The Impact of Mouse Allergen on Asthma

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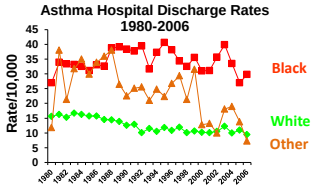
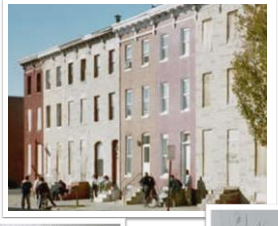
Inner-city Childhood Asthma



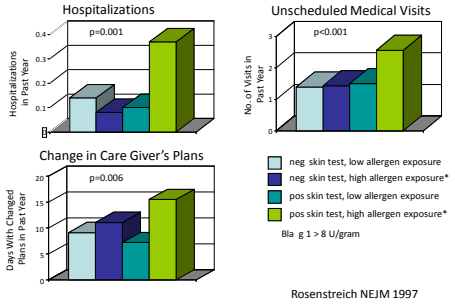
- Inner cities are low-income areas in the center of cities
- Race/ethnic minorities often comprise majority of residents in inner-cities
- Asthma prevalence rates 25-28% in inner-cities

Source: National Hospital Discharge Survey, CDC National Center for Health Statistics, * First-listed diagnosis, # Age-adjusted to 2000 U.S. population

Inner-city Childhood Asthma: An Environmental Problem



Cockroach Allergen Exposure and Asthma Morbidity in Inner City Children



Rosenstreich NEJM 1997

Mouse Biology and Behavior

- *Mus musculus*
  - Order Rodentia –incisors
- 4-8 pups/litter, 6-8 litters /year
- Jump 1' up, 8' down
- Run up vertical surfaces
- Squeeze through holes ¼ inches in diameter
- Good swimmers
- Prefer seeds and grains
- Mus m 1 found in hair, dander, and urine
- ~90% of Mus m 1 found on particles ≤10 microns

Image courtesy of Rivard's Resources: IPM

Prevalence of Mouse Allergen

Location	Study	Popul'n	Room	% detectable
Inner-City	NCICAS Phipatanakul et al., JACI, 2000;106:1070-4	608 children	kitchen, BR, or LR	95%
	Baltimore Matsui et al.,JACI,2005;115:358-363	100 children	kitchen	100%
US Housing/ Suburban	United States Cohn et al., JACI, 2004;113: 1167-1171	831 housing units	kitchen, BR, or LR	82%
	Suburban Maryland Matsui et al., JACI, 2004; 113:910-5	335 children	kitchen	75%

Mus m 1 Levels Highest in Inner-city Homes

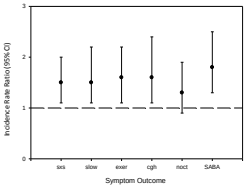
	Median Kitchen Mus m 1 (µg/g)
Suburban Maryland	**.007**
US sample (Cohn JACI 2004)	**0.36**
NCICAS (Phipatanakul JACI 2000)	**1.6**
Inner-city Baltimore	**14.7**

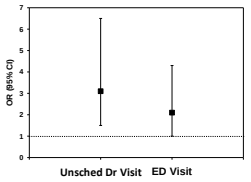
- **Detectable in air of 84% of bedrooms**
- **25% homes with levels similar to occupational levels**

Sensitization to Mouse

	Study Population	+ mouse SPT/IgE (%)
Occupational Matsui Annals 2004	**151 adults**	**20**
NCICAS Phipatanakul JACI 2000	**499 children**	**18**
ICAS Gruchalla JACI 2005; Pongracic Annals 2008	**937 children**	**22**
Baltimore Matsui Annals 2006; Matsui AAAAI 2011, 2012	**150 children**	**26-50**
West Virginia Welch Annals 2003	**209 children**	**12**
Suburban Maryland Matsui JACI 2004	**335 children**	**13**

Mouse Allergen Exposure is Associated with Asthma Morbidity





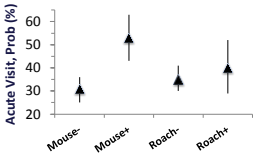
- 2-6 year old Baltimore children with asthma
- Comparison of mouse sensitized and exposed to those who were either not sensitized or not exposed
- 9/10 hospitalizations occurred among sensitized/high exposure group
- Adjusted for age, sex, atopy, cockroach sensitization and exposure, public health insurance, and study visit

Pest Allergen Exposure and Morbidity

Study population Characteristics	N=150
Male	57 %
Public Insurance	85%
Black	91%
Atopic	91%

	Sensitized (+SPT)	Sensitized and Exposed*
Cat	64%	10%
Roach	60%	41%
Mouse	51%	41%
Mite	56%	9%

*Cat: 8mcg/g Cockroach: 1U/g
Mouse: 1mcg/g Dust mite: 2mcg/g

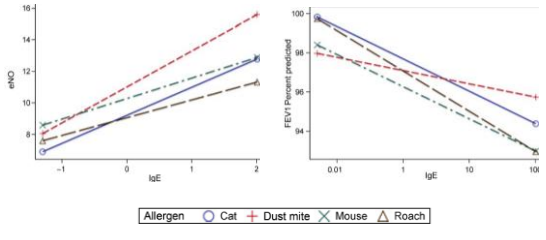


Adjusted for age, gender, total IgE, and public health insurance

Higher levels of mouse allergen in the bed was more strongly associated with an acute visit.

Allergen-Specific IgE Levels: Marker of Exposure and Sensitization

F_ENO FEV1 Percent Predicted

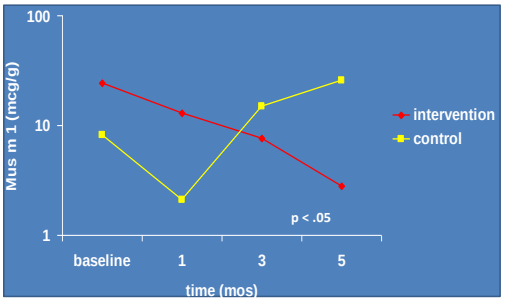


Matsui et al, Allergy 2010
From the Inner-City Asthma Consortium

Integrated Pest Management

- Assess & modify facilitative factors
  - Routes of ingress
  - Sources of food, water
- Assess infestation
  - Location(s) of greatest activity
- Source control:
  - traps
  - rodenticide if necessary

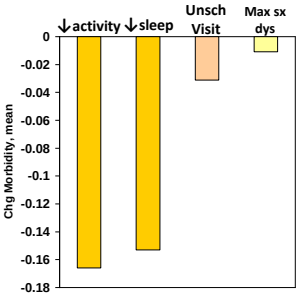
IPM Is Successful in Reducing Mouse Allergen Levels



Phipatanakul W. Ann All Asthma Imm. 92:420, 2004.

Integrated Pest Management Intervention: What Went Wrong?

- N=150/155
  - asthma
  - +SPT
- Rodent module
  - Traps, education, air filters
- Change in BR floor Mus m 1
  - -27% vs. +28%



Pongracic J, Ann Allergy Asthma Immunol 2008

Mouse Allergen and Asthma Intervention Trial

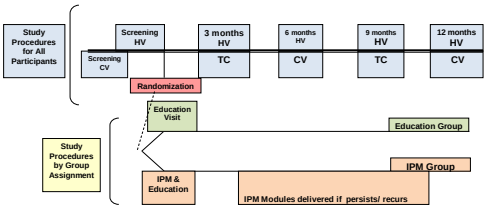


Figure 7. **MAAIT Study Scheme**

NIAID-funded
Clinical Site/Core Leaders: Elizabeth Matsui; Matt Perzanowski; Wanda Phipatanakul

Mouse Allergen Exposure in Schools

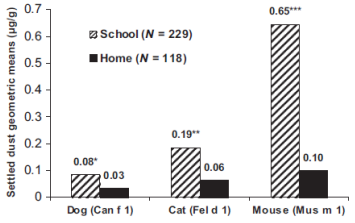


Fig 1 Settled dust geometric mean levels of Can f 1, Fel d 1, and Mus m 1 in all samples (school vs. home). *T*-tests were performed on logged values, *p = 0.0002, **p = 0.0013, ***p < 0.0001.

Permaul et al Pediatr Allergy Immunol 2012

Inner-city Asthma: Home-based Environmental Intervention

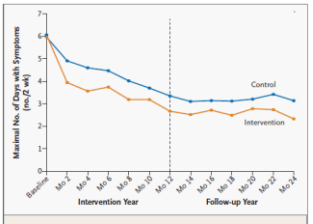


Figure 2. Mean Maximal Number of Days with Symptoms for Every Two-Week Period before a Follow-up Assessment during the Two Years of the Study.
The difference between the groups was significant in both the intervention year (P<0.001) and the follow-up year (P<0.001).

Morgan, NEJM 2004

What About Costs?

- **Medication Costs**
  - **fluticasone/salmeterol**
    - **500/50 = $275/month = $3300/y**
    - **250/50 = $215/month = $2580/y**
    - **100/50 = $175/month = $2100/y**
  - **montelukast = $125/month = $1500/y**
- **Cost of environmental intervention (Morgan et al NEJM): ~1500 dollars/family**

Conclusions

- Mouse allergen is prevalent everywhere with the highest levels in the Inner city (100-1000 fold higher)
- Mouse allergen is associated with worse lung function, pulmonary inflammation, and morbidity in mouse-sensitized
- Integrated pest management can reduce allergen levels
  - ? may improve asthma
- Questions for the future:
  - Are community-level interventions feasible and effective?
  - What is intervention worth compared to medications?
  - Does environmental control modify the natural history of asthma?