

2020 Expert Panel Updates – Indoor Allergen Mitigation

GHHI's comments on NHLBI Asthma Management Guidelines

In December 2020, the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health released a set of focused updates¹ to the Guidelines for the Diagnosis and Management of Asthma (EPR-3)², which was originally published in 2012.

In this issue brief, Green & Healthy Homes Initiative (GHHI) discusses the 2020 updates related to *Section III Recommendations for Indoor Allergen Mitigation in Management of Asthma*, and we provide our own notes on these new recommendations. The NHLBI expert panel reviewed and provided focused recommendations on six different priority areas of the EPR-3 guidelines. The guidelines related to environmental assessment and remediation are only strengthened by the four recommendations found in Section III which relates to environmental control of home triggers.

Overall, the 2020 Focused Updates provide further clarification specifically on indoor exposure to allergens which enhance the EPR-3 guidelines and recommendations related to mitigation of allergens in the home environment. The recommendations rely on the evidence-based findings of a 2017 systematic review entitled “Effectiveness of indoor allergen reduction in asthma management: A systematic review”.³ The systematic review was designed to answer the question “*among individuals with asthma, what is the effectiveness of interventions to reduce or remove exposures to indoor inhalant allergens on asthma control, exacerbations, quality of life, and other relevant outcomes?*”

In the systematic review 59 Randomized Clinical Trials (RCTs) and 8 non-RCTs were identified that addressed allergens mitigation through eight interventions known for reducing home-based indoor allergen exposure and improving asthma outcomes: acaricides, air purification, carpet removal, HEPA vacuum, mattress covers, mold removal, pest control, and pet removal. The systematic review assessed

¹ Cloutier, M. M., Baptist, A. P., Blake, K. V., Brooks, E. G., Bryant-Stephens, T., DiMango, E., ... & Ouellette, D. R. (2020). 2020 Focused Updates to the Asthma Management Guidelines: A Report from the National Asthma Education and Prevention Program Coordinating Committee Expert Panel Working Group. *Journal of Allergy and Clinical Immunology*, 146(6), 1217-1270. Full report can be found on the NIH website: <https://www.nhlbi.nih.gov/health-topics/all-publications-and-resources/2020-focused-updates-asthma-management-guidelines>

² National Heart, Lung, and Blood Institute. (2007). National asthma education and prevention program, third expert panel on the diagnosis and management of asthma. Bethesda (MD): National Heart, Lung, and Blood Institute. <https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma>

³ Leas, B. F., D'Anci, K. E., Apter, A. J., Bryant-Stephens, T., Lynch, M. P., Kaczmarek, J. L., & Umscheid, C. A. (2018). Effectiveness of indoor allergen reduction in asthma management: a systematic review. *Journal of Allergy and Clinical Immunology*, 141(5), 1854-1869.

evidence from 37 studies which evaluated single-component interventions, and 30 studies assessed multicomponent interventions. Key messages from the findings in the systematic review were as follows⁴:

- Evidence for single interventions designed to reduce indoor allergen exposure on asthma outcomes is lacking.
- Multicomponent interventions that bundle more than one strategy may improve some asthma outcomes, but it is unclear if specific combinations are more effective than others.
- Multicomponent interventions that include high-efficiency particulate air-filtration (HEPA) vacuums or pest control reduce exacerbations and improve quality of life.
- The evidence for both single and multicomponent interventions does not address many other important outcomes, including asthma-related health care utilization, pulmonary physiology, and asthma-related quality of life.

Appendix A provides a table of key differences between EPR-3 and the Focused Update. Appendix B provides a reference guide of GHHI recommended interventions and Appendix C provides a table of asthma interventions with strength of evidence based on 2007 EPR-3 guidelines.

Based on the Focused Update recommendations GHHI recognizes that the strength of evidence for multicomponent home interventions to reduce allergens is rated with low or moderate certainty of evidence due to the limited number of quality research studies and a high level of heterogeneity across studies. Therefore, we recognize that more rigorous program evaluation is necessary to provide robust evidence on the efficacy of multi-component interventions to reduce exposure to indoor allergens. We encourage existing asthma programs that provide multicomponent interventions to perform rigorous evaluations that further enhances the evidence base. We also encourage federal, state, and local agencies as well as research institutions and foundations to offer more grant-based research opportunities in this area. Below are the 2020 Focused Updates report recommendations with comments by GHHI. Note Recommendation 5 is the first recommendation in *Section III Recommendations for Indoor Allergen Mitigation in Management of Asthma*.

Expert Panel Recommendations

Recommendation 5: In individuals with asthma who do not have sensitization to specific indoor allergens or who do not have symptoms related to exposure to specific indoor allergens, the Expert Panel conditionally recommends against allergen mitigation interventions as part of routine asthma management. **(Conditional recommendation, low certainty of evidence)**

Recommendation 6: In individuals with asthma who have symptoms related to exposure to specific indoor

GHHI Notes

Together, Recommendations 5 and 6 describe two sides of the same coin. For comprehensive, home-based asthma programs that include asthma education, home assessment, or home repairs, these recommendations suggest that activities should be tailored to a client's specific set of needs rather than be delivered uniformly to all eligible clients. Programs should discuss client sensitivities and experience with indoor allergens and recommend allergen testing when appropriate. Based on this information, a plan for

⁴ Leas BF, D'Anci KE, Apter AJ, Bryant- Stephens T, Schoelles K, Umscheid CA. Effectiveness of Indoor Allergen Reduction in Management of Asthma. Comparative Effectiveness Review No. 201. (Prepared by the ECRI Institute–Penn Medicine Evidence-based Practice Center under Contract No. 290-2015-0005-I.) AHRQ Publication No. 18-EHC002-EF. Rockville, MD: Agency for Healthcare Research and Quality; February 2018. Posted final reports are located on the Effective Health Care Program search page. DOI: <http://doi.org/10.23970/AHRQEPCCER201>.

Expert Panel Recommendations

allergens, confirmed by history taking or allergy testing, the Expert Panel conditionally recommends a multicomponent allergen-specific mitigation intervention. **(Conditional recommendation, low certainty of evidence)**

Recommendation 7: In individuals with asthma who have sensitization or symptoms related to exposure to pests (cockroaches and rodents), the Expert Panel conditionally recommends the use of integrated pest management alone, or as part of a multicomponent allergen-specific mitigation intervention. **(Conditional recommendation, low certainty of evidence)**

Recommendation 8: In individuals with asthma who have sensitization or symptoms related to exposure to dust mites, the Expert Panel conditionally recommends impermeable pillow/mattress covers only as part of a multicomponent allergen mitigation intervention, not as a single-component intervention. **(Conditional recommendation, moderate certainty of evidence)**.

GHHI Notes

mitigating home triggers can be customized for the client. We should note that the Expert Panel repeats findings from EPR-3 that say individual measures are, in general, only effective as part of a multicomponent intervention.

Recommendation 5 specifies that allergen mitigation interventions should not be performed as “part of *routine* management.” This aligns with the approach of providing these types of services to individuals who have the highest need – e.g., having a recent emergency department visit or hospitalization due to asthma.

Additionally, we note that Recommendations 5 specifies a subpopulation that “does not have symptoms related to exposure to specific indoor allergens.” Again, if an individual has had an exacerbation and/or resulting ED visit or hospitalization related to asthma, this would presumably qualify as a symptom related to exposure.

Integrated pest management (IPM) is the only environmental control measure that the Expert Panel recognizes as potentially effective as a standalone intervention. The panel’s recommendation is conditional because research evidence for IPM is mixed.

Similar to previous recommendations, the Expert Panel’s emphasis on the use of impermeable pillow and mattress covers is that they should be part of a broader, multicomponent intervention. Research evidence shows that pillow and mattress covers provide high certainty of evidence in decrease of asthma symptom days but not in other outcome areas.

Table III.a “Examples of Allergen Mitigation Interventions and Their Targeted Allergens” from the 2020 Focused Update Report summarizes the level of evidence that exists for various home environment interventions. On the following page, we provide commentary to the Expert Panel findings.

Attached to this brief is an appendix containing GHHI’s Asthma Reference Guide and Asthma Intervention Table, which summarizes recommendations for environmental control from EPR-3, Community Guide, and relevant studies.

Table III.b: Summary of Certainty of Evidence on Allergen Mitigation Interventions

Intervention assessed in studies in the SR	EtD table number	Evidence on use as a single-component strategy for allergen mitigation (certainty of evidence)	Evidence on use as part of a multicomponent strategy for allergen mitigation (certainty of evidence)*
Acaricide	IV	†	Intervention makes no difference (moderate certainty of evidence)
Impermeable pillow and mattress covers	V	Intervention makes no difference (moderate certainty of evidence)	Evidence favors intervention (moderate certainty of evidence)
Carpet removal	VI	†	Intervention makes no difference (low certainty of evidence)
Integrated pest management (for cockroaches and mice)	VII	Evidence favors intervention (low certainty of evidence)	Evidence favors intervention (low certainty of evidence)
Air filtration systems and air purifiers	VIII	Intervention makes no difference (low certainty of evidence)	Intervention makes no difference (moderate certainty of evidence)
HEPA vacuum cleaners	IX	†	Evidence favors intervention (among children only; moderate certainty of evidence)
Cleaning products	X	†	†
Mold mitigation	XI	†	Evidence favors intervention (low certainty of evidence)
Pet removal	XII	†	†

... GHHI does not recommend using pesticides unless part of a broader IPM strategy.

... Limited and inconclusive evidence on benefits of carpet removal. GHHI recommends further evaluation of this measure and impact on asthma control and healthcare utilization.

... The Expert Panel notes that mold mitigation and IPM are good public health practices in addition to having beneficial impact on asthma.

*Combination of interventions used in the multicomponent studies varied, and the Expert Panel cannot identify or recommend any particular combination of strategies as optimal at this time.

† Evidence was insufficient for the Expert Panel to assess the intervention.

Abbreviations: EtD, evidence to decision; HEPA, high-efficiency particulate air (a type of filter).

Appendix A –
Key Differences in Recommendations in the 2007 (EPR-3)
and 2020 Asthma Guidelines, by Topic Area

Key Differences in Recommendations in the 2007 (EPR-3) and 2020 Asthma Guidelines, by Topic Area (page 109 in Update on Selected Topics in Asthma Management: A Report from the NAEPPCC Expert Panel Working Group)

TOPIC AREA - Allergen Mitigation Recommendations 5-8	
2007 Guideline	2020 Guideline
Patients who have asthma at any level of severity should reduce, if possible, exposure to allergens to which the patient is sensitized and exposed	Conditional recommendation against allergen mitigation interventions as part of routine asthma management in individuals with asthma who do not have sensitization to specific indoor allergens or who do not have symptoms related to exposure to specific indoor allergens (Recommendation 5)
Patients who have asthma at any level of severity should know that effective allergen avoidance requires a multifaceted, comprehensive approach; individual steps alone are generally ineffective (Evidence A)	Conditional recommendation for a multi-component allergen-specific mitigation intervention in individuals with asthma who are exposed and have symptoms related to exposure to identified indoor allergens, confirmed by history taking or allergy testing (Recommendation 6)
Recommended cockroach control measures if the patient is sensitive to cockroaches and the home has an infestation	Conditional recommendation for the use of integrated pest management alone or as part of a multi-component allergen specific mitigation intervention in individuals with asthma who are exposed and have sensitization or symptoms related to exposure to pests (cockroaches and rodents) (Recommendation 7)
Recommended the following mite-control measures: <ul style="list-style-type: none"> • Encase mattress in an allergen-impermeable cover • Encase pillow in an allergen-impermeable cover or wash • pillow weekly • Wash sheets and blankets weekly in hot water 	Conditional recommendation for impermeable pillow/mattress covers only as part of a multicomponent allergen mitigation intervention, not as a single-component intervention, in individuals with asthma who have sensitization or symptoms related to exposure to dust mites (Recommendation 8)

Appendix B – GHHI Asthma Reference Guide

Asthma Reference Guide

Asthma is one of the most prevalent chronic diseases in the United States. The Center for Disease Control and Prevention (CDC) calculates 18.7 million adults (8%) currently suffer from Asthma.⁵ Asthma also is the most common chronic disease among children in the US. Roughly 9.3% of US children currently have asthma.⁶ In 2010, asthma was responsible for 14.2 million physical visits, and 1.8 million emergency department (ED) visits in 2011.⁷

It is estimated that 40% of asthma episodes are caused by preventable indoor environmental conditions.⁸ Poor housing quality is the largest factor behind hazardous indoor conditions, and as a result, rectifying these issues can produce substantial improvements in asthma symptoms. Below is a reference guide that explain common household hazards, their impact on asthma symptoms and the recommended remediation activities.

Mold

There is a strong link between indoor mold and adverse asthma symptoms.⁹ An analysis of mold in indoor spaces found that dampness and mold cause 21% of asthma in the US.¹⁰ Early postnatal exposure has been shown to have a detrimental effect on lung development. Mold-sensitive people can be protected by cleaning mold from hard, nonporous surfaces.

- **Discard Contaminated Materials:** If cleaning is not possible, discard mold contaminated materials such as carpet, and ceiling tiles (Crocker, et al., et al., 2011, p. 7).
- **Dampness:** Because of the link between mold and asthma, measures that remove or control indoor dampness can be effective (EPR-3, p172). Sealing structural air leakages and cleaning wet areas (Kitchen, bathroom etc.) can help reduce dampness.
- **Humidity:** Reduce indoor humidity to or below 60%, ideally 30–50%. Basements are frequently susceptible to mold, therefore, it is recommended that basements are dehumidified if possible (EPR-3, p188)

⁵ Blackwell DL, Lucas JW, Clarke TC. Summary health statistics for U.S. adults: National Health Interview Survey, 2012. National Center for Health Statistics. *Vital Health Stat* 10(260). 2014.

⁶ Bloom B, Jones LI, Freeman G. Summary health statistics for U.S. children: National Health Interview Survey, 2012. National Center for Health Statistics. *Vital Health Stat* 10(258). 2013.

⁷ Center for Disease Control and Prevention “FastStats| Asthma” *US Center for Disease Control and Prevention* Last modified May 14, 2015 (2015) <http://www.cdc.gov/nchs/faststats/asthma.htm>

⁸ Robert Wood Johnson Foundation Commission to Build A Healthier America. *Beyond Health Care: New Directions To A Healthier America Report*. April 2009

⁹ Wang, Zuocheng, Stuart L. Shalat, Kathleen Black, Paul J. Liroy, Adam A. Stambler, Osiloke H. Emoekpere, Marta Hernandez, Taewon Han, Maya Ramagopal, and Gediminas Mainelis. "Use of a robotic sampling platform to assess young children's exposure to indoor bioaerosols." *Indoor air* 22, no. 2 (2012): 159-169.

¹⁰ IOM of the National Academies of Sciences, Board on Health Promotion and Disease Prevention. *Damp indoor spaces and health*. www.iom.edu/Reports/2004/Damp-Indoor-Spaces-and-Health.aspx.

- **Watering Infiltration:** Whether coming from structural cracks or leaking from pipes, water leakages can lead to mold growth, especially in isolated areas of the home. Sealing of structural air leakages, rerouting sub-pump drains, and waterproofing can diminish water intrusion into the home.

Carbon Monoxide and Fuel Combustion

The use of unvented combustion appliance, such as wood-burned stoves and gas furnaces, is observed to increase respiratory problems, such as lower FEV1 ratios in children sensitized to house-dust mites (EPR-3, p. 177). The effect is typically attributed to the combustion gases NO_x, CO and particulate matter. In infants with a risk for asthma, exposure to higher NO₂ levels was linked to bronchitis, wheezing and asthma in school aged girls.

- **Repair and Replace:** If possible, households should stop using or remove wood-burning stoves, kerosene heaters, fireplaces and unvented gas appliances, as they are observed to make asthma symptoms worse (p. 130). Unvented combustion appliance should be repaired so that they vents their emission outside or replaced with alternate appliances.

Environmental Tobacco/Second-Hand Smoke

Environmental tobacco smoke (ETS) is linked to increase risks of developing asthma, in addition to exacerbating asthma symptoms in children (Crocker, et al., 2011, p.7). Prenatal exposure smoking has been shown to increase the risk for the development of asthma in infancy and childhood (EPR-3, p.175). Research found that in children aged 4–16 years, who were exposed to pre- and postnatal tobacco smoke, had increased wheezing, increased school absences, and decreased lung function (EPR-3, p.112).

- **Indoor Smoking Bans:** Complete smoking bans in the home have been shown to reduce childhood ETS exposure in instances where caregivers are unwilling to stop smoking.
- **Smoking cessation programs:** Indoor smoking bans alone may not adequately reduce exposure for children. However smoking cessations programs aimed at guardians of asthmatic children, have been shown to reduce the number of cigarette smoked at home (Crocker, et al., 2011, p. 7).

Volatile Organic Compounds

Formaldehyde and other Volatile organic compounds (VOCs) have only recently been identified as a potential risk factor for asthma. VOC are normally emitted from carpeting, flooring, furniture and paint, in addition to household adhesives, and cleaning chemicals. As infants and young children typically spend more time in the home and nearer the floor, they are at increased risk of exposure to VOCs.

- **Reduce Exposure:** Discuss ways to reduce exposure to VOCs (EPR-3, p.189). This may include replacing flooring with safer alternatives, switching to alternative cleaning products, or limiting the use irritants around individuals with asthma.

Indoor Pets

Some people are allergic to the dander, skin, saliva and/or hair of animals. Although the link between allergies and asthma is not completely defined, some studies show dog and cat dander is associated with the development on asthma (EPR-3, p. 22)

- **Remove Animal:** If the patient is sensitized to an animal allergen, remove the animal from the home.

- **Isolate Animal from Patient:** If removal is not an option, keep animal from the patient's bedroom and keep bedroom door closed. Remove upholstered furniture and carpets that easily hold animal fur and dander or isolate the pet from these items to the extent possible.

Dust Mites and Allergens

Dust mites are one of the most common asthma triggers (Crocker, et al., 2011, p. 6). Dust mites can act as a trigger themselves or a conduit for other allergens. Mites need an atmospheric moisture and human dander for survival, thus mites are frequently found in dust from mattresses, pillows, carpets, upholstered furniture, bed covers, clothes, and soft toys (EPR-3, p. 171).

- **Allergen impermeable covers:** Encase mattresses, and pillows with allergen impermeable covers
- **Frequent Washing:** If possible, wash all clothing, stuffed toys and linens at high temperatures. If hot water is not available, use detergent and bleach.
- **Reduce Humidity;** Reduce indoor humidity to or below 60%. Ideally, humidity should be a 30-50%.
- **Remove Carpets and stuffed toys:** If necessary, remove carpets from the patient's bedroom and minimize the number of stuffed toys.

Domestic Hygiene, pests and refuse

Rodents and insects infestation are typically the result of poor indoor hygiene. Cockroach allergens often trigger asthma symptoms and are associated with high asthma hospitalizations among children.¹¹ Mice and rat allergens can cause allergic reactions, which in turn exacerbate asthma symptoms. Both Cockroach and pest allergens exposure and sanitization are common in inner-city children with asthma. (EPR-3, p.170).

- **Integrated Pest Management Strategies:** If the patient is infested with cockroaches or rodents, clean surfaces and floors, seal trash containers, and store food carefully. Gel bait can be used for insects, while traps are more effective for rodents. Seal cracks and small holes to remove pest infiltration points. (Crocker, et al., 2011 p. 6)

¹¹ Rabito, Felicia A., John Carlson, Elizabeth W. Holt, Shahed Iqbal, and Mark A. James. "Cockroach exposure independent of sensitization status and association with hospitalizations for asthma in inner-city children." *Annals of Allergy, Asthma & Immunology* 106, no. 2 (2011): 103-109.

Appendix C – Asthma Intervention Table

Housing Condition	Healthy Homes Activity	Healthy Homes Activity Supplies/Tool	EPR-3			Comm. Guideline	
			Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
Dampness (Mold risk factor)	Sealing of structural air leakages		Yes. pp. 172	“Because an association between indoor fungi and respiratory and allergic disease is suggested by some studies... measures to control dampness or fungal growth in the home may be beneficial”.	C	Yes pp.7	“Mold-sensitive people can be protected by removing mold from hard, nonporous surfaces; discarding mold contaminated materials (e.g., carpet, ceiling tiles);and addressing the source(s) of moisture responsible for mold growth” (moderate to major)
Humidity (Mold risk factor)	Ventilation of dryers, bathrooms and kitchen Air sealing	Dehumidifier and air conditioners (EPR-3 pp. 129)	Yes pp. 188	“Consider reducing indoor humidity to or below 60 percent, ideally 30–50 percent. Dehumidify basements if possible”			
Water Infiltration (Mold risk factor)	Sealing of structural air leakages Reroute Sub Pump Drain Waterproofing		Yes pp. 188	“Fix all leaks and eliminate water sources associated with mold growth...”			
Mold Present			Yes pp.188	“...Clean moldy surfaces...”		Yes pp.7	Removing mold from hard, nonporous surfaces (moderate); discarding mold contaminated materials (e.g., carpet, ceiling tiles) (Major);
CO and fuel combustion products	Replace/ repair furnace Replace/ repair hot water heater		Yes- pp.188	Reduce or remove; Wood-burning stoves or fireplaces and	C	No pp. 7	“...recent studies suggest that single-component interventions or those that address a single asthma trigger may not be as effective as

Housing Condition	Healthy Homes Activity	Healthy Homes Activity Supplies/Tool	EPR-3			Comm. Guideline	
			Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
	Replace/ repair gas stove			Unvented gas stoves or heaters			interventions that address multiple triggers using multiple intervention components.”
Volatile Organic Compounds	Whole house ventilation Education		Yes pp. 188	Discuss way of reducing exposure to - Other irritants (e.g., perfumes, cleaning agents, sprays) -Volatile organic compounds (VOCs) such as new carpeting, particle board, painting			
Environmental tobacco smoke (ETS)			Yes. pp 112	“...specifically consider referring to smoking cessation programs adults who smoke and have young children who have asthma in the household.	B	Yes. Pp.7	“...smoking cessation counseling as part of treatment for smokers with asthma, or smokers with children who have asthma.” (Minor)
						Yes Pp.7	“Complete smoking bans in the home have been shown to ...reduction in ETS exposure in caregivers who are unwilling to stop smoking”(Minor) Limited evidence “that air filters and ventilation can reduce the indoor concentration of ETS particles in the air...”(Moderate to Major)

Housing Condition	Healthy Homes Activity	Healthy Homes Activity Supplies/Tool	EPR-3			Comm. Guideline	
			Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
Pets			Yes. pp.170	If the patient is sensitive to an animal, remove animal from the home	D	Yes. pp.6	“Removing pets from the home is the most effective method to reduce exposure to pet dander in sensitized patients.”
			Yes. pp.170	If Removal is not an option, keep animal from the patient’s bedroom and keep bedroom door closed. “Remove upholstered furniture and carpets from the home, or isolate the pet from these items to the extent possible”		Yes. pp.6	“Alternately, keeping pets out of bedrooms can reduce airborne pet dander allergen levels fivefold”
Dust Mites allergens		HEPA filter Vacuums (EPR-3, pp. 130) Impermeable mattress and pillow covers/case (EPR-3, pp.170)	Yes pp. 171	“Encase the mattress and pillow in allergen impermeable cover or wash it weekly. Wash the sheets and blankets on the patient’s bed weekly in hot water”	A	Yes pp.6	“This asthma trigger can be removed by using allergen-impermeable pillow and mattress covers, washing bedding in hot water 130°F (minor). Removing old carpet (Major). Reducing home humidity to 60%, (Moderate) Washing stuffed animals weekly (Minor)”

Housing Condition	Healthy Homes Activity	Healthy Homes Activity Supplies/Tool	EPR-3			Comm. Guideline	
			Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
		Dehumidifier and air conditioners (EPR-3, pp. 129 & 174)	Yes pp. 171	2.Reduce indoor humidity to or below 60 percent; Ideally 30–50 percent.			
Domestic Hygiene, pests and refuse	Insects: Integrated Pest Management		Yes pp. 171	Cockroaches, if patient has sensitized to cockroaches and there is an infestation in the home, control measures should be implemented	B	Yes pp.6	Cockroaches --Integrated pest management strategies: teaching residents to remove food and water sources, clean surfaces and floors, seal trash containers, store food carefully (minor-moderate). Use gel baits to exterminate roaches, and seal cracks and small holes in the residence to keep roaches out (moderate).
	Rodents: Integrated Pest Management	Vacuum Traps pesticides	Yes pp.171	Mouse allergen exposure can be reduced by a combination of blocking access, low-toxicity pesticides, traps, and vacuuming and cleaning	D	Yes pp. 6	Mice and Rats —Integrated pest management techniques: holes, vacuuming cleaning, using low-toxicity pesticide, placing traps, (Moderate) and storing food carefully (minor)
Long term Asthma Care	Asthma Management Behaviors		Yes. pp.35-37	Measures of asthma assessment and monitoring. Emphasis on current severity, control and treatment response, in addition to future risk.	A through C	pp.9 & 18-19	Both environmental and educational asthma interventions intent to improve asthma outcomes through improved asthma management behaviors (AMBs). AMBs include more frequent use of

Housing Condition	Healthy Homes Activity	Healthy Homes Activity Supplies/Tool	EPR-3			Comm. Guideline	
			Inter.	Quote or Partial Quote	Evidence	Inter.	Quote or Partial Quote
			Yes. pp.93	Education for a partnership in asthma care should be integrated into all aspects of asthma care and involves all members of the health care team;	A or B, Depending on point of care		asthma controller medications, better recognition of asthma symptoms, and use of peak flow meters. AMBs could also include reducing asthma triggers by using integrated pest management to decrease both the number of insect and rodent pest and by washing bedding in hot water to reduce dust mites. 9 out of 10 studies that measured and reported outcomes for AMBs, reported improvements in AMBs compared to baseline values (18-19). Four of six controlled studies (67%) showed a significant improvement in at least one AMB compared to the control group
			Yes. pp.35 & 165	“Control of environmental factors and comorbid conditions that affect asthma.” (35) “Know that effective allergen avoidance requires a multi-faceted, comprehensive approach; individual steps alone are generally ineffective” (165)	Evidence A		
				Pharmacologic therapy			

Environmental remediation, major Major structural improvements to the home, which may include some combination of carpet removal, replacement of ventilation systems, or extensive repairs to restore structural integrity (e.g., to roof, walls, floors)

Environmental remediation, moderate Providing multiple low-cost materials with the active involvement of the trained home visitor(s); activities in this category may include providing and fitting mattress and pillows with allergen-impermeable covers, installing small air filters and dehumidifiers, integrated pest management, professional cleaning services or equipment, and minor repairs of structural integrity (e.g., patching holes)

Environmental remediation, minor Minor changes to the home, which at a minimum include providing advice on recommended environmental changes to be performed by the members of the household and may include providing low-cost items such as mattress and pillow allergen-impermeable covers

EPR-3 evidence ranking (p. 7)

Evidence Category A: Randomized controlled trials (RCTs), rich body of data. Evidence is from end points of well-designed RCTs that provide a consistent pattern of findings in the population for which the recommendation is made. Category A requires substantial numbers of studies involving substantial numbers of participants.

Evidence Category B: RCTs, limited body of data. Evidence is from end points of intervention studies that include only a limited number of patients, post hoc or subgroup analysis, of RCTs, or meta-analysis of RCTs. In general, category B pertains when few randomized trials exist; they are small in size, they were undertaken in a population that differs from the target population of the recommendation, or the results are somewhat inconsistent.

Evidence Category C: Nonrandomized trials and observational studies. Evidence is from outcomes of uncontrolled or nonrandomized trials or from observational studies.

Evidence Category D: Panel consensus judgement. This category is used only in cases where the provision of some guidance was deemed valuable, but the clinical literature addressing the subject was insufficient to justify placement in one of the other categories. The Panel consensus is based on clinical experience or knowledge that does not meet the criteria categories A through C.