Environmental Interventions to Improve Health

James L. Sublett MD, FACAAI
Clinical Professor, Chief
Section of Allergy & Immunology
Department of Pediatrics
University of Louisville School of Medicine
Managing Partner, Family Allergy & Asthma
Disclosures

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OBJECTIVES

The participant will be able to:

• Describe various interventions commonly recommended to reduce environmental triggers of allergic respiratory disease.

• Understand research evidence supporting environmental avoidance measures.

• Develop a targeted intervention plan for patients with allergic respiratory disease.
“What works? What doesn’t?”

• Everything works.

• Nothing works.

• Questions?
Cochrane Reviews

• **House dust mite avoidance measures for perennial allergic rhinitis**
  Aziz Sheikh, Brian Hurwitz, Ulugbek Nurmatov, Constant Paul van Schayck
  July 2010

• **House dust mite control measures for asthma**
  Peter C Gøtzsche, Helle Krogh Johansen
  October 2011

• **House dust mite reduction and avoidance measures for treating eczema**
  Helen Nankervis, Emma V Smith, Robert J Boyle, Lesley Rushton, Hywel C Williams,
  Deanne M Hewson, Thomas Platts-Mills;
  December 2011

• **Feather versus non-feather bedding for asthma**
  Fiona Campbell, Peter G Gibson
  July 2009

• **Humidity control for chronic asthma**
  Meenu Singh, Anna Bara, Peter G Gibson
  October 2008
Dust mite control measures don't help asthma patients: forget about mattress covers and air filtration systems. They don't work, despite what the guidelines say.

Journal of Family Practice, Dec, 2008 by Sarah-Anne Schumann, John Hickner, Bernard Ewigman

Stop recommending dust mite control measures to your asthma patients.

Neither chemical nor physical reduction measures are effective in improving peak flow, symptoms of asthma, or medication usage. (1)

ILLUSTRATIVE CASE
The parents of a 10-year-old patient whom you recently diagnosed with asthma want to do everything they can to reduce his asthma symptoms. They are considering buying hypoallergenic mattress covers and an expensive air filtration system …..this extensive Cochrane review …..

confirms that interventions like mattress covers and air filtration don’t work, despite recent reviews and guidelines recommending them.
Rostrum

Allergen avoidance in the treatment of asthma: Problems with the meta-analyses
Thomas A. E. Platts-Mills, MD, PhD Charlottesville, Va

- Decreasing exposure to indoor allergens has been studied extensively and is a well accepted part of the treatment for allergic disease.
- The 2007 revision of the evidence-based guidelines recommends allergen avoidance as part of the management of asthma.
- In contrast, a recent meta-analysis concluded that dust mite avoidance is “of no use” in the treatment of asthma.
- The recent meta-analysis on dust mite avoidance appears to be seriously flawed because of the decisions about inclusion and exclusion as well as the way in which studies were evaluated.
- The conclusion is that the criticisms of the recommendations in the 2007 guidelines were not well founded.

A Systematic Review of Housing Interventions and Health: Introduction, Methods, and Summary Findings

• Expert panel brought together by CDC & NCHH
• Systematically reviewed evidence on the effectiveness of specific housing interventions in improving health
  – interior biological agents (toxins) interventions
  – interior chemical agents (toxics) interventions
  – structural deficiency (injury) interventions, and
  – community-level housing interventions
• 2 broad categories of evidence
  – Clinical evidence
  – Environmental measurements

*J Public Health Management Practice*, 2010, September(Suppl), S3–S8
A Systematic Review of Housing Interventions and Health: Introduction, Methods, and Summary Findings

• 11 interventions had sufficient evidence of effectiveness
• 15 required more field evaluation
• 19 needed formative research
• 7 either had no evidence of effectiveness or were ineffective.

*J Public Health Management Practice*, 2010, September(Suppl), S3–S8
Sufficient Evidence for Implementation

1. Multifaceted, in-home, tailored interventions for asthma
   1. Reduce exposure to triggers
   2. Decrease symptoms and health care use
   3. Improve quality of life
2. Cockroach control through integrated pest management (reduce allergens)
3. Combined elimination of moisture intrusion and leaks and removal of moldy items

*J Public Health Management Practice, 2010, September(Suppl), S3–S8*
Sufficient Evidence for Implementation

Controlling Asthma Symptoms and Reducing Asthma Mortality

1. Home Environmental Assessment
2. Education
3. Use of mattress & pillow encasings
4. Use of HEPA vacuums & HEPA air cleaners
5. Smoking cessation and reduction in ETS exposure
6. Cockroach and rodent management
7. Minor building/HVAC repairs
8. Intensive household cleaning
More Field Evaluation

1. Dehumidification
2. General & local exhaust ventilation (kitchen & bath)
3. Air cleaners alone
4. Carpet cleaning
5. Vacuuming

More Research

1. One-time professional cleaning
2. Residential ventilation
3. VOC interventions other than garage

J Public Health Management Practice, 2010, September (Suppl), S3–S8
No Evidence/Ineffective

1. Bedding encasement and/or sheet and/or upholstery cleaning alone
2. Acaracides as a single intervention
3. Portable HEPA air cleaners to reduce secondhand smoke
4. Air cleaners releasing ozone (recommended NOT to use them)

J Public Health Management Practice, 2010, September(Suppl), S3–S8
Barriers in Proof of Concept

Applied Epidemiology

– Need large study populations
  • Multiple interventions (several pieces to the puzzle)
– Observational study designs (Ex: Lung Cancer & Smoking)
– Multiple measures
– Clinical (e.g. FEV1, Bronchial Hyperreactivity, eNO, Inflammatory markers)
– Outcomes (Quality of Life)
– **Time**
  • Requires long-term studies (12 to 24 months or longer)
PubMed search for published studies 2002-present

• Allergy antihistamines 10,596
• Inhaled bronchodilators 15,397
• Inhaled steroids 10,864
• Sub-cutaneous immunotherapy 436
• Allergy/asthma air filtration 68*

*14 studies published that are applicable to the role of air filtration as an environmental control measure for allergic respiratory diseases.

PubMed accessed July 2011
Home-based environmental intervention among urban children with asthma.

(Inner-City Asthma Study Group)

• 937 allergic asthmatic children
• Randomized, controlled trial of individualized environmental interventions based on the positive skin test response and known environmental triggers identified in the home
• Remediation of exposure to:
  – Dust mites
  – Passive smoking
  – Cockroaches
  – Pets
  – Rodents
  – Mold

Home-based environmental intervention among urban children with asthma.  
(Inner-City Asthma Study Group)

• Interventions included:
  – Allergen-impermeable covers on the mattress, box spring, and pillows of the child's bed
  – Use of a vacuum cleaner equipped with a high-efficiency particulate air (HEPA) filter
  – a HEPA air purifier was set up in the child's bedroom if the child was exposed to passive smoking, sensitized and exposed to cat or dog allergens, or sensitized to mold.
  – For children sensitized and exposed to cockroach allergen, professional pest control was provided

Home-based environmental intervention among urban children with asthma.

(Inner-City Asthma Study Group)

– Significantly fewer symptoms of asthma during both the intervention year and the follow-up year.

– The maximal number of days with symptoms was lower in the intervention group by 0.82 day per 2-week period in the first year ($P < 0.001$) and 0.60 day per 2-week period in the second year ($P < 0.001$).

– This effect is similar to that described in placebo-controlled studies of inhaled corticosteroids.

**Conclusion**

An “individualized, home-based, comprehensive environmental intervention decreases exposure to indoor allergens, including cockroach and dust-mite allergens, results in reduced asthma-associated morbidity.”

Multiple Interventions

- 219 children with asthma, from 186 homes
- Interventions:
  - high-efficiency furnace filter (72.3%)
  - HVAC service (78.2%)
  - room air cleaner (69.3%) placed in bedroom
  - basement dehumidifier (54.5%)
  - dryer exhaust ventilation (35.6%)
- All four interventions 33.7%
- Asthma quality of life surveys
- Most effective interventions ($p < 0.05$)
  - HVAC servicing/improved air filtration
  - dehumidifiers

Air filters and air cleaners: Rostrum by the American Academy of Allergy, Asthma & Immunology Indoor Allergen Committee

James L. Sublett, MD, a,b James Seltzer, MD, c Robert Burkhead, ME, d P. Brock Williams, PhD, e H. James Wedner, MD, f Wanda Phipatanakul, MD, MS, g,h and the American Academy of Allergy, Asthma & Immunology Indoor Allergen Committee  Louisville, Ky, Irvine, Calif, Kansas City and St Louis, Mo, and Boston, Mass

The allergist is generally recognized as possessing the greatest expertise in relating airborne contaminants to respiratory health, both atopic and nonatopic. Consequently, allergists are most often asked for their professional opinions regarding the appropriate use of air-cleaning equipment. This rostrum serves as a resource for the allergist and other health care professionals seeking a better understanding of air filtration. (J Allergy Clin Immunol 2010;125:32-8.)

Key words: Air conditioning, air ionization, air Pollution, indoor/adverse effects/prevention and control, allergens/adverse effects, asthma/prevention and control, environmental exposure/adverse effects/prevention and control, filtration/methods/standards, inhalation exposure/adverse effects/prevention and control, ozone/adverse effects, particulate matter/adverse effects

Home environmental intervention 1 strategies are effective in reducing allergic respiratory disease manifestations. To date, most research has focused on allergens 2 Clinicians often ignore other

role in human respiratory disease. Consequently, air filtration studies focused only on the efficacy of reducing airborne allergens might fail to recognize the health benefits of air filtration.

The study of the effectiveness of avoidance measures is limited by the fact that a single method is not enough. Multiple interven-
U.S. Housing Stock

• 75% of U.S. housing units have ducted forced air heat.
• 63% have ducted central air-conditioning.
• Poorly maintained or contaminated systems may actually increase the risk for asthma and other allergic respiratory symptoms
• People forget to change (or ignore) their HVAC filters.

CONCLUSIONS

• Source control and ventilation plays a more important role than attempts to clean the air after the fact by means of filtration.
• “However, based on our review of the literature, there is sufficient evidence that air filtration does reduce indoor levels of ambient particulates that might trigger disease processes themselves.”
• Air filtration relates to reduction of disease progression rather than a ‘‘treatment.’

Effectiveness of Air Filters and Air Cleaners in Allergic Respiratory Diseases: A Review of the Recent Literature

James L. Sublett

Current Allergy and Asthma Reports
ISSN 1529-7322
Curr Allergy Asthma Rep
DOI 10.1007/s11882-011-0208-5
Residential Air Cleaning Options

Whole House Filtration

Sleep Breathing Zone HEPA Air Cleaners

Portable Room HEPA Air Cleaners
HEPA Air Cleaners

- Offer portability
- Provide filtration in homes without forced-air HVAC systems.
- Filtration efficiency of 99.97% of 0.3 µm particles in laboratory setting.
- Effective filtration may be only about 80% in real world setting due to by-pass within appliance.
- Limited on the amount of air volume they can clean
- Effective only in the room where they are used.
Clean Air Delivery Rate (CADR)

- Developed by the Association of Home Appliance Manufacturers (AHAM)
- Rating based on the amount of clean air the product will deliver per minute in cubic feet
- CADR at least 2/3 your room's area
  Ex: 10' x 12' x 8’ room - 120 square feet - would require an air cleaner with CADR of at least 80
### Whole House Clean Air Delivery Rates

<table>
<thead>
<tr>
<th>Type of Filter/Room Air Cleaner</th>
<th>Whole house particle removal rates per hour for PM2.5</th>
<th>Whole House CADR m³/minute for 0.3 to 20 microns</th>
</tr>
</thead>
<tbody>
<tr>
<td>No air cleaner</td>
<td>0.0</td>
<td>NA</td>
</tr>
<tr>
<td>Ionizers with no fan running simultaneously in 3 rooms</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>MERV 2 flat panel furnace filter (1”)</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>1 HEPA room air cleaner</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>MERV 8 pleated media furnace filter (5”)</td>
<td>4.0</td>
<td>10</td>
</tr>
<tr>
<td>5 HEPA room air cleaners running simultaneously in 5 rooms</td>
<td>4.1</td>
<td>19</td>
</tr>
<tr>
<td>Electronic air cleaner on HVAC system</td>
<td>5.5</td>
<td>23</td>
</tr>
<tr>
<td>Electrostatic air cleaner with intense field dielectric technology on HVAC system</td>
<td>7.0</td>
<td>33</td>
</tr>
</tbody>
</table>

Sleep Breathing Zone Filtration

- Stillerman et al
  - HEPA filtration attached to a dust mite proof pillow encasement.
  - 35 patients with perennial allergic rhinoconjunctivitis; randomized, double blind, placebo-controlled crossover trial lasting 42 weeks.
  - Allergies: dust mite (89%); cat (57%); dog (43%)
  - Outcome Measures: Total Nasal Symptom Scores (TNSS); Nocturnal Rhinoconjunctivitis Quality of Life (NRQL)
  - treatment group had significant improvement versus placebo (P <0.001) in both instantaneous on waking and overnight reflective TNSS & NRQL

Whole House Filtration

• Most studies of whole house filtration are engineering modeling studies to determine particulate removal

• Typical inexpensive (fiber glass woven) furnace filter (no ASHRAE rating) reduced particulates about 20%

• Moderate efficiency filters (MERV 11- 12) reduce 10 micron particulates 65-85%.

• Filters with an efficiency rating of ASHRAE 45% (MERV 9) or lower were not found to be effective for reducing indoor concentrations of these smaller particles.

CONCLUSIONS

• Inexpensive, low-efficiency HVAC filters offer no better particle removal than no filter.
• WHF with high efficiency HVAC filtration is shown to be more effective in particulate reduction than individual HEPA PRACs.
• A study of HEPA PRACs trended toward clinical benefit, but their effectiveness is limited to a single room and not the entire dwelling.

CONCLUSIONS

• The best and most cost-effective approach may be to consider “combination filtration” using high-efficiency WHF with PRAC or breathing zone filtration in the bedroom

Environmental Assessment and Exposure Control: A practice parameter. Furry Animals

Members of the Joint Taskforce on Practice Parameters

– David Bernstein MD
– Joann Blessing-Moore MD
– Linda Cox MD
– David Khan MD
– David Lang MD
– Richard Nicklas MD
– John Oppenheimer MD
– Jay Portnoy MD,
– Christopher Randolph MD
– Diane Schuller MD
– Sheldon Spector MD
– Stephen A Tilles MD
– Dana Wallace MD

Chief Editors:

– Jay Portnoy, MD
– Kevin Kennedy, MPH
– James Sublett, MD

Workgroup:

– Charles Barnes PhD,
– David Bernstein MD
– Jonathan Bernstein MD
– Carl Grimes
– Elizabeth Matsui MD,
– Jeffrey D. Miller MD
– J David Miller PhD
– Wanda Phipatanakul MD, MS
– James Seltzer MD
– P Brock Williams PhD
Environmental Assessment and Exposure Control: A practice parameter. Furry Animals
Atopy and the Environment

• The atopic state is a function of genetics waiting for environmental influences to manifest disease.

• The phenotypic presentation of atopic disease is the result of a complex set of genetic and environmental interaction.
Treatment Options for Allergic Diseases

- Pharmacological Management
- Environmental Exposure Control
- Allergen Vaccine Immunotherapy
Environmental Exposure Control

• The use of one or more interventions to reduce the amount of contaminant in the environment.

• To be effective, environmental control generally requires the use of one or more interventions including source control and abatement.
Contaminant

• Any physical, chemical, biological or radioactive substance that can have an adverse effect on air, water or soil or on any interior or exterior surface
• Has the potential to cause harm to a building’s occupants
• Can be allergens, irritants or other types of substances including biologically active ones.
Triggers of Airways Disease

- **Allergic**
  - House Dust Mites
  - Domestic Animals
    - Cat
    - Dog
    - Horse
  - Pests
    - Mouse
    - Cockroach
  - Fungi spores
  - Pollen

- **Non-allergic**
  - Cigarette Smoke
  - Combustion by-products
  - Vehicle exhaust
  - Volatile Organic Compounds
  - Ozone
  - Formaldehyde
  - Ergosterols
  - Glucans
Source

• A mechanism for the production of contaminants.
• Allergen sources
  – biologic organisms: fungi, rodents, dust mites, furry animals and insects.
• Non-allergen sources
  – chemical reactions, combustion and microbial organisms that produce substances such as endotoxin and volatile organic compounds.
• Production of contaminants from sources can be augmented by facilitating factors.
After Peyton Eggleston MD
Reservoirs

• Contained spaces, or microenvironments in which contaminants can accumulate for subsequent release into the environment.
In homes with attached garages, 30% of the indoor air comes from the garage. Most of the rest of the “Fresh” air in our homes comes from the attic, crawlspace or basement.
Abatement

– a diminution in amount, degree, or intensity
– Includes removing, treating or isolating reservoirs of contaminants
– Includes interventions such as air filtration, vacuuming or removal of carpeting, use of denaturing chemicals and removal of contaminated building materials
– Example: asbestos, lead paint, radon

Environmental Assessment and Exposure Control: A practice parameter. Furry Animals (in press)
Exposure Reduction

• An attempt to block pathways to contaminants or reduce their prevalence with the goal of reducing occupant exposure.
• The goal is to keep contaminant exposure below the threshold where adverse health effects can occur.
Source Control

• The process of reducing or eliminating sources of allergens or irritants.

• If the source is removed, then exposure will decrease over time as the previously released contaminants are removed from the environment.
Environmental Avoidance as Primary Prevention

• Directed at preventing the clinical manifestations of atopy by suppressing or delaying the onset of allergic sensitivity
• Begins before birth, during pregnancy and extends into the first few months of life
• Avoidance of Environmental Tobacco Smoke
  – Consensus among researchers that both primary and secondary prevention measures for avoidance of ETS is beneficial
  – ETS avoidance by both the expectant mother and in the child’s environment is effective
• Benefit of primary prevention measures directed toward other allergens and triggers is not clear

Environmental Assessment and Exposure Control: A practice parameter. Furry Animals (in press)
Environmental Avoidance as Secondary Prevention

• Directed at reducing or removing triggers, especially of allergens, in the environment that lead to the development of allergic disease in an already sensitized individual.

• Secondary prevention studies that focus on one allergen (e.g. HDM) or intervention (e.g. air filtration) have generally fared poorly.

• Strategies to identify and focus on multiple allergens or interventions have shown effectiveness.

Environmental Assessment and Exposure Control: A practice parameter. Furry Animals (in press)
Environmental Avoidance as Tertiary Prevention

• Tertiary prevention, or what is commonly called treatment, consists of avoiding triggers for individuals who are sensitized and who already have developed an allergic disease.

• Strategies to identify and focus on multiple allergens and measures have shown effectiveness.
Human Health is Affected by Building Health

after John Ouellette MD, FACAAI, FAAAAAI
Building Science

• the collection of scientific knowledge that focuses on the analysis and control of the physical phenomena affecting buildings.
• includes the detailed analysis of building materials and building envelope systems
• the performance and interaction of building components and systems and their effect on the occupant’s living environment.
The Healthy Home

BUILDING Enclosure/Envelope

AIR Ventilation Filtration

WATER Moisture Control

PEOPLE Occupant Behavior
Residential Housing: General Principles to Consider

- View the house as a total unit
- All parts and functions of the building are related – the house is a system.
- Air with pollutants moves throughout the entire structure – even from basements to attics.
- Time weighted exposures affects all occupants of the conditioned space.

Drawing Courtesy of National Center for Healthy Housing, 2008
Air Ventilation and Circulation

1. Around plumbing vent stack
2. Attic hatch
3. Tops of interior walls
4. Recessed light
5. Behind built-in cabinets
6. Around door
7. Plumbing penetrations
8. Around bathtub
9. Sill plate
10. Around chimneys and flues
11. Fireplace damper
12. Furnace or air conditioner air handler box
13. Where additions join house
14. Around window
15. Behind baseboards
16. Around electrical sockets
17. Around duct boot and register
18. Ducts
19. Around dryer vent
Mold Spores Dispersal within a Building

- In 1924 Storm van Leeuwen from Holland suggested that inhaled fungal spores could cause asthma.
- To investigate this possibility, the allergy department of St. Mary's Hospital, Paddington, London obtained fungal cultures which they intended to grow so that they could assess the effects and possibly test patients.
- One of these was the mold *Penicillium*.
- Directly above the allergy laboratory was Fleming's laboratory.
- The bacteriological plate containing *Staphylococci* was contaminated by *Penicillium* which may very well have originated in the allergy department downstairs.
- Therefore it can be said that it was the allergists interest in fungal spores that resulted in the discovery of penicillin.
Outlook pollution moves indoors

Effect of the Environment and Genetics on Immune Responses
Hygiene Hypothesis

Early exposures to endotoxins appear protective

German farm home with attached barn.
Photo by James Sublett MD

Photo courtesy of Fernando Martinez MD
Housing characteristics, reported mold exposure, and asthma in the European Community Respiratory Health Survey

• Population of 18,873
• 38 study centers
• Europe (14 countries)
• USA
• Australia / New Zealand
• India

Jan-Paul Zock, PhD,a Deborah Jarvis, MD,b Christina Luczynska, PhD,b Jordi Sunyer, MD,a and Peter Burney, MD,b on behalf of the European Community Respiratory Health Survey*
Housing characteristics, reported mold exposure, and asthma in the European Community Respiratory Health Survey

- Central heating
- Ducted air heating
- Air conditioning
- Double glazing
- Fitted carpets, living room†
- Only rugs, living room†
- Fitted carpets, bedroom‡
- Only rugs, bedroom‡
- Water damage in last year
- Water on basement floor§
- Mold or mildew in last year

Jan-Paul Zock, PhD,a Deborah Jarvis, MD,b Christina Luczynska, PhD,b Jordi Sunyer, MD,a and Peter Burney, MD,b on behalf of the European Community Respiratory Health Survey* Barcelona, Spain, and London, United Kingdom J Allergy Clin Immunol 2002;110:285-92
<table>
<thead>
<tr>
<th></th>
<th>Wheezing in past year</th>
<th>Wheezing apart from colds in past year</th>
<th>Current Asthma</th>
<th>Bronchial Responsiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ducted air heating</td>
<td>1.07</td>
<td>1.16</td>
<td>1.43</td>
<td>1.02</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>1.31</td>
<td>1.01</td>
<td>1.46</td>
<td>1.05</td>
</tr>
<tr>
<td>Water Damage in last year</td>
<td>1.16</td>
<td>1.23</td>
<td>1.13</td>
<td>1.15</td>
</tr>
<tr>
<td>Water on basement floors</td>
<td>1.46</td>
<td>1.26</td>
<td>1.54</td>
<td>1.05</td>
</tr>
<tr>
<td>Mold or mildew in past year</td>
<td>1.34</td>
<td>1.44</td>
<td>1.28</td>
<td>1.14</td>
</tr>
</tbody>
</table>

Dirty collapsed 1” fiberglass filters allow downstream contamination of HVAC system.

Photos by James L. Sublett MD
©AllergyZone
Do you have a damp basement?

“No, only when it rains”
ABCs of Moisture Transfer

Air transported & Ventilation

Bulk moisture

Diffusion

Capillary action
Steps to an Environmental Control Plan in the Allergist’s Office

• Detailed medical history determining triggers recognized or perceived by the patient.
  – Important not to dismiss perceived triggers at this stage – you lose your credibility

• Detailed environmental history looking for unrecognized triggers, including potential building issues (ask open ended questions)

• If significant potential building issues surface, a home inspection by a certified Healthy Homes Specialist should be considered. (www.healthyhomestraining.org)
# Targeted Avoidance Measures

<table>
<thead>
<tr>
<th>General Measures</th>
<th>Specific Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improve Ventilation</td>
<td>• No Smoking</td>
</tr>
<tr>
<td>• Control humidity</td>
<td>• Mite-proof Encasings</td>
</tr>
<tr>
<td>• Regular maintenance of HVAC, gas appliances, fireplaces.</td>
<td>• Removal of allergen reservoirs e.g. carpeting, upholstered furniture</td>
</tr>
<tr>
<td>• High efficiency air filtration</td>
<td>• Reduce animal exposure</td>
</tr>
<tr>
<td>• Vacuum (HEPA, cyclonic, central)</td>
<td>• Pest control</td>
</tr>
<tr>
<td>• Wear personal respiratory protection (N95 Respirator)</td>
<td>• Minimize use of candles, incense, aerosols, air fresheners, etc.</td>
</tr>
</tbody>
</table>
Summary...

• Targeted avoidance measures should be the cornerstone for the treatment of atopic diseases

• Avoidance may play more of a role in altering disease progression rather than thinking of them as a treatment. (e.g. the way we approach smoking cessation)

• Identification of triggers by thorough environmental history and allergen skin testing very helpful.

• Avoid a “shot-gun” approach with avoidance

• Multiple interventions are necessary to see measurable clinical results
Top Ten Tips for Improving Indoor Air Quality and Reducing your Allergen Exposure

1. No smoking inside the home at any time.
2. Measure the indoor humidity and keep it below 50%. Do not use vaporizers or humidifiers. You may need a dehumidifier.
3. Use vent fans in bathrooms and when cooking to remove moisture. Repair all water leaks.
4. Vent gas appliances and fireplaces to the outside and maintained regularly.
5. Keep pets out of the bedroom at ALL times.
6. Remove wall-to-wall carpets from the bedroom if possible.
7. Use a central vacuum, a cyclonic vacuum or a vacuum with a HEPA filter regularly. Remember it takes over 2 hours for the dust to settle back down.
8. Wear a NIOSH N95 particulate respirator when vacuuming, sweeping, or doing yard work to reduce your exposure to fine particulates and allergens.
9. Install a MERV 11 or 12 disposable high efficiency media filter in the furnace and air-conditioning system. Change the filter every 3 months. Leave the fan “on” to create whole house filtration.
10. Use a HEPA Air Cleaner in the bedroom with an adequate CADR (Clean Air Delivery Rate) for the size of the room.

James L. Sublett MD, FACAAI, FAAAAI