



Peanut Allergy

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Learning Objectives

At the conclusion of this course, the student will be able to:

1. Understand the risk factors associated with peanut allergy and anaphylaxis
2. Have a detailed knowledge about how to create a peanut-safe environment
3. Be able to formulate a peanut-free diet, with a knowledge of which nutrients may be deficient, and how to replace them with safe alternatives
4. Understand the differences between peanut allergy, allergy to tree nuts, and allergy to other legumes
5. Be aware of the fact that peanuts contain several different allergens, and understand which allergens are most likely to trigger allergy
6. Be aware of the symptoms that suggest an allergy to peanuts, and know the steps involved in diagnosing peanut allergy
7. Understand the potential routes whereby a baby may encounter peanut allergens and become sensitized to them, and the current recommendations to prevent the onset of peanut allergy
8. Understand the concept of threshold doses of allergen and how this applies to peanut allergy in practice, especially with regard to peanut derivatives such as peanut oils
9. Understand the factors that can influence the allergenicity of peanuts associated with cultivation, processing, and inclusion in meals
10. Understand how to manage the peanut-allergic client at each stage of their allergy

In November 2005, the story of a Canadian teenager who died following a kiss from her boyfriend made headlines. The cause was supposedly a peanut butter sandwich the lad had eaten hours before their date — his saliva, it was thought, contained enough residue to trigger an anaphylactic reaction. The girl — who knew she had an extreme sensitivity to peanuts — died four days later.

Later research cast doubt on peanut butter as the cause. Apparently, the girl had asthma, and an autopsy revealed that at the time of death she was suffering from a lack of oxygen to her brain as a consequence of an asthma attack. The media hardly noticed — after all, a deadly peanut butter kiss is much more interesting than a death from an asthmatic suffocation.

However tragic the girl's death, and however flawed the reporting of it, it did call attention to the growing problem of food allergies, and improved awareness of one of the most common allergens. And peanut butter residue *could* cause such a reaction. Peanuts are one of the most frequently cited causes of life-threatening anaphylactic reactions in Western countries. Although all food allergies have the potential to induce anaphylaxis, some foods are more likely than others to cause potentially life-threatening reactions. Peanuts, tree nuts, fish, and shellfish are the foods most frequently identified as causes of anaphylaxis, and of these, peanuts seem to prompt the greatest concern.

In this module, we'll examine our current understanding about the mechanisms responsible for hypersensitivity reactions to peanuts, why peanuts are so highly allergenic, and discuss strategies for the management of peanut allergy.

Prevalence

The prevalence of peanut allergy in the Western world has been estimated to be between one person in 10,000, and up to one in 200 in various populations. It seems to have increased during the last decade. The incidence of peanut allergy was reported to have doubled in American children less than 5 years of age in the five years between 1998 and 2003 (Sampson, 2003). One study reported that allergy to peanuts represents 28 percent of food allergies in children, develops before age 1 in 46 percent of cases, and under age 15 in 93 percent (Moneret-Vautrin, *et al.*, 1998).

Having put forth these numbers, however, we must realize that the true incidence of peanut allergy in any population is largely a matter of speculation, based on questionnaires and occasional epidemiological studies. Interestingly, the incidence of peanut allergy in other countries differs from that in the USA, and evidence suggests that immigrants from a part of the world with low levels of peanut allergy who adopt the American diet and lifestyle, quickly assume the same incidence as in the indigenous population. The reason for the high incidence of the allergy in some countries and not others is presently largely unknown, and we must question the accuracy of reporting causation in some countries.

However, there is data about fatalities arising from food allergy, which provides definite information about the incidence of fatal anaphylactic reactions to specific foods. For example, in a 2001 report of 32 fatal cases of anaphylactic reactions to foods reported to a national registry in the US, peanut was identified as the responsible food in 14 (67 percent) and possible cause in six more (55 percent). For comparison, tree nuts were identified as the cause in seven (33 percent) and possible cause in another three (27 percent) cases. The other two cases were thought to be due to milk and fish (1 each — 19 percent).

Most of the victims were adolescents or young adults; all but one were known to have food allergy before the fatal event; and all but one were known to have asthma. In this report, peanuts and tree nuts accounted for more than 90 percent of the fatalities (Bock, *et al.*, 2001).

In contrast, clinical allergy to peanut is far less prevalent in China, despite the high rate of peanut consumption. Allergy to all foods reportedly affects only 3.4 percent – 5.0 percent of the residents in Beijing, Guangdong, and the Sheng-Li oil fields, with fish, shrimp, crab and seaweed, but not peanut, being the major allergens. In 29 children aged 2 to 12 years with diagnosed food allergy in the Chinese population studied, none had signs of clinical allergy to peanut, although 2 percent of them were skin-test positive to peanut. Interestingly, the Chinese-American population living in the USA had an incidence of peanut allergy similar to that of the general US population (Beyer, *et al.*, 2001).

In Australia, the risk of a fatal reaction to food, particularly in pre-school children is remote: an estimated one fatality in 30 years in the under 5-year-old population and two deaths in 10 years in the entire child population. Statistics seem to indicate that the proportion of Australian children at risk of a severe peanut reaction is only 0.25 percent even in a high-risk sector of the population. Skin-prick testing for peanut allergy in 456 Tasmanian children aged 7 to 8 years was negative in all, indicating that in this population the risk for peanut allergy was less than 0.2 percent (Kemp, 2005).

Reports from the UK, indicate that fatal anaphylactic reactions to foods are rare. Of 20 fatal anaphylactic reactions reported each year to a national registry from 1998 to 2000, five were due to food, and none were caused by peanuts or nuts. Furthermore, peanuts and nuts did not seem to play a significant role even in nonfatal anaphylactic reactions (Pumphrey, 2000).

A recent report from Germany indicated that of 103 cases of anaphylaxis reported by physician questionnaire in 2004, foods were the most frequent cause of the reaction (57 percent), followed by insect stings (13

percent) and immunotherapy injections (12 percent). Peanuts and tree nuts were the foods most frequently causing the reactions (Mehl, *et al.*, 2005).

In Canada, the prevalence of peanut allergy was determined to be between 1.5 percent and 1.76 percent of children in kindergarten through grade 3 in randomly selected schools in Montreal. The study encompassed a questionnaire, followed by skin-prick tests, measurement of peanut-specific IgE, and oral peanut challenge tests in a response population of 4,339 out of 7,768 children surveyed (Kagan, *et al.*, 2003).

These few examples indicate the wide disparity in anaphylactic reactions to peanuts in diverse populations throughout the world. Undoubtedly, the incidence of peanut allergy in the US is higher than in any other country. Various suggestions have been put forward to account for this observation, including differences in the varieties of peanuts consumed in different places, differences in the processing methods of peanuts offered in the retail market, and differences in the genetic predisposition of the population. These points are discussed further below.

Symptoms

Symptoms reported to be due to peanut allergy include urticaria (hives), angioedema (tissue swelling, especially of the face), wheezing, asthma, nausea, vomiting, nasal congestion, itching, allergic conjunctivitis (itchy, watery eyes), and anaphylaxis. Contact dermatitis and hives from direct peanut contact have also been reported. In addition, eczema (atopic dermatitis) is often reported as a symptom of peanut allergy.

A 2003 review (Al-Muhsen, *et al.*, 2003) indicates that the first allergic reaction to peanuts usually appears between 14 and 24 months of age, and commonly occurs at home.

According to a voluntary registry in the US (Sicherer, *et al.* 2001), 50 percent of peanut allergic children have symptoms in one organ system, 30 percent have symptoms in two systems, 10 to 15 percent in three systems, and 1 percent in four systems. The organ systems affected are:

- Skin (hives, reddening, tissue swelling, especially of the face)
- Respiratory tract (wheezing, noisy breathing, cough, breathing difficulty, throat tightening, nasal congestion)
- Gastrointestinal tract (vomiting, diarrhea, abdominal pain)
- Cardiovascular system (drop in blood pressure, irregular heart rate, cardiac arrest)

Primary Sensitization

In more than 70 percent of children with peanut allergy, symptoms develop at their first known exposure to peanuts. Because IgE-mediated allergic reactions require an initial exposure to an allergen to induce sensitization, and this primary exposure is characteristically symptom-free, it seems logical to assume that children who develop symptoms on the first observed contact with the allergen must have been exposed by an earlier, unknown event. Possible suggested routes of exposure include fetal exposure to peanut protein ingested by the mother during pregnancy, exposure to peanut protein in mother's breast milk, exposure through the skin from peanut oils in topical creams, or from accidental exposure through siblings, caretakers and other unnoticed sources in the home or elsewhere.

Except for accidental contact or ingestion, none of these routes of exposure have strong scientific validation, but preliminary evidence has been provided for the following.

• **Fetal exposure.** Although there is evidence for the presence of peanut protein, and blood cells (T cell lymphocytes) that can respond to antigens in amniotic fluid, there is no strong evidence to suggest that peanuts in the maternal diet during pregnancy can sensitize the fetus *in utero* (Hayday and Shannon, 2003). However, authorities recommend that during pregnancy the mother refrain from consuming large quantities of any potentially allergenic food. Small quantities of all foods as part of a balanced diet should promote tolerance rather than sensitization to potential allergens;

• **Breast milk.** Evidence for the passage of peanut protein from mother’s diet into her breast milk during lactation was provided by a study using a very sensitive assay for peanut allergens in breast milk.

Samples of breast milk were tested for the presence of peanut protein at various times after consumption of dry, roasted peanuts by a group of volunteers. The two major peanut allergens associated with anaphylaxis were detected in breast milk within one to three hours after ingestion in approximately 50 percent of the volunteers (Vadas, *et al.*, 2001). The authors suggest that exposure to peanut protein during breast-feeding might be a route for sensitization to peanut for at-risk infants.

However, there is a difference of opinion amongst clinicians and researchers regarding the response of the infant’s immune systems to potentially allergenic proteins both *in utero* and in breast milk. Exposure to low doses of food proteins has been shown to “tolerize” the infant to allergens by “educating” the immune system to recognize the protein as safe. It is this process of immunological tolerization that allows us to consume foods without our immune systems mounting a defense against the animals and plants that we consume as food, all of which are distinct from, and foreign to, the human body.

Exposure to peanuts and other food allergens during pregnancy, lactation and early childhood may be important in the development of immunological tolerance and may prevent allergic sensitization to these foods (For a discussion of the immunological mechanisms responsible for food allergy, and the processes of tolerance and sensitization, please refer to the Nutrition Dimension course *Understanding Food Allergies.*)

Consequently, the concentration of peanut protein, the timing of the child’s exposure to it, and the frequency with which the infant encounters it may lead to either allergic sensitization or to tolerization. In some cases, exposure to peanut protein in breast milk may actually protect against later development of peanut allergy.

Therefore, at this stage in our knowledge, it would not be prudent to suggest that all lactating women avoid peanut products during breastfeeding. While this may protect some children from peanut sensitization, it may predispose other children to acquiring peanut allergy by preventing the process of tolerization (Lack *et al.*, 2003).

Given the present state of knowledge, authorities suggest that lactating mothers should avoid peanuts and peanut products while breastfeeding high-risk infants, namely those who have a strong family history of allergies or those who already have a first degree relative with peanut allergy (Vadas, 2001).

• **Topical exposure.** The possibility that the first exposure to peanuts may be through topically applied peanut oil-containing skin creams has been suggested by a number of studies (Lack, *et al.*, 2003). It is recommended that any skin creams containing peanut oil should not be used on babies because of the risk for sensitization to peanut allergens through this route.

Diagnosis

Diagnosis of peanut allergy includes four major steps (Roberts, *et al.*, 2005):

1. A medical history of allergy, and appearance of symptoms (see above) after exposure to peanut;
2. Positive skin tests for peanut;
3. Presence of peanut-specific IgE in blood measured by a radioallergosorbent test (RAST); and
4. Where necessary for confirmation, a positive challenge test in which symptoms develop after the patient consumes peanut in a supervised, controlled setting. (This test is usually not carried out if there is a risk for a life-threatening anaphylactic reaction.)

• **Threshold doses.** Several studies have attempted to determine the smallest amount of peanut protein that is likely to trigger an allergic reaction in a peanut-allergic person. However, because there are so many variables associated with peanut allergy, it is very difficult to specify a dose of peanut that would elicit symptoms in all peanut-allergic people, or to define a dose that would be safe for all peanut-sensitive individuals. Variables in individual responses to peanut, include:

- **Individual differences** in the dose of peanut protein required to elicit symptoms among peanut allergic subjects: some people report symptoms after consuming peanut protein doses as low as 100 mcg, while others do not develop symptoms until they have consumed 1 gm or more.
- **Differences in the type of symptoms** elicited in different individuals, especially with regard to subjective (felt and reported by the patient, but not visible to the observer) and objective (visible and measurable) symptoms.
- **Variability in symptoms** within the same individual on different occasions.

One typical study that demonstrates the wide variability in the dose of peanut eliciting symptoms in different individuals was reported in 2002 (Wensing, *et al.*, 2002). Twenty-six adult patients with a convincing history of peanut-related symptoms, presence of peanut-specific IgE in their blood, and a positive skin prick test response to peanut underwent double-blind, placebo-controlled food challenges with increasing doses of peanut. Threshold doses for allergic reactions ranged from a dose as low as 100 mcg up to 1 gm of peanut protein. Fifty percent of the study population had an allergic reaction after ingestion of 3 mg of peanut protein.

Other studies have suggested that contact or inhalation of peanut protein may be sufficient to elicit a potentially life-threatening anaphylactic reaction, so usually it is wise for peanut-allergic people to avoid even the smallest quantity of peanut in foods, or in their environment (Sicherer, *et al.*, 1999).

The possibility that anaphylaxis can be triggered by accidental contact with a minute amount of peanut in another person's saliva — as in the Canadian case noted above — is intriguing. The fear that the kiss might have been the cause of the reaction prompted an immediate preliminary study of the saliva of 10 people who had eaten peanut. The peanut allergen was detectable in a majority of the subjects after eating but left the saliva after several hours. The authors of the study advised people with peanut allergies to make sure that their partners brush their teeth and then wait a number of hours before kissing, especially if the kissing is going to be passionate.

Allergenicity of Peanut Oil

While it is possible to minimize overt contact with peanuts, peanut oil is much more difficult to detect and avoid. Most of the oils available to the public for consumption are highly refined. The oil is subjected to physical and chemical methods of purification, such as degumming, refining, bleaching, and deodorization. It is then referred to as refined oil, and ingredients other than oil itself — most notably, proteins — are virtually undetectable. This is the case with refined peanut oil, and until recently it was thought that refined peanut oil was completely free from peanut protein.

Since an allergic reaction requires the presence of the allergenic protein, refined oil was considered to be incapable of eliciting an allergic response. However, extremely sensitive techniques now developed allow detection of much smaller quantities of protein than previously, and it is now recognized that refined peanut oil does indeed contain sufficient peanut allergen to elicit a reaction in highly sensitive individuals (Olszewski, *et al.*, 1998). Nevertheless, all but the most highly sensitive peanut allergic individuals can consume the refined oil without risk.

However, if an oil is used to cook peanuts, peanut protein will transfer in some amount to the previously pure oil, which would then be a great hazard to people with peanut allergy. The reuse of oil is common in some homes and in fast food outlets, so these sources of contamination with allergenic protein must constantly be avoided by individuals at risk for anaphylaxis (Hourihane, *et al.*, 1997).

In contrast, *crude* peanut oil does not go through the complex process of refining and may contain sufficient peanut protein to cause an allergic reaction in a peanut-sensitive individuals. Cold-pressed oils, by definition, are not refined and therefore are potential sources of allergenic protein.

Crude peanut oil is strongly flavored and is often used in Oriental and East Indian cooking. As much as 3.3 mcg of peanut protein per mL of oil has been measured in crude oils, which is quite enough to trigger an anaphylactic reaction in peanut-allergic individuals (Hoffman, *et al.*, 1994).

In the interests of safety, individuals who are anaphylactic to peanut, nuts, or a grain are usually cautioned

to avoid the oil derived from the allergenic plant because of the danger of the inclusion of traces of plant protein in the oil. Such individuals are particularly cautioned against use of cold-pressed oils from the plant food to which they are allergic.

Botanical Classification of Peanut

Peanut (*Arachis hypogea*) belongs to the biological family *Leguminosae* or 'legumes', which include peas, beans, soy, lentils, vegetable gums as acacia and tragacanth, and licorice.

Nuts belong to a wide array of different biological families, for example:

- **Walnuts and pecans belong to the *Judanglacea* family, which also include the hickory nut**
- **Almond is of the *Drupaceae* family which includes peaches, apricots, plums, nectarine and cherries**
- **Cashews and pistachios belong to the *Anacardiaceae* family group, which also includes mango**
- **Hazelnut (filbert) is part of the *Betulaceae* family, to which Birch trees belong**
- **Chestnuts belong to the *Fagaceae* family, which includes Beech trees**
- **Coconut belongs to the *Arecaceae* family group which also includes dates and palm trees**
- **Brazil nuts belong to the *Lecythidaceae*, a family of tropical trees which include the anchovy pear (*Grias cauliflora*) (a West Indian species with edible fruit used for pickles), and several lumber trees of South America.**
- **Macadamia nuts belong to a tropical plant family called the *Proteaceae* which includes the cone flower and pincushion tree**

As shown in the chart, peanuts are unrelated botanically to nuts that grow on trees. Most people are able to eat a variety of tree nuts, such as walnuts, pecans, Brazil nuts, almonds, cashew nuts, hazelnuts (filberts), macadamia nuts, coconut, etc. without risk. An allergy to nuts should be distinguished from an allergy to peanuts and other legumes, otherwise the diet can become stressful and cumbersome if all traces all tree nuts are being avoided in addition to every trace of peanuts.

However, because tree nuts are also highly allergenic foods, they are also frequent causes of strong allergic reactions and anaphylaxis. In addition, often no differentiation is made in the marketing of peanuts and nuts, and the two are often found together in nut mixtures.

Publications originating in the UK often include peanuts when discussing nut allergy, and many people do not realize that in the strict definition of the term, peanuts are not the same as tree nuts. Furthermore, tree nuts easily become contaminated with peanuts, for example, when a utensil used to handle nuts has been previously used with peanuts without cleaning in between. In the manufacture of candies, confectioneries and ice cream, there is frequent cross-contamination between nuts of different species and peanuts, so a person with severe peanut allergy is advised to avoid any product containing nuts because of the danger of encountering peanuts inadvertently.

“Mandalona” nut is one of the names given to a manufactured product made from deflavored, decolored peanut meal that is pressed into molds, re-flavored and colored and sold as a cheaper substitute for tree nuts such as almonds, pecans, and walnuts. Persons with peanut allergy must be cautious when consuming any food that may contain such a product.

Allergens

Peanuts contain many different proteins, each with its own distinct structure. Several of these are allergenic, and can trigger IgE antibodies – each antibody molecule being specific to its inciting allergen. The term “peanut protein” may thus include some or all of the known peanut allergens.

The major peanut protein allergens have been characterized and named. These include:

- Ara h1
- Ara h2 (5 subtypes)
- Ara h3
- Ara h4
- Ara h5
- Ara h6
- Ara h7
- Ara h8
- Ara h Agglutinin
- Ara h LTP
- Ara h Oleosin
- Ara h TI

The relative quantity of each specific allergen will affect individuals differently when they are sensitized to one more than another. The assumption that all of the known allergens in a specific food are of equal importance to each person may not hold true.

Some of these allergens are more frequently detected as triggers of peanut-specific IgE in peanut-allergic individuals than others. For example, in a recent study, Ara h2 was recognized most frequently as the causative allergen in all tests for symptom-triggering, and induced a reaction at relatively low concentrations, whereas Ara h1 and Ara h3 were recognized less frequently and reacted only at hundredfold higher concentrations than Ara h2. The authors conclude that for their patient group Ara h2 was the most important peanut allergen, that a few of the other proteins may be important allergens, but less frequently, and at higher concentrations (Koppelman, Wensing, *et al.*, 2004).

In another study (Becker, *et al.*, 2001) the authors calculated the prevalence of sensitization to every single allergen in a population of 40 patients sensitized to peanut. Their results indicated that in addition to Ara h1 (prevalence 65 percent) and Ara h2 (prevalence 85 percent), Ara h4 (53 percent) was also a major allergen, while Ara h5 (13 percent), Ara h6 (38 percent) and Ara h7 (43 percent) were minor allergens.

Interestingly, although Ara h6 was considered a minor allergen, the authors found that sensitization to Ara h6 was associated with more severe clinical symptoms than most of the other allergens.

Future research will undoubtedly reveal which of the allergenic proteins in peanuts are most important to a specific population, and which are affected by various processing methods in the manufacture of foods that include peanuts. This information may then explain why certain populations are at risk for peanut allergy and why others are relatively safe. Furthermore, improved understanding of the molecular structure of the major peanut allergens and the peanut-specific immune response will eventually lead to effective methods for diagnosis, therapy, and possibly prevention strategies for peanut allergy (Scurlock and Burks, 2004). We may also see genetic engineering to eliminate the most virulent allergenic proteins.

Effects of Cooking Methods

Roasting of peanuts has been demonstrated to increase their allergenicity, compared to the same variety of peanut when processed by other methods (Maleki, *et al.*, 2000). This means that a roasted peanut, the form in which most peanuts and peanut butter is consumed in the US because of the improved flavor and taste, is more likely to trigger a severe anaphylactic reaction than a fried or boiled peanut, the form in which people in countries such as China where the incidence of peanut allergy is virtually non-existent (Beyer, *et al.*, 2001).

It appears that the main factor influencing the increase in the allergenicity of peanut during roasting is due to the higher temperature reached in roasting, in comparison to frying or boiling.

Peanut proteins, like many highly allergenic proteins in foods, are not degraded at high temperatures, and retain their potential to trigger an allergic reaction even after cooking. However, the excessively high temperatures achieved during roasting has the effects of changing the protein to a more insoluble form compared to the protein in the raw state, or when it is subjected to only slightly elevated temperatures. The increase in insolubility means that less of the protein will move into solution in the digestive tract, and will consequently be more protected from digestive enzymes and destruction by gastric acid than a more soluble form would be. This results in non-degraded peanut protein remaining available as a continuous source of major allergens in the digestive tract long after the same protein in a more soluble form would have been removed from the system (Kopper, *et al.*, 2005).

In addition, roasting, compared to boiling and frying, altered the binding of peanut specific IgE₁ antibodies to the individual allergens Ara h1, Ara h2, and Ara h3, even though the amounts of each of the allergens were similar in all the peanut samples tested. This indicates that the method of heating the proteins significantly affects the interaction between the allergen and the antibodies produced by the allergic individual, and therefore the likelihood of the individual developing symptoms, and probably the severity of the symptoms in a subsequent reaction (Beyer, *et al.*, 2001; Mondoulet, *et al.*, 2005).

Other factors that might affect the allergenicity of peanut proteins are thought to include the type and variety of the peanut (of which there are about 14,000), the conditions under which the peanut has been grown, and the degree of maturation of the peanuts (Chung, *et al.*, 2003).

Fat Content

Another factor that may affect the allergenicity of peanut is the fat content of the food in which the peanut is included as an ingredient. A 2003 study of six people with a known peanut allergy demonstrated that the reactivity of four of the subjects was significantly increased when the peanut was included in a lower-fat meal compared to when the food had a high fat content (Grimshaw, *et al.*, 2003). The subjects reacted to a dose equivalent to 23 times less peanut with the low-fat recipe compared to the higher fat meal.

This study emphasizes the probability that a number of factors have a significant effect on the response of individuals to peanuts in their diets, and that the level of fat is one such factor to be considered in assessing the risk of certain foods to food-allergic consumers.

Cross-Reactivity with Other Legumes

A common problem faced by peanut-allergic people is whether they should avoid all legumes, for example soy, chick peas, lentils, beans, peas, licorice, and all other members of the *Leguminosae* family, to which peanut belongs. In laboratory experiments, cross-reactivity between peanut and soy, for example, is quite frequent, but in clinical trials, the cross-reactivity is quite uncommon; one study reports only two out of 41 peanut-allergic patients reacted mildly to other members of the legume family (Bernhisel-Broadbent, *et al.*, 1989).

Previously, the incidence of soy allergy was reported to be low compared to other highly allergenic foods, but recent studies seem to suggest that the prevalence of soy allergy is increasing (Sicherer, *et al.*, 2000). It has been suggested that the increase in the incidence of soy allergy, especially in children, could be the result of exposure to the allergenic protein, in the form of soy-based infant formulas, in early infancy when the child is at highest risk for allergic sensitization.

In addition, recent research suggests that an association between peanut and soy allergy could arise from cross-sensitization from soy-based infant formulae. Soy and peanuts contain a similar allergen, and it is thought that exposure to the soy allergen in infant formula could prime the child's immune system to respond to the peanut allergen, even when he or she shows no signs of allergy to soy (Lack, *et al.*, 2003). As a result, the child

could exhibit allergic symptoms on an apparent first exposure to the peanut.

Some researchers consider that there is under-reporting of anaphylactic reactions to other legumes, such as soy. A report of life-threatening anaphylactic reactions to foods from 1993 to 1996 included six reactions to soy, and four fatal cases of anaphylaxis, probably due to soy, in asthmatic peanut-allergic patients with no previously known allergy to soy (Foucard, *et al.*, 1999). Other legumes that have been linked to peanut allergy include chick peas (garbanzo beans), lentils, and lupine flour (Moneret-Vautrin, *et al.*, 1999).

Although many members of the legume family can be allergenic and trigger allergic symptoms in individuals sensitized to them, there is no evidence to support the thinking that peanut-allergic individuals should avoid all legumes. Allergy to multiple foods is usually due to reactions to botanically unrelated, highly allergenic foods, such as peanut, egg, milk, shellfish, fish and tree nuts. Highly allergic individuals are most likely to react to the most highly allergenic foods for their age group. Therefore, allergy to specific foods is usually a result of independent sensitization to each individual food allergen.

Prognosis and Management

In spite of the high incidence of peanut allergy in some Western countries, and the potential for severe anaphylactic reactions to the food, peanut allergy, like many early food allergies, can be outgrown. In 2001, pediatric allergists in the US reported that about 21.5 percent of children will eventually outgrow their peanut allergy (Skolnick, *et al.*, 2001), and those with a mild peanut allergy, as determined by the level of peanut-specific IgE in their blood, have a 50 percent chance of outgrowing the allergy (Fleischer, *et al.* 2003). In contrast, only about 9 percent of patients are reported to outgrow their allergy to tree nuts (Fleischer, *et al.*, 2005).

Studies indicate that when there is no longer any evidence of symptoms developing after a child has consumed peanuts, it is preferable for that child to *eat peanuts regularly*, rather than avoid them, in order to maintain tolerance to the peanut. Children who outgrow peanut allergy are at risk for recurrence, but the risk has been shown to be significantly higher for those who continue to avoid peanuts after resolution of their symptoms (Fleischer, *et al.*, 2004).

A Peanut-Safe Environment

Currently there is strong pressure for public places such as schools, hospitals and airliners to be “peanut-free” in an attempt to protect vulnerable individuals, especially children and young adults, from accidental exposure to peanuts. However, declaring an environment as “peanut-free” in itself could be a mistake, since when people assume that the area is free from contamination, they may relax their guard, and thus be at risk for inadvertent exposure to the allergen.

Another term, “Peanut-safe,” indicates that although people using the facility are requested to avoid bringing peanuts into the area, and special precautions are in place to reduce the possibility of exposure of the at-risk population, there must be constant vigilance on the part of everyone to maintain the environment in a peanut-safe condition.

A list of important measures for a peanut-safe environment is shown on the following page.

A Peanut-Safe Environment

Important measures for a peanut-safe environment should include:

- Ensuring that all personnel in a peanut-safe facility are well-informed about dangers to the peanut-allergic person of accidental contamination
- Clear strategies for maintaining the facility in a peanut-safe condition, with strict rules about cleaning
- Informing everyone entering the facility to avoid introducing peanuts into the area, and the reasons for the restrictions
- Education of the peanut-allergic person concerning avoidance of their own exposure to peanuts, including:
 - Avoidance of foods likely to contain, or be contaminated by, peanuts
 - Being aware of all terms on food labels that would indicate the possible presence of peanut
 - Carrying an EpiPen of injectable adrenalin (epinephrine), and being familiar with its use in case of accidental exposure and an allergic reaction
 - Wearing a MedicAlert tag or bracelet in case of loss of consciousness in an allergic reaction
- Informing all staff in the facility about emergency procedures should anyone in the area develop symptoms and require medical treatment. Such information should include:
 - Familiarity with the use of the EpiPen where appropriate
 - Contacting key care-givers such as parents and guardians of children,

The Peanut-Safe Lifestyle

The person who is allergic to peanuts must avoid peanuts in any and every form as long as he or she develops symptoms after consuming the food.

It is important that all sources of peanut should be carefully avoided if there is even a moderate risk of an anaphylactic reaction to it. However, there is no evidence that even a severe allergy to peanut requires avoidance of all other legumes. Avoidance of legumes such as soy, lentils, dried peas and beans is only necessary when allergy to the individual foods has been identified. It is also unnecessary to avoid tree nuts, which are botanically unrelated to peanuts, unless the individual has an allergy to them. However, because of the risk that tree nuts, especially nut mixtures, may contain, or be contaminated by peanuts, a person who has a known allergy to peanuts is usually advised to avoid nuts of all types in the interests of safety.

Peanuts are widely used in the food industry owing to their nutritive value and their taste. Many manufactured foods contain peanuts, resulting in an increased risk for inadvertent ingestion of peanuts by allergic individuals. Additionally, contamination of intended peanut-free products with traces of peanuts during the manufacturing process has sometimes resulted in several fatal and near-fatal allergic reactions. It is essential for the peanut-allergic individual to be familiar with all the terms on a product label that could indicate the presence of peanut, as shown on the following page:

Food Labels Terms that Indicate Presence of Peanut Protein		
Peanut protein	Peanut flour	Beer nuts
Hydrolysed peanut protein	Mandalona nuts	Mixed nuts
Peanut oil	Artificial nuts	Goober nuts
Cold-pressed peanut oil	Nu-nuts flavored nuts	Goober peas
Peanut butter		
Products that May Contain Peanut		
Marzipan (almond paste)	Baked goods	Cheese balls and other cheese products coated with nuts
Prepared soups	Cookies	Vegetable oil
Dried soup mixes	Candies	Hydrogenated vegetable oil
Chili	Chocolate bars	Vegetable shortening
Egg rolls	Prepared and frozen desserts	
Thai dishes	Ice cream with nuts	
Chinese dishes	Chocolate ice cream	
Satay sauces		
<p><i>Note on peanut oil:</i> Although highly refined peanut oil contains barely detectable amounts of peanut protein, and should be safe for consumption by most peanut-allergic individuals, there is no guarantee that any peanut oil is completely free from peanut protein. A person anaphylactic to peanut is strongly advised to avoid all types of peanut oil entirely. Cold-pressed oils (also labelled “pure-pressed”, “expeller pressed” or “unrefined”) in particular should be avoided.</p>		

Replacing Important Nutrients

Peanuts supply niacin, magnesium, vitamin E, manganese, pantothenic acid, chromium and (in smaller amounts) vitamin B₆, folacin, copper and biotin. For peanut-sensitive people, these nutrients are easily replaced by including meat, whole grains, legumes and vegetable oils in the diet, and therefore a diet completely free from peanuts should not pose any nutritional risk to the average consumer. A peanut-free diet is shown at the end of this text.

However, strict vegans may need to eat tree nuts and seeds in order to obtain adequate quantities of high-grade proteins, so this population is strongly advised to undergo a careful investigation of their allergic reactivity to tree nuts and seeds, so that they can be assured that these nutritious foods can be consumed in safety.

Peanut-allergic Infants

Protein from peanuts in the mother’s diet can pass into her breast milk and cause allergic symptoms in the breast-fed baby (Vadas *et al.*, 2001). If the breast-fed infant is allergic to peanut protein, the elimination of all peanut and peanut containing products from the mother’s diet should be beneficial. If peanut elimination only partially eases the infant’s distress, carefully kept records of mother’s intake of foods, supplements and medications, and time of onset of baby’s symptoms, may indicate other possible triggers for the problem. Use of skin creams containing peanut oil, or vegetable oil from undeclared sources, should be carefully avoided.

Foods Allowed/Restricted for a Peanut-Free Diet

Type of Food	Foods Allowed	Foods Restricted
Milk and Milk Products	<ul style="list-style-type: none"> • Milk • Cream • Plain yogurt • Buttermilk • Ice cream made w/allowed ingredients • Plain cheese • Sour cream • Quark • Dips made w/allowed ingredients 	<ul style="list-style-type: none"> • Milk-based desserts and confectioneries (<i>e.g.</i> ice cream) containing peanuts or nuts • Chocolate ice cream or other milk-based confectioneries unless labeled “peanut-free” • Cheese foods (<i>e.g.</i> slices, dips, spreads, cheese balls) containing nuts or undisclosed ingredients
Breads and Cereals	<ul style="list-style-type: none"> • Any breads, buns, or baked goods that are known to be free from peanut and peanut oil • Plain cooked grains • Plain oatmeal • Regular Cream of Wheat® • Ready to eat cereals without added oil or nuts • Homemade granola without peanut • Dried pasta 	<ul style="list-style-type: none"> • Commercial or homemade baked goods made w/peanut oil or peanuts • Baked goods made w/undisclosed sources of “nuts,” oil, or shortening • Baking mixes • Ready-to-eat cereals w/added oils and nuts, such as granola
Vegetables	<ul style="list-style-type: none"> • All pure vegetables and their juices 	<ul style="list-style-type: none"> • Vegetable dishes w/sauces containing peanuts, peanut oil or unknown nuts or oils • Salads with dressings containing unknown oil or nuts • Vegetables canned in undisclosed oils
Fruit	<ul style="list-style-type: none"> • All pure fruit and fruit juices 	<ul style="list-style-type: none"> • Fruit dishes containing peanuts or nuts • Fruit dishes made with oil or shortening of unknown origin
Meat, Poultry, and Fish	<ul style="list-style-type: none"> • All pure fresh or frozen meat, poultry or fish • Fish canned in broth, water or non-peanut oils 	<ul style="list-style-type: none"> • Meat, poultry or fish dishes made w/peanut or undisclosed nuts or oils • Fish canned in undisclosed oils • Chinese dishes • Thai dishes • Egg rolls • Commercial chilli • Vegetarian burgers unless labelled “peanut-free” • Peanut protein
Eggs	<ul style="list-style-type: none"> • All without restricted ingredients 	<ul style="list-style-type: none"> • Egg dishes prepared w/oils or nuts from unknown sources • Egg rolls

Foods Allowed/Restricted for a Peanut-Free Diet

Type of Food	Foods Allowed	Foods Restricted
Legumes	<ul style="list-style-type: none"> • All pure legumes except peanut • Tofu 	<ul style="list-style-type: none"> • Peanut and peanut products including: <ul style="list-style-type: none"> - Artificial nuts - Goober nuts - Goober peas - Hydrolyzed peanut protein - Mandalona nuts - Mixed nuts - Peanut butter - Peanut flour - Peanut oil - Peanut protein • Legume dishes containing peanut, or oils, or nuts from undisclosed sources
Nuts and Seeds	<ul style="list-style-type: none"> • All packaged plain, pure nuts and seeds • All pure nut and seed oils and their butters, such as: <ul style="list-style-type: none"> - sesame tahini - almond butter - almond paste - cashew butter 	<ul style="list-style-type: none"> • Mixed nuts • Mandalona nuts • Artificial nuts • Nuts or oils of undisclosed origin • Goober nuts • Goober peas
Fats and Oils	<ul style="list-style-type: none"> • Butter • Cream • Pure vegetable, nut, or seed oil w/ source specified (except peanut) • Lard • Meat drippings • Gravy made with meat drippings 	<ul style="list-style-type: none"> • Peanut oil • Salad dressings that list “oil” without revealing source • Margarine, unless source of all oils is revealed and is peanut-free
Spices and Herbs	<ul style="list-style-type: none"> • All pure herbs and spices • Blends of herbs and spices, without added oils 	<ul style="list-style-type: none"> • Seasoning packets with undisclosed ingredients • Vegetables such as garlic or sun-dried tomatoes packed in oil, unless source of oil is disclosed and is peanut-free
Sweets and Sweeteners	<ul style="list-style-type: none"> • Plain sugar • Honey, • Molasses • Maple syrup • Corn syrup • Pure chocolate • Pure cocoa • Artificial sweeteners • Homemade cookies and candies w/ allowed ingredients 	<ul style="list-style-type: none"> • Chocolates w/unknown ingredients • Chocolate bars • Marzipan (almond paste) • Cookies and candies • Any confectionery containing nuts unless specified to be peanut-free

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On-Line Resources

John Weisnagel. Peanut allergy: where do we stand? www.allerg.qc.ca/peanutallergy.htm#backg

Glossary of Terms

Allergen-specific IgE – IgE antibodies formed in response to a specific allergen. These are the antibodies that are detected in allergy tests such as RAST and skin tests.

When a person eats the allergenic food, antigens (allergens) in the food couple with the allergen-specific IgE, which is attached to specialized cells, called mast cells. The allergen-IgE coupling causes the release of specialized chemicals stored within the mast cells, called inflammatory mediators. The release of inflammatory mediators causes symptoms typical of allergy when they react with body cells and tissues (see Allergic disease)

Allergic diseases – Disorders caused by exposure to specific antigens (allergens) in people who are sensitized to them. Includes allergic asthma, allergic rhinoconjunctivitis (hayfever), atopic dermatitis/eczema, food allergy, hypersensitivity to drugs, allergy to insect stings

Allergic sensitization – Presence of IgE antibodies against environmental and/or food antigens.

Anaphylaxis – A severe and potentially life-threatening allergic reaction. Symptoms can include hives, swelling (especially of the lips and face), difficulty breathing (either because of swelling in the throat or an asthmatic reaction), vomiting, diarrhea, cramping and a fall in blood pressure

Atopy/atopic – A term applied to people exhibiting symptoms of allergic disease

Food challenge test – Subjects consume the test food under controlled conditions and their response is monitored for onset of allergy symptoms.

IgE mediated hypersensitivity – Immunological hypersensitivity due to formation of excessive amounts of immunoglobulin E (IgE) in response to otherwise innocuous antigens (allergens) in the environment or in food. Another name for allergy.

Immunoglobulin E (IgE) – Abbreviated IgE. A class of immunoglobulins that includes the antibodies elicited by an allergic substance (allergen). A person who has an allergy usually has elevated blood levels of IgE. IgE antibodies attack and engage the invading army of allergens

Immunologic tolerance – Usually applied to foods. The immune system recognizes that the food is foreign to the body, but as a result of a complex interplay of antigen recognition and response, immunological defence systems remain dormant and the foreign antigens are deemed to be safe. This process allows us to eat foods, which of course originate from sources entirely foreign to the body, without developing symptoms, except in the case of allergy.

RAST – an abbreviation for RadioAllergoSorbent Test, a trademark of Pharmacia Diagnostics, which originated the test. RAST is a laboratory test used to detect IgE antibodies to specific allergens in a sample of blood. The aim with RAST, as with skin tests, is to check for allergic sensitivity to specific antigens. In the test, the sample of blood is mixed with substances known to trigger allergies. The test measures the level of IgE allergy antibodies to specific antigens in the blood which are present if there is an allergic reaction.

Skin testing – The skin test is a method of measuring the patient's level of IgE antibodies to specific allergens. Using diluted solutions of specific allergens, the physician either injects the patient with the solutions (intradermal test), or scratches (scratch test), or pricks the skin with a sharp lancet (prick test) through the allergen drop. A positive reaction appears as a small raised area (wheal) surrounded by a flat red area (flare) on the skin (the wheal and flare reaction). The size of the reaction, measured in millimetres (mm), is usually considered to be a rough estimate of the level of IgE in the patient's body formed against the allergen in the test reagent. A positive reaction to the skin test, especially with food allergens, does not always mean that the patient is will develop symptoms when the food is eaten.

Total IgE level – The quantity of IgE antibodies in a subject's serum, without reference to any specific antigen to which the IgE may be formed.

Examination for PNT06

1. Compared to all other food allergies, peanut allergy and the risk of anaphylactic reactions to peanuts is of greatest concern to people living in:
 - a. China
 - b. USA
 - c. Australia
 - d. United Kingdom (UK)
 - e. All of the above

2. Peanuts contain a number of allergenic proteins, all labeled with the prefix Ara; the following is most often associated with allergy:
 - a. Ara h1
 - b. Ara h2
 - c. Ara h3
 - d. Ara h4
 - e. Ara h6

3. The peanut protein suggested to be associated with the most severe allergic reactions to peanuts is thought to be:
 - a. Ara h1
 - b. Ara h2
 - c. Ara h3
 - d. Ara h4
 - e. Ara h6

4. The form in which peanuts are eaten can affect their allergenicity (likelihood of triggering an allergic reaction). The most highly allergenic form of peanut is:
 - a. Raw, natural peanut
 - b. Roasted
 - c. Boiled
 - d. Fried
 - e. Ground into flour

5. Symptoms associated with peanut allergy include:
 - a. Nasal congestion
 - b. Hives
 - c. Vomiting
 - d. Hypotension (drop in blood pressure)
 - e. All of the above

6. Information obtained from a voluntary register for peanut allergy in the USA indicated that 12 percent of the population had allergy in:
 - a. One organ system
 - b. Two organ systems
 - c. Three organ systems
 - d. Four organ systems
 - e. None of the above

7. The most frequent route for initial sensitization to peanut protein in a young infant is thought to be:
 - a. From mother's diet during pregnancy
 - b. From mother's diet during breast-feeding
 - c. Accidental exposure from siblings and care-takers
 - d. From peanut oil in creams used to treat diaper rash
 - e. None of the above

8. A diagnosis of peanut allergy is made on the basis of:
 - a. A positive skin prick test with peanut allergen
 - b. RAST for antigen-specific IgE in a patient's blood
 - c. History of development of allergy symptoms after consuming peanut
 - d. Development of symptoms after a challenge test with peanut
 - e. All of the above

9. Differences in one person's response to peanuts compared to that of another peanut-allergic individual consuming the *same amount of peanut* may be due to:
 - a. The person's age
 - b. The fat content of the meal
 - c. The type of symptoms the person experiences
 - d. The amount of peanut consumed
 - e. All of the above

10. Consumption of peanut oil is considered to be safe for a peanut-allergic individual if the oil is:
 - a. Cold-pressed and kept in a refrigerator
 - b. Refined and deodorized
 - c. Only used for frying non-allergenic foods
 - d. Included as a flavoring in a meal
 - e. None of the above

11. Peanut-allergic people can eat tree nuts as long as they:
 - a. Avoid nuts from bulk food bins
 - b. Avoid nut mixtures
 - c. Avoid chocolate ice cream
 - d. All of the above
 - e. None of the above

12. A peanut-allergic person can eat the following, unless they are independently allergic to them, *except*:
 - a. Nuts of the *Drupacea* family
 - b. Nuts of the Birch family
 - c. Mandalona nuts
 - d. Coconuts
 - e. Chestnuts

13. Even if they show no signs of allergy to the food, peanut-allergic individuals are advised to avoid:
- Soy and soy products
 - Lentils
 - Lupine flour
 - None of the above
 - All of the above
14. Which of the following statements is *false*?
- Children who have outgrown their peanut allergy should continue to carefully avoid peanuts
 - More than 20 percent of peanut-allergic children will outgrow their early peanut allergy
 - If the peanut allergy is mild, as many as 50 percent of peanut-allergic children will outgrow their early peanut allergy
 - Children who have outgrown their peanut allergy should eat peanuts regularly
 - 90 percent of children allergic to tree nuts will continue to be allergic to the nut as adults
15. Peanut-allergic individuals must be careful to avoid products containing the following, *except*:
- Green peas
 - Goober peas
 - Beer nuts
 - Packaged soup mixes
 - Marzipan
16. The following milk products are safe for a peanut-allergic individual, *except*:
- Full cream (homogenized) milk
 - Canned milk
 - Cheese foods
 - Plain yogurt
 - Sour cream
17. The following should be strictly avoided by a peanut-allergic individual, *except*:
- Fish canned in soy oil
 - Chinese egg rolls
 - Commercial chili
 - Packaged granola
 - Vegetarian burgers
18. Even if not labeled “peanut-free”, a peanut-allergic person can safely consume the following, *except*:
- Butter
 - Margarine
 - Lard
 - Cream
 - Tomato juice

19. Peanuts are a source of the following important micronutrients, *except*:
- Niacin
 - Pantothenic acid
 - Calcium
 - Magnesium
 - Manganese
20. Select the single most important point from the following list that the peanut-allergic individual should observe:
- When away from home confine yourself to places that are designated “peanut-free” in order to limit your risk of accidental exposure to peanuts
 - Only share kisses and intimacy with a person whom you know to be “peanut-free” (completely avoids peanuts)
 - Avoid any and everything that looks like a nut
 - Make sure that you are familiar with every term that might indicate the presence of peanut in a manufactured food and always question restaurant staff to ensure that your meal is peanut-free
 - Avoid all legumes such as soy, lentils, peas, beans, and licorice because peanuts belong to the same botanical family



Continuing Education credit

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