Asthma and allergen exposure

People with asthma and persistent rhinitis are frequently allergic to ‘domestic’ allergens, sourced from furred pets (cats, dogs), cockroaches (*P. americana* and *B. germanica*), rodents, house dust mites (*Dermatophagoides*, *Blomia* sp) and fungi of many types. The allergen(s) dominant within any population vary according to geography, climate, time, housing types and social factors as well as between individuals. While the allergen sources are typically perennial within houses, because the allergens are carried on clothing, aeroallergen exposure also occurs in many other locations including in schools, workplaces and on transport following the disturbance of reservoirs.

Asthma is a complex, variable and multi-factorial disease, and, as our understanding of its pathology changes, so too does our understanding of the role of chronic and acute allergen exposure. While acute exposure to some allergens (eg cat, dog, rat, mouse) may precipitate asthma symptoms in sensitised subjects, this rarely occurs following exposure to other allergens such as cockroaches, mites or fungi. Instead, it is likely that chronic exposure to these has ‘subclinical’ and synergistic effects, evidenced by increased expression of inflammatory markers, airway hyper-responsiveness, and increased risk of exacerbations associated with viral infections. Because aeroallergen exposure is common and ubiquitous, its individual contribution to reductions in asthma control is difficult to establish, although the success of anti-IgE therapy and observational studies in very low allergen environments indicates it is likely to be important.

Overall, the evidence that the incidence of asthma or allergic sensitisation can be reduced by domestic allergen avoidance interventions alone, practiced during infancy (‘primary avoidance’) is not currently supported. This session will largely examine the role of domestic allergen avoidance in the management of established asthma (‘tertiary avoidance’)

1. The current guidelines for allergen avoidance in asthma management

The current guidelines for the role of allergen avoidance in asthma management differ greatly internationally. Briefly the US National Institutes of Health, National Heart Lung and Blood Institute 2007 (NHLBI) guidelines broadly advocate the primary importance of avoidance measures, whereas the global (GINA) and British Thoracic Guidelines (BTS) guidelines do not, and the Finnish guidelines advocate alternative approaches. The NHLBI report provides a summary of the evidence for ‘the strong association between sensitisation to allergens and asthma’, but does not provide a comprehensive and updated comparison of the literature or refer to any of the several meta-analyses of interventions. The report notes that effective avoidance requires a multifaceted, comprehensive approach. Recommended measures for mites include encasing mattresses and pillows, washing bedding weekly in hot water (130 °F), maintaining low indoor humidity, removing carpets from bedrooms and concrete floors, avoiding lying on soft furnishings and minimising the number of stuffed children’s toys and washing them weekly. The use of chemicals or air filters alone is not supported, and it advises that regular vacuum cleaning will remove allergens but not living mites. This report is broadly consistent with the recent (2013) AAAAI Practice Parameters for Environmental Assessment and Exposure Control of mites which provides a more comprehensive review of technical matters, particularly of indoor humidity, laundry (warm rather than hot water) and recent changes in allergen standards.

Both GINA (2009) and BTS guidelines note that evidence of measures to create low allergen domestic environments to reduce asthma symptoms is either inconsistent or inconclusive, while noting there is some support for individualised, home-based, comprehensive interventions. They question the cost effectiveness of avoidance and note the findings of the Cochrane meta-analysis, which were unsupportive of dust mite allergen avoidance, have also been found by other reviews. They also note that many families are committed to reducing allergen exposure, and if so, they may wish to consider measures similar to NHLBI. By contrast, the Finnish Allergy program 2008-2018 only supports allergen avoidance in ‘mandatory situations’ and instead promotes ‘allergy health’ and the strengthening of immune tolerance through diet (Baltic/Mediterranean), physical activity, a connection with nature, microbial exposures and immunotherapy.

Other comprehensive Practice Parameters for the control of cockroach and rodent allergens were also published in 2012/3; the approaches differ due to differences in the domestic distribution of the sources and focus on integrated pest management and hygiene measures.

2. Methods of reducing allergen exposure and evidence-based studies of their effectiveness

Methods and evidence cannot be summarised in simple terms. The methods conventionally “recommended” are those in the NHLBI guidelines (above). However many of these were also utilised within the 54 interventions studies selected for the Cochrane dust mite meta-analysis, which despite its limitations concluded no overall clinical benefit. This analysis, which has had enormous global impact mainly outside the USA, implied that the methods used were ineffective at reducing mite allergen exposure, although a sufficient reduction might have clinical benefits.

While the methods advocated by NHBLI may seem ‘logical’, in fact there is limited and mixed experimental data showing that large and long term reductions in aeroallergen exposure can be obtained by bed encasing, carpet removal, hot (55 °C) water laundry, air filtration, HEPA vacuuming or acaricides, either singly or in combination. While some methods may provide acute reductions in reservoir concentrations, this may not result in large reductions in aeroallergen...
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Exposure, or ensure the reductions are maintained over time. The effect of a reduction at any single site also needs to be understood in terms of 24-hour exposure. Some of the general complexities of measuring exposure in the context of interventions and relating this to clinical outcomes are reviewed in the 2013 Practice Parameters for rodent allergens.

At present we do not have a clear idea of when and where people get most of their personal exposure to cockroach, mite, cat, mouse allergens over the entire 24 hour period in different populations, age and lifestyle groups. Our models have been based largely on assessing allergen content of a few reservoirs, rather than longitudinal aeroallergen exposure, which is more complex to measure. For example, while the main site of mite exposure is conventionally thought to be the bed, one recent study of mite aeroallergen exposure over 24 hours found the bedroom exposures were lower than lounge/living room and school exposure and another study found the highest mite exposures occurred in the day and were associated with people and part disruption; exposure was lowest during sleep. More recent evidence of clinically effective allergen avoidance approaches come from (1) studies which use multiple domestic interventions tailored to the individual, (2) the use of complex engineering to provide clean air to a dwelling, and (3) the use of laminar, HEPA-filtered air delivered over the bed. Together these suggest effective avoidance needs to focus on reducing chronic aeroallergen exposure.

The title of this session is “Rethinking allergen avoidance” and the take home message is that there is good reason to think that, at least in some patients at some time, avoidance of domestic allergens may be practical and beneficial. However, to be more effective, the following uncertainties need resolution. (1) the best way to measure a person’s domestic exposure, (2) understand where and when most aeroallergen exposure occurs, (3) the best methods to reduce overall aeroallergen exposure, (4) bio/genetic markers to identify subjects in whom such avoidance should be attempted, (5) an understanding of the synergies, risks, benefits and cost-effectiveness of long term allergen avoidance strategies compared to pharmaceutical and lifestyle approaches, (6) approaches to improve compliance with recommendations. (3)

Discuss new strategies for allergen avoidance that take into account the complex interactions between allergens, the innate immune system and genetic markers.

Some complexities include: (1) The shape of dose response relationships between exposures for allergens and allergic sensitisation and asthma may be non-linear for some allergens (mite, cat, mouse, cockroach for outcome of sensitization), but linear for others (mouse for outcome of asthma morbidity). (2) The effects of high-dose tolerance, which may contribute to non-linear relationship between allergen exposure and allergic disease as described above. (3) The periodicity, or degree of variability, of allergen exposure. (4) The effects of exposures to innate immune stimulants and other environmental factors (cigarette smoke exposure, volatile organic compounds, particulate matter, nitrogen dioxide, and endocrine regulators such as phthalates, tributyl tin, and triclosan). (5) The underlying influence of the gut and airways microbiome in modulating allergy and asthma. (6) Intrinsic factors, such as genetic polymorphisms, that confer (or protect against) susceptibility to these environmental exposures.


