 75% PPVs for soy and wheat IgE levels. Although these proposed thresholds have been of great value in the food challenge decision-making process, they are most helpful in establishing when a patient's specific IgE level is so high that a challenge is unnecessary, rather than helping to predict the likelihood of passing a challenge at lesser IgE levels for those patients who might have outgrown their food allergy or have false-positive test results.

When comparing median IgE levels between those patients who passed and those who failed challenges for milk, egg, peanut, wheat, and soy in this study, statistically

**TABLE IV.** Egg challenges by specific IgE cutoff level (n = 131)

| IgE level  | Group 1 (n = 95) |          | Group 2 (n = 36) |         |
|------------|------------------|----------|------------------|---------|
|            | Total            | Passed   | Total            | Passed  |
| <0.35      | 24               | 16 (67%) | 5                | 3 (60%) |
| 0.36 to <1 | 30               | 19 (63%) | 10               | 8 (80%) |
| 1 to 2     | 29               | 14 (49%) | 13               | 7 (54%) |
| >2         | 12               | 5 (41%)  | 8                | 3 (38%) |

Group 1 had a clear history of a previous reaction, and group 2 had an unclear history or a positive test response only.  
P = .05 for trend for whole group, P = .07 for trend for group 1, and P = .09 for trend for group 2.

**TABLE V.** Peanut challenges by specific IgE cutoff level (n = 169)

| IgE level  | Group 1 (n = 110) |          | Group 2 (n = 59) |          |
|------------|-------------------|----------|------------------|----------|
|            | Total             | Passed   | Total            | Passed   |
| <0.35      | 38                | 29 (76%) | 17               | 15 (88%) |
| 0.36 to <2 | 38                | 17 (44%) | 21               | 15 (71%) |
| 2 to 4.9   | 27                | 11 (40%) | 12               | 4 (33%)  |
| >5         | 7                 | 0 (0%)   | 9                | 7 (77%)  |

Group 1 had a clear history of a previous reaction, and group 2 had an unclear history or a positive test response only.  
P < .01 for trend for whole group, P < .01 for trend for group 1, and P = .1 for trend for group 2.

significant differences were found for each food. Detecting these differences was somewhat surprising because only patients with relatively low specific IgE levels were challenged, especially for milk, egg, and peanut. This suggests that food-specific IgE levels have quantitative value and can provide clinically useful information, even at low levels for many foods.

We attempted to determine cutoff levels of specific IgE that would serve as predictors of challenge outcome for each food. Clear values emerged for milk, egg, and peanut, whereas outcomes for wheat and soy were less clear. Although it is reasonable to consider different cutoff levels depending on the particular food and clinical situation, we generally recommend challenges in our clinical practice when we suspect that there is approximately a 50% likelihood that the food challenge will be passed on the basis of the available data.<sup>10-12</sup> This 50% level has proved very useful when considering the risk, expense, and time that each challenge entails and has been well accepted by patients and families.

With the data from this study, it is possible to make recommendations as to when the chance of passing a challenge approximates 50% for the typical patient with milk, egg, and peanut allergy. The proposed cutoff level for milk-specific IgE is 2 kUA/L, below which 53% of patients passed their challenge compared with 38% with a level between 2 and 3 kUA/L and 21% with a level greater than 3 kUA/L. We would also recommend a cutoff level of 2 kUA/L for egg, with 60% of patients at less than this level passing their challenge with and without a clear

**TABLE VI.** Wheat challenges by specific IgE cutoff level (n = 44)

| IgE level   | Group 1 (n = 30) |          | Group 2 (n = 14) |          |
|-------------|------------------|----------|------------------|----------|
|             | Total            | Passed   | Total            | Passed   |
| <0.35       | 4                | 4 (100%) | 2                | 2 (100%) |
| 0.36 to <10 | 11               | 8 (73%)  | 5                | 5 (100%) |
| 10 to 20    | 6                | 2 (33%)  | 2                | 1 (50%)  |
| >20         | 9                | 5 (56%)  | 5                | 2 (40%)  |

Group 1 had a clear history of a previous reaction, and group 2 had an unclear history or a positive test response only.  
P < .01 for trend for whole group, P = .10 for trend for group 1, and P = .03 for trend for group 2.

**TABLE VII.** Soy challenges by specific IgE cutoff level (n = 74)

| IgE level  | Group 1 (n = 56) |          | Group 2 (n = 18) |          |
|------------|------------------|----------|------------------|----------|
|            | Total            | Passed   | Total            | Passed   |
| <0.35      | 9                | 7 (78%)  | 1                | 1 (100%) |
| 0.36 to <5 | 22               | 17 (77%) | 9                | 8 (89%)  |
| 5 to 15    | 16               | 9 (56%)  | 2                | 1 (50%)  |
| >15        | 9                | 6 (67%)  | 6                | 4 (67%)  |

Group 1 had a clear history of a previous reaction, and group 2 had an unclear history or a positive test response only.  
P = .18 for trend for whole group, P = .30 for trend for group 1, and P = .24 for trend for group 2.

history of reaction. For peanut, we recommend that patients with a clear history of reaction be challenged when the IgE level is less than 2 kUA/L, whereas a cutoff level of 5 kUA/L is recommended for those without a clear history of reaction. Cutoff levels for these 2 reaction groups most likely differ because many patients who were avoiding peanut solely on the basis of a positive test result might never have truly had peanut allergy.<sup>12,13</sup> It is also important to recognize that for these foods, even a specific IgE level less than the limit of detection does not guarantee a successful challenge outcome, with about one third of such patients failing their challenges. The final caveat for these foods is that although milk or egg challenges could be considered at any age, peanut challenges are not recommended in children younger than 4 years of age to minimize the risk of promoting increased sensitization by introducing it too early.

Firm recommendations for wheat cannot be provided on the basis of the current study or previous findings by other investigators. It is clear from our patient population that even some patients with high wheat-specific IgE levels successfully pass challenges. For example, 56% of patients with an IgE level of greater than 20 kUA/L with a clear history of wheat allergy passed their challenges, and one patient with a wheat-specific IgE level of greater than 100 kUA/L passed his challenge. Conversely, only 33% of patients with a wheat level of between 10 and 20 kUA/L passed their challenges when there was a clear reaction history. Although a clear cutoff level for wheat cannot be established and challenges might be considered

**TABLE VIII.** Atopic history and challenge results

|                  | Eczema | Asthma | rhinitis | Other food allergy |
|------------------|--------|--------|----------|--------------------|
| Milk (n = 129)   |        |        |          |                    |
| With disease     | 53%    | 47%    | 39%      | 85%                |
| Passed           | 42%    | 40%    | 46%      | 45%                |
| Egg (n = 119)    |        |        |          |                    |
| With disease     | 71%    | 65%    | 46%      | 95%                |
| Passed           | 49%*   | 48%*   | 51%      | 58%                |
| Peanut (n = 160) |        |        |          |                    |
| With disease     | 51%    | 41%    | 48%      | 61%                |
| Passed           | 52%    | 57%    | 57%      | 53%                |
| Wheat (n = 41)   |        |        |          |                    |
| With disease     | 73%    | 66%    | 49%      | 98%                |
| Passed           | 60%    | 63%    | 65%      | 68%                |
| Soy (n = 75)     |        |        |          |                    |
| With disease     | 68%    | 52%    | 41%      | 95%                |
| Passed           | 73%    | 74%    | 71%      | 72%                |

Percent passed represents the percentage of patients with disease that passed the challenge. Data are based on first challenge results for those patients undergoing more than one challenge.

\* $P \leq .01$ .

at any level for a given patient, a challenge should definitely be considered if the wheat IgE level is less than 10 kUA/L because more than 50% of patients with those levels passed their challenges.

It is also not possible to provide firm recommendations for soy challenge because many patients passed their soy challenge despite having high soy-specific IgE levels. As shown in Table VII, 67% of patients in both reaction groups passed the challenge when the soy-specific IgE level was greater than 15 kUA/L. However, despite the high pass rate with high IgE levels, there were some patients with negative or very low levels who did not pass their challenges, making it difficult to propose guidelines for recommending a soy challenge. We would generally recommend challenges for patients with soy IgE levels of less than 5 kUA/L because more than 50% of patients in that range passed their challenges, although challenge at higher levels would be appropriate for many patients.

It should be noted that our study population consists of patients who were referred to a tertiary-care facility and who had a high prevalence of multiple food allergies and other atopic diseases. Our population might therefore differ from that seen in primary- or secondary-care facilities, and it is possible that patients in other settings could have slightly higher pass rates than those reported in the current study. Our population also included a large number of children with atopic dermatitis who might be expected to skew the IgE levels upward and result in higher cutoff levels. In addition, the fact that we used open rather than blinded food challenges could have led to artificially increased failure rates because of false-positive challenge results. This, however, is unlikely to be a significant issue because more than 95% of patients who were deemed to have failed their challenge had objective findings to support this conclusion, including 77% with urticaria or other skin manifestations and 60% with reactions involving more than one organ system.

The previous studies by Sampson and coworkers<sup>10,11</sup> and others<sup>14-17</sup> have approached the same question on the predictive value of IgE levels from the opposite perspective, that being the ability of these tests to predict a positive challenge result. Although these studies have provided extremely valuable information and have made it possible to avoid many unnecessary food challenges, they give more guidance as to when a food challenge might not be necessary than helping to decide when to perform a challenge. For example, clinicians and patients alike often assume that a challenge is warranted just because an IgE level is below the 90th or 95th percentile cutoff levels proposed in those studies. In reality, although the proposed 90th and 95th PPVs for milk were 15 and 32 kUA/L in the Sampson study,<sup>10</sup> our findings indicate that the level needs to be far less than these cutoff levels for a patient to have any realistic chance of passing a challenge. It is also reassuring that the cutoff levels found in this study are very consistent with those that were reported by Osterballe and Bindslev-Jensen,<sup>14</sup> Martinez et al,<sup>15</sup> and Garcia-Ara et al,<sup>16</sup> as well as those that would be obtained if data were extrapolated from the probability curves from the prospective study by Sampson<sup>11</sup> for milk, egg, and peanut. The difficulty in making reliable recommendations for soy and wheat are also consistent with the previously published data on these foods.

In summary, this study provides practical guidelines for the clinician regarding the appropriate timing of food challenges. Although we have suggested that a 50% pass rate is the ideal circumstance for performing a food challenge for most patients, the data can be used to make individual decisions for each patient on the basis of their personal situation. For example, for some patients, a 20% pass rate for an important food like milk might be reasonable, whereas other patients might not want to undergo challenge with even a 50% chance of success. In any event, all clinicians who are faced with the difficult decision as to when to challenge patients with food allergy can use the data provided here to more accurately inform their patients about the true chances of success.

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