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AEROALLERGEN AVOIDANCE: UPDATED EVIDENCE AND HOW TO ADVISE PATIENTS

Introduction
Allergic rhinitis (AR) is highly prevalent in Canada, affecting approximately 20–25% of the population. Asthma is estimated to affect approximately three million Canadians, and between 12% and 25% of Canadian children. Approximately two-thirds of individuals with asthma are allergic to aeroallergens, and these allergens act as triggers for asthma exacerbations. Overall, approximately 7.7 million individuals were affected by aeroallergens in Canada in 2016. High concentrations of ambient aeroallergens, including tree pollen and fungal spores have been associated with increased risk of premature birth, myocardial infarction (MI) and asthma-related Emergency Department visits and hospitalizations in cities across Canada. This demonstrates that nation-wide aeroallergen counts are associated with severe signs and symptoms.[1]

Children exposed to various indoor allergens are placed at an increased risk of developing asthma in later life, with sensitization in these individuals being a strong predictor of disease morbidity. Common indoor exposures for infants include house dust mite, pet, cockroach, mould, and rodent allergens.

Sensitization to at least one indoor allergen has been demonstrated to be present in nine of every ten children hospitalized with asthma.[2]

It has been noted that more than 90% of children worldwide breathe polluted air. While the impact of climate change on aeroallergen exposure is not fully understood, there is increasing evidence that it may have an impact on outdoor aeroallergens and, by extension, asthma control in children. Global warming has been projected to influence the duration and intensity of pollen seasons, and may lead to increased pollen production, prolonged pollen seasons, and increased pollen protein allergenicity.

The changing weather patterns including rainfall and wind may cause pollen species to reach environments in which they had not previously been present, contributing to a shift in geographic pollen distributions.

Avoidance and Removal Measures
For indoor allergens, the Global Initiative for Asthma (GINA) strategy does not recommend allergen avoidance as a general strategy, noting limited evidence of clinical benefit particularly with a single-

strategy indoor aeroallergen avoidance approach. A comprehensive approach is most likely to be beneficial, especially in the presence of multiple allergies.

Allergen avoidance and various methods of controlling exposure and allergen concentration have been studied in the setting of AR. Although commonly employed in AR management, most allergen avoidance strategies have demonstrated mixed evidence. Optional physical techniques for allergen exposure control include air filtration, barrier methods, bait traps, insecticides, and acaricides in household cleaners.[3]

There is support for improved AR and asthma control following pet avoidance and removal; however, compliance with pet removal strategies is extremely poor. Pollen avoidance strategies (e.g., air conditioning in buildings and automobiles) are generally well tolerated and are associated with low cost; however, further work is needed to investigate the effectiveness these methods. Overall, pet, pest and pollen allergen avoidance is considered an optional intervention, and occupational avoidance of triggers is considered a recommendation.[3]

House dust mites

Measures to remove house dust mites include mattress and pillow covers (with a pore diameter no more than 10 microns); regular washing of bedding in hot water; removal of stuffed toys, upholstered furniture and carpeting; regular vacuuming; and maintaining low household humidity levels (<50%) **(Figure 1)**. It has been shown that the use of dust mite-eliminating agents, i.e., acaricides (benzyl benzoate, tannic acid), not only cause an insignificant and impermanent reduction in the number of dust mites, but that their population is rapidly restored following acaricide use.[8] Furthermore, the direct effect of these chemical agents on patients' health is uncertain. For this reason, the use of chemical products is not recommended for patients with a house dust mite allergy.

In a systematic review of 20 studies in children and adolescents, multicomponent dust mite interventions reduced the number of asthma symptoms by 0.8 days per two weeks (21.0 symptom days per year) and reduced the number of asthma acute care clinician visits by 0.57 visits per year.[18]

PET allergens

The optimal approach to remove pet allergen from the home is removal of the pet itself from the home. However, even with pet removal it can take months for the pet aeroallergen to reduce to baseline. In a study of 15 homes over a 9-to 43-week period following cat removal, Fel d 1 levels declined gradually in most homes. At 20 to 24 weeks following cat removal, the Fel d 1 levels in 8/15 homes were consistent with those found in control homes without cats.[19] Whether or not the pet is removed from the home, thoroughly cleaning the home and removal of any allergen reservoirs (upholstered furniture and carpeting) may be beneficial. The use of high-efficiency particulate air (HEPA) filters, mattress and pillow covers, and regular washing (in particular for dogs but only if twice a week or more) can be helpful if the pet remains in the home. However, whether or not this reduction in airborne allergen levels impacts asthma disease activity remains controversial. The GINA strategy notes limited evidence of clinical benefit for asthma with pet avoidance strategies. This may be partly because exposure to pet allergens occurs in schools, public buildings and public transportation even if the pet is removed from the home.

Air filters and purifiers fitted with a HEPA system are a frequently recommended method of reducing the quantity of inhalant allergens derived from pets. Based on a current literature review, the most effective of these in terms of effectiveness and cost are free-standing, portable HEPA filters, central air filtration systems and laminar air flow systems. Unfortunately, reports on their efficacy are conflicting. Sulser et al have shown that 12-month usage of laminar flow filters only slightly reduced the quantity of inhalant allergens in the air and did not significantly affect bronchial hypersensitivity.[9] Nevertheless, another study conducted by Sicco van der Heide et al revealed that three-month use of a HEPA air purification system significantly reduced bronchial reactivity and decreased the amplitude of Peak Expiratory Flow (PEF).[9] Despite inconsistencies and doubts regarding the efficacy of this method in animal-produced inhalant allergen reduction, it is worth recommending and can be used as part of a multifaceted approach.

The efficacy of a feline diet with an egg product ingredient containing anti-Fel d 1 IgY antibodies was demonstrated in vitro, ex vivo and in vivo.[17] Data on this topic is scare and further clinical studies to evaluate its efficacy are needed.

Murine and cockroach allergens

Integrated pest management (IPM) strategies have demonstrated efficacy in removing cockroach, mouse and rat allergens from the home. IPM includes sealing all cracks/holes in the home; cleaning surfaces with detergent; vacuuming with HEPA filtration; the use of tracking powder (pesticides) on wall voids/pipe chases; snap traps; and family education about food

storage and kitchen cleaning. Simple interventions such as the use of insecticides can make a significant difference in the removal of these allergens. A recent study of 122 children with moderate-to-severe asthma noted that insecticidal bait in the homes resulted in lower levels of cockroach infestation (P<0.01). Children in control homes without the bait experienced more severe asthma symptoms (P=0.03), greater frequency of unscheduled medical visits (P=0.03); and worsening lung function (P=0.01) vs children in the intervention group.[21] Rodenticide can be considered in this context. For outdoor allergens, the GINA strategy notes that these are impossible to avoid completely.

Pollen allergens

Closing doors and windows and remaining indoors when pollen and/or mould counts are highest play have a role in reducing allergen exposure, although only low-quality evidence is available to support this intervention.

The strategies recommended most frequently include shutting windows and doors; avoiding going outside and, when returning home, washing clothes and taking a bath; wearing glasses to protect the eyes from contact with allergens; and using HEPA filters at home and on car air conditioning systems. Pollen calendars and monitoring of pollen and mould counts may be helpful at the individual and population level, as a correlation has been found between the pattern of pollen load and allergen content, and asthma symptoms. The investigation of novel methods to predict pollen counts, including mobile solutions, is ongoing.[2]

In addition, patients must be aware of the pollens to which they are sensitized. This will allow them to know when to exercise these pollen avoidance measures in order to gain maximum benefit from them.[10] Various methods and smartphone applications to support patients' knowledge regarding pollination periods are available.[11]

Fungi and mould

The basic method of avoiding inhaled allergens produced by moulds is elimination of all mouldy areas.[12] Mould is often found on ceilings, walls, floors, carpets, and toys. These surfaces should be cleaned with agents containing antifungal substances; in addition, they should frequently be dried and vacuumed **(Figure 2)**.

The application of proper drying and mould removal methods may result in as much as a 20-fold decrease in the number of mould spores suspended in the air. If a given area cannot be cleaned in a satisfactory way, the offending substance (e.g., wallpaper, wood panelling, carpet) should be removed. This is often required in old houses or following flooding. Reducing air humidity, ideally to below 50%, is an important measure in reducing the number of fungal allergens. This can be achieved by installing and using ventilators in rooms with high humidity (especially in bathrooms, cellars and attics); sealing and insulating pipes and areas of leakage or water deposition; reducing the number of plants requiring frequent watering; and employing ventilation and air conditioning in months when air humidity is increased.[13] Air conditioning devices in houses and cars are common sites for allergy-causing fungus. They should undergo frequent inspection and filter replacement as, instead of decreasing the number of allergens in the patient's environment, they may actually increase air contamination with spores and fungal allergens **(Figure 3)**.

For outdoor mould, the same recommendations as those mentioned above for pollens apply, including the use of smart phone apps.[14]

Conclusion

Allergen avoidance is one of the pillars in the management of allergic diseases **(Table 1)**. Despite this, the literature involving allergen avoidance in patients with AR is scarce, making it difficult to recommend environmental modifications or measures to reduce allergen exposure. In a 2008 systematic review by Getzsche et al[5] that assessed the effects of reducing exposure to house dust mite antigens with environmental measures in patients with asthma, no statistically significant differences were found in asthma symptom scores or medication usage. This systematic review was published after several randomized, controlled trials produced conflicting results regarding the effectiveness of environmental measures. It remains to be established if the same can be concluded regarding AR.

Several findings have consistently emerged in the controlled trials of allergen avoidance and immunotherapy: the studies are difficult to blind, the number of subjects enrolled is generally modest; and in many cases other treatments have been permitted for use.[15] In some of the successful studies on allergen avoidance, a significant result has been recorded despite small numbers [6,16]

Therefore, a scarcity of data should not alter our recommendations. Allergen avoidance remains a cornerstone of the treatment of allergic patients who present with rhinitis, asthma, or atopic dermatitis. Successful treatment requires defining specific sensitivity (skin tests or serum IgE antibodies), education, and an overall plan to reduce exposure in

the home.[6] Success depends on patient involvement, the relevance of other allergens, and exposure outside the patient's home. In a world in which a large proportion of the population is taking allergy tablets or inhalers on a daily basis, we should take full advantage of a treatment strategy that can be easily maintained without side effects; improves symptoms; consistently decreases bronchial hyperactivity; and decreases reliance on drug treatment.[7]

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Financial Disclosures:

None declared

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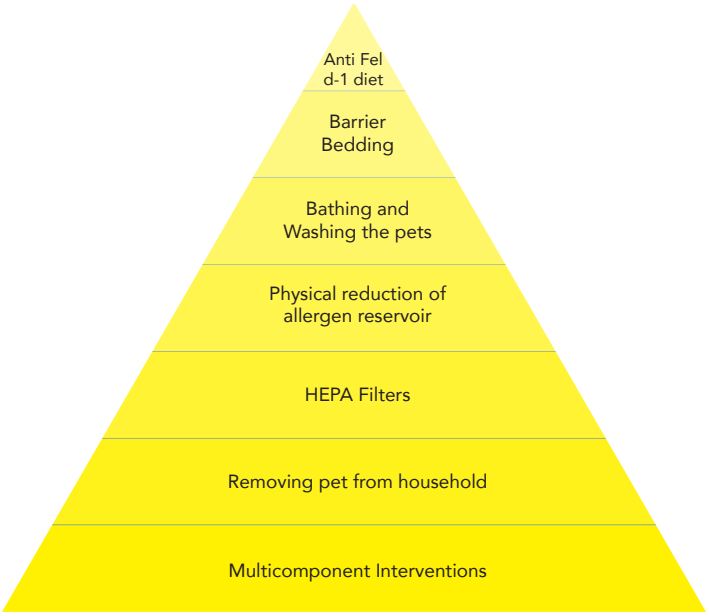

Figure 1: *Pyramid of furry pet allergens avoidance methods. Arrangement based on the clinical effectiveness of each intervention.*[20]

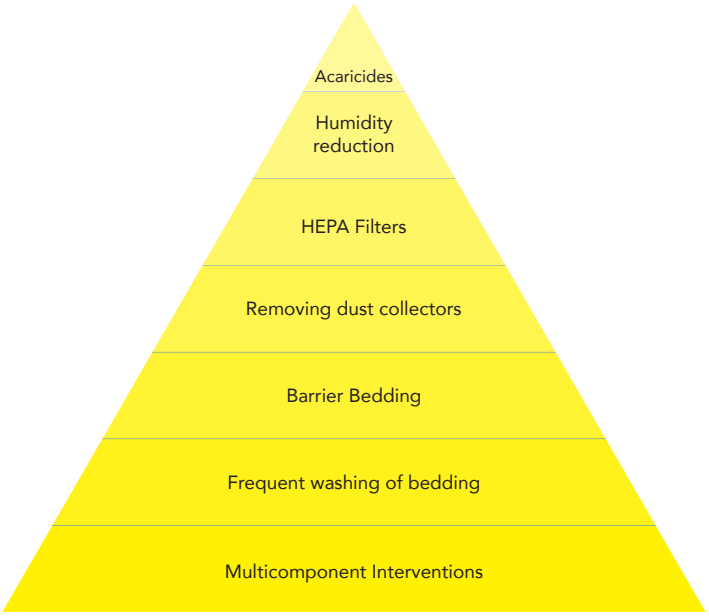

Figure 2: Pyramid of dust mites allergens avoidance methods. Arrangement based on the clinical effectiveness of each intervention.[20]

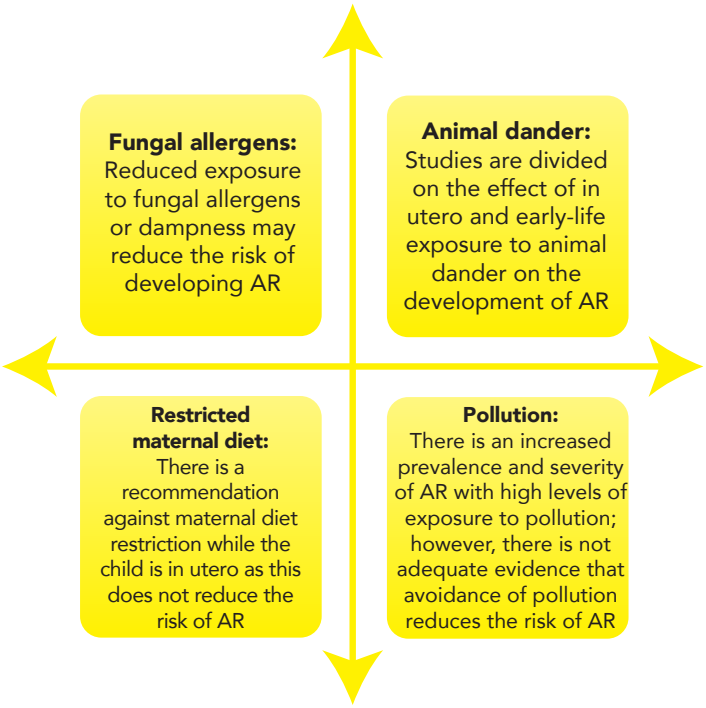

Figure 3: *In utero and/or early-life risk factors for the development of AR: Summary of ICAR:AR-2023* Aeroallergen avoidance and environmental controls: summary of ICAR:AR-2023.*[3]

House dust mites	Data support environmental control strategies with/without use of acaricides
Cockroach	Data support a combination of physical measures and education-based methods
Pets	Highest-level evidence supports environmental controls in patients with Fel d 1 sensitivity
Rodents	Consider work-related exposure and avoidance
Pollen	Option for pollen avoidance and environmental controls. It is recommended to avoid allergens associated with occupational exposures.

Table 1: Effective aeroallergen avoidance strategies per ICAR-AR 2023.[3]