# 2008 National Healthy Homes Conference

# Home-Based Environmental Interventions to Reduce Asthma Morbidity

## The Community Guide Asthma Review

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CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

DEPARTMENT OF HEALTH & HUMAN SERVICES · USA

# Disclaimer

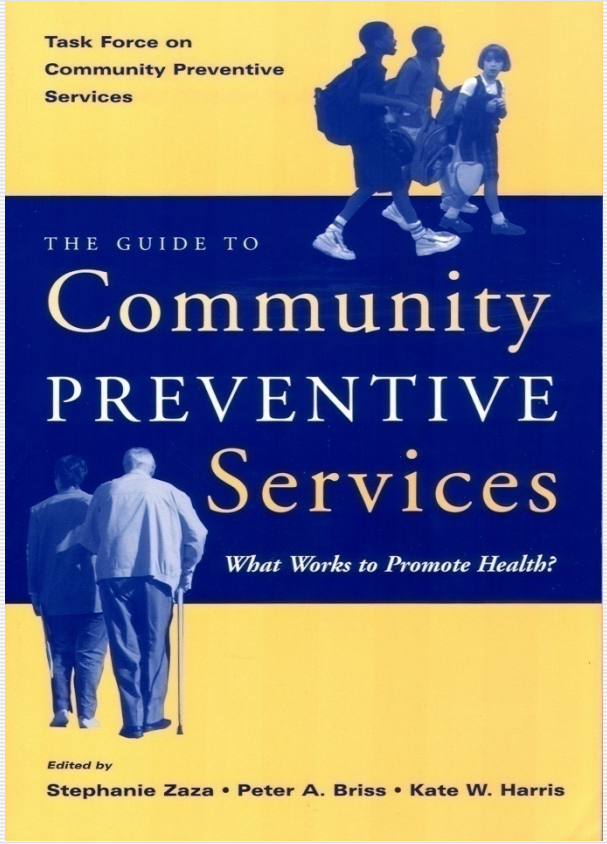
The findings and conclusions in this presentation are preliminary and have not yet been formally disseminated by the Task Force on Community Preventive Services or the Centers for Disease Control and Prevention.

# The Air Pollution & Respiratory Health Branch, CDC

- Under the National Center for Environmental Health (NCEH)
- APRHB National Asthma Control Program
- Asthma Community Guide Initiative
  - To guide our funded programs and others in appropriately allocating their resources
  - To direct our research and evaluation activities

# About the Community Guide

- Established in 1996
- Housed at CDC
- Directed by the Task Force on Community Preventive Services
- Conducts rigorous systematic reviews of evidence for community interventions
- Issues recommendations for use of public health interventions based on evidence of effectiveness



# Coordination/Consulting Team

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# U.S. Burden of Asthma

>20 million Americans

$19.7 billion /yr

~697,000 ED visits

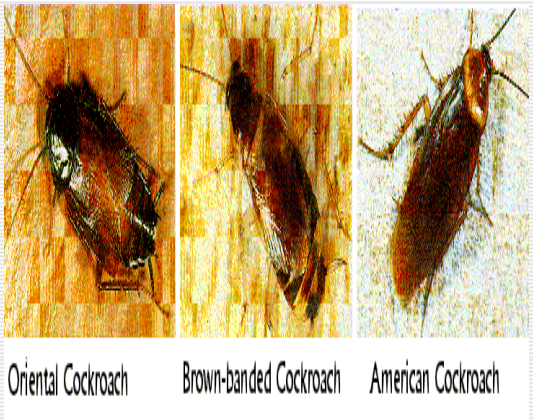
~203 000 Hospitalizations

4.7 million office visits

~14 million missed school days annually

# Asthma Triggers in the Home

**Dust Mites**




**Cockroach Allergen**

**Rodents**

**Pet Dander**

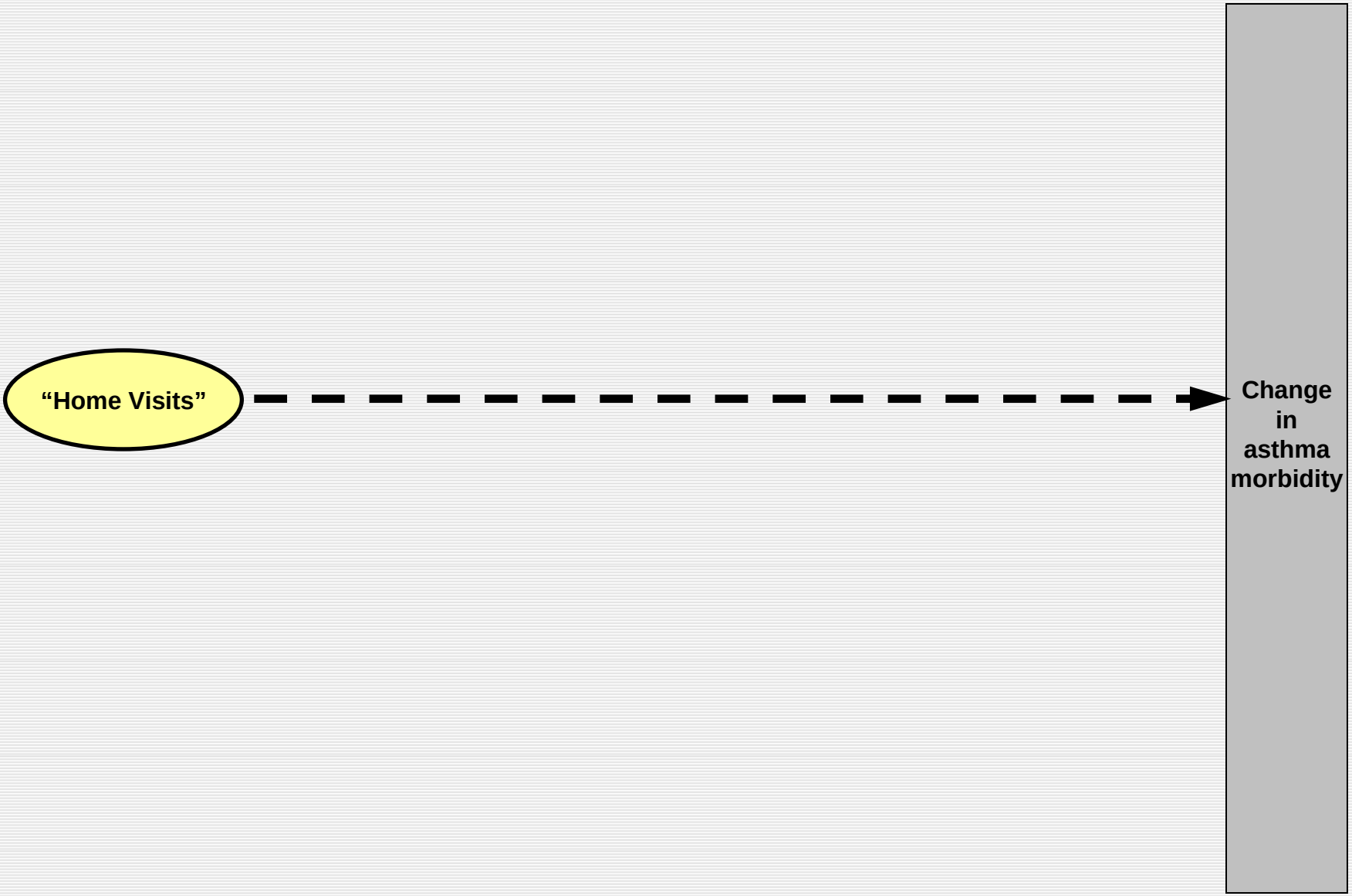
**Mold**

**Cigarette Smoke**

# Our Goal for This Review

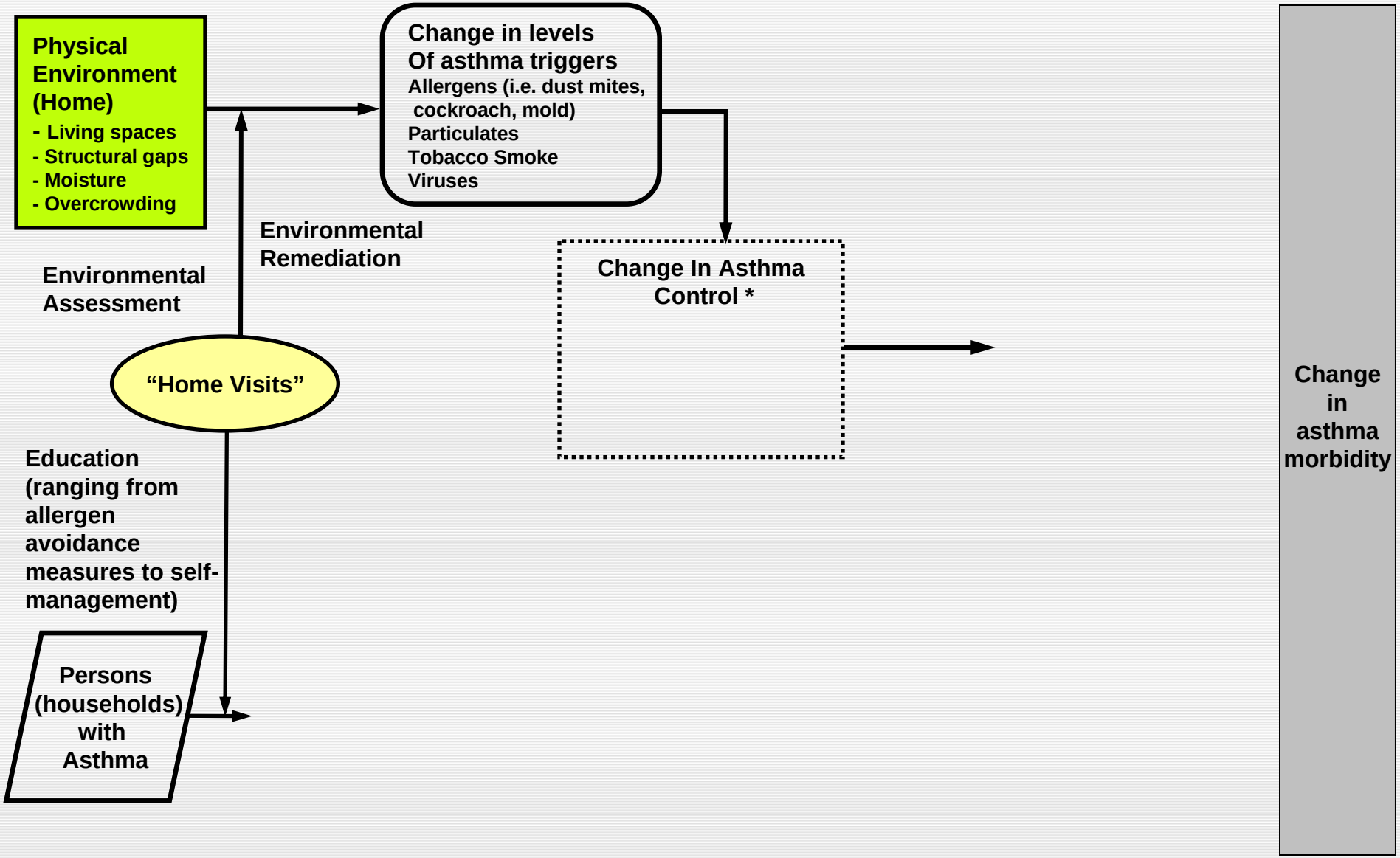
To conduct the first systematic review on effectiveness of home-based multi-trigger, multi-component environmental interventions to improve asthma morbidity

# Home-Based Environmental Interventions



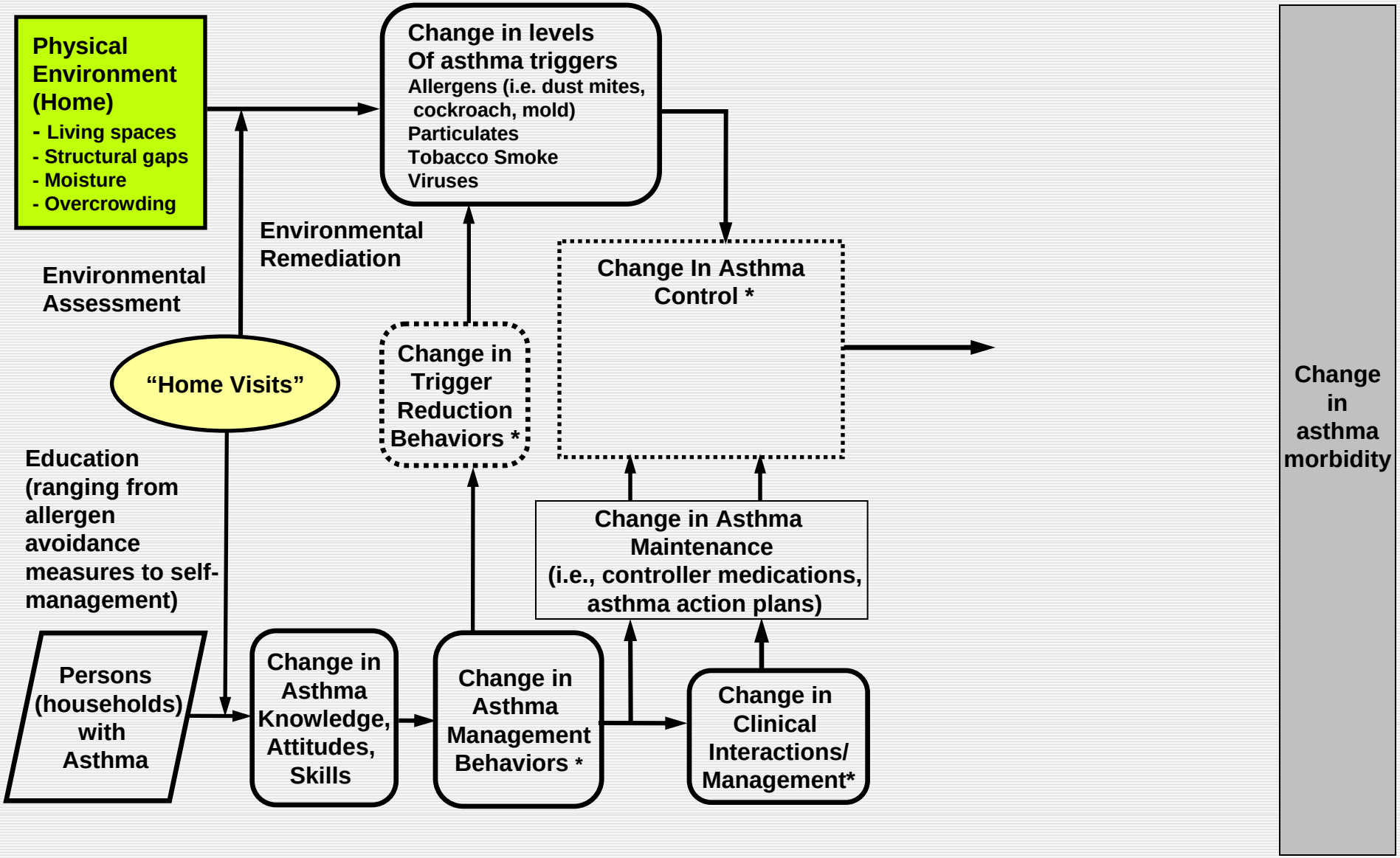
# Two Major Pathways: Environmental and Behavioral Change

# Environmental Change



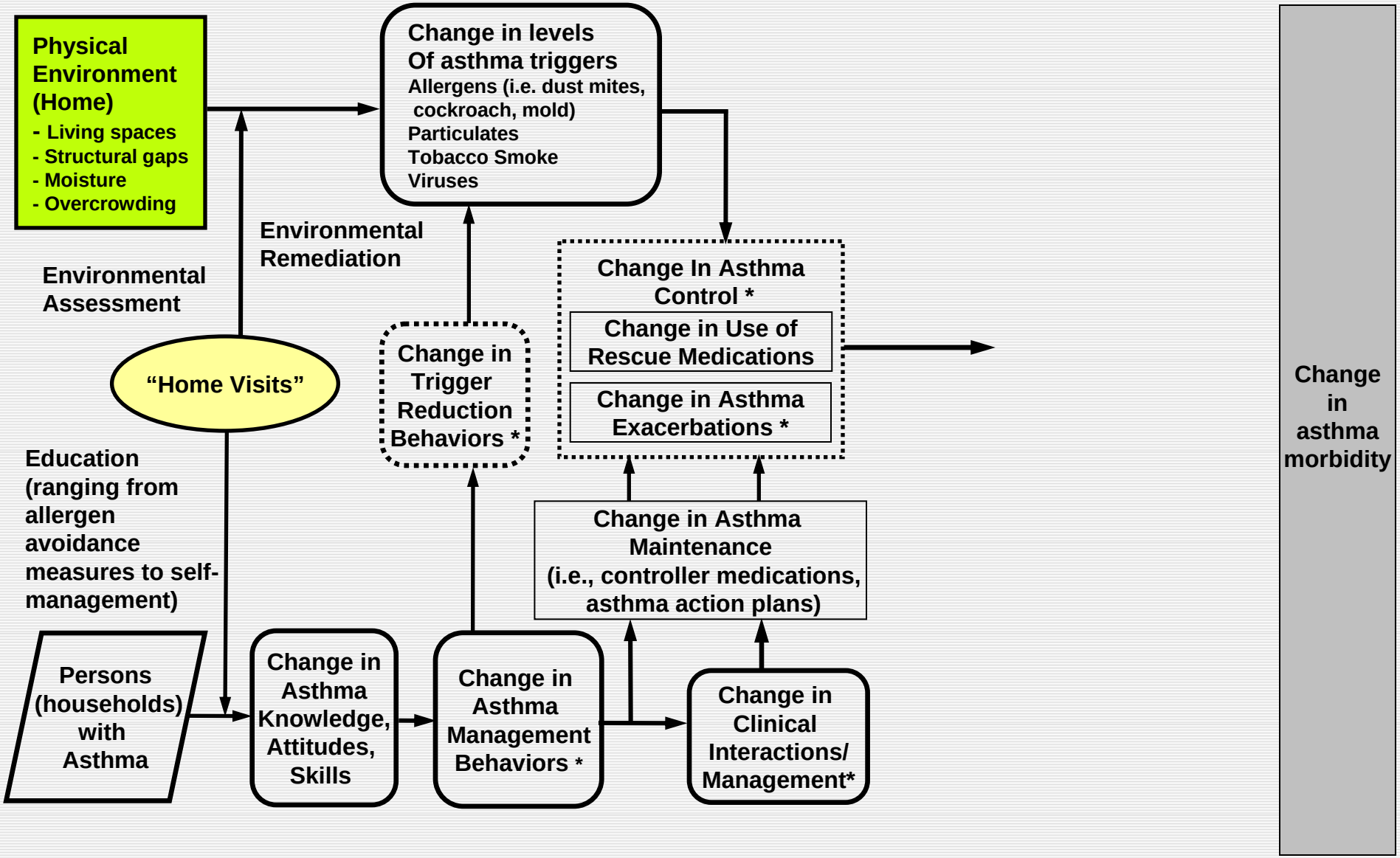

* With additional definitions and criteria

# Behavior Change



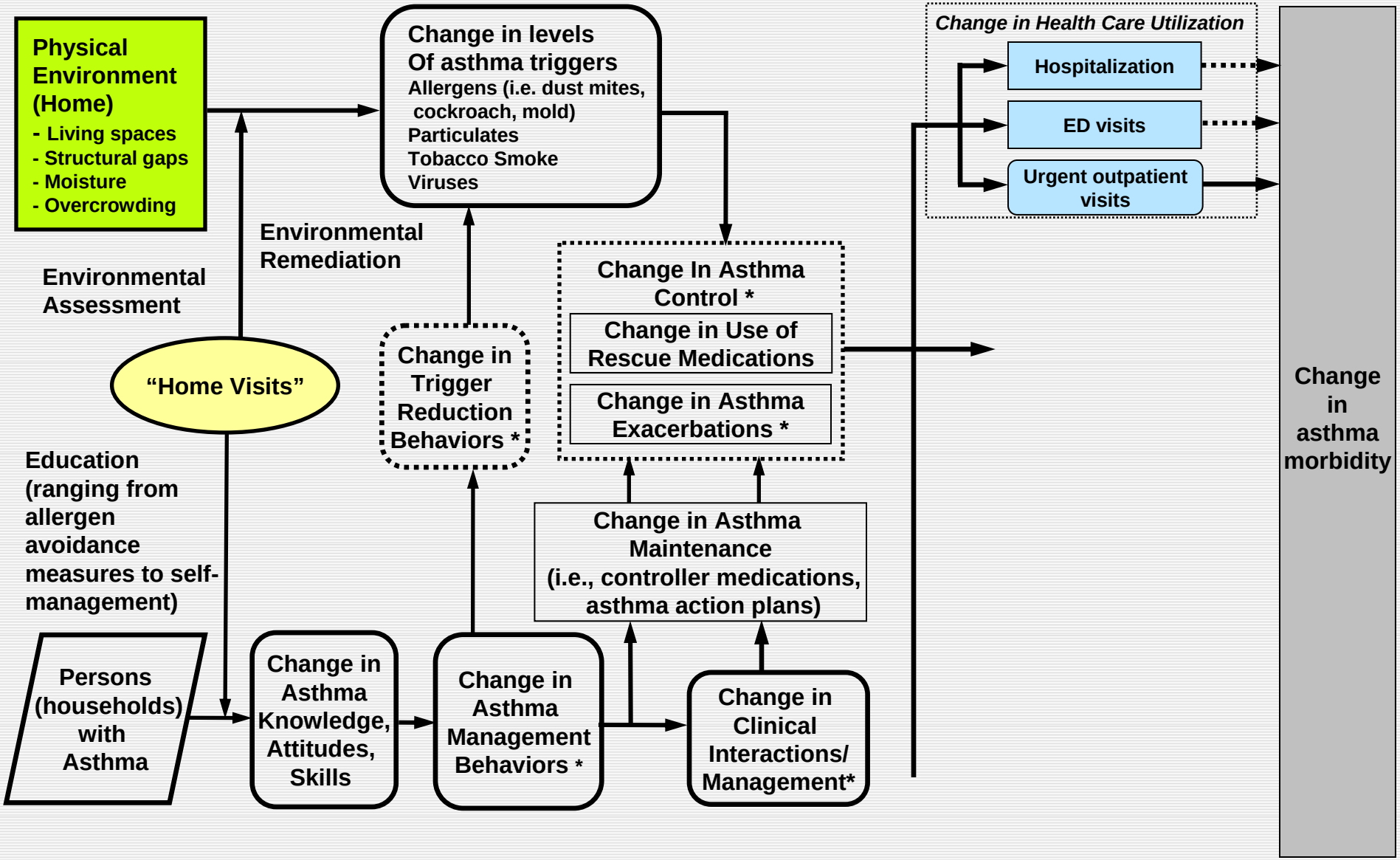

* With additional definitions and criteria

# Environmental and Behavioral Change Should Impact "Control"



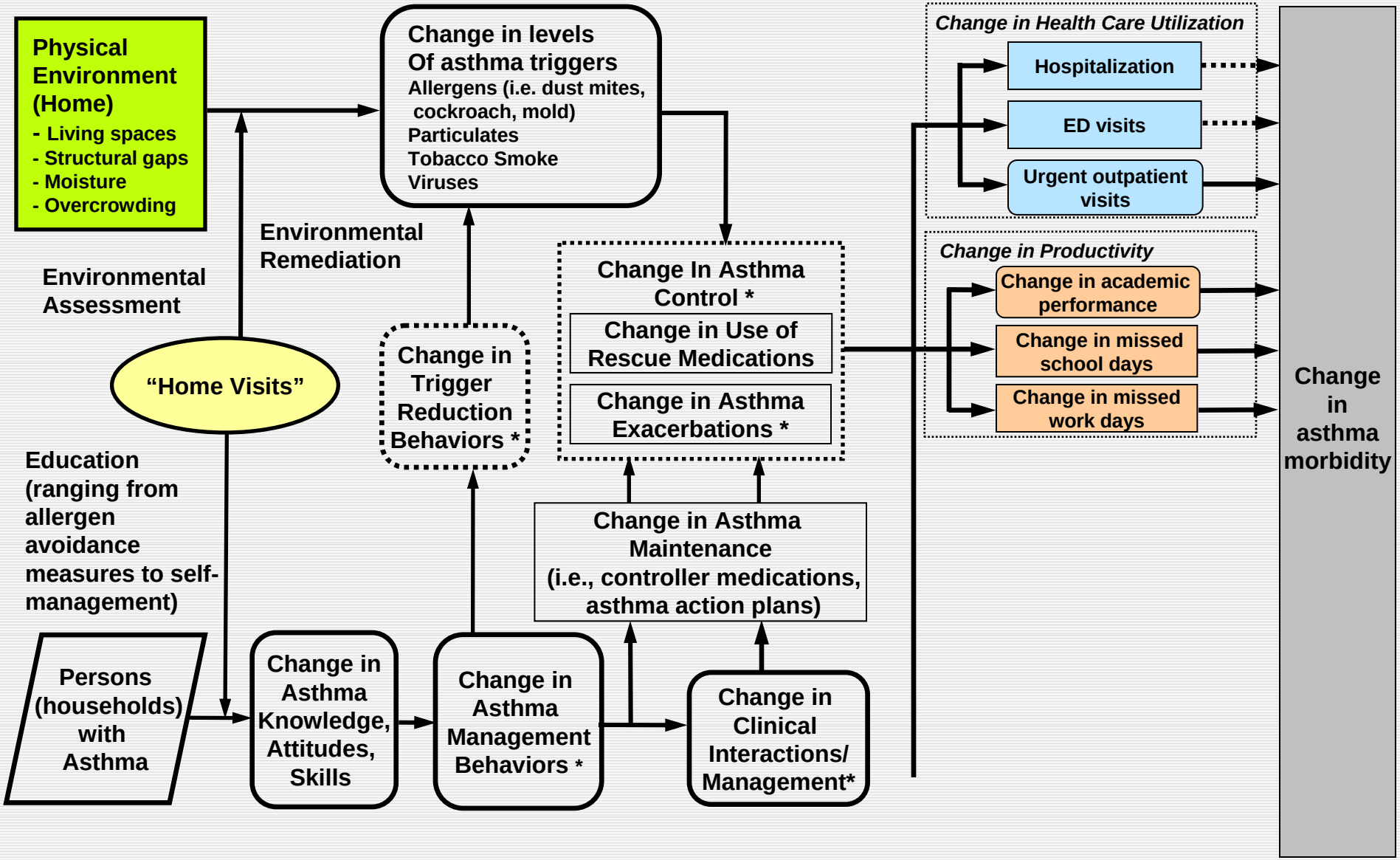

* With additional definitions and criteria

# Better Control Results in Improved Outcomes Such As Reductions in Urgent Health Care Utilization



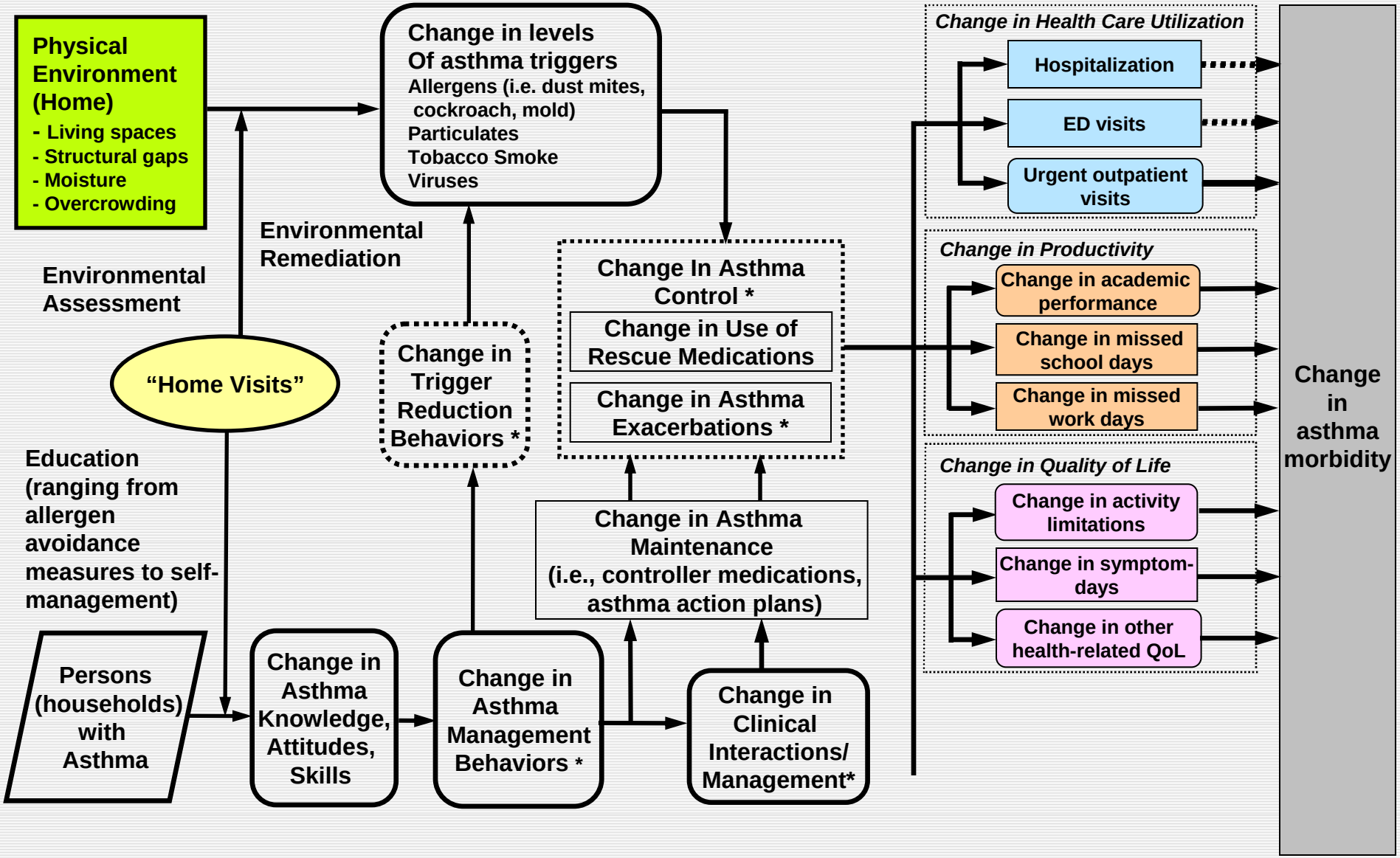

* With additional definitions and criteria

# …or Fewer Days Missed from School or Work (Productivity)



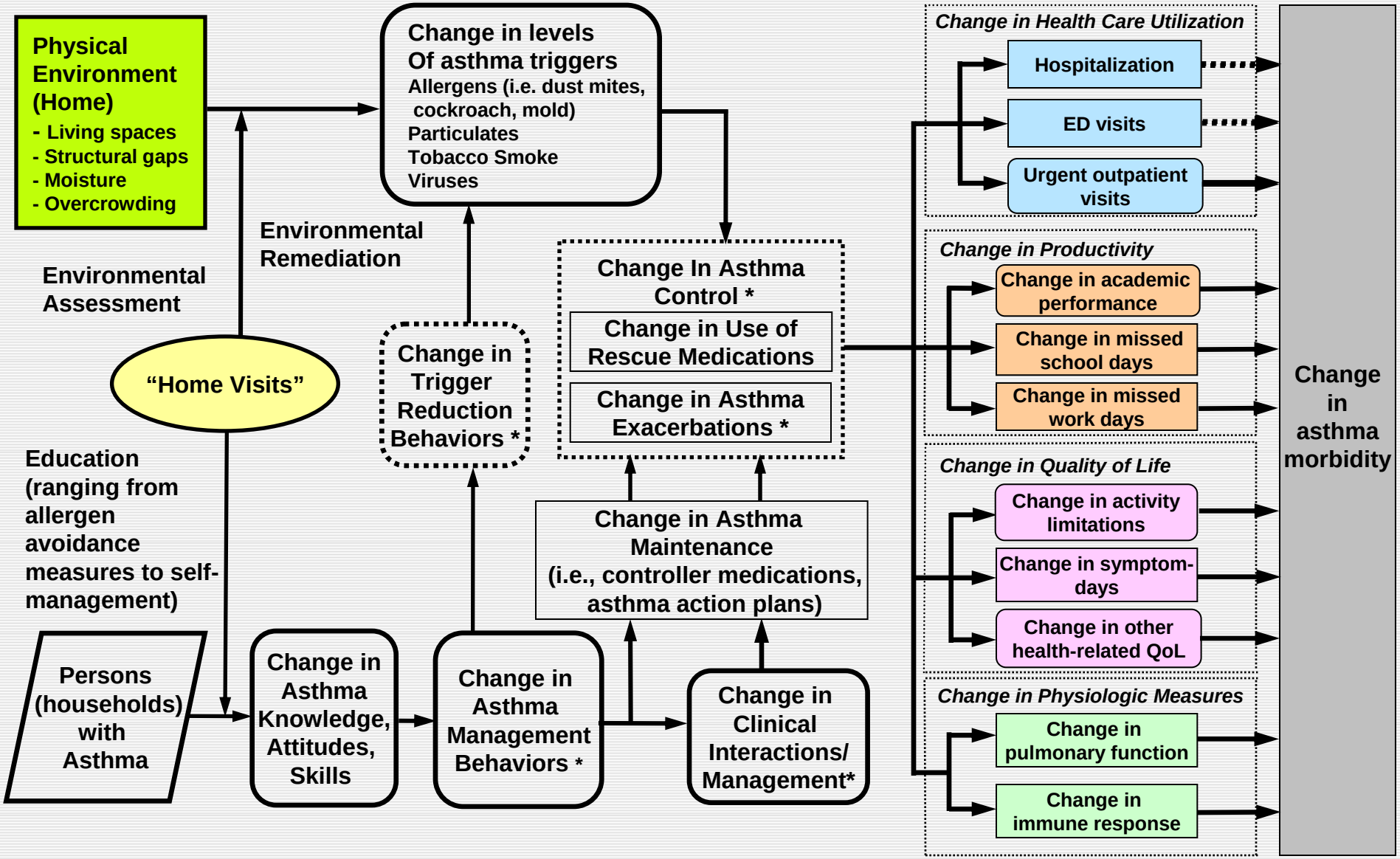

* With additional definitions and criteria

# …or Changes in Symptoms and Activity Levels




* With additional definitions and criteria

# …and May Improve Physiologic Measures of Asthma




* With additional definitions and criteria

# Intervention Criteria

- Mandatory
  - Home based (≥ 1 home visit)
  - Multi-trigger (≥ 2 asthma triggers addressed)
  - Multi-component (> 2 asthma components)
  - Environmental
    - At least one component directed towards home environment (assessment, remediation, education)
- Optional
  - Additional efforts to improve asthma management behaviors
    - Self-management, social services, coordinated care

# Home Visit Defined

- Some effort to change the home environment
  - Assess
  - Fix (remediation)
  - Educate
- Conducted by someone with training or experience
  - Clinicians or healthcare provider
  - Community health workers
  - Pest control professionals

# Multicomponent Defined

≥2 of these components:

- **Environmental Assessment (EA)**
  - In home written assessment of environmental triggers
- **Environmental Remediation (ER)**
  - Actions conducted or financed to reduce triggers in the home
    - Major remediation - large structural changes
    - Minor remediation - small additions
- **Environmental Education (EE)**
  - Patient education regarding actions to reduce triggers in the home

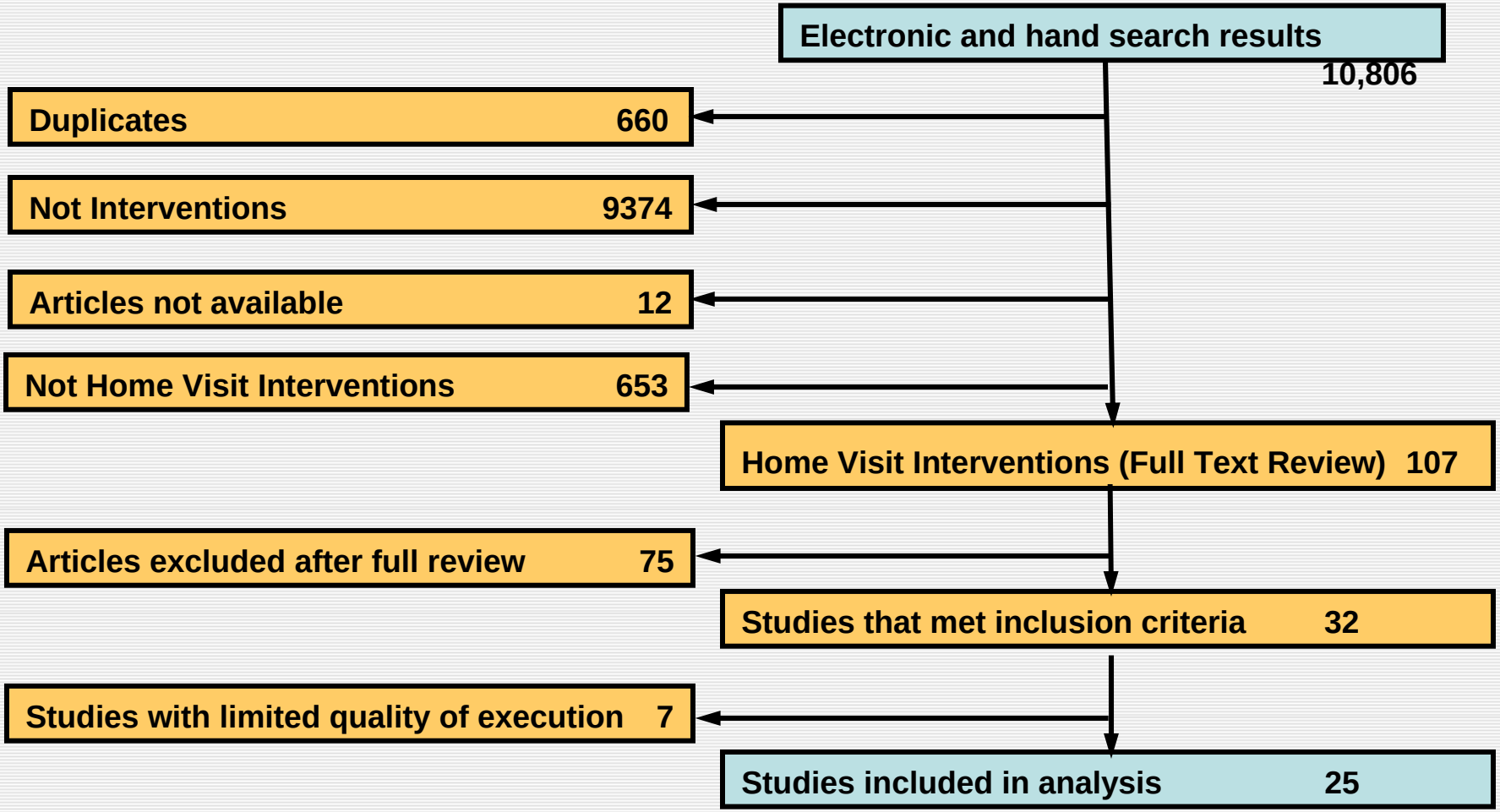
# Multicomponent defined (continued)

- **Self-Management Education (SM)**
  - Patient education on monitoring symptoms and taking action to modify treatment
- **Asthma Education (AE)**
  - General education on asthma without a SM component
- **Social Services (SS)**
  - Services to improve access to medical care or to advocate for environmental remediation
- **Coordinated Care (CC)**
  - Services to improve coordination of care between health care providers and home health workers

# Multi-Trigger Defined

- Activities to reduce exposures to two or more environmental triggers/allergens that exacerbate asthma
  - Barriers such as allergen impermeable covers
  - Cleaning interventions, equipment, or behaviors
  - Integrated pest management
  - Home improvements
  - Moisture remediation
  - Education to reduce environmental tobacco smoke exposure
- Can be tailored to client sensitivities

# Search Results: 1966–February 2008



# Data Analysis and Results

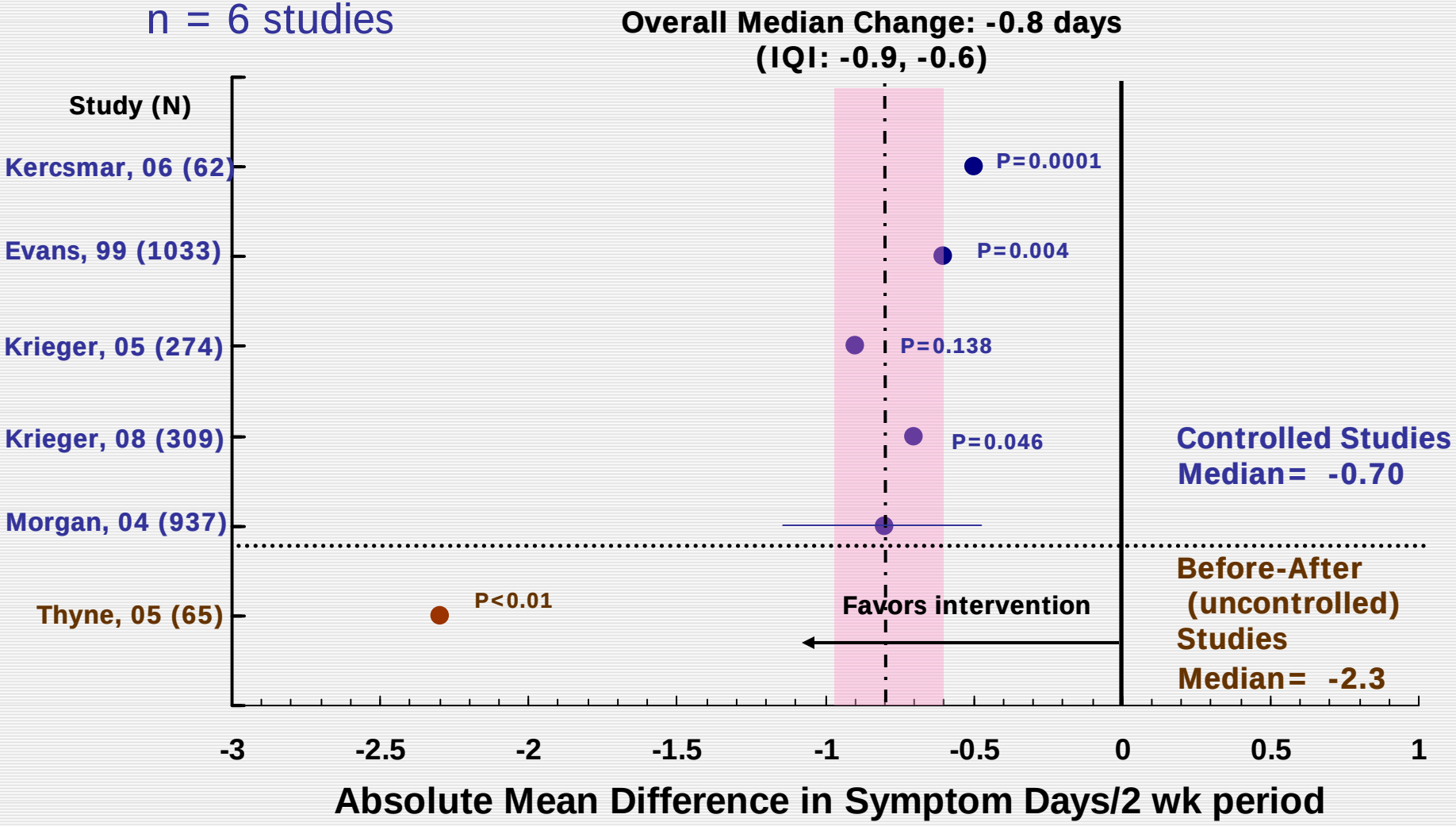
- Stratified data based on age
  - Children
  - Adults
- Results of 4 main outcomes presented
  - Quality of life
  - Health care utilization
  - Productivity
  - Physiologic Outcomes

# Subset of Studies Targeting Children with Asthma

# Quality of Life:

## Mean Difference in Symptom Days/2wk Period

n = 6 studies



# Results Summary-Children

- Asthma symptom days (6 studies):
  reduced by a median of 0.8 days/2 wks (21 symptom days/yr)
- Symptom/Quality of Life scores (10 studies):
  increased by a median of 21.8%
- Number of school days missed due to asthma (6 studies): reduced by a median 11 days/year
- Acute healthcare visits (10 studies):
  reduced by a median 0.57 visits/year
- Physiologic outcomes (7 studies):
  showed no overall improvement

# Subset of Studies Targeting Adults with Asthma

- Four studies measured outcomes in adults
- 3 studies were controlled trials; 1 study before-after
- Results
  - Symptom/QOL Score (3 studies)
    - 5%-16.7% relative % improvement in QOL or symptom scores
  - Health care utilization (2 studies)
    - Inconsistent results
  - Productivity (2 studies)
    - Inconsistent results
  - Physiologic Outcomes (0 studies)

# Applicability of Intervention

- The majority of the 25 analyzed studies targeted US urban low-income, minority children

- Most studies were implemented by community health centers (8), clinics (7) and academic institutions(8)

- Trained personnel conducting home visits included
  - Community Health Workers (9)
  - Nurses (8)
  - Respiratory Therapists (3)
  - Social Workers (2)
  - Physicians (2)
  - Research assistants (1)
  - Housing officer (1)

# Additional Benefits

- Improved caregiver support
- Caregiver smoking cessation
- Health benefits for parents and siblings of study children
- Home visit identifies additional public health concerns in the home

# Barriers to Implementation

- Inability to maintain follow up
- High cost of the intervention
- Sustainability
- Personnel to conduct home visits
- Acceptability of home visit (privacy)
- Insurance issues

# Conclusions

# Task Force Recommendation: Children

The Task Force recommends the use of home-based multi-component multi-trigger interventions with an environmental focus for children with asthma on the basis of strong evidence of effectiveness in reducing symptom days, improving quality of life or symptom scores, and reducing the number of school days missed.

# Task Force Recommendation: Adults

The Task Force found insufficient evidence to determine the effectiveness of home-based multi-component multi-trigger interventions with an environmental focus for adults with asthma due to a small number of studies with inconsistent results.

# Important Research Gaps

- Need more studies in adults
- Determine impact of secondhand smoke
- Range of remediation (major vs. minor)
- Determine the added benefit of conducting intervention in home
- Ideal population for this intervention
  - Frequent flyers?
  - Participants with more severe asthma?

# Step 9: Wrap up & Dissemination

- Complete any additional sub-analyses
- Disseminate findings
  - CG web summary
  - Journal Supplement (AJPM)
  - MMWR
  - Conferences

# For more information…

- Contacts

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  Gema Dumitru ggd7@cdc.gov
  David Hopkins dhh4@cdc.gov

- Community Guide website

www.thecommunityguide.org

- CDC's Air Pollution & Respiratory Health website

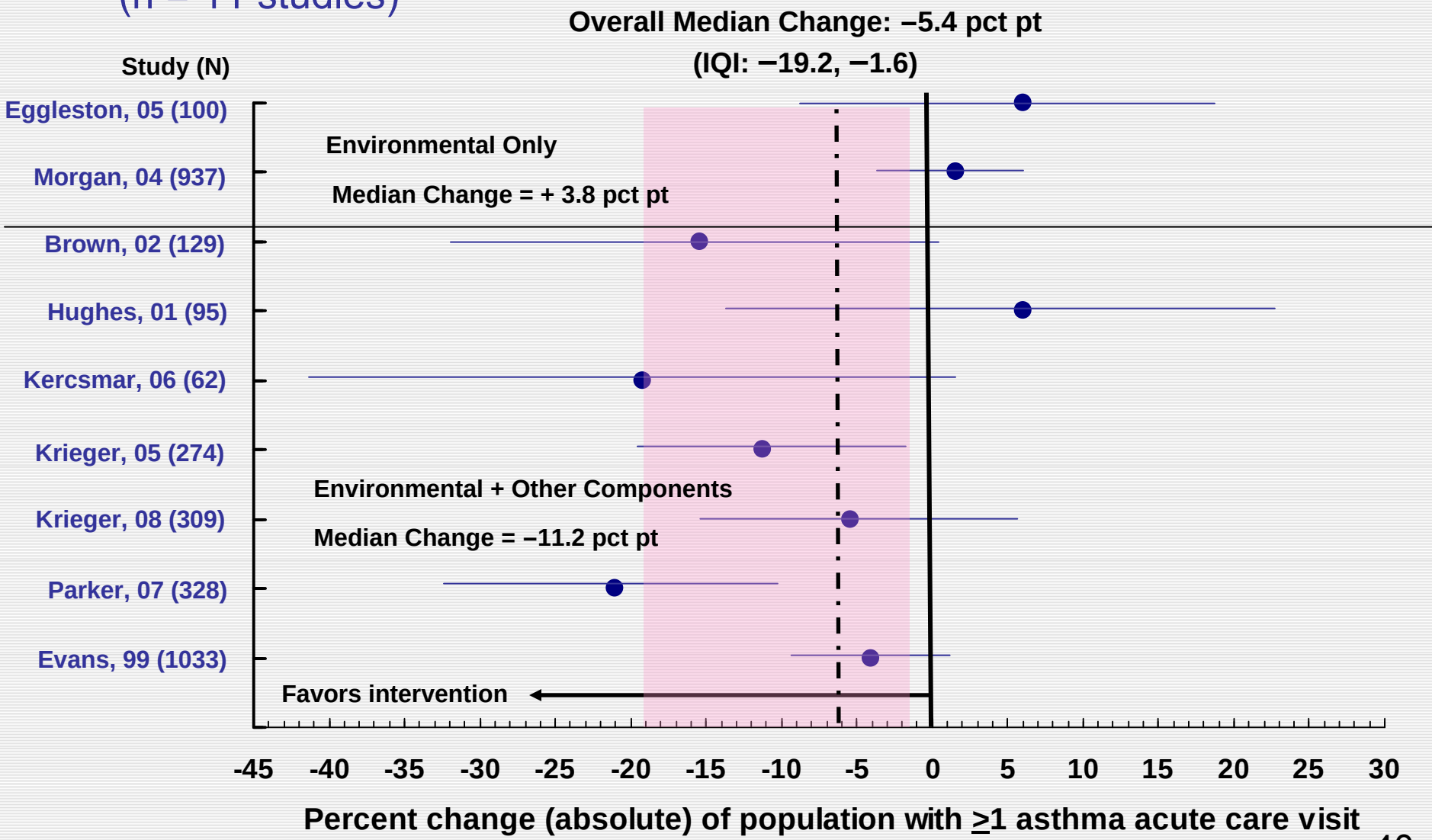
http://www.cdc.gov/nceh/airpollution/

# Questions

# Additional Analyses

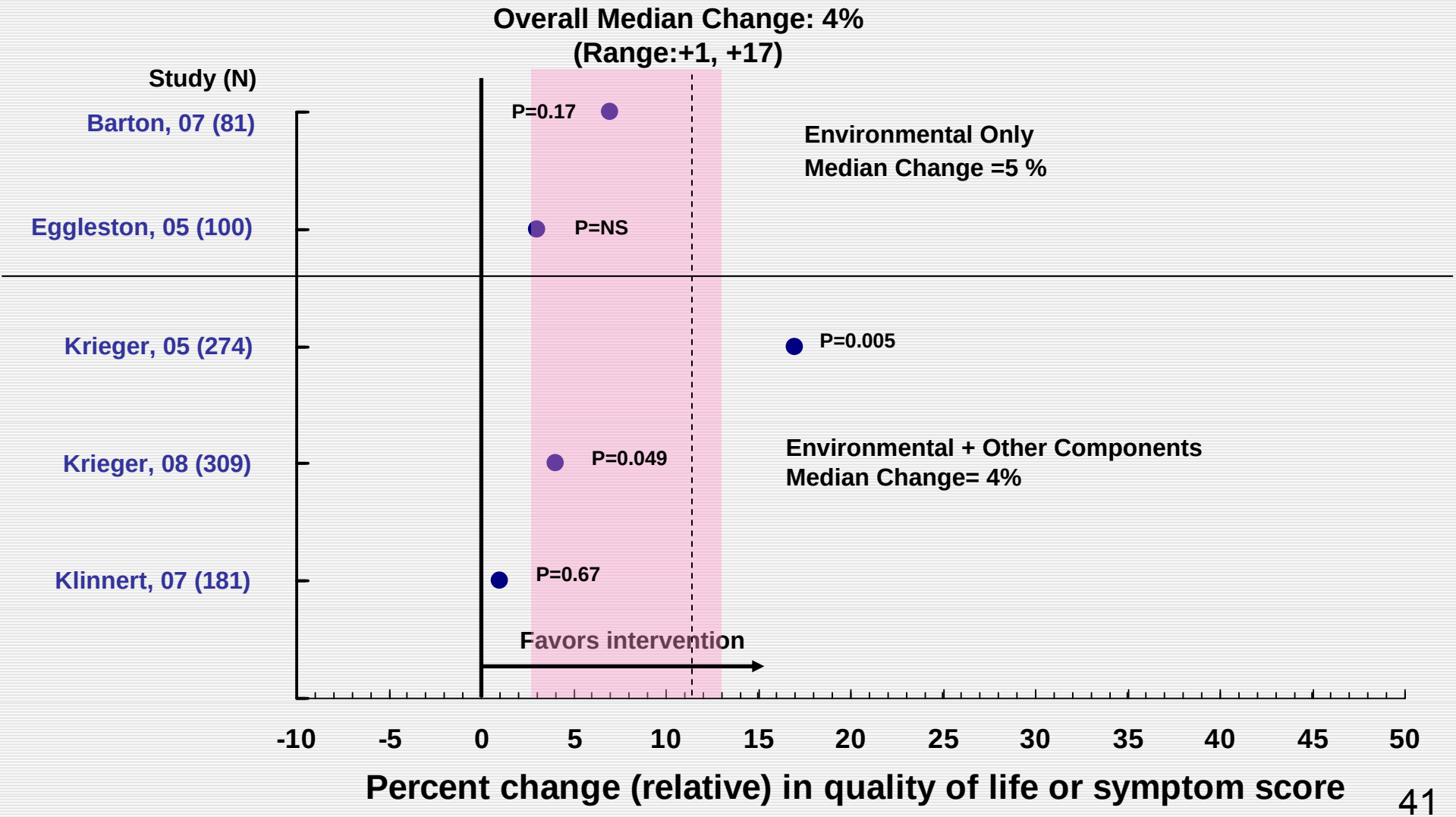
# Percentage of Population with Asthma Acute Care Visits by Component

(n = 11 studies)



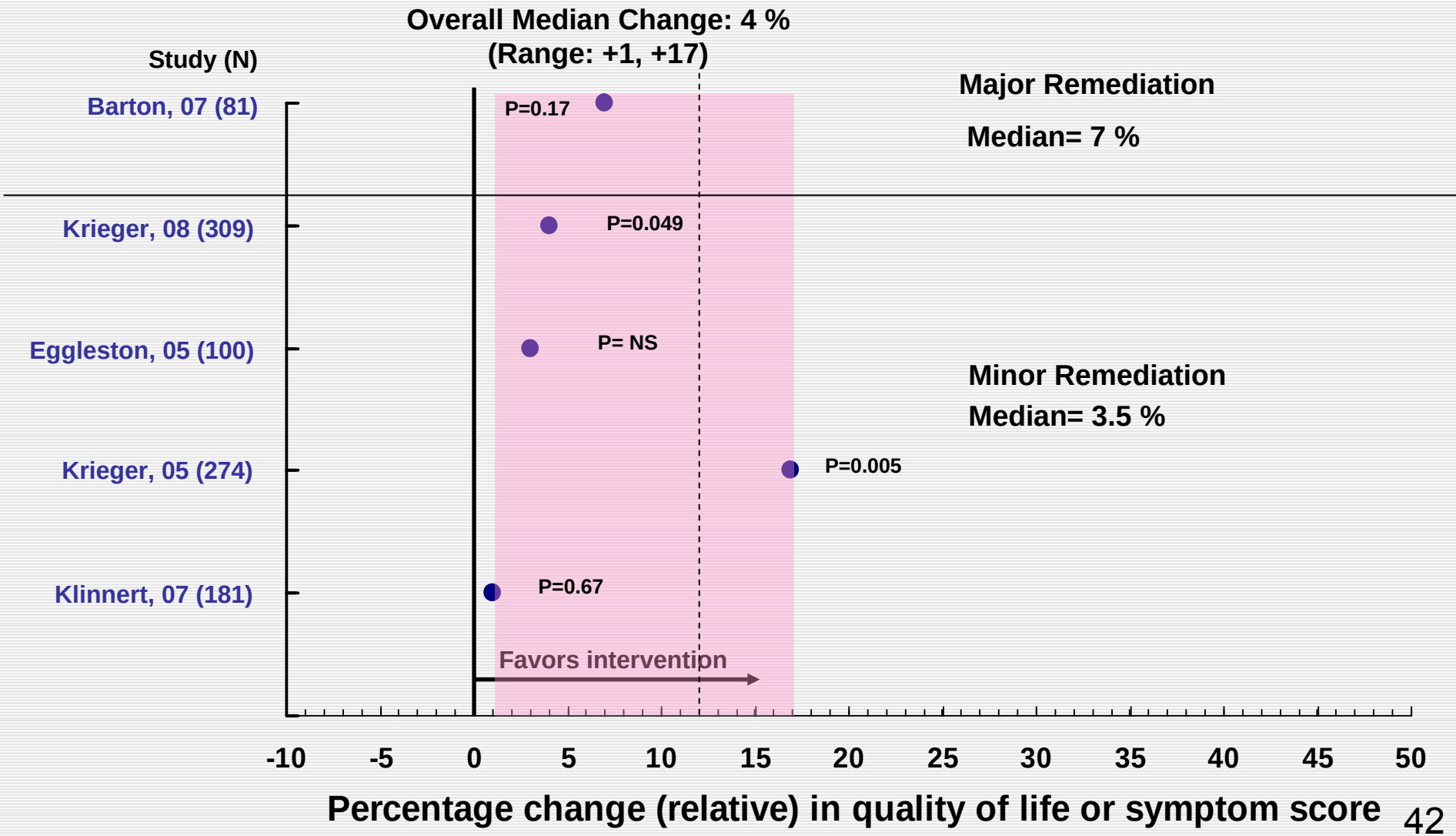
# Percent Change in Symptom/Quality of Life Score by Component

(n = 8 studies)

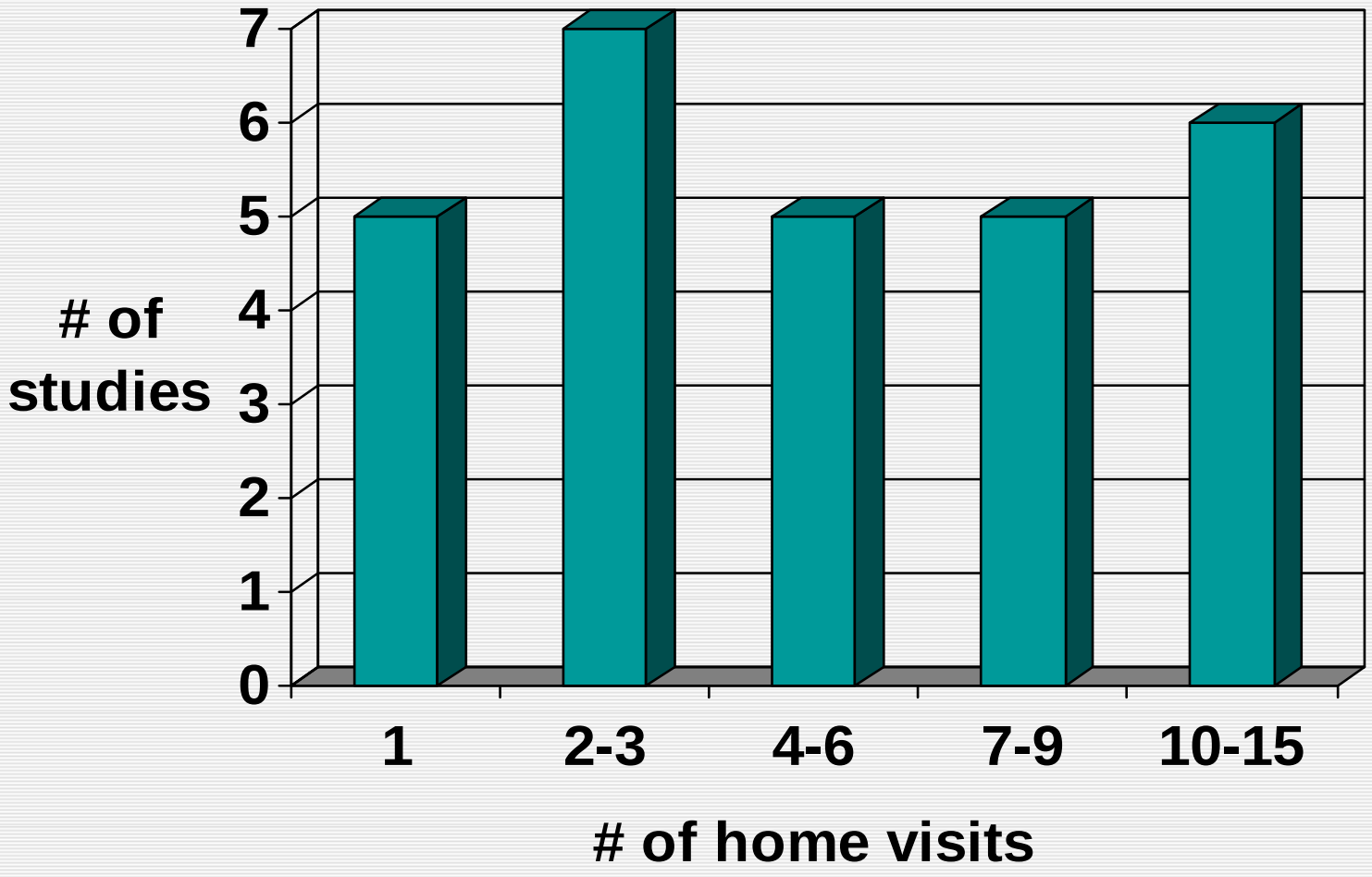


# Quality of Life: Symptom/Quality of Life Score

(n = 5 studies)

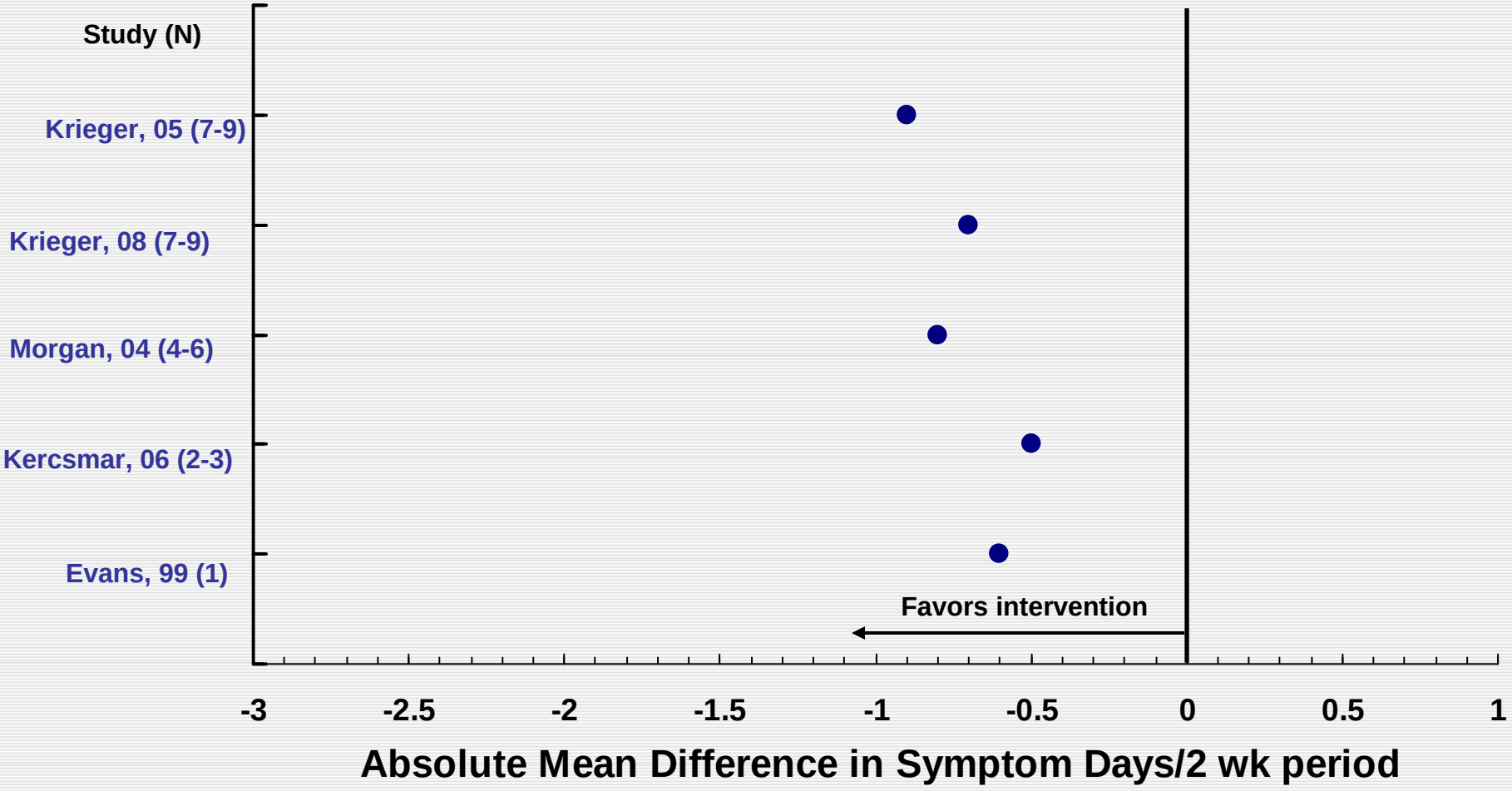


# Number of Home Visits



# Quality of Life: Mean Symptom Days by # of home Visits

n = 5 studies



# Impact of the Home Visit: Carter, 2001

- Individual RCT (Atlanta, GA)
- Population: 104 children (ages 5–16) with asthma
- Intervention group: 4 home visits over 1 year (EA, ER, EE)
- Placebo group: 4 home visits over 1 year (EA, **ineffective** ER)
- Control group: usual care (no home visits)

| Group | Total # acute care visits/yr | | |
|---|---|---|---|
| | Baseline | 1yr | Difference |
| Intervention | 51 | 34 | -17 |
| Placebo | 64 | 45 | -19 |
| Control | 45 | 48 | +3 |

NS

$P \leq 0.001$

# “Strength” of the Evidence Depends on these Rankings

| Strength of Evidence of Effectiveness | Quality of Execution | Design Suitability | Number of Studies | Consistent | Effect Size |
|---|---|---|---|---|---|
| Strong | Good | Greatest | ≥ 2 | Yes | Sufficient |
| | Good | Greatest or Moderate | ≥ 5 | Yes | Sufficient |
| | Good or Fair | Greatest | ≥ 5 | Yes | Sufficient |
| | Meet criteria for sufficient evidence | | | | Large |
| Sufficient | Good | Greatest | 1 | -- | Sufficient |
| | Good or Fair | Greatest or Moderate | ≥ 3 | Yes | Sufficient |
| | Good or Fair | Greatest, Moderate or Least | ≥ 5 | Yes | Sufficient |
| | Meet criteria for Strong evidence, but.. | | | One or more concerns | |
| Insufficient | Insufficient design or execution | | Too few | No | Small |

# SDS Designs and Grades

| Study Design | Suitability Grade |
|---|---|
| -Individual randomized trial<br>-Group randomized trial<br>-Prospective cohort<br>-Individual non-randomized trial<br>-Group non-randomized trial<br>-Other designs with concurrent comparison | GREATEST |
| -Time series with appropriate analysis<br>-Retrospective cohort<br>-Case control<br>-Simple time series | MODERATE |
| -Before after<br>-Cross sectional | LEAST |

# Body of Evidence for Home Visits

(n= 32 studies)

| Quality of Execution | Suitability of Study Design | | |
|---|---|---|---|
| | Greatest | Moderate | Least |
| Good (0–1 limitations) | 1 | 0 | 0 |
| Fair (2–4 limitations) | 14 | 0 | 10 |
| Limited (≥5 limitations) | 1 | 0 | 6 |

Qualifying studies: 25 Excluded studies: 7

# Intervention Combinations in Controlled Trials

(N = 15)

| Study | Home Visit | Env Edu | Env Asses | Env Rem | Self-Mgmt | Asthma Edu | Social Srvcs | Coord Care |
|---|---|---|---|---|---|---|---|---|
| Barton, 2007 | X | | X | X | | | | |
| Eggelstein, 2005 | X | X | X | X | | | | |
| Morgan, 2004 | X | X | X | X | | | | |
| Nishioka, 2006 | X | X | X | X | | | | |
| Carter, 2001 | X | X | X | X | | | | |
| Evans, 1999 | X | X | X | X | X | | X | |
| Krieger, 2008 | X | X | X | X | X | | X | |
| Kercsmar, 2006 | X | X | X | X | X | | | |
| Williams, 2006 | X | X | X | X | X | | X | |
| Brown, MD 2002 | X | X | X | | X | | | |
| Smith, 2005 | X | X | | | X | | X | |
| Klinnert, 2007 | X | X | X | | X | | X | |
| Parker, 2007 | X | X | X | X | | X | X | |
| Krieger, 2005 | X | X | X | X | | | X | |
| Hughes, 2001 | X | X | X | | X | | | |
| Total | 15 | 14 | 14 | 11 | 8 | 1 | 7 | 0 |

# Intervention Combinations in Before-After Studies

(N = 10)

| Study | Home Visit | Env Edu | Env Asses | Env Rem | Self-Mgmt | Asthma Edu | Social Srvcs | Coord Care |
|---|---|---|---|---|---|---|---|---|
| Somerville, 2000 | X | | X | X | | | | |
| Primomo, 2006 | X | X | X | X | X | | | |
| Levy, 2006 | X | X | X | X | X | | X | |
| Nicholas, 2005 | X | X | X | X | X | | X | |
| Thyne, 2006 | X | X | X | X | X | | X | X |
| Shelledy, 2005 | X | X | X | X | X | | X | X |
| Jowers, 2000 | X | X | X | | X | | | X |
| Stout, 1998 | X | X | X | | X | | X | X |
| Oatman, 2007 | X | X | X | X | | X | | |
| Hasan, 2003 | X | X | | | X | | | X |
| Total | 10 | 9 | 9 | 7 | 8 | 1 | 5 | 5 |

# Outcomes Reported in Analyzed Studies

(N=25)

| Outcome / Study Design | Quality of Life (QOL) | Health Care Utilization (HCU) | Productivity (PC) | Physiologic Measures (Phys) | Allergen Levels (AL) | Trigger Reduction Behaviors (TRB) | Asthma Control (AC) | Asthma Mgmt Behaviors (AMB) |
|---|---|---|---|---|---|---|---|---|
| **Controlled** | 11 | 11 | 5 | 6 | 11 | 6 | 6 | 7 |
| **Before-After** | 8 | 8 | 6 | 1 | 1 | 2 | 4 | 4 |
| **Total #** | 19 | 19 | 11 | 7 | 12 | 8 | 10 | 11 |

*Blue = recommendation outcome*
*Gray = intermediate outcome*

BUILDING A FRAMEWORK FOR HEALTHY HOUSING

2008 National Healthy Homes Conference

# Cuyahoga County Urban Mold & Moisture Program: Home Interventions for Asthmatic Children

Carolyn Kerscmar, Stuart Greenberg,

and Dorr Dearborn

Case Western Reserve Univ, Environ Hlth Watch

Cleveland, Ohio

# Asthma: Cleveland/Cuyahoga County

- Prevalence: 5-20% (<18yr)
- School screening program (east side)
  - 9% report current asthma
    - 12% ever
    - 14% for Black males; 7% White males
  - East side, inner city (grades 1-5)
    - 26% reported child with asthma
    - Consistent with 31.4% reported in Harlem

# ICAS: Irritant/ Allergen Exposure

| | | |
|---|---|---|
| Smoker in Household | 48.2% | **54%** |
| Dampness/mold | 45.4% | **70%** |
| Cockroach | 57.8% | **73%** |
| Rodents | 39.5% | **49%** |

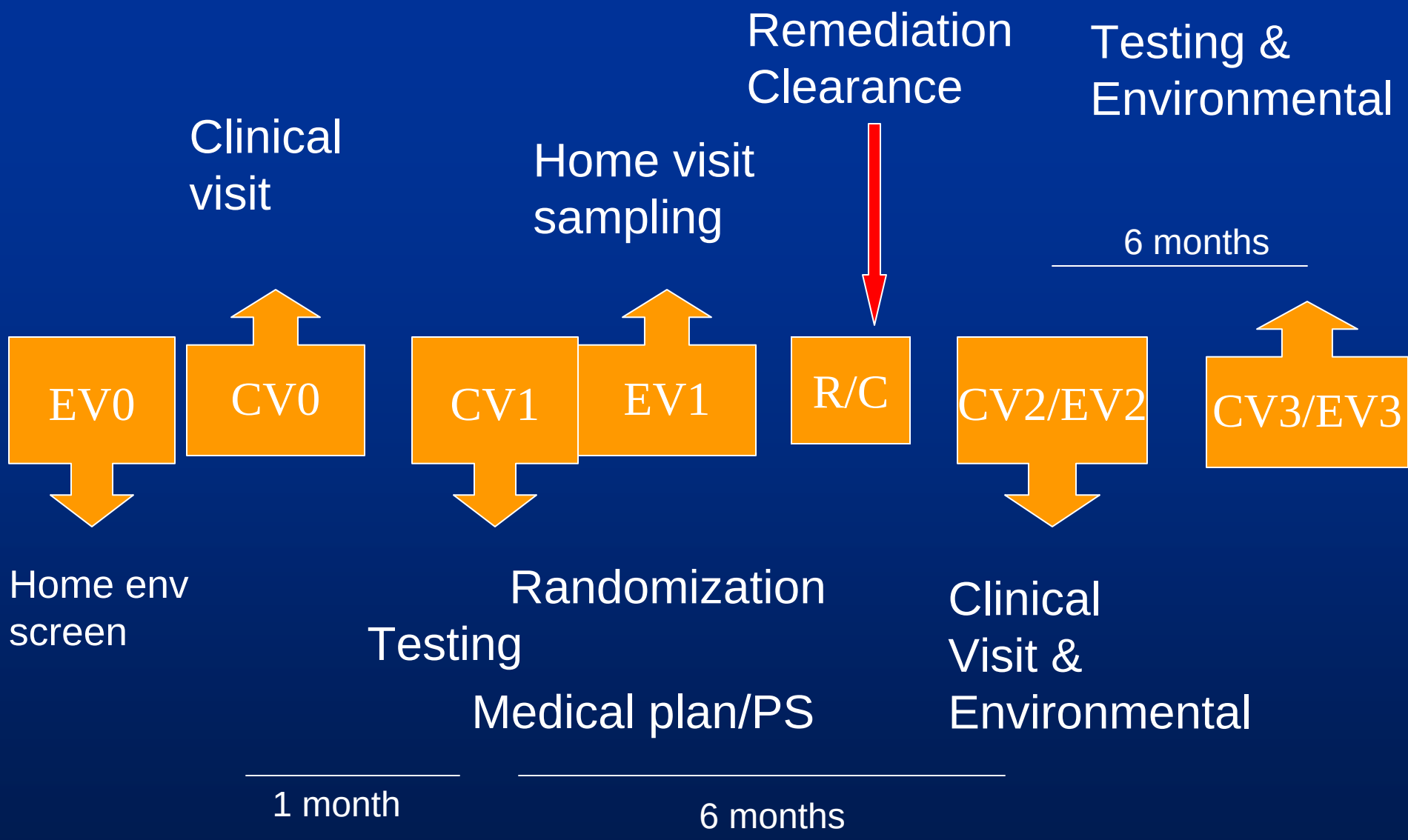
Crain, et al 2002. EHP 110:939-45

# UMMP: Asthma Study

**Do targeted interventions for Mold and Moisture make a significant impact on asthmatic children's health?**

# UMMP: Asthma Study

- **Do targeted interventions for Mold and Moisture make a significant impact on asthmatic children's health?**
- **Study Design:**
  - **Moderately severe asthmatics (2-18 y/o)**
  - **Residing in home with mold problem**
  - **Enhanced asthma care plan**
  - **Randomize to Intervention vs Education**
  - **Follow outcome for 12 months:**
    Environmental sampling; clinical evaluation

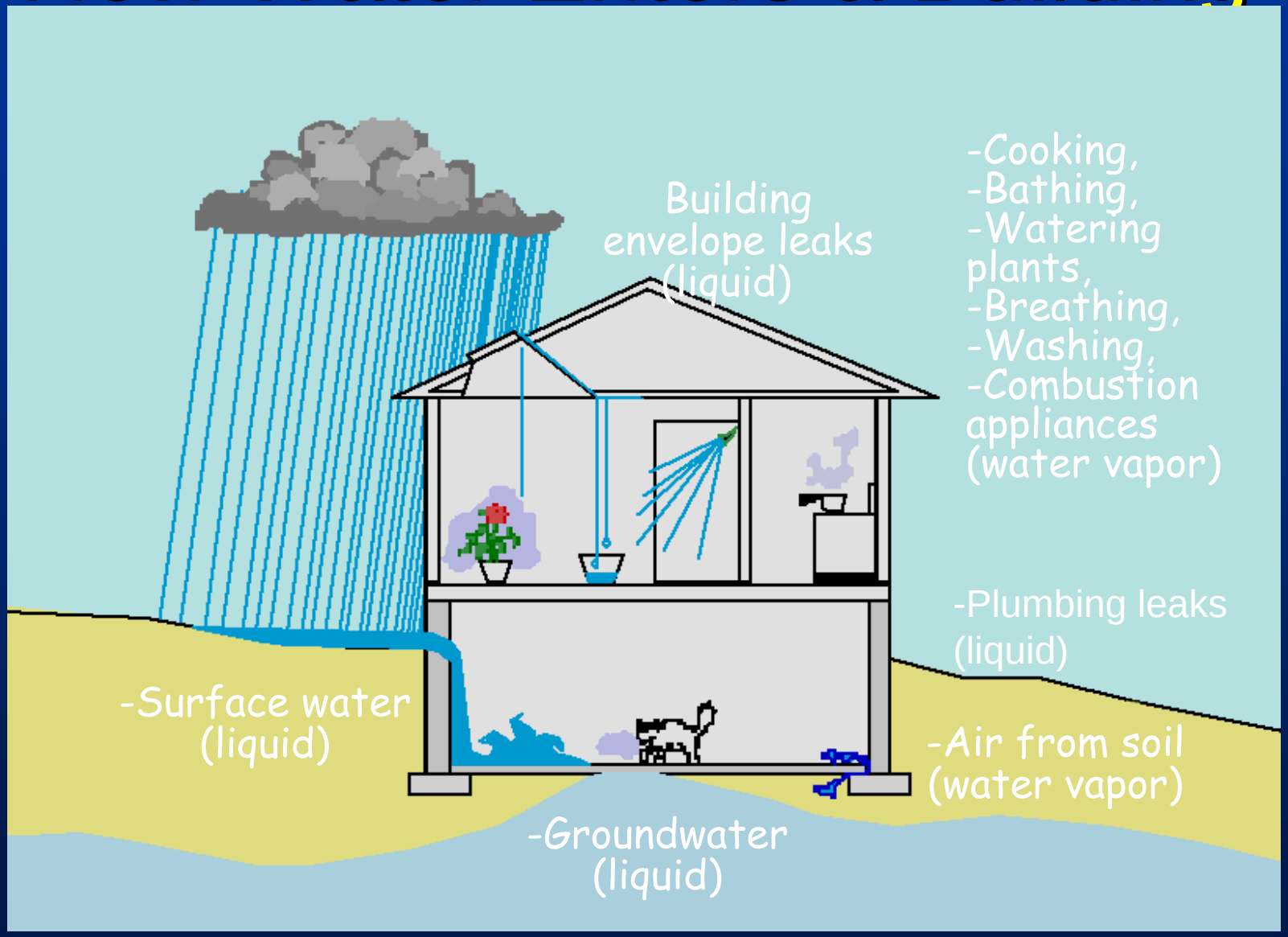



Testing: CBC, urine, nasal, RAST

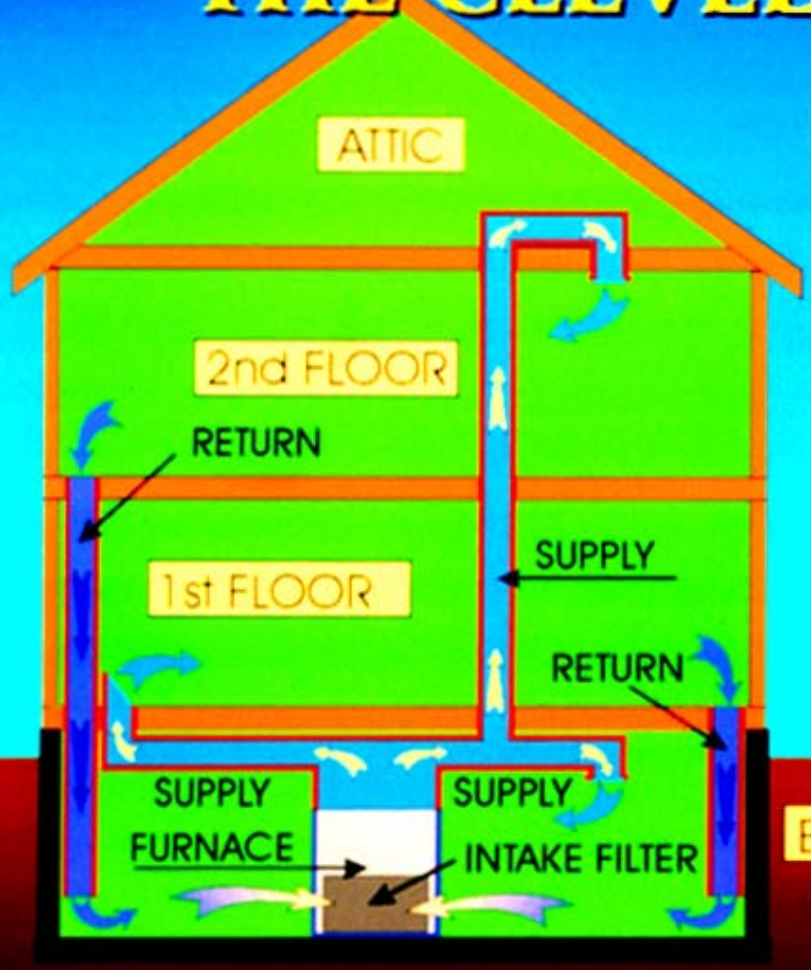
# Housing Characteristics

- Pre>Post-WW II bungalows, ranch homes (slab foundation)
  - **Large leaky basements and/or crawl spaces**
  - **Foundations extend under porches**
  - **‘Cleveland drop’ forced air heating**
  - **Finished basements: moist/moldy walls & floor coverings**
  - **Leaking sub-slab heating ducts, water vapor condensing on cold surfaces**

# How Water Enters a Building



# THE CLEVELAND DROP

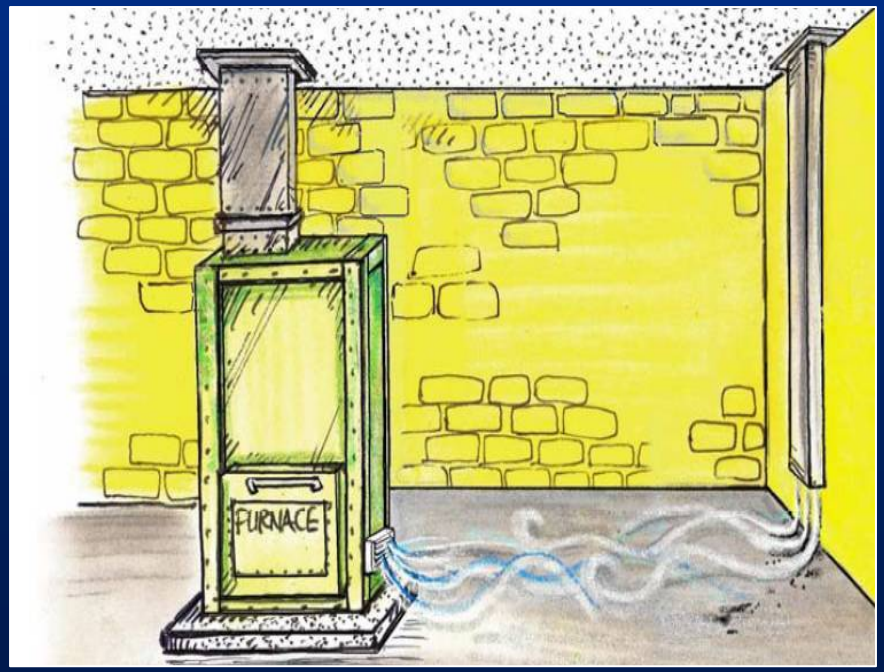


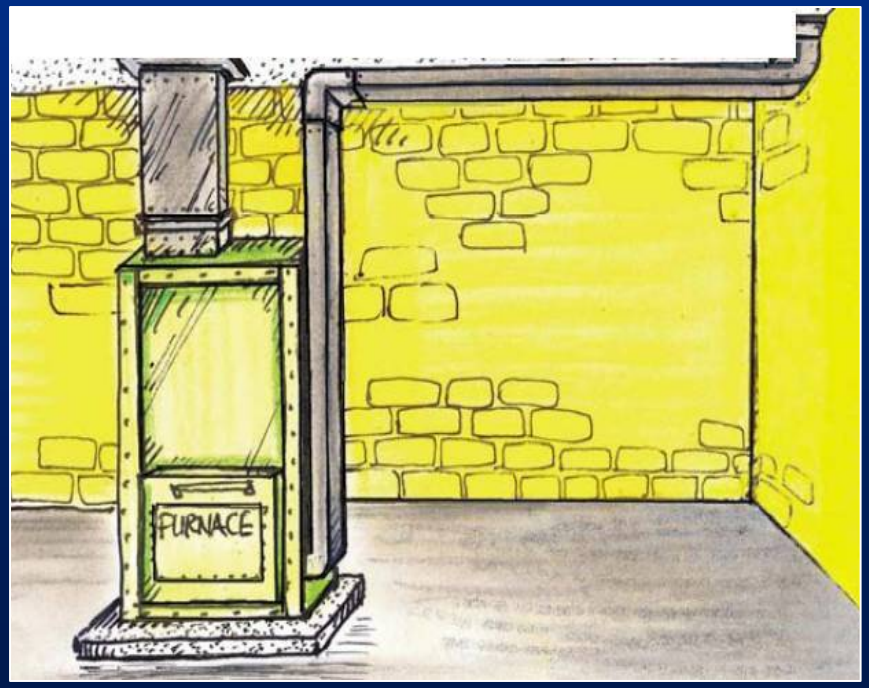

A type of configuration for an HVAC system where the cold air return ducts drop down to the basement near the floor, and are not connected to the furance. The return air for the furnace is drawn directly from the basement via the filter intake.

PREPARED BY THE CUYAHOGA COUNTY BOARD OF HEALTH

# UMMP intervention

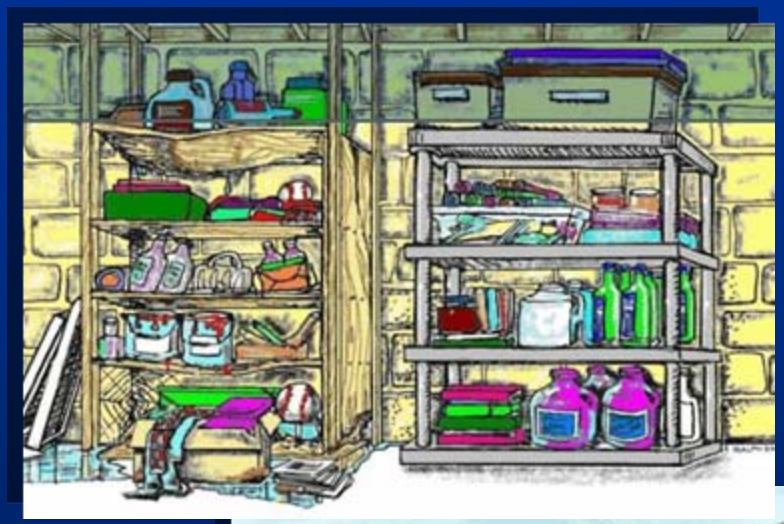
Duct cold air return directly to the furnace (repair the "Cleveland Drop")

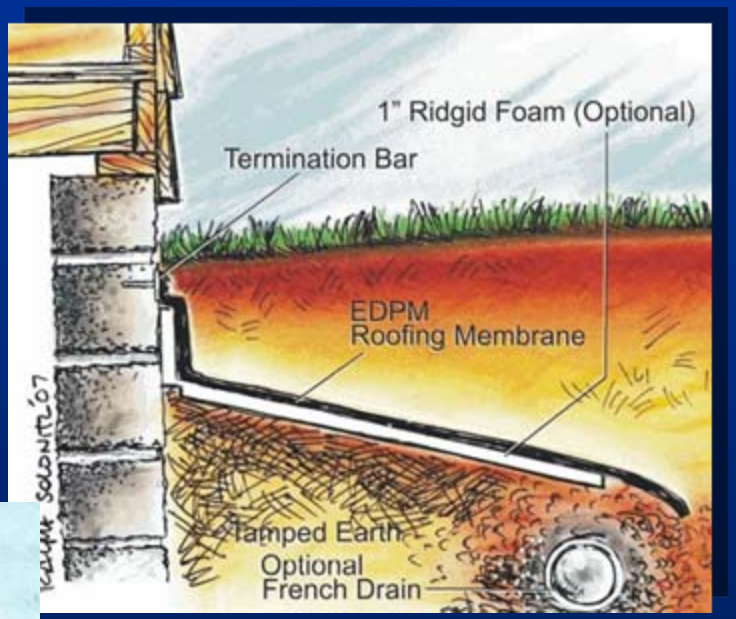


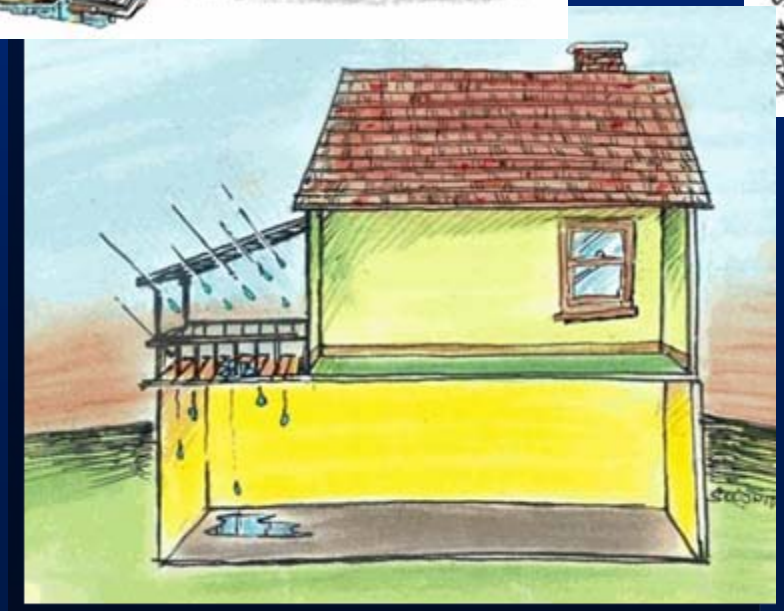




<http://ehw.org/Asthma/ASTH_home1.htm#Moisture>

# UMMP intervention





http://ehw.org/Asthma/ASTH_Control_Triggers.htm#CCHHI

# Mold & moisture control strategy

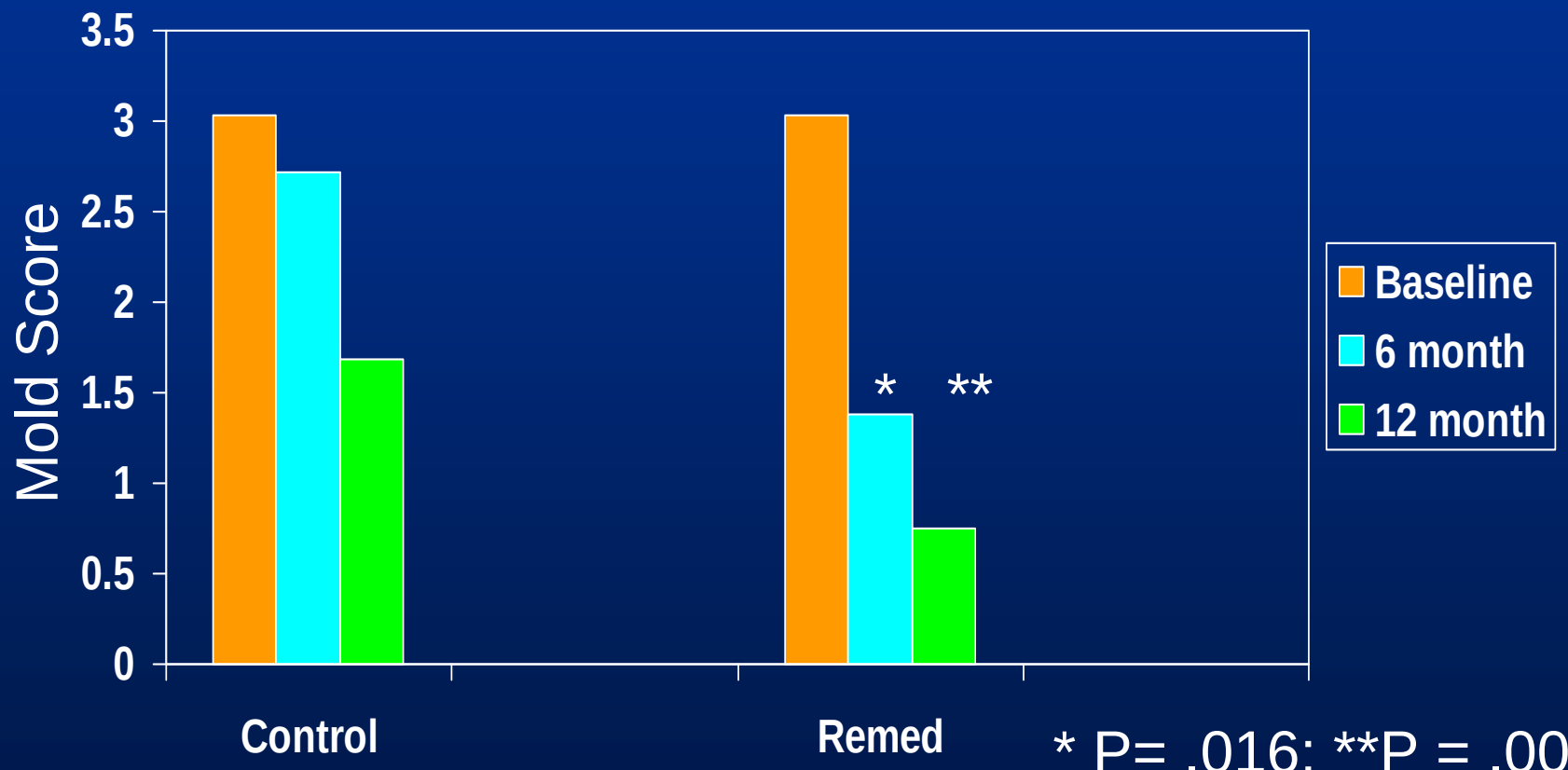
- Remove moisture damaged material
- Remove mold exposure pathway
- Clean mold from hard surfaces
- Stop rain water intrusion
- Exhaust water vapor
- Repair plumbing leaks

# Mold & moisture control strategy

- Remove moisture damaged material
- Remove mold exposure pathway
- Clean mold from hard surfaces
- Stop rain water intrusion
- Exhaust water vapor
- Repair plumbing leaks

Mean Cost per House: $3,458 (up to $6260)

# Visible Mold Scores: Pre-Post Remediation




* P= .016; **P = .009

Scoring: 0 = none, 1 = <4 sq ft, 2 = 4-32 sq ft, 3 = >32 sq ft
Total Score: summed across all rooms

# Allergen Levels from Dust Samples

| Allergen | Visit | Change from Baseline | | |
|---|---|---|---|---|
| | | Control | Remediated | p-value |
| Cockroach (U/m$^2$) | EV2<br>EV3 | 0.38 ±1.97<br>0.01 ±1.78 | 0.08 ±1.73<br>-0.20 ±2.22 | 0.79<br>0.67 |
| Dust mite (Der f 1+Der p1) (µg/m$^2$) | EV2<br>EV3 | -0.91 ±3.07<br>0.53 ±3.04 | -0.53 ±1.60<br>-0.48 ±1.98 | 0.50<br>0.51 |
| Mouse (ng/m$^2$) | EV2<br>EV3 | 0.24 ±1.88<br>-0.19 ±1.54 | -0.43 ±1.67<br>-1.08 ±1.99 | 0.14<br>0.08 |
| Rat (ng/m$^2$) | EV2<br>EV3 | -0.90 ±2.61<br>-0.85 ±1.84 | -0.83 ±1.83<br>-.96 ±2.06 | 0.74<br>0.91 |
| Endotoxin (µg/m$^2$) | EV2<br>EV3 | 0.02 ±3.67<br>-0.41 ±2.69 | -0.70 ±1.80<br>-0.76 ±1.98 | 0.03<br>0.87 |

# UMMP Asthma Study: Demographic Data

| Characteristic | Control<br>N=33 | Remediation<br>N=29 |
|---|---|---|
| **AGE** | **6.5 ± 3.9** | **7.1 ± 3.8** |
| **Gender (♂)- #(%)** | **18 (54.5)** | **19 (65.5)** |
| **Ethnicity- #(%)**<br>Black/other<br>White | **23 (71.9)**<br>**9 (28.1** | **24 (82.8)**<br>**5 (17.2)** |
| **Insurance- #(%)**<br>Medicaid/self-pay<br>Private insurance | **17 (58.6)**<br>**12 (41.4)** | **13 (54.1)**<br>**11 (45.8)** |

# Baseline Rast by Study Group

| | Control | | Remediated | | |
|---|---|---|---|---|---|
| Positive Baseline RAST Class 2 | N | % | N | % | P-Value* |
| Any Mold | 10 | 31.3 | 9 | 33.3 | 0.88 |
| Any RAST | 13 | 40.6 | 18 | 66.7 | 0.09 |
| Cockroach(german) | 6 | 22.2 | 4 | 18.2 | 0.65 |
| D. Ptero Mite | 8 | 25.8 | 10 | 37.0 | 0.51 |
| Mouse urine | 2 | 9.5 | 5 | 22.7 | 0.22 |
| Rat urine | 3 | 13.6 | 1 | 5.3 | 0.38 |

* P-value from a logistic generalized estimating equation (GEE) controlling for age

# Asthma Symptom Days

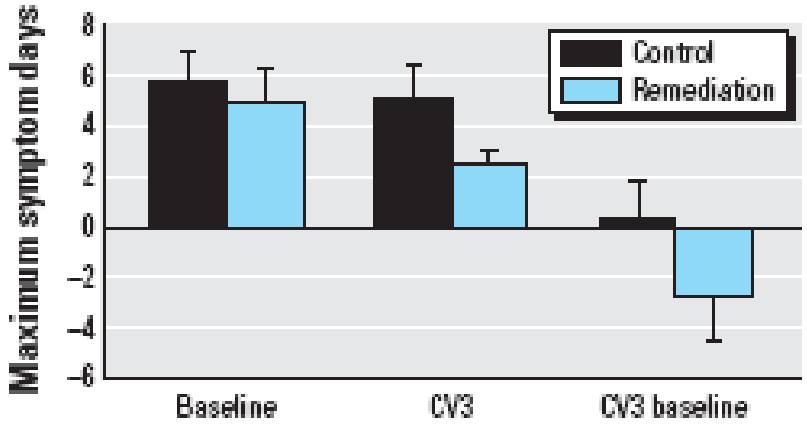
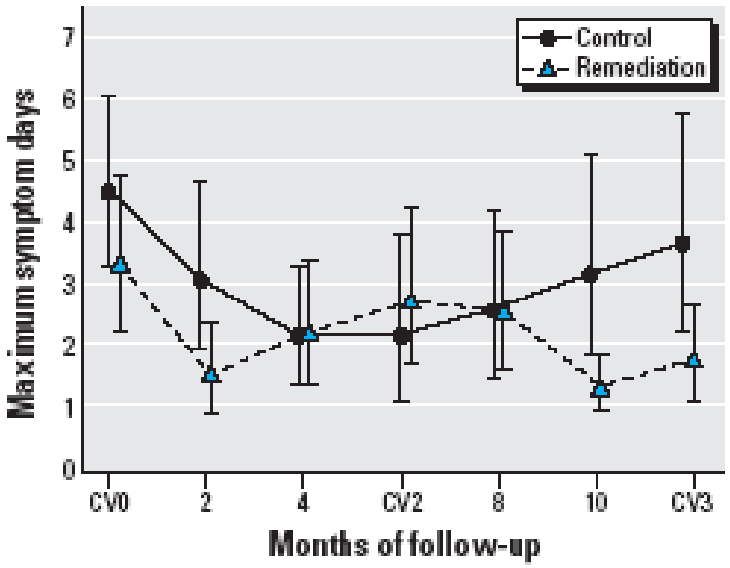



**Figure 1.** Unadjusted mean maximal symptom days ± 1 SE for control group and remediation group.




Kercsmar, et al. Env Health Perspect. 2006; 114:1574-1580

# UMMP: Asthma Study

| Change in: | CONTROLS (n = 33) | REMEDIATED (n = 29) |
|---|---|---|
| **Symptom Days** | -0.22 ±0.24 (p = 0.36) | -0.54 ±0.18 **(p = 0.003)** |
| **Symptom Scores** | -0.12 ±0.17 (p = 0.50) | -0.42 ±0.15 **(p = 0.006)** |

# UMMP: ASTHMA Exacerbations*

| | CONTROLS | REMEDIATED | P value |
|---|---|---|---|
| # with ≥1 ED visit or hospitalization | 11/33 | 1/29 | 0.003 |

* During 6 months follow-up period after remediation

Kercsmar et al., Environ Hlth Perspect, 114:1574–1580 (2006).

# Conclusions

- Home remediation targeting structural repair of water incursion and mold removal leads to improved asthma control
  - Decreased symptoms & exacerbations
- Sustaining lowered allergens levels is difficult
- Cost-effectiveness is possible
- Results of this small study support the need for expanded studies

# Cuyahoga County
# Urban Mold & Moisture Program

- **CWRU Swetland Center**

Dorr Dearborn, PhD, MD

Iwona Yike, PhD

Asha Garg, MD, MPH

Margaret Pizzi, RN

- **CWRU Dept of Pediatrics**

Carolyn Kercsmar, MD

Mark Schluchter, PhD

Lester Kirchner, PhD

Lintong Hue, MS

Pamela Scott, RN

Terry Casey, RN

- **Board of Health**

Terry Allan, MPH

John Sobolewski

- **Environmental Health Watch**

Stuart Greenberg

James LaRue

- **Dept of Development**

Mary Jo O'Brien

Paul Herdeg

- **US EPA, NERL**

Steve Vesper, PhD

Rich Haugland, PhD

# Healthy Homes In Seattle

Jim Krieger, MD, MPH

National Healthy Homes Conference

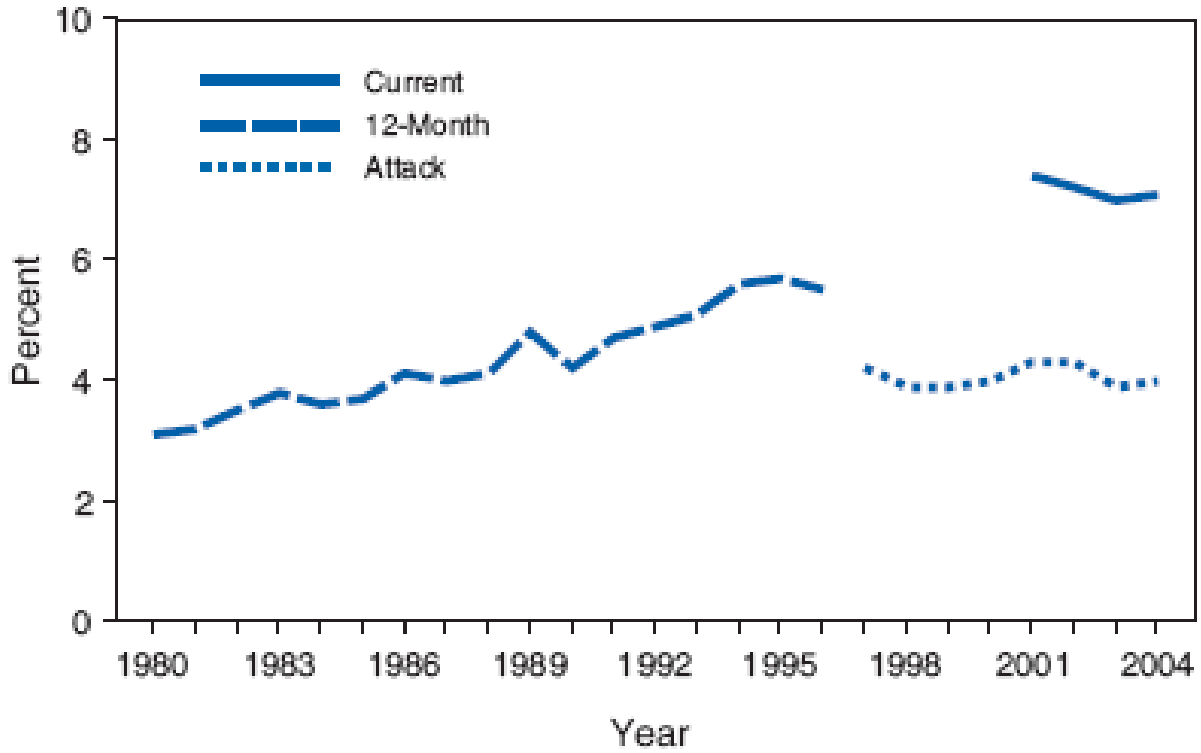
September 2008

Public Health
Seattle & King County

# Thanks to Colleagues and Funders…


- Tim T. Takaro, MD, MPH, MS: Co-Investigator
- Lin Song, PhD: Co-Investigator
- Kris Edwards, RN, MN, MPH: Project Nurse
- Lisa Carol Ross, MPH: Project Manager
- Nancy Beaudet, MS, CIH: Industrial Hygienist
- Carol Allen, Community Health Worker
- Cindy Mai, Community Health Worker
- Margarita Mendoza, Community Health Worker
- John Roberts, Consulting Engineer
- Denise Sharify, Project Manager
- Monica Cheng, Field Coordinator
- Tom Phillips, Seattle Housing Authority Project Manager
- Primary funding: NIEHS grant 1R01-ES11378
- Additional support: Allies Against Asthma Program of the Robert Wood Johnson Foundation, CDC Urban Research Centers Cooperative Agreement U50/CCU011820-02, NIH Grant MO1-RR-00037 of the University of Washington General Clinical Research Center.

# Asthma Prevalence Growing

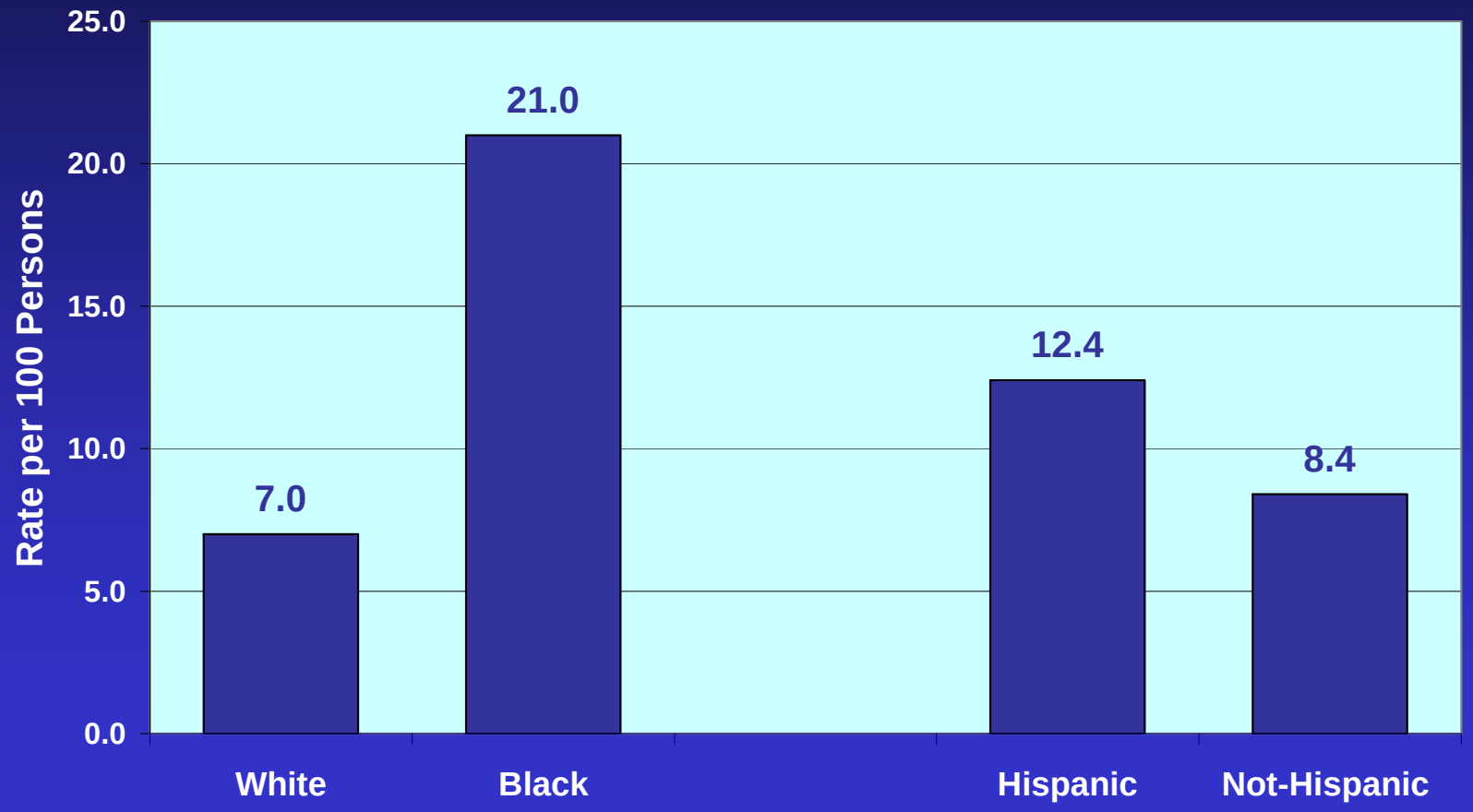



**Source:** National Health Interview Survey; National Center for Health Statistics.

# Racial Disparities Persist

## ED Visits among Persons with Current Asthma

### US, 2001-2003



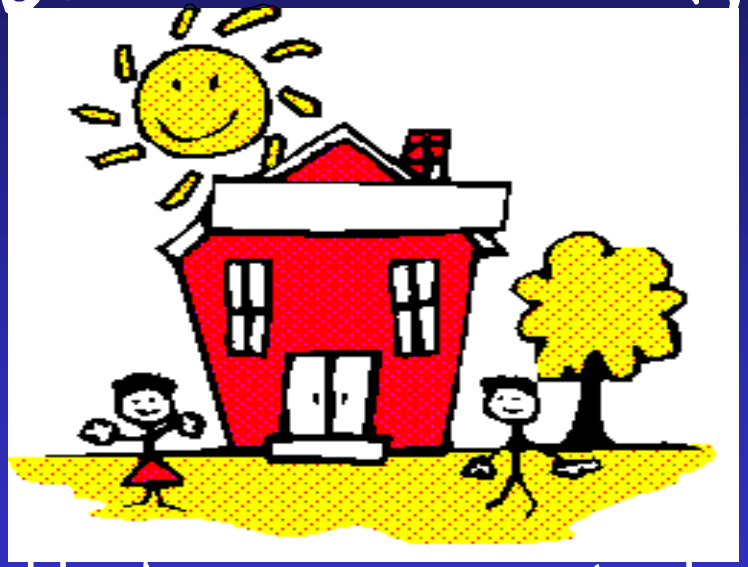

Source: NHAMCS

# Addressing Asthma at Multiple Levels is the Ultimate Strategy

# Seattle Healthy Homes Asthma Intervention Spectrum

# Healthy Homes /

Seattle-King County



Healthy Homes Project

# Healthy Homes I

- In-home environmental assessment and education by community health workers
- Comparison of single visit model to more intensive multi-visit model
- RCT of 274 low-income households children with asthma
- Published in American Journal of Public Health, April 2005

# Community Health Worker Home Visits

- 5-7 visits to low-income children with asthma.
- Assess home environment and develop environmental Action Plan.
- Offer client education and encourage behaviors to implement environmental Action Plan.

Putting on a mattress cover

# Trigger Control Resources

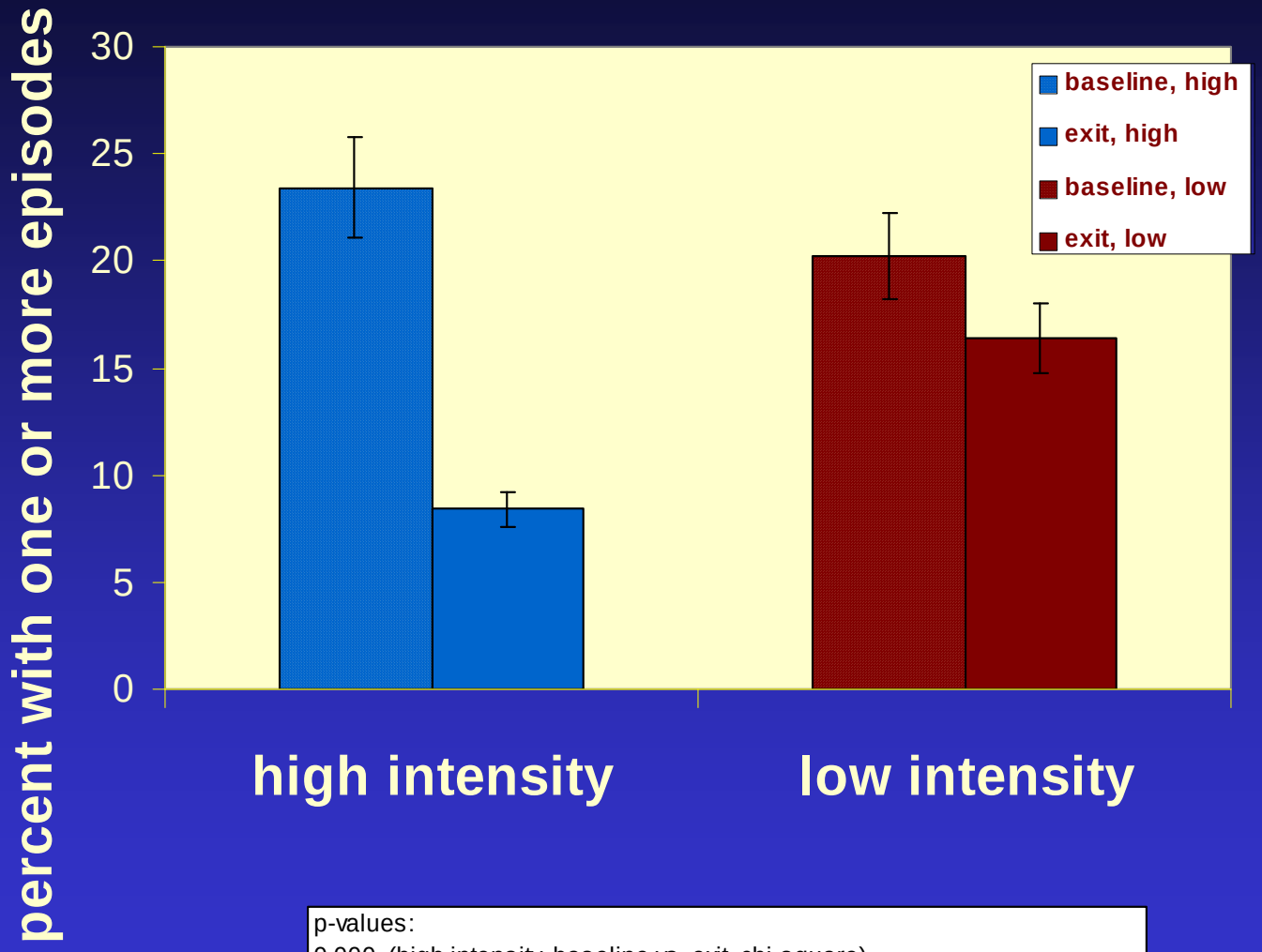
- Allergy control bedding covers
- Low-emission vacuum cleaner with dirt finder sensor
- 1-Year supply of microfiltration vacuum bags
- Commercial doormat
- Cleaning supplies (green kit, mop, pail, scrub brushes, bleach)

# Community Health Worker Home Visits

- Promote tenant-landlord communication
- Liaison with Housing Authority
- Provide social support
- Offer advocacy/referral (housing, food, furniture, jobs, etc.)
- CHWs are from participating communities, receive rigorous training, and have personal experience with asthma

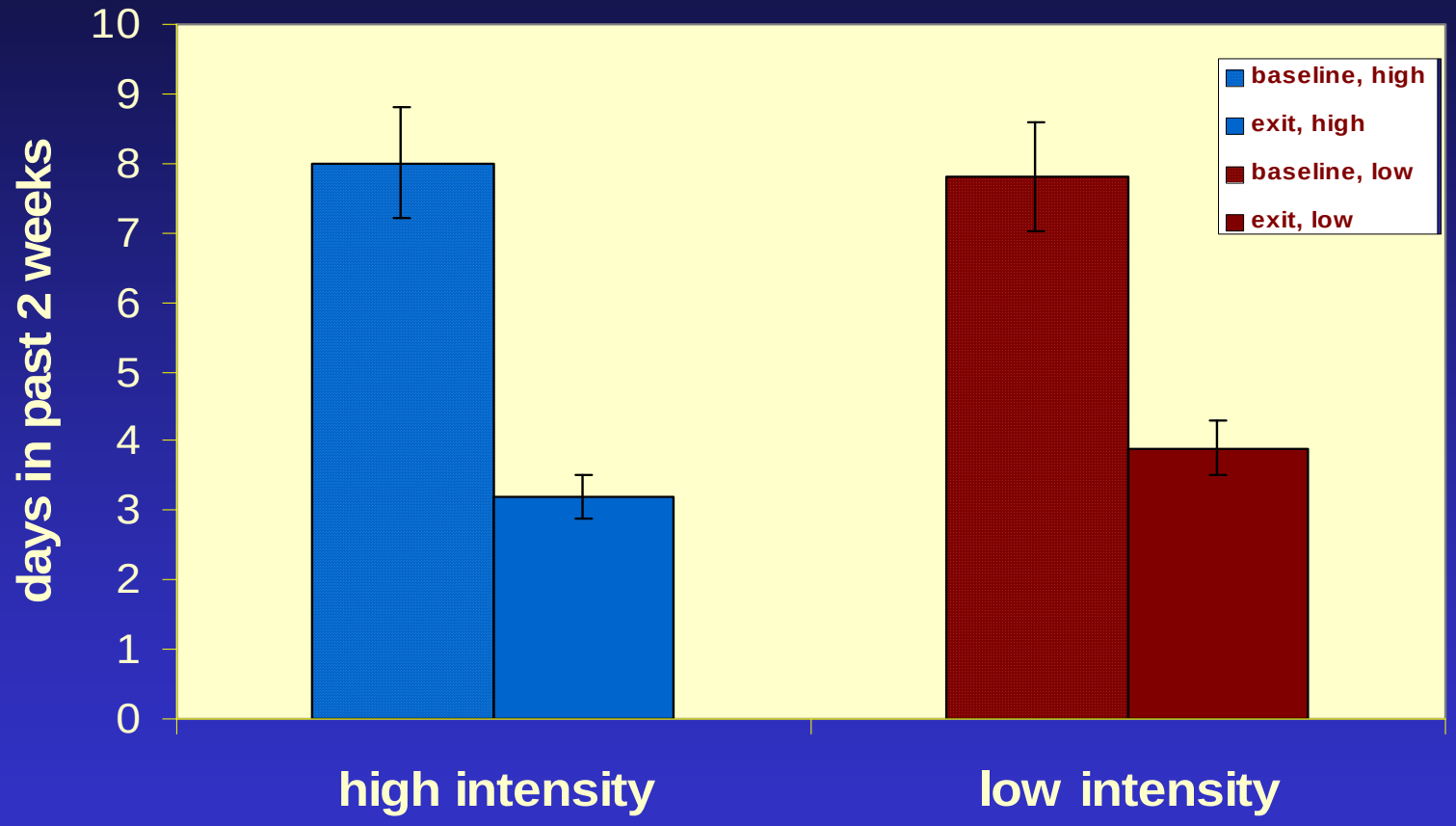
# CHW on the job....

# Outcome: Urgent Health Services



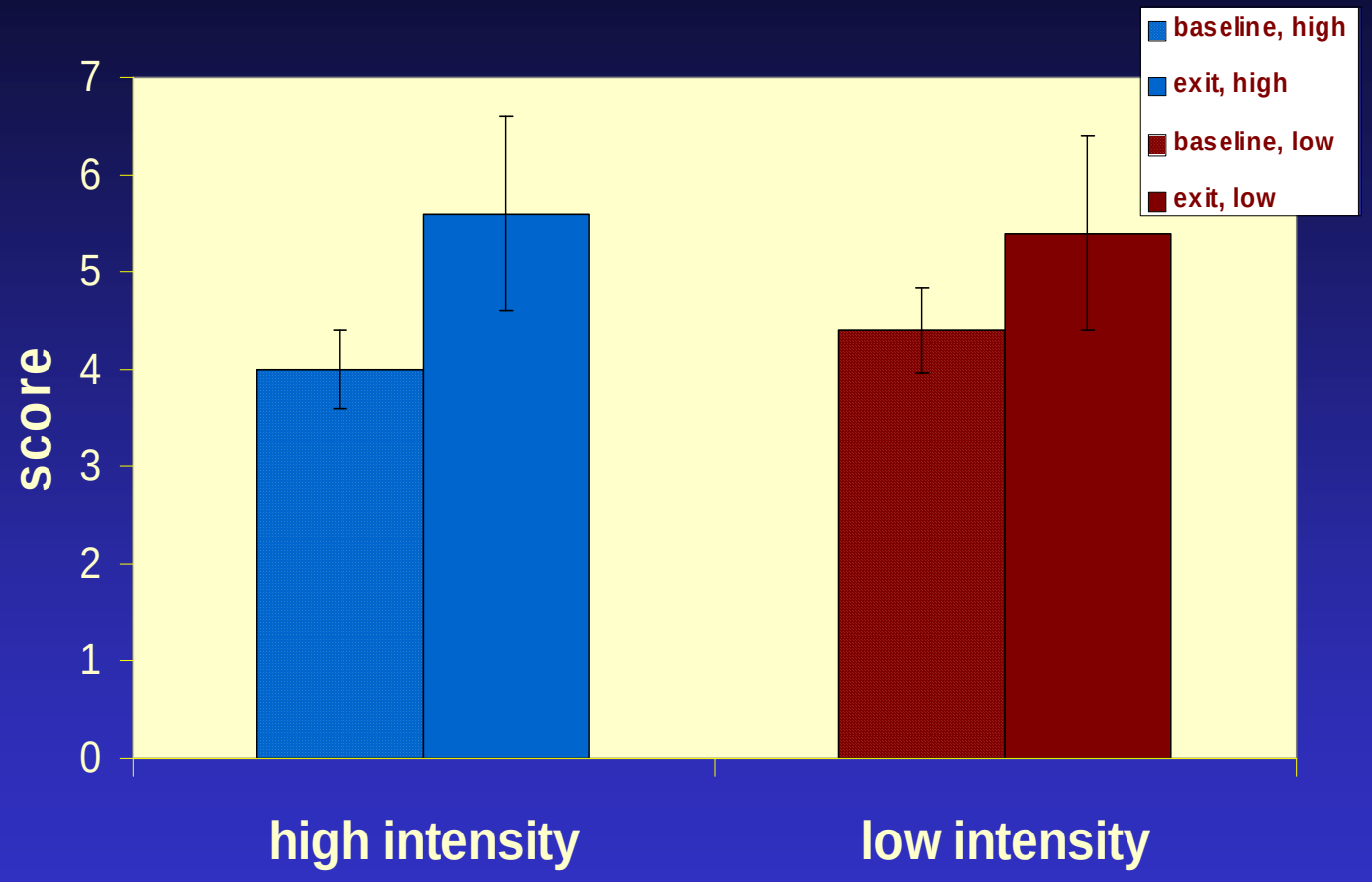

p-values:
0.000 (high intensity, baseline vs. exit, chi-square)
0.414 (low intensity, baseline vs. exit, chi-square)
0.041 (exit, low vs. high intensity, regression adjusted for baseline score)

# Outcome: Symptom Days



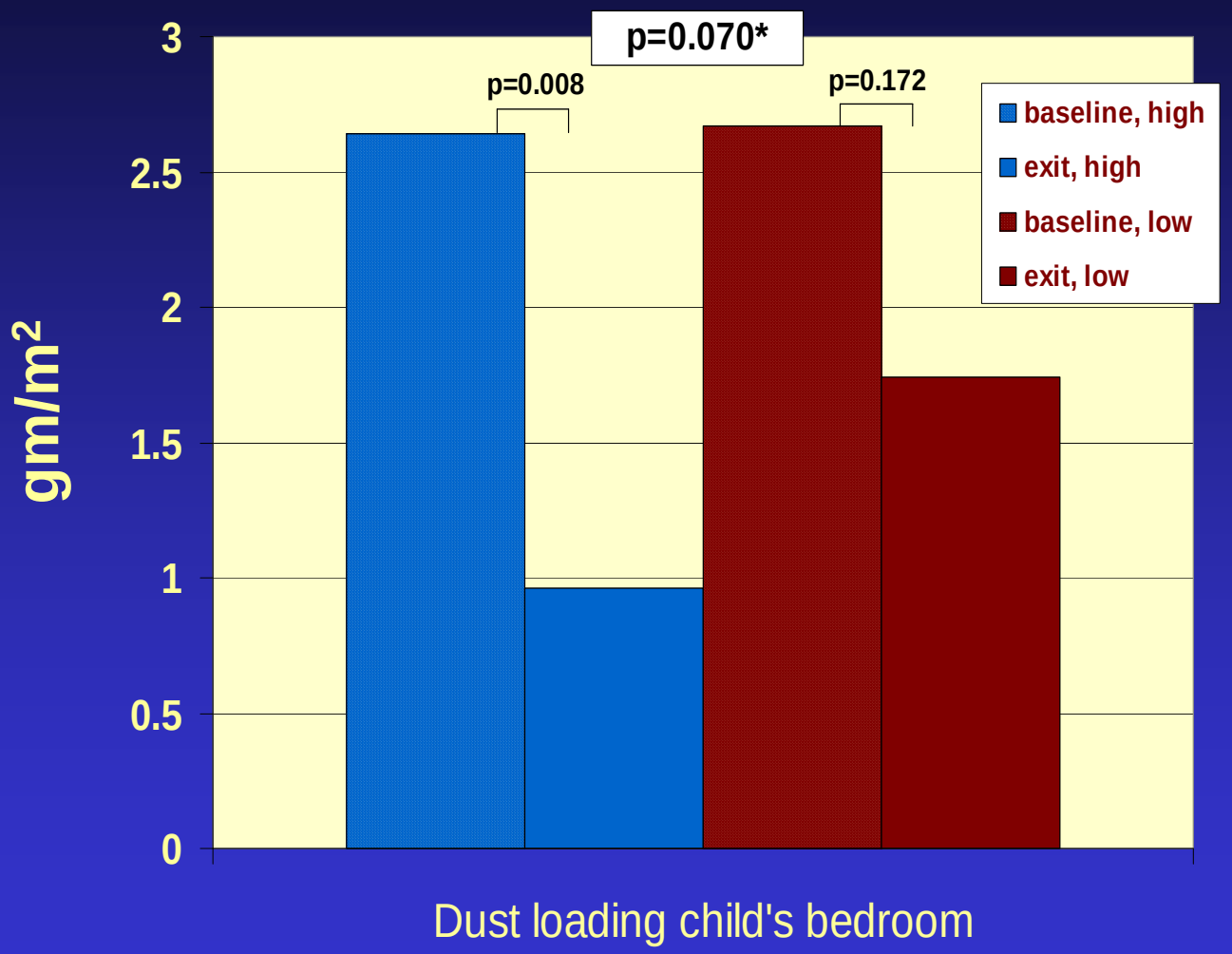

p-values:
0.000 (high intensity, baseline vs. exit, chi-square)
0.000 (low intensity, baseline vs. exit, chi-square)
0.123 (exit, low vs. high intensity, regression adjusted for baseline score)

# Outcome: Caregiver Quality of Life




p-values:
0.000 (high intensity, baseline vs. exit, chi-square)
0.006 (low intensity, baseline vs. exit, chi-square)
0.001 (exit, low vs. high intensity, regression adjusted for baseline score)

# Outcome: Floor Dust Loading




* p value comparing high vs. low exit values after adjustment for baseline values using linear regression

# Summary

| Outcome | High Intensity | Low Intensity |
|---|---|---|
| Symptoms | ⇩ | ⇩ |
| Quality of Life | ⇧ | ⇧ |
| Urgent Utilization | ⇩ | |
| Behaviors to ⇩ Exposure | ⇧ | |
| Surface Dust Loading | ⇩ | |
| Allergen Loading | ⇩ (mite) | ⇩ (cat) |
| Moisture | ⇩ | |
| Trigger Knowledge | ⇧ | ⇧ |
| Trigger Score | ⇩ | |

# Outcome: Costs and Savings

- Program costs per client
  - High Intensity: $1345
  - Low intensity: $222
- Urgent medical care savings per client (12 months)
  - High intensity: $1205 - 2001
  - Low intensity: $1050 - 1786
- High vs. Low Intensity projected over 4 years
  - Marginal cost of high: $1127
  - Marginal savings in urgent medical care: $1316-1849
- Cost of fluticasone 220 ug: $1392/year

# Healthy Homes II

# Overview

- Home visits by Community Health Workers (mean 4.1)
- Address reduction of indoor triggers and improving self-management skills
- Comparison of addition of CHW in-home asthma support to clinic-based nurse-provided education
- RCT of 309 low-income households with children age 3-13 with persistent/poorly controlled asthma

# Home Visits

- CHW makes 3-5 visits over one year
- Asthma self-management skills
  - Medication use
  - Self monitoring
  - Action plan use
- Home environment assessment and trigger reduction
- Asthma Control Plan
- Motivational Interviewing
- Education and support
- Provider-patient communication
- Health system navigation
- Social support
- Advocacy/referral (housing, food, furniture, jobs, etc.)

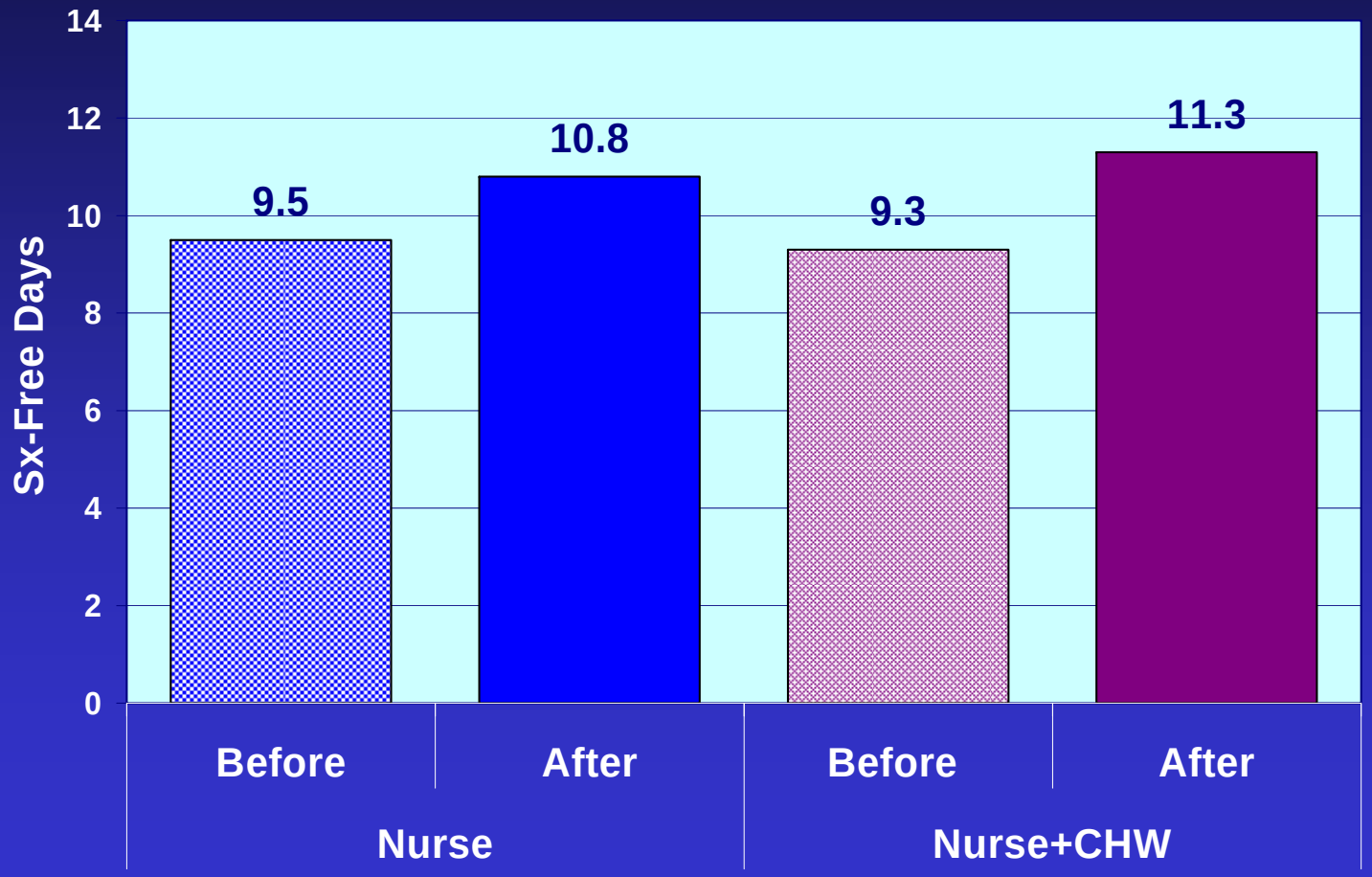
# Clinic-Based Education

- Received by all participants
- Initial assessment
- Average of 1 follow-up visit
- Asthma action plan
- Allergen-proof bedding covers for all participants

# Linkage to Primary Care

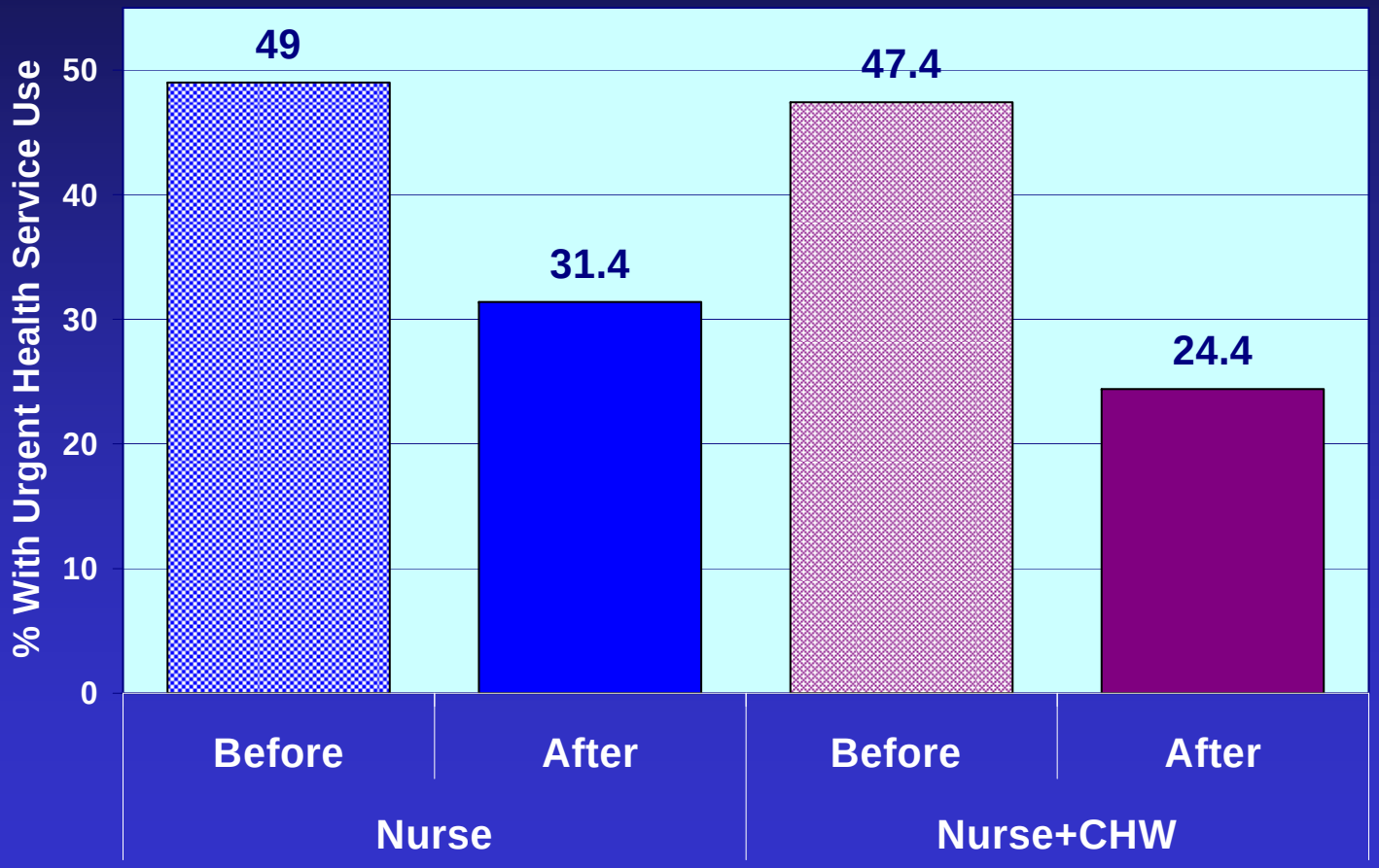
- CHWs send primary provider visit report
- Supervising nurse contacts provider as needed
- Providers can call, email or fax requests to CHWs
  - Assess medication adherence
  - Make appointment

# Symptom-Free Days



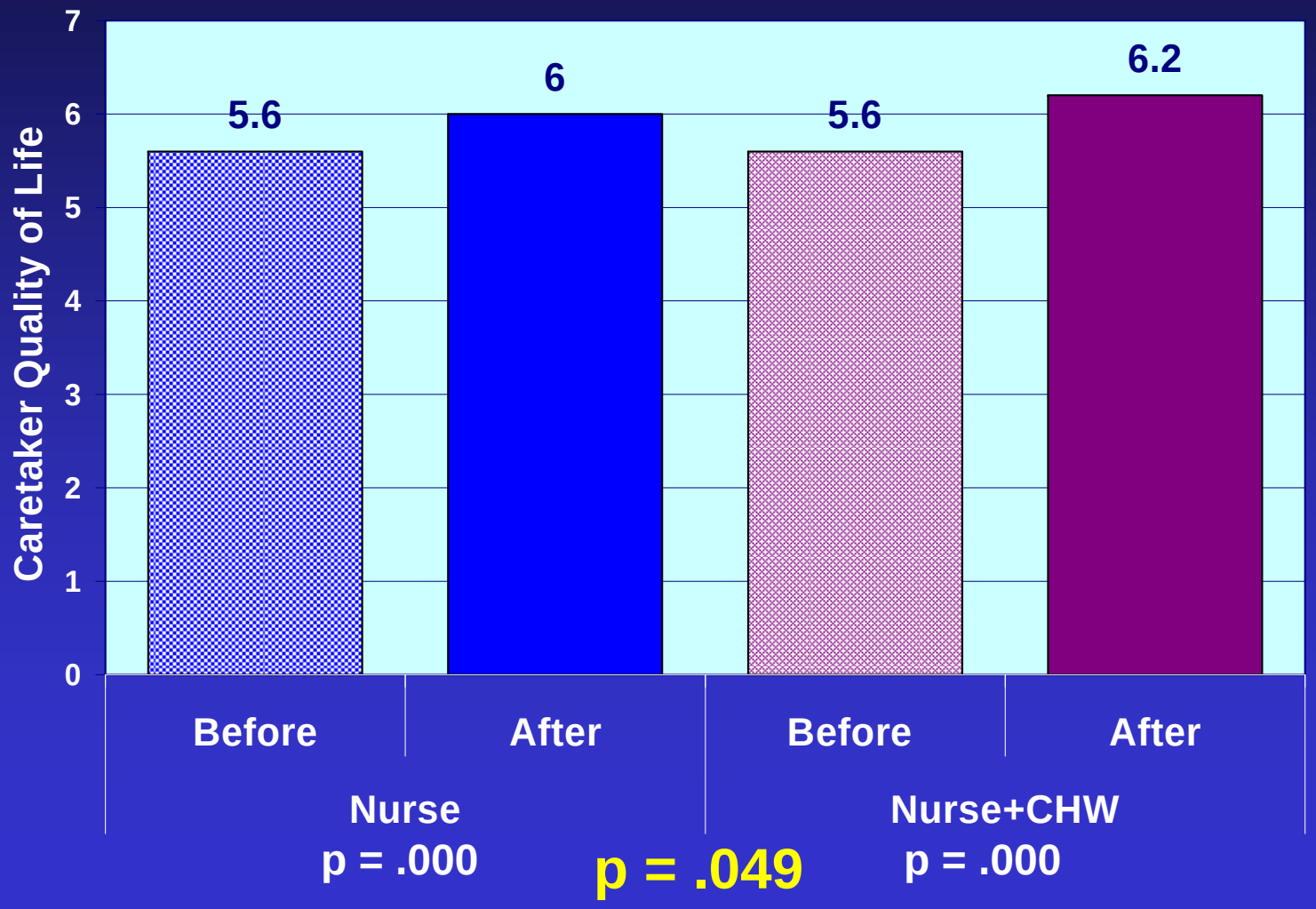

p = .003 p = .046 p = .000

# Urgent Health Services Use




p = .000 p = .228 p = .000

# Caretaker Quality of Life



# Summary

| Outcome | Nurse Only | Nurse + CHW |
|---|---|---|
| Symptoms | ⇩ | ⇩ |
| Quality of Life | ⇧ | ⇧ |
| Urgent Utilization | ⇩ | ⇩ |
| Actions to Control Asthma | ⇧ | ⇧ |
| Trigger Score | ⇩ | ⇩ |

# Breathe Easy Homes

# Housing Conditions and Disparities in Asthma

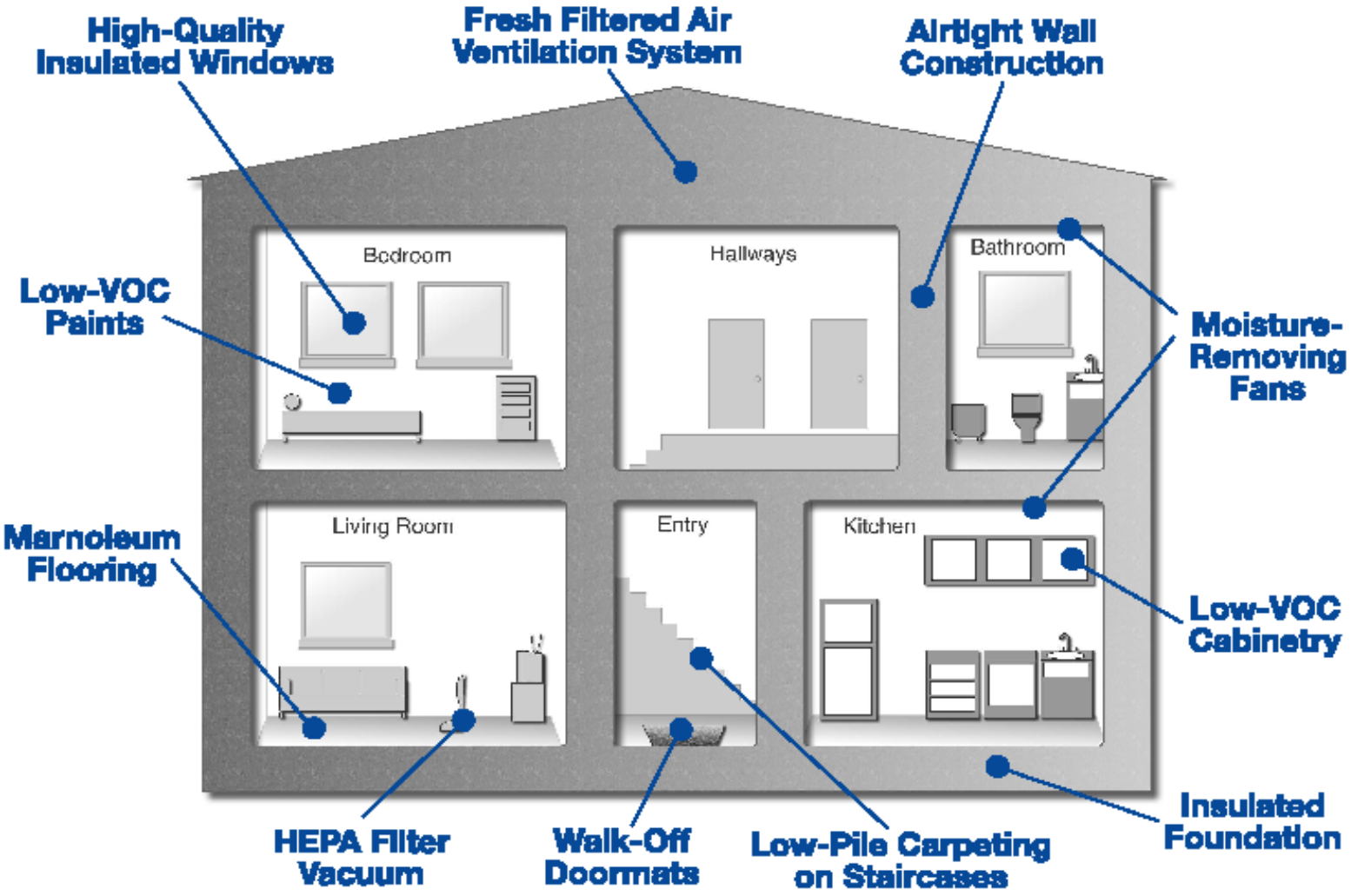
- Mold
- Moisture
- Leaks
- Pests
- Poor ventilation
- Carpeting
- Deteriorating structure

# Breathe Easy Homes:
## Building New Asthma-Friendly Homes

- Build 35 Breathe Easy units for children with asthma at High Point Public Housing site
  - Insulated slab to keep floor warm and dry
  - Exterior grade plywood (no OSB)
  - Airtight drywall with low-emission joint compound
  - Cement board exterior siding/rain screen
  - Low emission doors, trim, cabinets, finishes, adhesives
  - Hard surface floors (marmoleum)
  - Enhanced ventilation (HEPA whole house continuous fan, kitchen/bath fans with timers)
  - Radiant/Hydronic baseboard heat to decrease humidity

Old High Point Housing

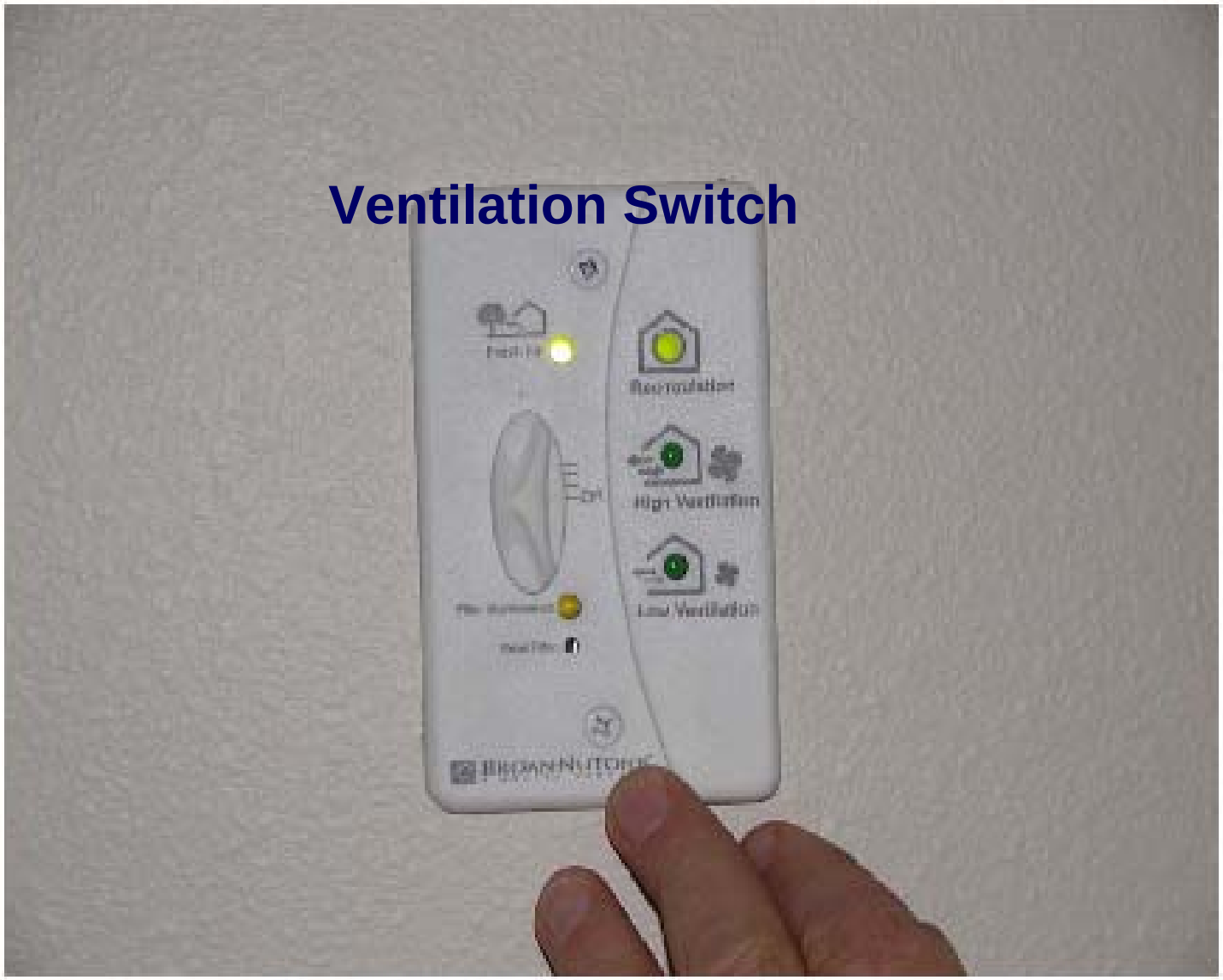
New High Point Breathe Easy Home




# HIGH POINT BREATHE EASY HOMES

FB1 T2

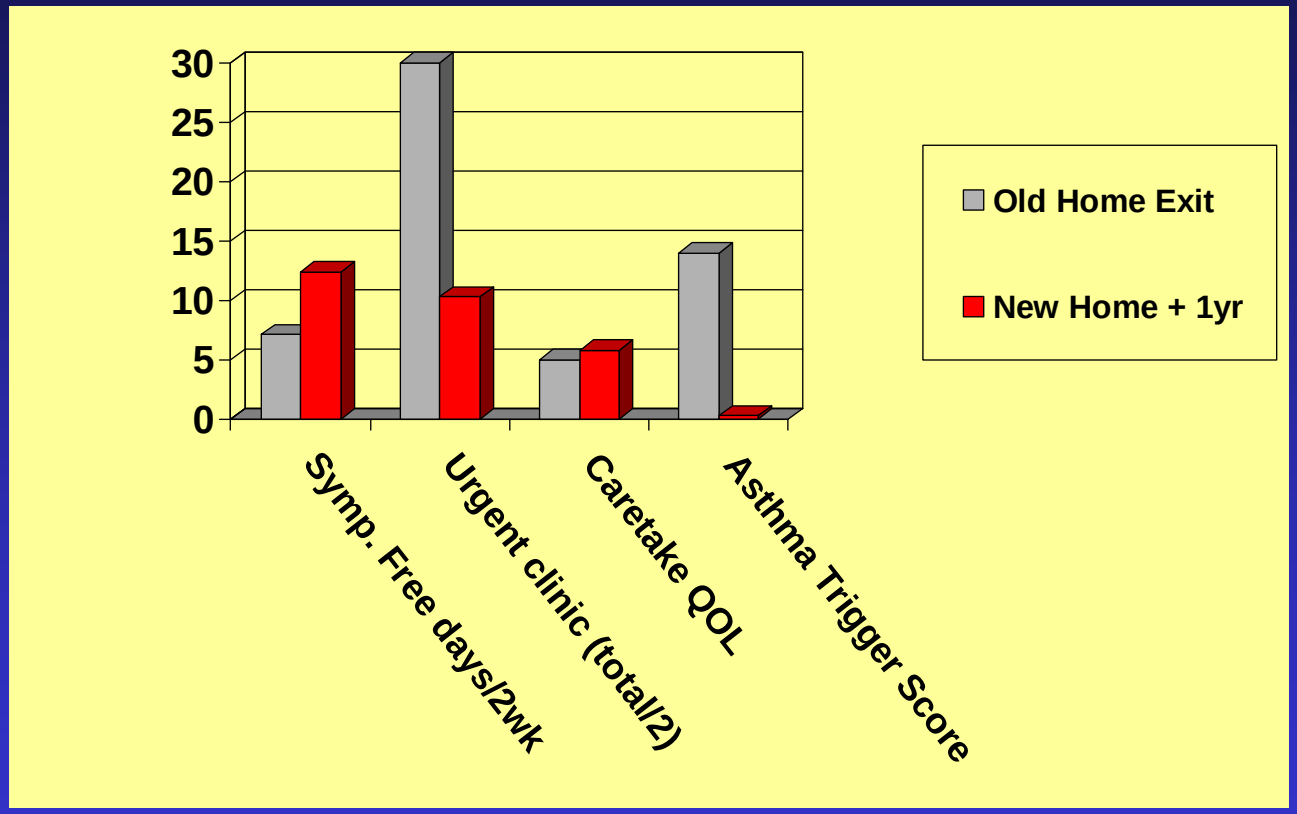
# Ventilation Switch



# Breathe Easy Homes:
# Providing Resident Support

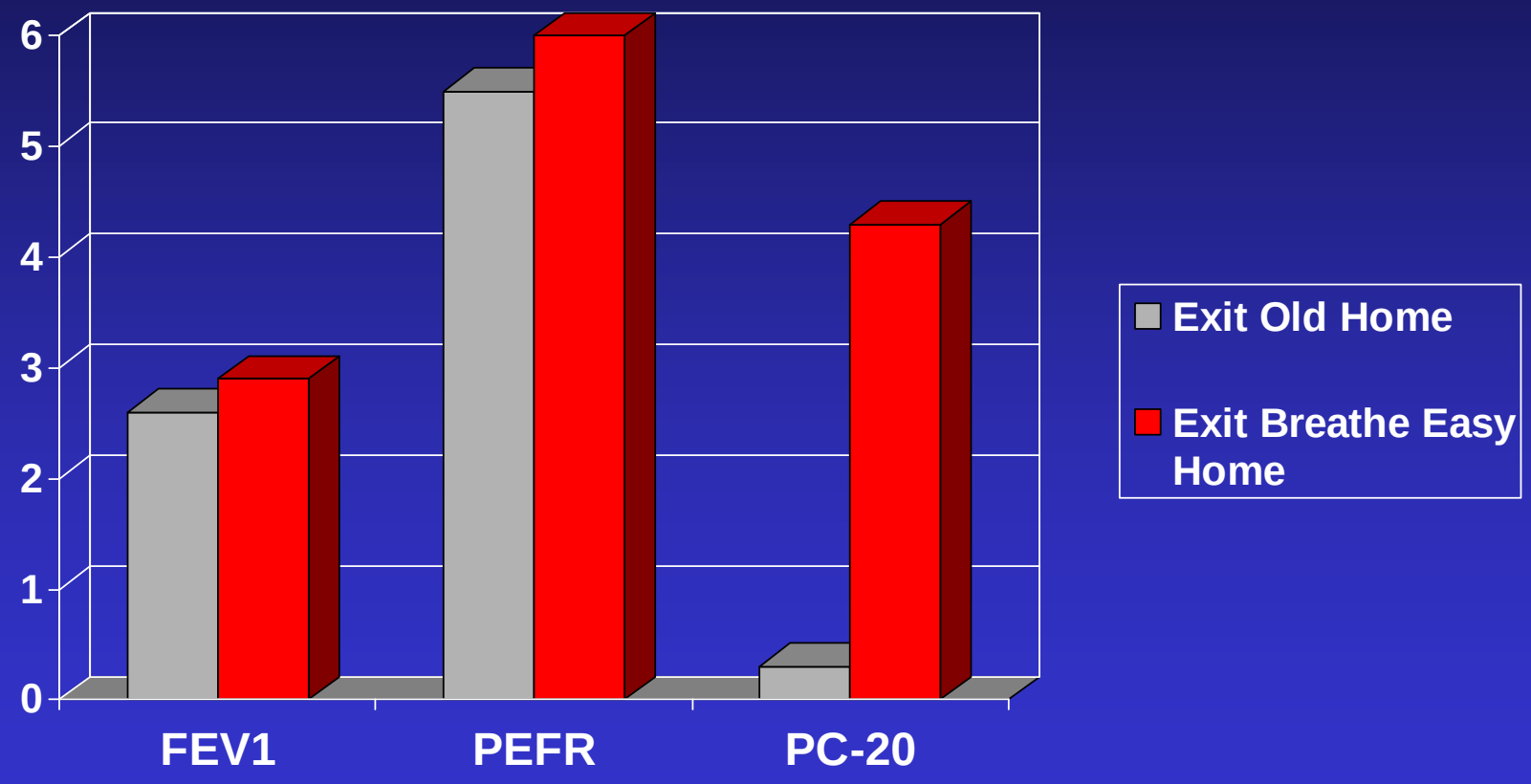
- Community Health Worker visits to teach how to maintain new home
- Resources: vacuums, cleaning supplies, steam cleaning of furniture
- Mutual housing agreements
  - No smoking, pets
  - Use of ventilation
  - SHA maintenance

# Clinical Outcomes



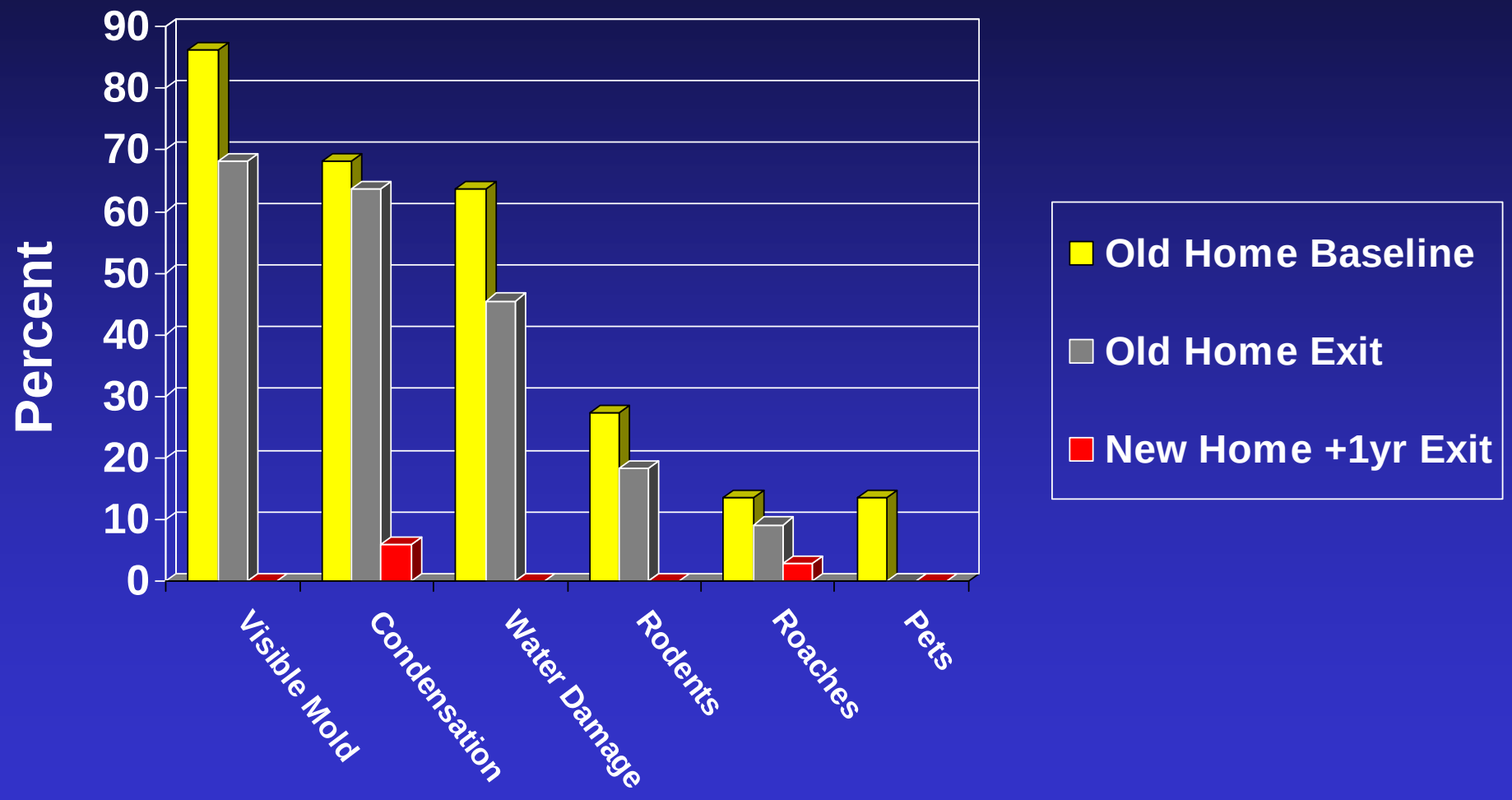

* $p < 0.004$ Old Home to New Home +1 yr.

# Breathing Tests

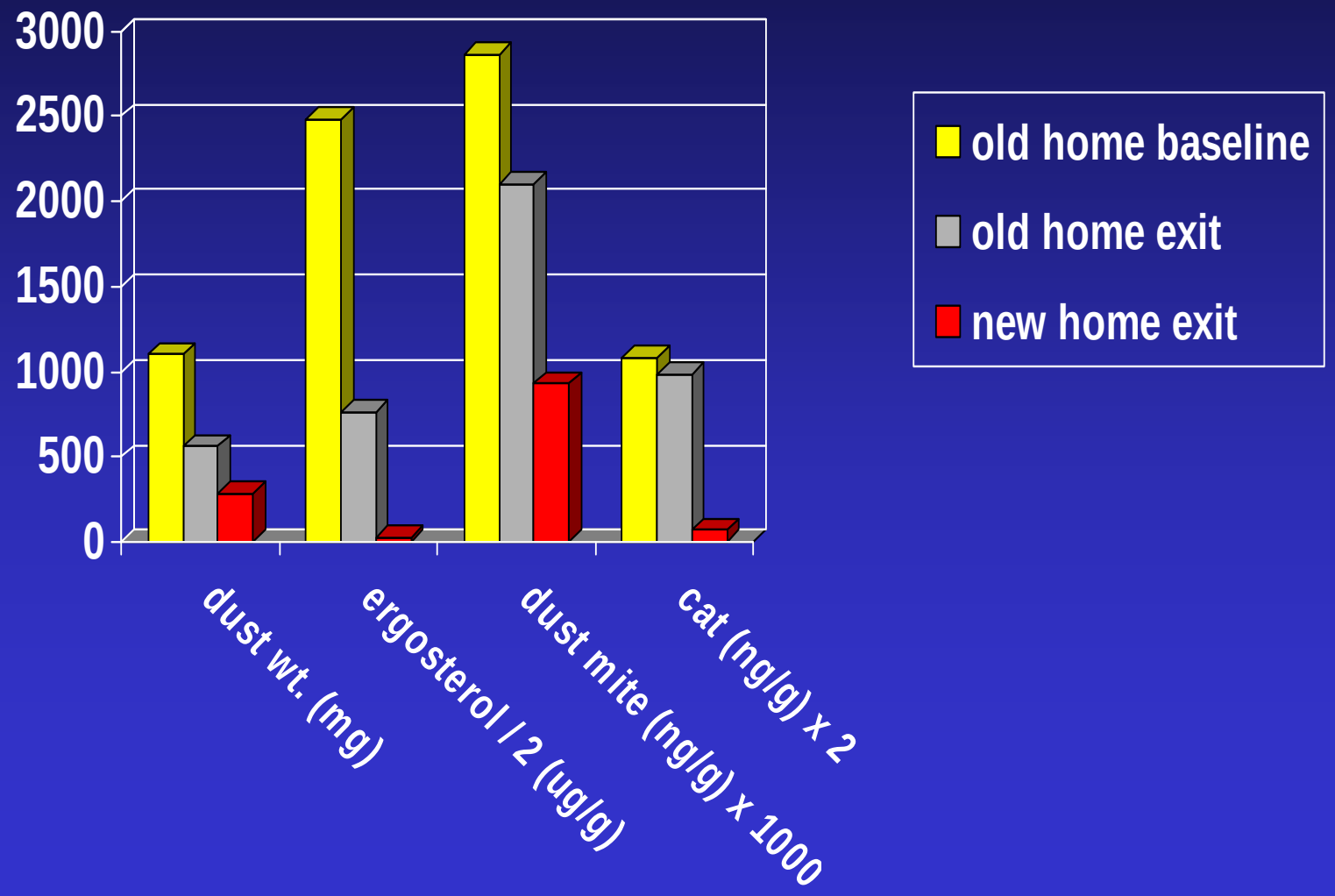



p = 0.002 p = 0.003 p = 0.051

# Observational Measures



# House Dust Measures
## Child's Bedroom Floor



# Limitations

- Findings apply to low-income children
- Need more information about durability of effects
- Pre-post design of BEH
- Unable to “unpack” intervention components to determine which are most important

# Conclusions

- Home visits by CHWs that address indoor trigger exposure improve asthma outcomes
- Addition of home visits by CHWs to clinic-based education improves asthma outcomes
- CHW home visits added 24 more symptom-free days per year
- Benefits in quality of life and urgent health service use were more modest

# Conclusions

- Offering CHW home visits is a promising strategy for reducing asthma disparities
- Offering families a choice of options for self-management support may be optimal
  - Home visits
  - 1:1 clinic-based education
  - Group activities

# Next Steps

- HomeBASE
- Medicaid Demonstration Project
- Translational research
- Building more BEH at High Point

# It Works…
# but How to Sustain and Spread It?

- Use evidence to encourage others to adopt the model
  - National Asthma Guidelines (EPR-3)
  - Community Guide
- Use evidence to encourage funders to pay for the service
  - WA State Medicaid Agency

# Clinical Outcomes

| Asthma Questionnaire Endpoints | Old Home | New Home | Δ | |
|---|---|---|---|---|
| | n= 35 | n= 34 | Δ | p |
| Symptom-free days / 2 weeks | 7.6 | 12.4 | +4.8 | .004 |
| Caretaker quality of life | 5.0 | 5.8 | +0.8 | .002 |
| Urgent clinical care (% in past 3 months) | 61.8 | 20.6 | -41.2 | .002 |
| Rescue medicine use/2 weeks (mean) | 6.0 | 1.9 | -4.1 | 0.0002 |
| Controller use/2 weeks (mean) | 8.6 | 6.5 | -2.1 | 0.073 |
| Activity limitation days/2 weeks (mean) | 4.0 | 1.2 | -2.8 | 0.010 |
| Symptom nights/2 weeks (mean) | 4.5 | 1.0 | -3.5 | 0.001 |
| Asthma attacks/3 months (mean) | 6.0 | 1.1 | -4.9 | 0.007 |

BUILDING A FRAMEWORK FOR HEALTHY HOUSING

2008 National Healthy Homes Conference

# *New Orleans Pediatric Asthma Study*: Results of a Home-Based Intervention for Children with Asthma

*Felicia Rabito, Elizabeth Holt, Shahed Iqbal*

Tulane University
School of Public Health and Tropical Medicine

*a global commitment to public health*

# New Orleans Pediatric Asthma Study

- Goal of the study:
  - To test whether a multifaceted home-based intervention, tailored to children's sensitization status and potential exposure, could reduce asthma morbidity in a population of inner-city asthmatic children *ages 4 to 17 years*.

# New Orleans Pediatric Asthma Study

- **Study Design**
  - A randomized controlled intervention trial
    - 9 home visits over 4 months
    - 2 sustainability visits for a subgroup of participants

- **Inclusion Criteria**
  - 4 – 17 years of age
  - Resident of New Orleans
  - Doctor diagnosed asthma
  - Reside in current home at least 3 months
  - Positive skin test for any indoor allergen (medical record evidence)
  - No plans to move for next 8 months
  - Family kept last 2 clinic appointments

# New Orleans Pediatric Asthma Study

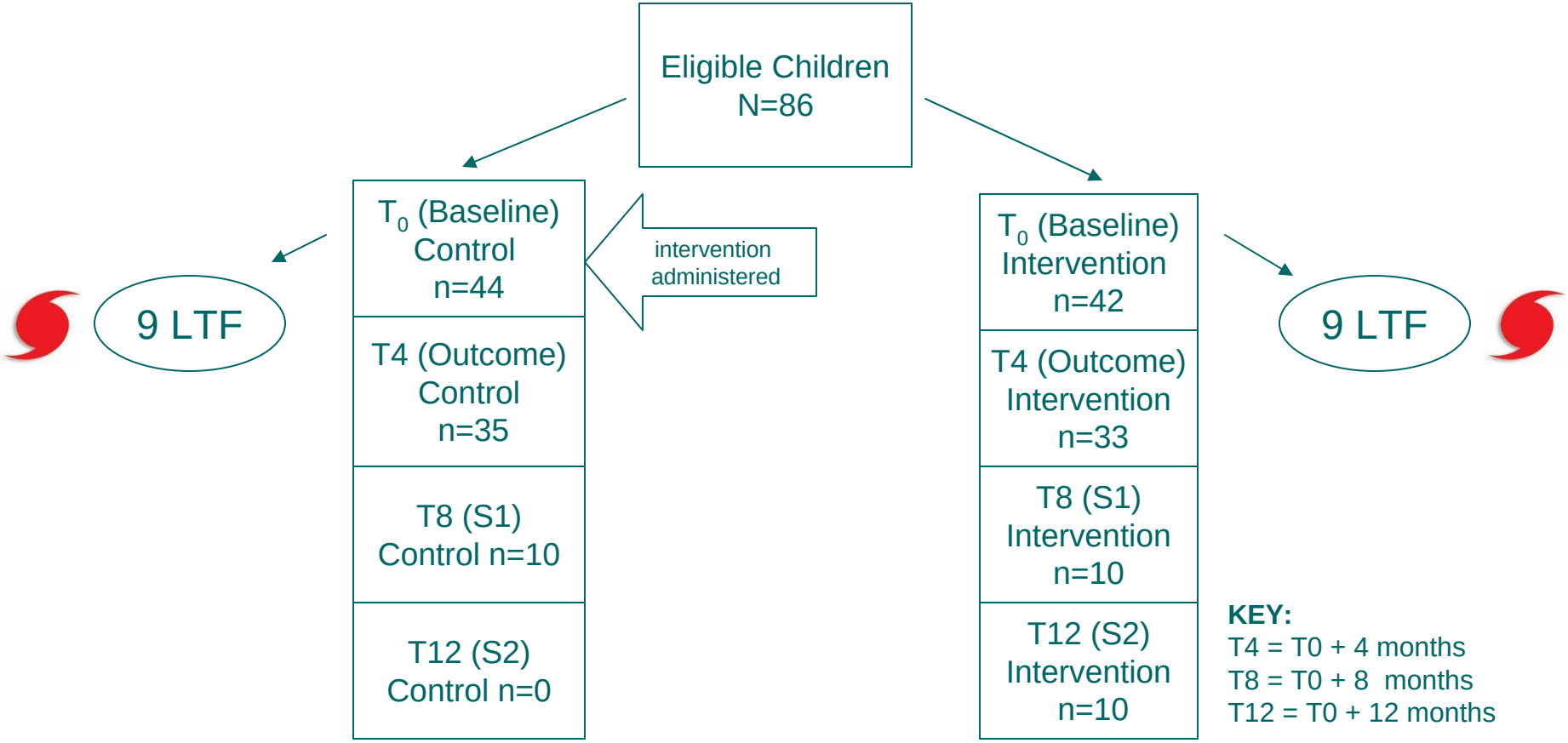
- **Baseline activities**:
  - Environmental sampling
  - Blood sample
  - Resident questionnaire / knowledge tests administered
  - Visual observation
  - Peak flow / FEV
- **Intervention activities** (tailored based on results of environmental and biologic sampling) :
  - Mattress and pillow covers provided with demonstration on proper use.
  - Dusting, mopping, and cleaning material provided with instructions and demonstration on proper use.
  - Gel bait, food storage containers, covered trash can provided with instructions and demonstration on proper use.
  - Vacuum cleaner (HEPA filter) provided with instructions and demonstration on proper use.
  - Mold cleaning materials provided with instructions and demonstration on proper use.

# New Orleans Pediatric Asthma Study

- Recruitment Sites
  - Medical Center of Louisiana Asthma and Allergy Clinic
  - Tulane Allergy Clinic
  - Children's Hospital
  - LSU Lion's Clinic

# Results

# Study Flowchart




**KEY:**
T4 = T0 + 4 months
T8 = T0 + 8 months
T12 = T0 + 12 months

# Baseline Characteristics of the Study Population

| Demographic Characteristics | Intervention n=42 | Control n=44 |
|---|---|---|
| Age of child | 9.0(2.9) | 9.3(3.7) |
| Male gender | 31(75.6) | 24(54.6) |
| Caretaker Employed at Baseline | 28(66.7) | 32(72.7) |
| Household Income | | |
| Less than 10,000 | 24(58.5) | 26(61.4) |
| $10,000 to $15,000 | 6(14.6) | 6(13.6) |
| $15,001 to $25,000 | 4(9.8) | 6(13.6) |
| $ 25,001 to $50,000 | 3(7.3) | 4(9.1) |
| Refused to answer | 3(7.3) | 1(2.3) |
| Race / Ethnicity | | |
| African American | 42(95.5) | 42(97.6) |
| White | 2(4.6) | 0(0.0) |
| Other | 0(0.0) | 1(2.4) |

# Baseline characteristics : allergies and asthma

| Allergies and Asthma | Intervention n=42 | Control n=44 |
|---|---|---|
| Positive Skin Tests | | |
| Dust Mite Allergen (Der p1 or Der f1) | 34(80.9) | 37(84.1) |
| Cat Dander | 11(26.2) | 11(25.0) |
| Dog Dander | 9(21.4) | 10(22.7) |
| Cockroach | 21(50.0) | 25(56.8) |
| Mold | 2(52.4) | 20(45.5) |
| more than 1 allergen | 29(69.1) | 35(79.6) |
| Sibling with asthma | 22(28.6) | 8(18.2) |
| Asthma-related Symptoms and health care use* | | |
| 16 or more days with wheezing episodes | 7(16.7) | 3(6.8) |
| Asthma-related Health Care | | |
| 1 or more Emergency Room Visit* | 20(47.6) | 28(63.6) |
| 1 or more Hospital Admission* | 9(21.4) | 12(27.3) |
| 1 or more Urgent Physician Visit* | 28(66.7) | 34(77.3) |
| Ever admitted to the ICU for asthma | 9(21.4) | 12(27.3) |

# Baseline characteristics: lead and allergens

| Exposure and Sensitization Status | Intervention | Control |
|---|---|---|
| Blag 1 exposed (define) | 12(35.3) | 20(51.3) |
| Der p 1 exposed | 7(17.5) | 11(26.3) |
| Der f 1 exposed | 8(20.0) | 13(30.2) |
| | | |
| Blag1 sensitized | 15(35.7) | 20(45.5) |
| Der f 1 sensitized | 32(72.7) | 36(76.2) |
| Der p 1 sensitized | 33(76.6) | 31(70.5) |
| **Blood Lead Levels** | | |
| Blood Lead Levels >10 MCG/DL | 0(0.0) | 0(0.0) |
| Blood Lead Levels >5 MCG/DL | 3(7.1) | 9(20.5) |
| Blood Lead Levels >3 MCG/DL | 12(28.6) | 22(50.0)* |
| | | |
| **Soil Lead Levels** | | |
| Soil Lead >400 ppm | 6(14.3) | 8(18.2) |
| Soil Lead >1200 ppm` | 2(4.8) | 3(6.8) |
| | | |
| **Indoor Lead Dust Levels** | | |
| Bedroom Floor >40 ug/g | 4(14.8) | 2(7.1) |
| Bedroom Sill >250 ug/g | 6(15.4) | 3(7.1) |
| Kitchen Floor >40 ug/g | 2(4.8) | 5(11.6) |
| Kitchen Sill >250 ug/g | 7(18.9) | 6(17.1) |
| Living Room Floor >40 ug/g | 3(9.4) | 3(8.1) |
| Living Room Sill >250 ug/g | 4(9.8) | 3(7.3) |

# Baseline characteristics of participants LTF

| Demographic Characteristics | Intervention n=9 | Control n=9 |
|---|---|---|
| Age of child (mean (± SD)) | 7.5(3.5) | 8.6(4.0) |
| Male gender | 5(55.6) | 5(55.6) |
| Caretaker Employed at Baseline | 7(77.8) | 6(66.7) |
| Household Income | | |
| Less than 10,000 | 4(44.4) | 8(66.7) |
| $10,000 to $15,000 | 1(11.1) | 1(11.1) |
| $15,001 to $25,000 | 2(22.2) | 0(0.0) |
| $ 25,001 to $50,000 | 0(0.0) | 0(0.0) |
| Refused to answer | 2(22.2) | 0(0.0) |
| Race / Ethnicity | | |
| African American | 8(88.9) | 89(88.9) |
| White | 0(0.0) | 1(11.1) |
| Other | 1(11.1) | 0(0.0) |

# Baseline allergy and asthma characteristics of participants LTF

| Allergies and Asthma | Intervention n=9 | Control n=9 |
|---|---|---|
| Positive Skin Tests | | |
| Dust Mite Allergen (Der p1 or Der f1) | 7(77.8) | 7(77.8) |
| Cat Dander | 3(33.3) | 2(22.2) |
| Dog Dander | 3(33.3) | 3(33.3) |
| Cockroach | 3(33.3) | 5(55.6) |
| Mold | 6(66.7) | 3(33.3) |
| more than 1 allergen | 6(66.7) | 6(66.7) |
| Sibling with asthma | 2(22.2) | 1(11.1) |
| Asthma-related Symptoms and health care use* | | |
| 16 or more days with wheezing episodes | 1(11.1) | 1(11.1) |
| Asthma-related Health Care | | |
| 1 or more Emergency Room Visit* | 4 (44.4) | 6(66.7) |
| 1 or more Hospital Admission* | 1(11.1) | 4(44.4) |
| 1 or more Urgent Physician Visit* | 5(55.6) | 6(66.7) |
| Ever admitted to the ICU for asthma | 0(0.0) | 1(11.1) |

# Intervention: Adherence

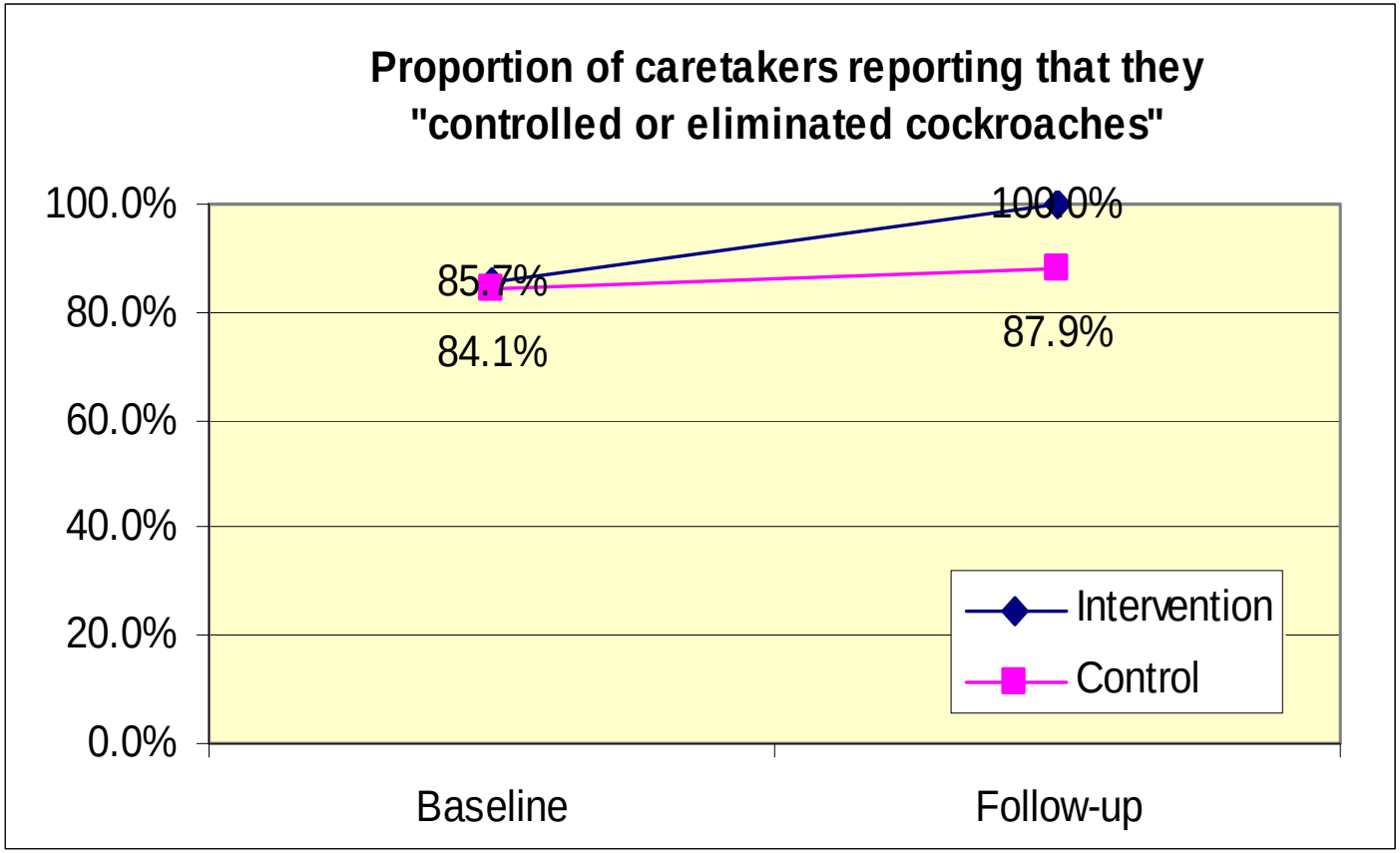
## Question #1: Did the intervention change participant behavior?

Were caretakers in the intervention group more likely than those in the control group to report that they:

- controlled or eliminated cockroaches
- used dust mite covers
- vacuumed their home
- cleaned up mold/mildew promptly

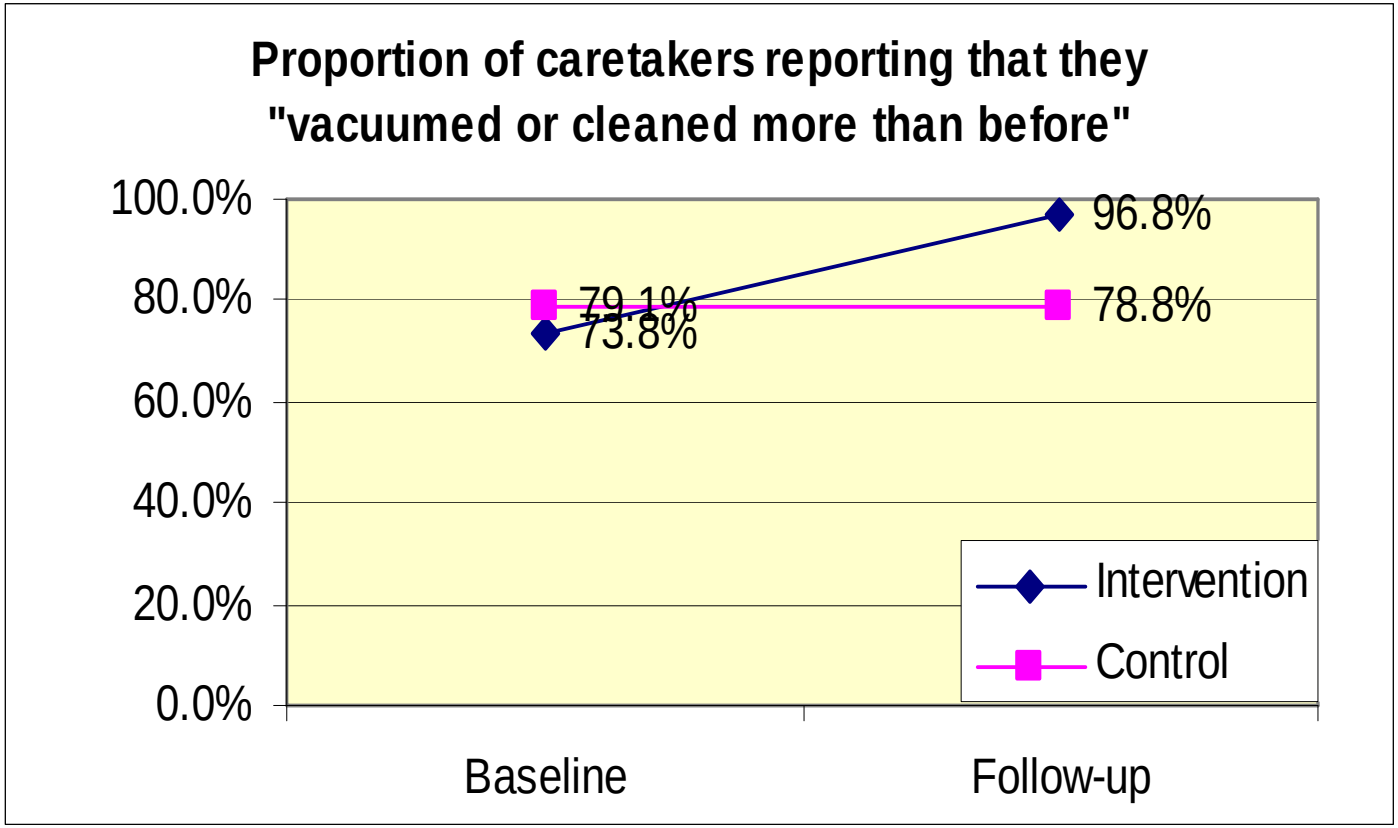
# Intervention: Adherence - Cockroach Control

***Have you done any of the following things around the house because of your child's asthma?***



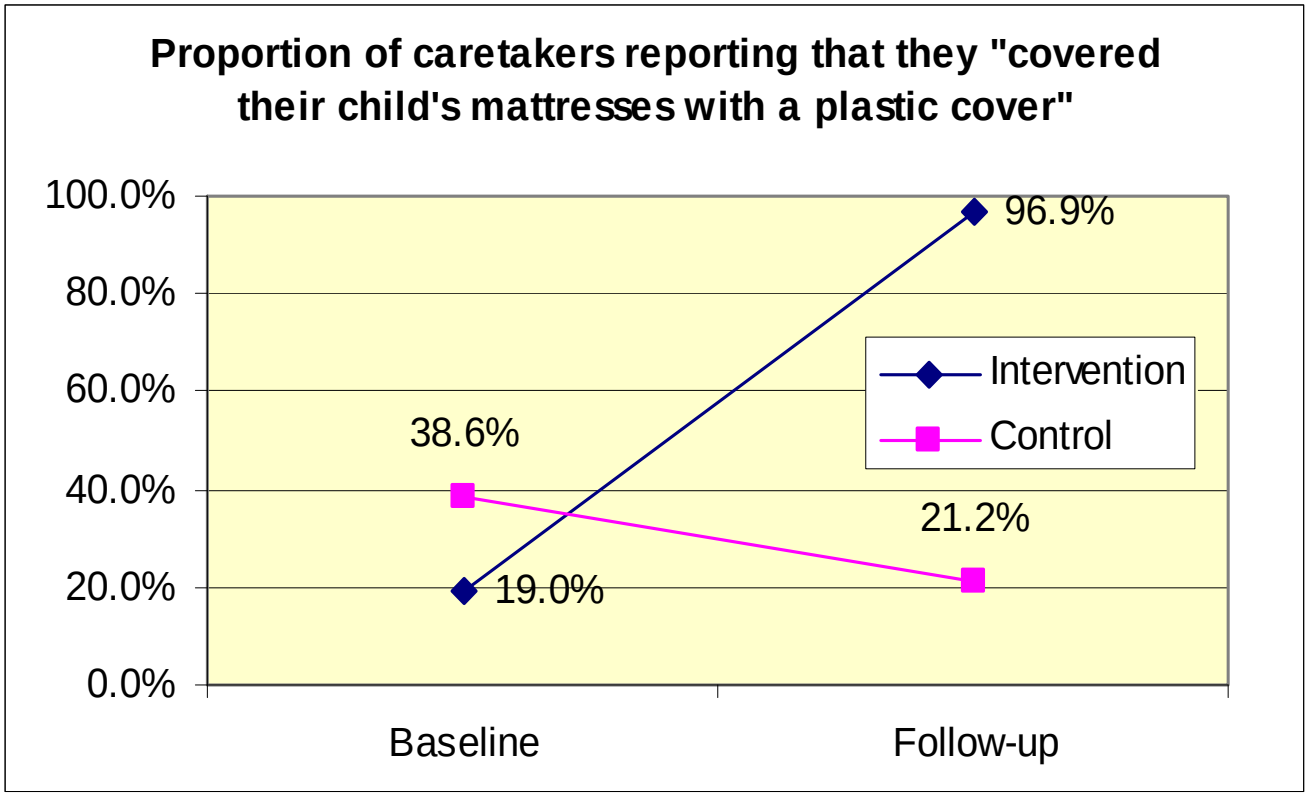
# Intervention: Adherence - Indoor Vacuuming

***Have you done any of the following things around the house because of your child's asthma?***



# Intervention: Adherence - Mattress Covers

***Have you done any of the following things around the house because of your child's asthma?***

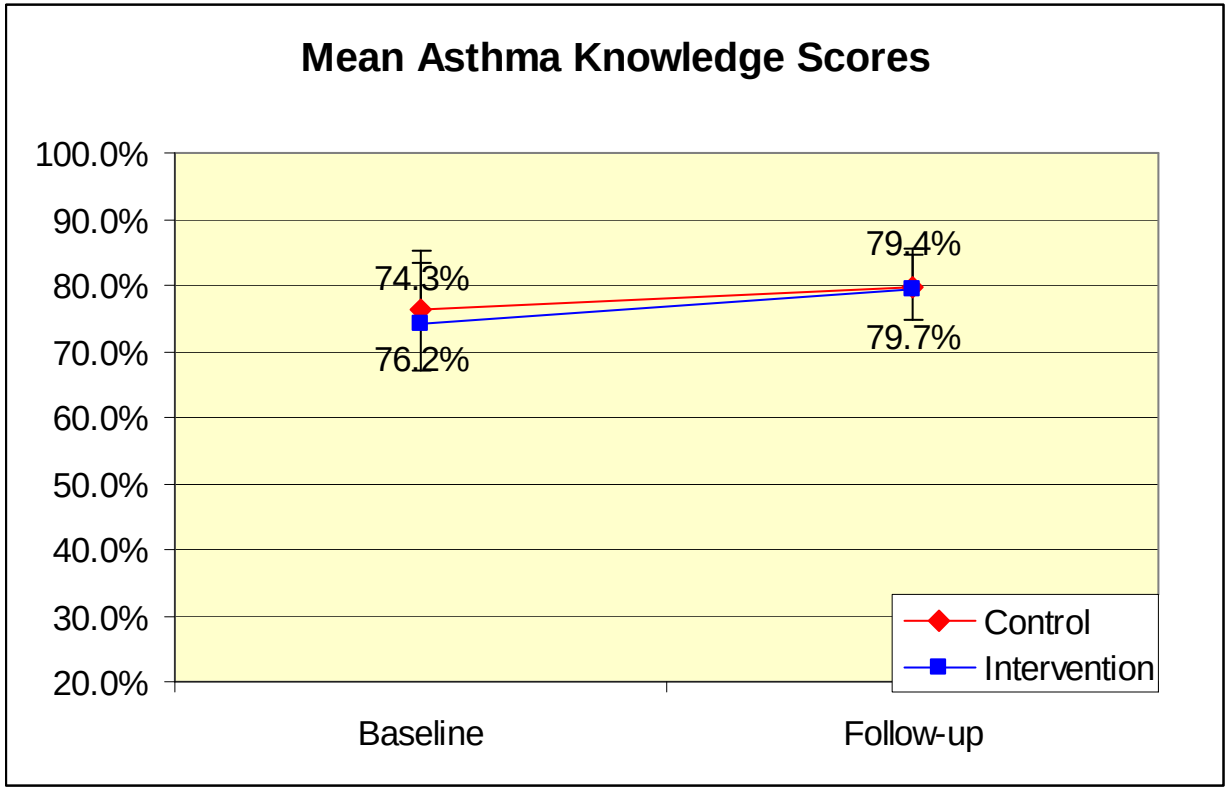


# Intervention: Knowledge

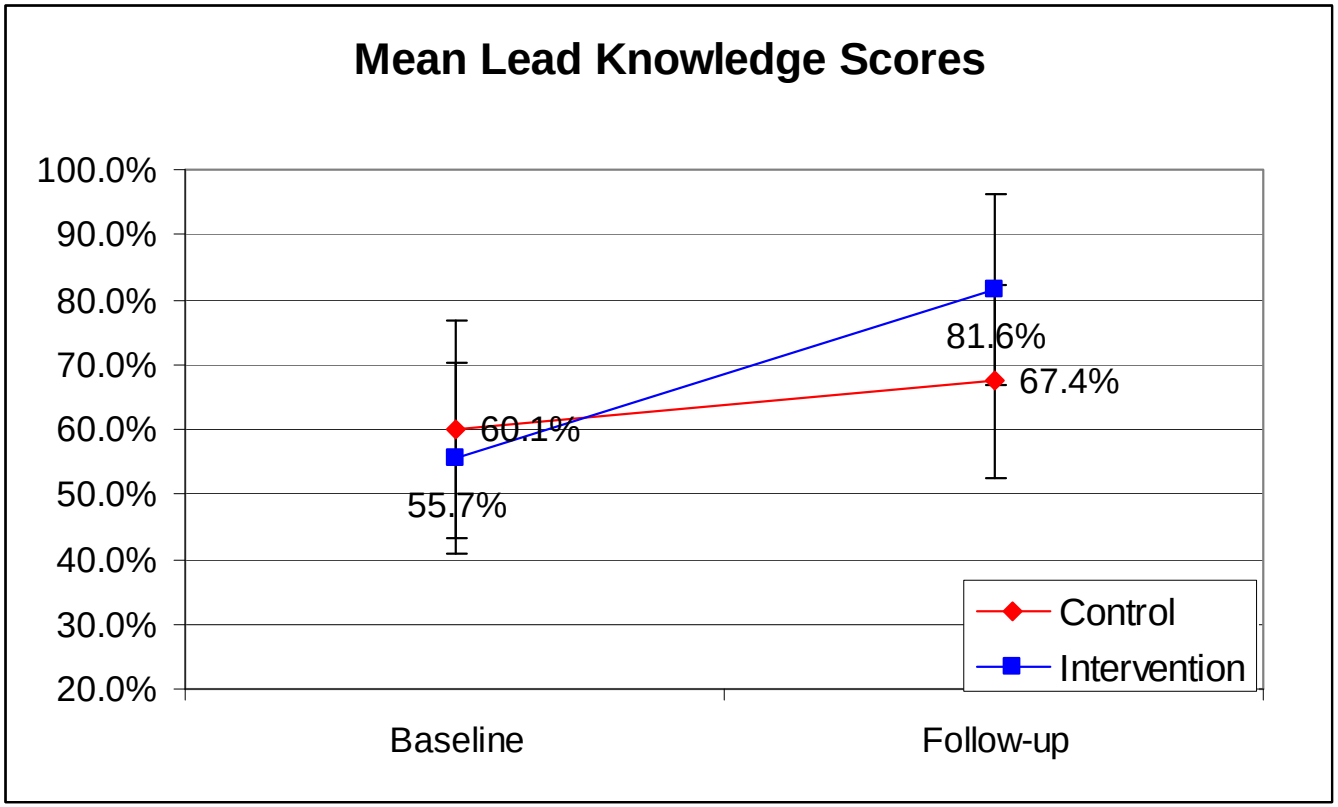
Question #2:

Did the intervention change participant knowledge of lead hazards and asthma?

# Intervention Adherence 4: Asthma Knowledge Scores



# Intervention: Lead Knowledge Scores

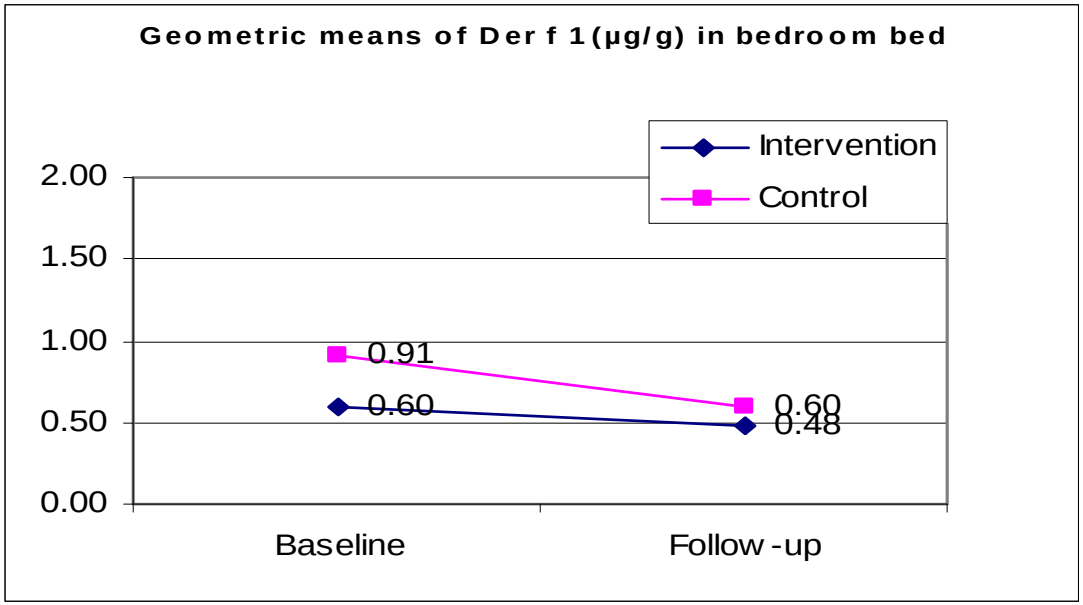


# Results: Environmental

# Environmental Results 1: Dust mite (Der f 1) allergen levels

Median (IQR) values for Der f 1 (µg/g) by time and intervention group

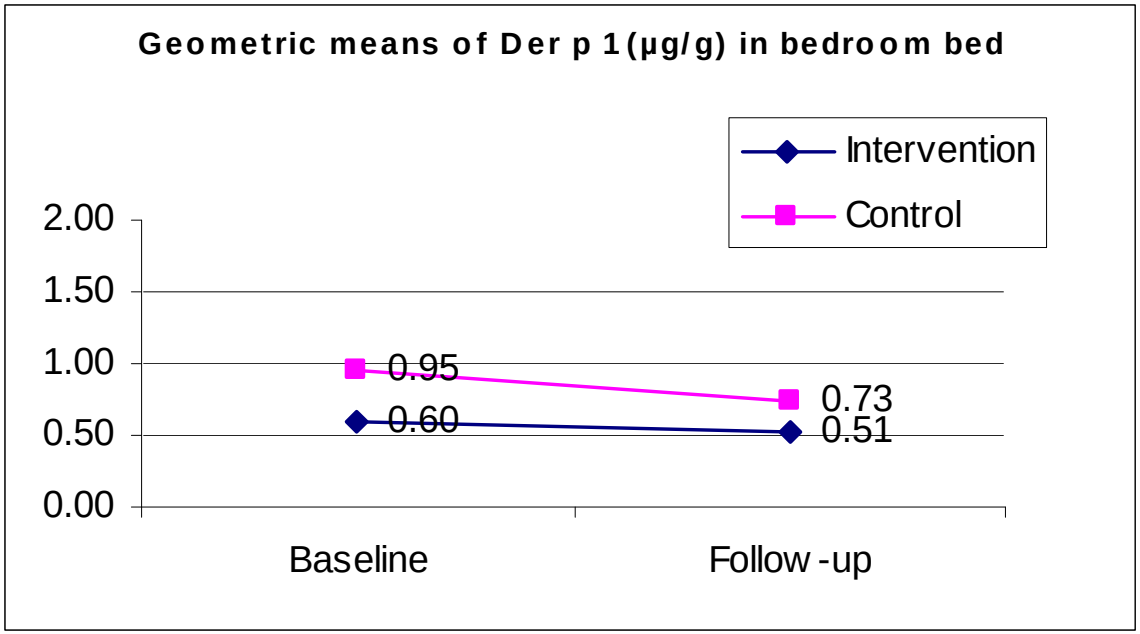
| | Control | | Intervention | |
|---|---|---|---|---|
| | **Baseline** | **Follow-up** | **Baseline** | **Follow-up** |
| Der f 1 Bedroom Bed | 0.8 (0.4, 2.5) | 0.5 (0.2, 1.9) | 0.7 (0.4, 1.7) | 0.4 (0.2, 0.9) |



# Environmental Results 2: Dust mite (Der p 1) allergen levels

Median (IQR) values for Der f 1 (µg/g) by time and intervention group

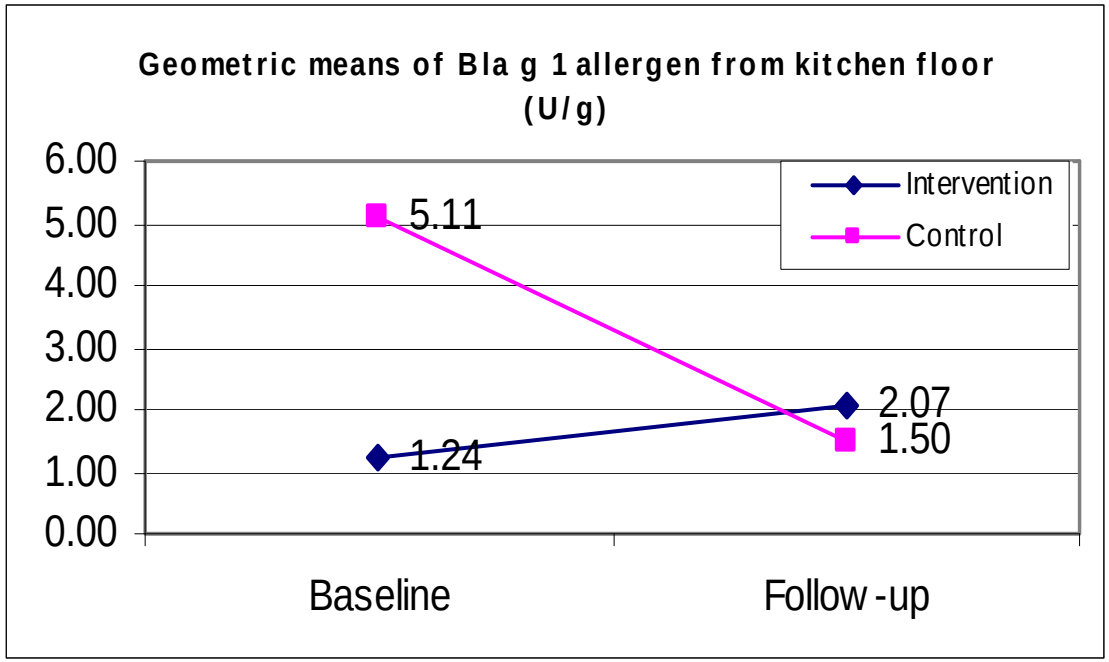
| | Control | | Intervention | |
|---|---|---|---|---|
| | Baseline | Follow-up | Baseline | Follow-up |
| Der p 1 Bedroom Bed | 0.6 (0.3, 2.3) | 0.4 (0.2, 1.1) | 0.5 (0.2, 1.6) | 0.4 (0.2,0.8) |



# Environmental Results 3: Cockroach (Bla g 1) allergen levels

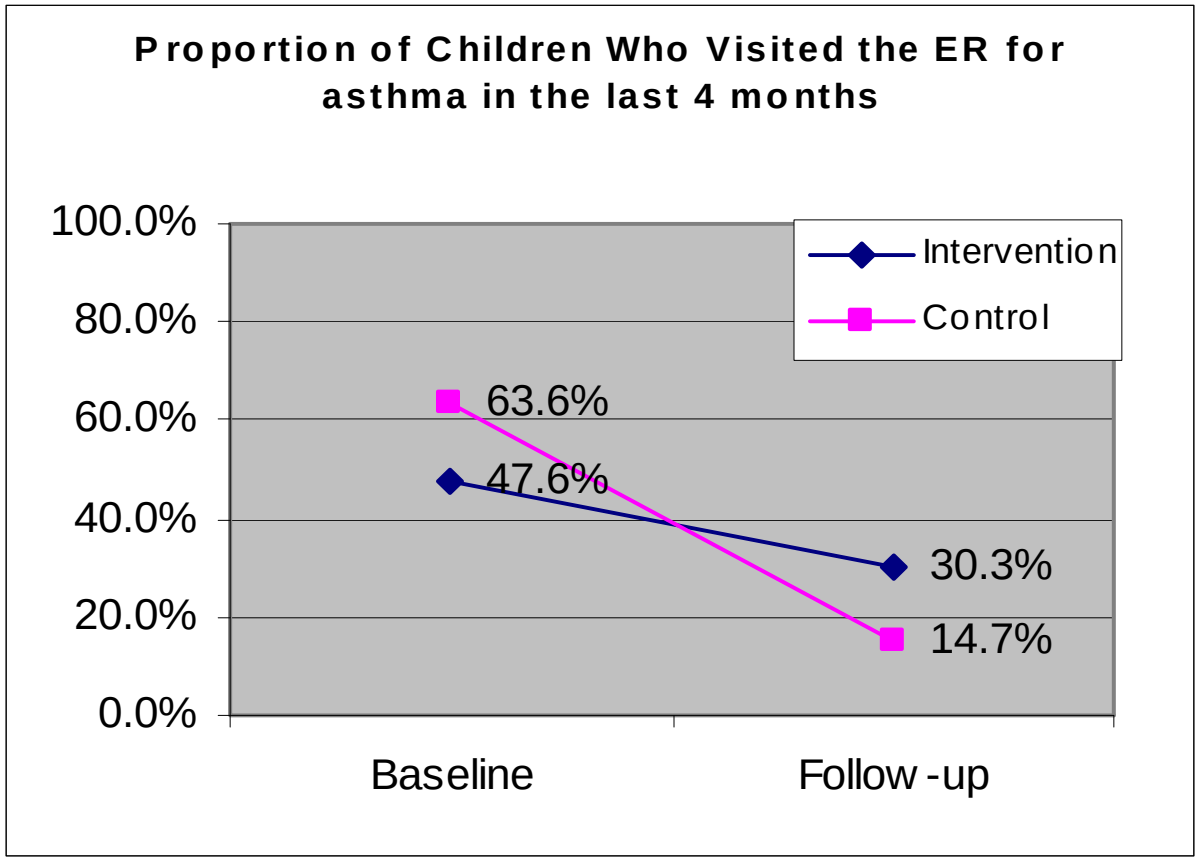
Median (IQR) values for Bla g 1 (U/g) by time and intervention group

| | Control | | Intervention | |
|---|---|---|---|---|
| | Baseline | Follow-up | Baseline | Follow-up |
| Bla g 1, Kitchen Floor | 2.5 (0.6, 27.0) | 0.7 (0.8, 2.9) | 0.9 (0.7, 4.2) | 1.6 (0.8, 3.6) |

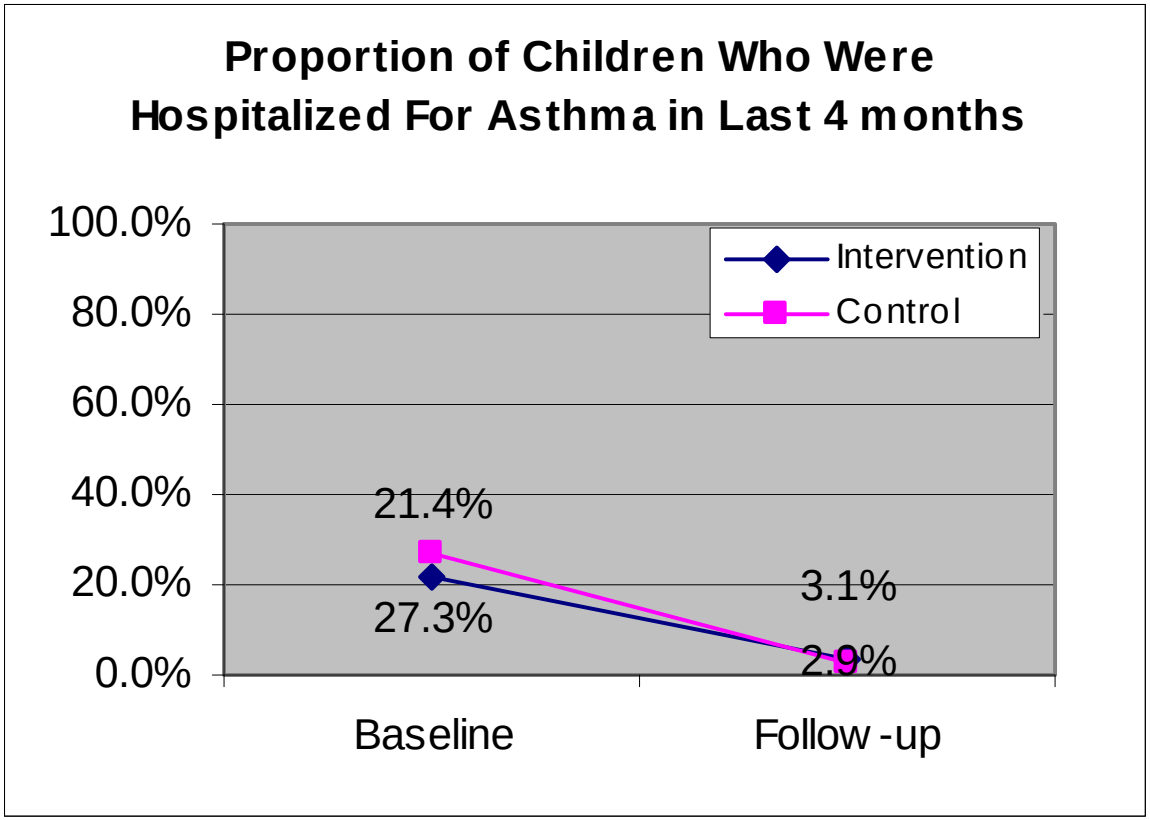


# Results: Health Outcomes

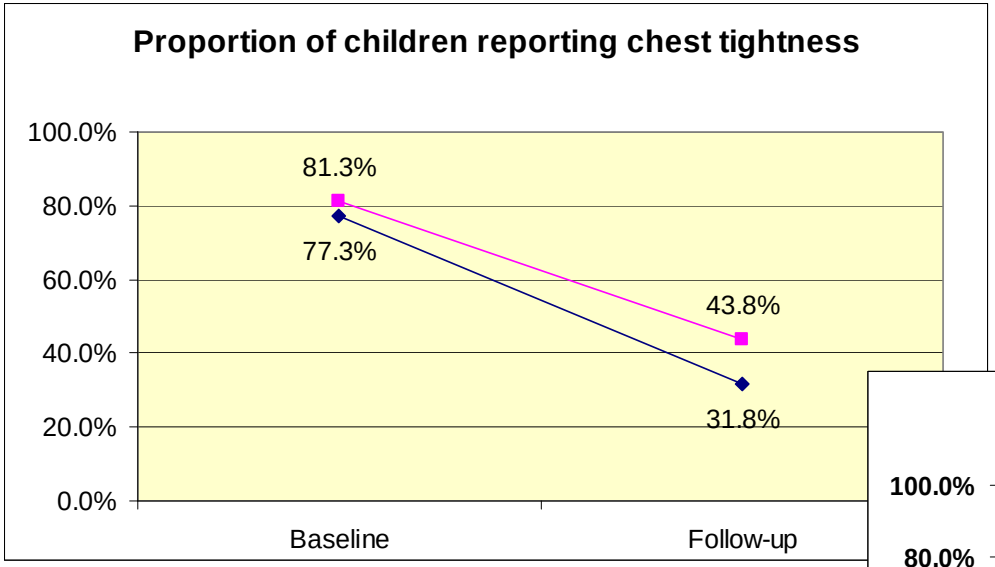
# Differences in health care utilization by intervention group



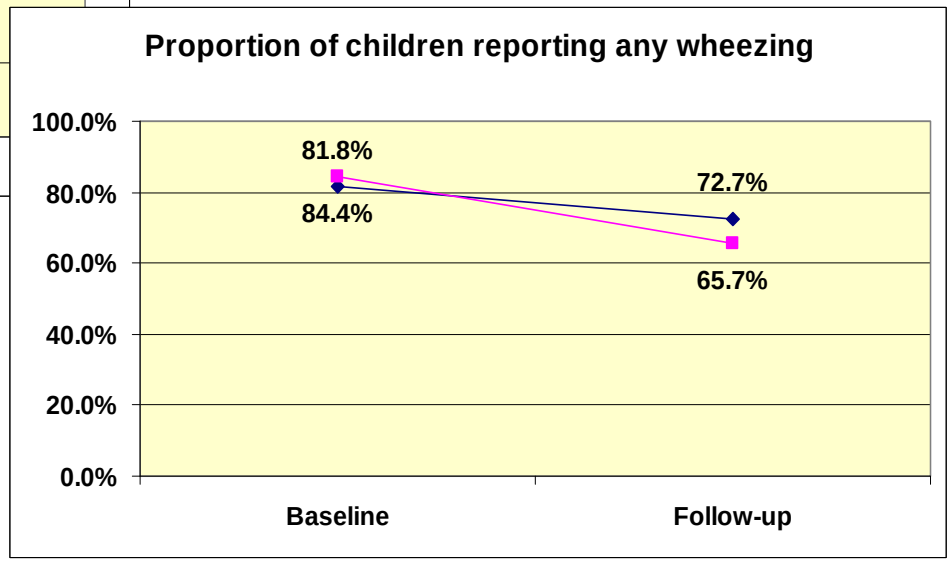
# Differences in health care utilization by intervention group



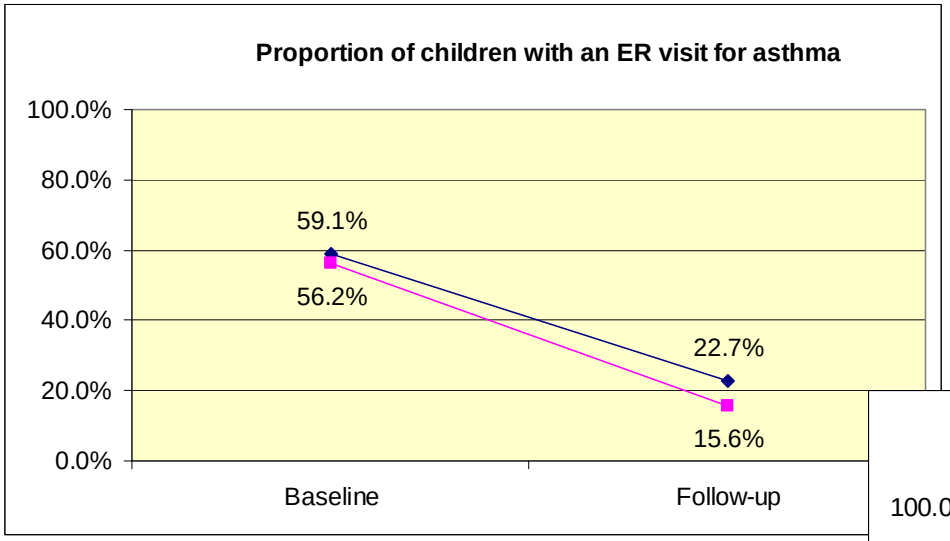
# Differences in symptoms by cockroach allergen reduction (ignoring group)



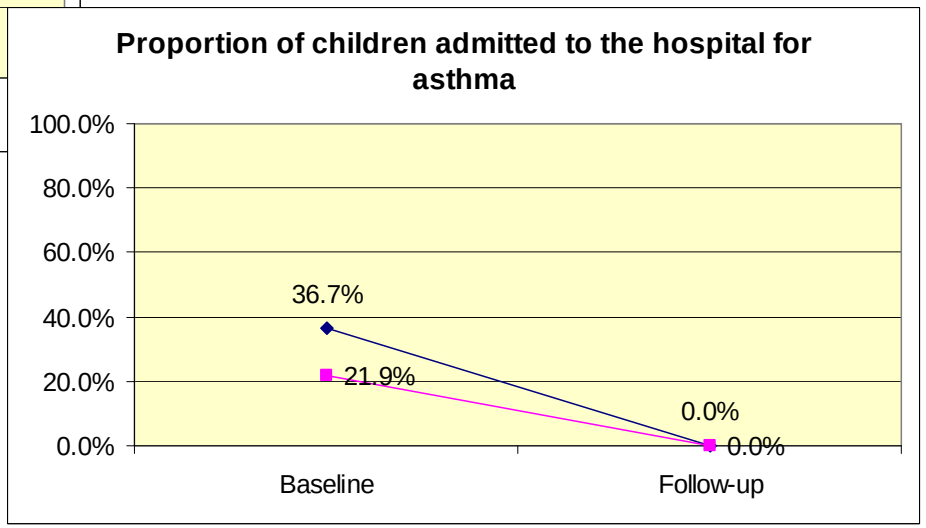

- 50% reduction in cockroach allergen (baseline - follow-up) n=22
- increase, no change, or less than 50% reduction in cockroach allergen n=32



# Differences in health care use by cockroach allergen reduction




- 50% reduction in cockroach allergen (baseline - follow-up) n=22
- increase, no change, or less than 50% reduction in cockroach allergen n=32



# Summary

- Substantial evidence exists that interventions to reduce allergen exposure can succeed in high risk populations.
- However, less evidence exists to support a subsequent reduction in asthma exacerbation.
- A multi-faceted intervention, tailored exposure and sensitization status did not reduce severe asthma outcomes in this inner-city cohort, despite having access to health care, keeping clinic visits and adherence to study interventions.

# Acknowledgments


- **Clinical Partners**
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  - Jane el-Dahr, MD
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2008 National Healthy Homes Conference

# Home-Based Environmental Interventions to Reduce Asthma Morbidity

## The Community Guide Asthma Review

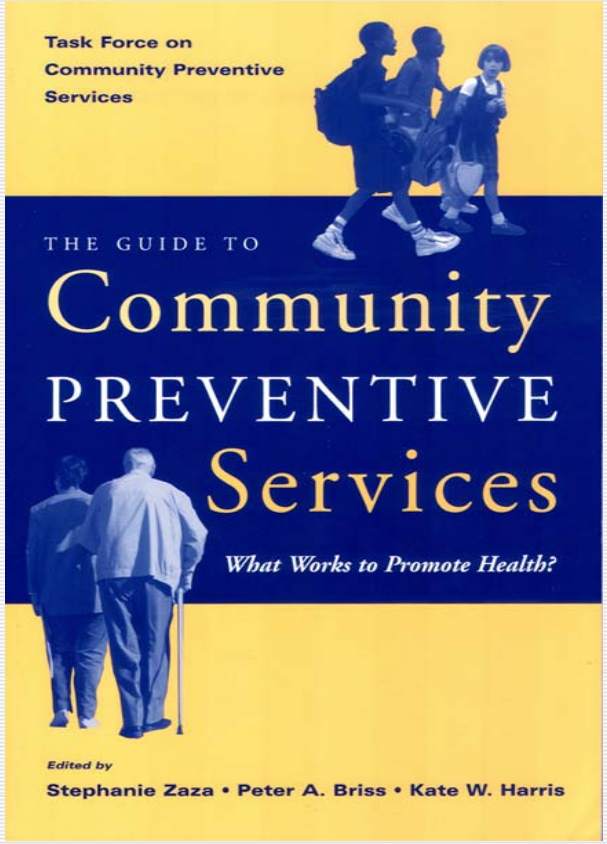
Crocker D, Hopkins D, Kinyota S, Dumitru G, Ligon C, Lawrence B, Sipe T

# Disclaimer

The findings and conclusions in this presentation have not yet been formally disseminated by the Task Force on Community Preventive Services or the Centers for Disease Control and Prevention.

# About the Community Guide

- Established in 1996
- Housed at CDC
- Directed by the Task Force on Community Preventive Services
- Conducts rigorous systematic reviews of evidence for community interventions
- Makes recommendations for use of public health interventions based on evidence



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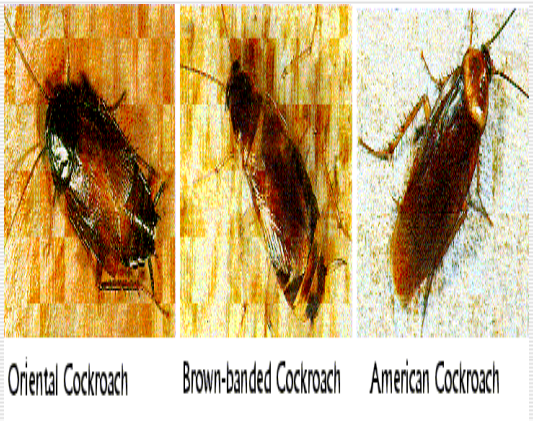
# Why Review Home Based Asthma Interventions?

- Asthma is an important health problem
- Many asthma triggers occur in the home

# Asthma Triggers in the Home

**Dust Mites**




**Cockroach Allergen**

**Rodents**

**Pet Dander**

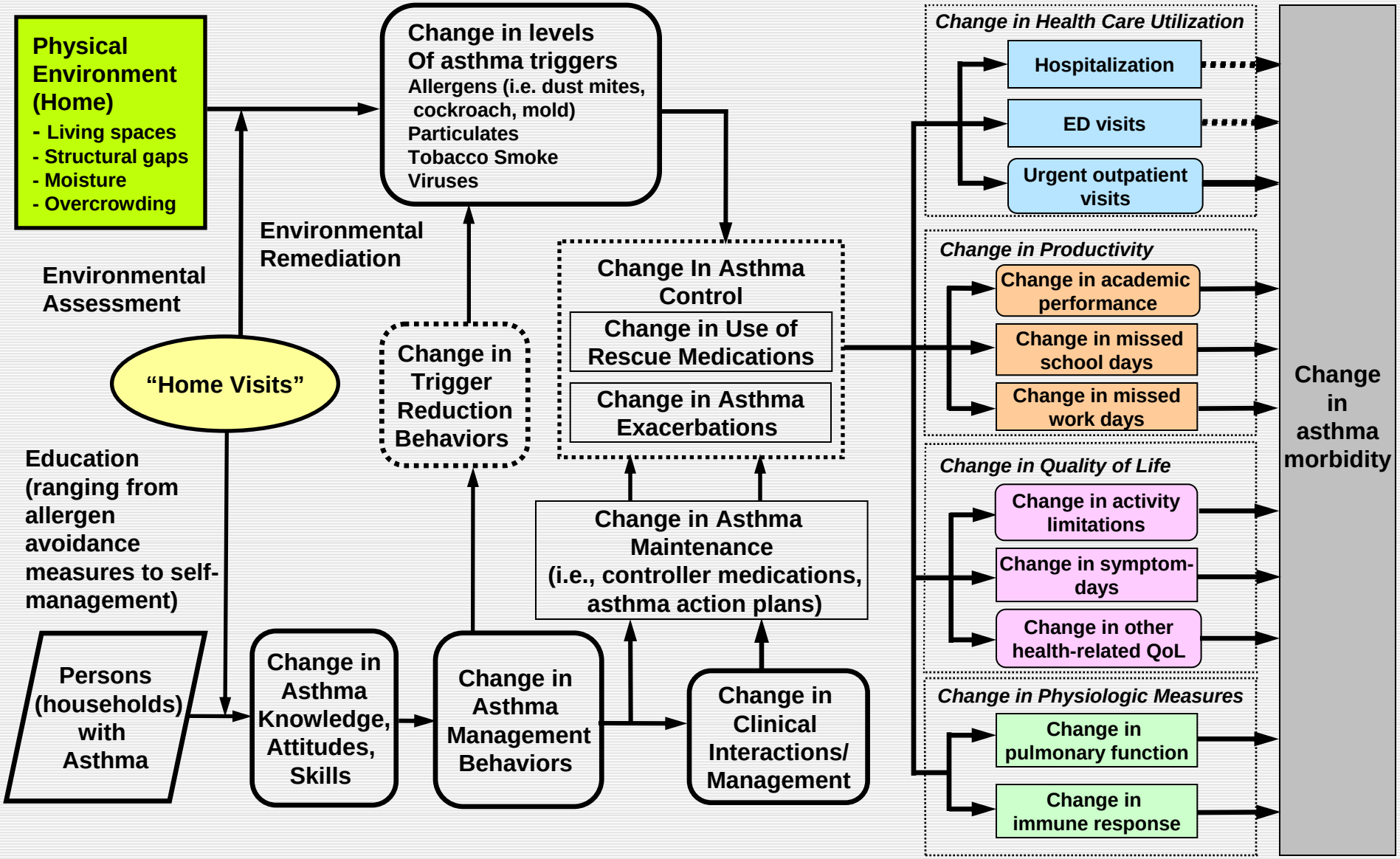
**Mold**

**Cigarette Smoke**

# Our Goal for This Review

To conduct the first systematic review on effectiveness of home-based multi-trigger, multi-component environmental interventions to improve asthma morbidity

# Analytic Framework



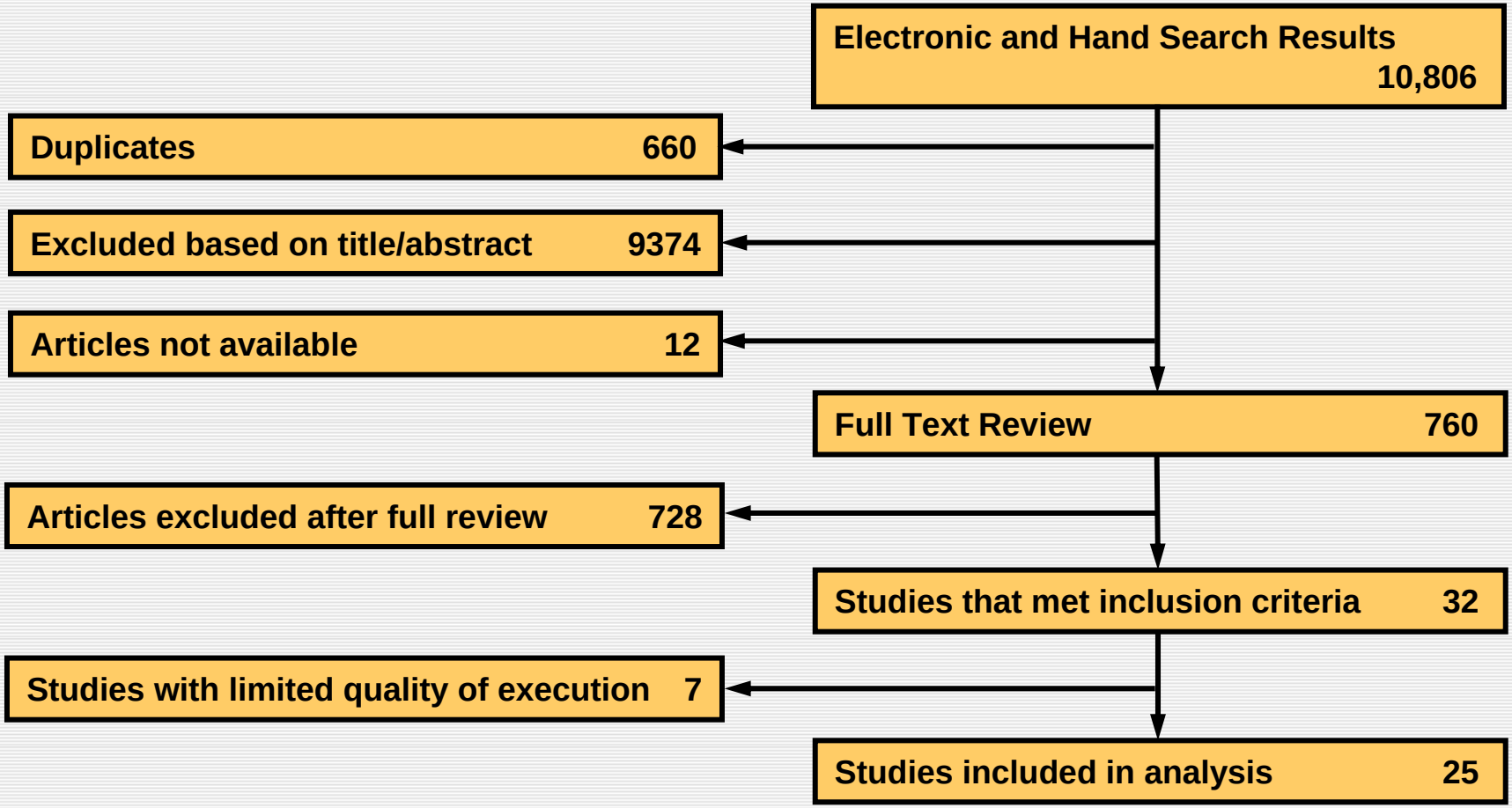
# Intervention Criteria

- Home-based, multi-trigger, multi-component environmental intervention
- Mandatory
  - Home based ($\geq$ 1 home visit)
  - Multi-trigger (> 2 asthma triggers addressed)
  - Multi-component (> 2 components)
  - Environmental
    - At least one component directed towards home environment (assessment, remediation, education)
- Optional
  - Additional efforts to improve asthma management behaviors
    - Self-management, social services, coordinated care

# Literature Search

- For the period 1966 – Feb. 2008
- Inclusion Criteria
  - English-language
  - Published or unpublished
  - Home based
  - Meets intervention definition
  - Evaluates $\geq$1 outcome of interest
- Exclusion Criteria
  - Drug trials
  - Primary prevention

# Search Results



# Data Analysis and Presentation

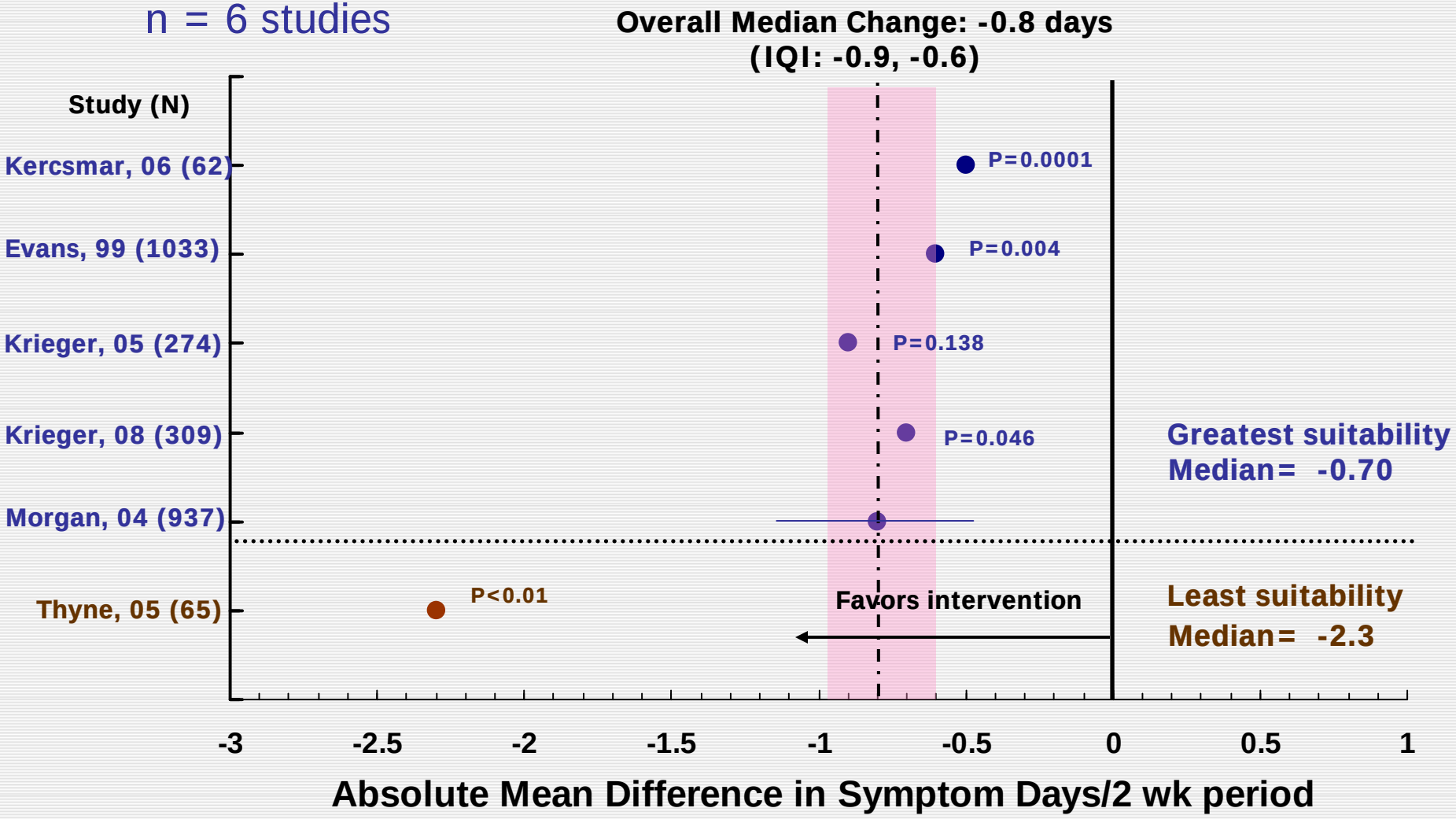
- Stratified data based on age
  - Children
  - Adults
- Results of 4 main outcomes presented
  - Quality of life
  - Health care utilization
  - Productivity
  - Physiologic Outcomes

# Subset of Studies Targeting Children with Asthma

# Quality of Life:

## Mean Number of Symptom Days/2wk Period

n = 6 studies



# Results Summary-Children

- Asthma symptom days:
  - Median decrease of 0.8 days/ 2wks (21 days per year)
- Asthma Quality of Life
  - Relative median increase of 21.8% from baseline in Symptom or Quality of Life scores
- School days missed:
  - Median decrease of 11 days per year
- Acute healthcare visits:
  - Median decrease of 0.57 visits per year
- Pulmonary function or immunologic response:
  - No improvement

# Subset of Studies Targeting Adults with Asthma

- Four studies measured outcomes in adults
- 3 studies were controlled trials; 1 study before-after
- Results
  - Symptom/QOL Score (3 studies)
    - 5%-16.7% relative % improvement in QOL or symptom scores
  - Health care utilization (2 studies)
    - Inconsistent results
  - Productivity (2 studies)
    - Inconsistent results
  - Physiologic Outcomes (0 studies)

# Applicability of Intervention

- The majority of the 25 analyzed studies targeted US urban low-income, minority children
- Most studies were implemented by community health centers (8), clinics (7) and community health centers (8)
- Trained personnel conducting home visits included
  - Community Health Workers (9)
  - Nurses (8)
  - Respiratory Therapists (3)
  - Social Workers (2)
  - Physicians (2)
  - Research assistants (1)
  - Housing officer (1)

# Potential Harms

- Expense of interventions to participant
  - Major remediation
- Remodeling may increase triggers and worsen asthma/allergies
- Potential danger of going into home for healthcare worker

# Additional Benefits

- Improved caregiver support
- Caregiver smoking cessation
- Health benefits for parents and siblings of study children
- Home visit identifies additional public health concerns in the home

# Barriers to Implementation

- Inability to maintain follow up
- High cost of the intervention
- Sustainability
- Personnel to conduct home visits
- Acceptability of home visit (privacy)
- Insurance issues

# Conclusions

# Task Force Recommendation: Children

The Task Force recommends the use of home-based multi-component multi-trigger interventions with an environmental focus for children with asthma on the basis of strong evidence of effectiveness in reducing symptom days, improving quality of life or symptom scores, and reducing the number of school days missed.

# Task Force Recommendation: Adults

The Task Force found insufficient evidence to determine the effectiveness of home-based multi-component multi-trigger interventions with an environmental focus for adults with asthma due to a small number of studies with inconsistent results.

# Important Research Gaps

- Need more studies in adults
- Determine impact of secondhand smoke
- Range of remediation (major vs. minor)
- Determine the added benefit of conducting intervention in home
- Ideal population for this intervention
  - Frequent flyers?
  - Participants with more severe asthma?

# Next Steps

- Complete any additional sub-analyses
- Complete web summary
- Disseminate findings
- Supplement in the American Journal of Preventive Medicine

# Questions