Childhood Asthma and Housing Conditions in Seattle

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Acknowledgements

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National Childhood Asthma Impact

- In 2002 over 4 million US children had asthma.
- In 1999
  - 650,000 emergency department visits
  - 190,000 hospitalizations - #1 dz. diagnosis
  - 176 deaths attributed to asthma – more than doubled since 1980
- Asthma is the most common reason for school absences (14 Million days in 1996).
- Low-income and minority populations experience substantially higher rates of fatalities, hospital admissions, and emergency department visits.
- The combined direct and indirect costs for asthma in United States was approximately $12.7 billion in 1998

Weiss and Sullivan, 2001 *Allergy Clin Immunol* 107:3 and NCHS
Hospitalization Rates in King Co. Neighborhoods with Highest Poverty

PHSKC- Epid, Prev. & Eval. 1998
Asthma and Housing

• Exposure to indoor asthma triggers is a major contributor to asthma morbidity.
• Substandard housing is related to increased exposure to asthma triggers
  - Moisture promotes mites & mold (25 million homes ’99 w/ water damage)
  - Roach specific allergen
  - Poor ventilation (higher allergen and ETS levels)
  - CO and/or NO_x from stoves or heaters
• Low income tenants have few resources to address these exposures.
Exacerbation of Asthma by Indoor Hazards

- Cats*
- Cockroaches*
- Dust mites † *
- Environmental Tobacco Smoke* (pre-school age)
- Dogs
- Molds
- NO$_2$, NO$_x$
- Rhinovirus
- Multiple irritants (VOCs)

IOM, *Clearing the Air*, 2000

* adequate evidence for causation. Others show association.
† Sufficient evidence for causation in the development of asthma
Seattle-King County
Healthy Homes Project
In-Home Intervention
Recruitment and Research Design

• Community-based participatory research methods
• Eligibility
  ◆ household income below 200% poverty
  ◆ child age 4-12 with asthma
• Randomized controlled design: participants randomized into high (n=138) and low (n=136) intensity intervention groups.
  ◆ High group: full intervention
  ◆ Low group: one visit, action plan, follow-up call, bedding covers
  ◆ Low group crosses over to high group after one year
In-Home Intervention
Main Outcome Measures

Primary Outcomes
◆ Child’s asthma symptoms
◆ Caregiver quality of life
◆ Asthma-related health services utilization

Secondary outcomes
◆ Behavioral changes
◆ Evidence for mold, moisture, ETS, pets and pests
◆ Surface dust loading & antigens in carpet sample
  • Dust mite
  • Roach
  • Cat
  • Dog
Community Health Worker Home Visits

- Make 5-9 visits over one year (high intensity) or 1 visit (low intensity).
- Assess home environment and develop Action Plan to reduce exposure to moisture, ETS, mites, mold, pets, roaches.
- Offer client education and encourage behaviors to implement plan (e.g. dust control, ventilation, tobacco).
- Review progress in implementing Action Plan at each visit.

Putting on a mattress cover
Community Health Worker Activities

- CHWs are from participating communities, receive rigorous training, and have personal experience with asthma.

In addition to trigger focused action plan:

- Counsel about smoking, refer to free telephonic smoking cessation program (Free and Clear™), provide nicotine patches.

- Promote tenant-landlord communication.
- Provide social support.
- Offer advocacy/referral (housing, food, furniture, jobs, etc.).
## Participant Demographics

### Baseline Characteristics of Higher and Lower Intensity Groups (%)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>high</th>
<th>low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>138</td>
<td>136</td>
</tr>
<tr>
<td>Income &lt; 100% poverty</td>
<td>51.9</td>
<td>60.9</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>34.1</td>
<td>27.3</td>
</tr>
<tr>
<td>African American</td>
<td>31.9</td>
<td>27.2</td>
</tr>
<tr>
<td>White non-Hispanic</td>
<td>11.6</td>
<td>20.6</td>
</tr>
<tr>
<td>Hispanic</td>
<td>17.4</td>
<td>16.9</td>
</tr>
<tr>
<td>Other</td>
<td>5.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Renter</td>
<td>81.9</td>
<td>83.0</td>
</tr>
<tr>
<td>Completed high school</td>
<td>59.1</td>
<td>52.4</td>
</tr>
<tr>
<td>Caretaker employed</td>
<td>47.8</td>
<td>57.4</td>
</tr>
</tbody>
</table>
Extent of Exposures in Seattle

Baseline data from Healthy Homes I, n = 274
Outcome: Urgent Health Services

percent with one or more episodes

high intensity

low intensity

n = 214

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)
Outcomes: Caregiver Quality of Life

n = 214

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: 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)

n = 214
Primary Outcomes

- Healthy Homes reduced urgent health services utilization and improved caretaker quality of life.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>High Intensity</th>
<th>Low Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Quality of Life</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Urgent utilization</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>

- The degree of improvement in quality of life and utilization was greater with the higher intensity intervention.
Outcomes
Floor Dust Loading

* p value comparing high vs. low exit values after adjustment for baseline values using linear regression
### Secondary Outcomes Related to Exposure

<table>
<thead>
<tr>
<th>Outcome</th>
<th>High Intensity</th>
<th>Low Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviors to ↓ Exposure</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Surface Dust Loading</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Der p1 Loading</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Trigger Knowledge</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Trigger Score *</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>

* Trigger score: 1 point ea. for condensation, mold, roaches, pets, daily ETS
Conclusions

- A community health worker intervention addressing multiple exposures reduced asthma symptom days, improved caretaker quality of life and reduced urgent health services utilization.

- More exposure measures improved in the high intensity group, e.g. reduced loading of dust and Der p1 antigen, moisture and trigger score.

- The degree of improvement in quality of life, symptoms and medical utilization was greater with the higher intensity intervention.

- The intervention increased caretaker knowledge and actions, in both groups, but more so in the high intensity group.
Healthy Homes II

• Goals
  ◆ Link indoor environmental and clinical approaches for improving asthma control
  ◆ Demonstrate value of in-home interventions to health care payors and others
• Combines support for medical aspects of asthma self-management with reduction of indoor triggers
• Compares effectiveness of CHW in-home asthma support to clinic-based education & case management
• RCT of 380 low-income households with children with asthma funded by NIEHS
Better Homes for Asthma

Tim K. Takaro, MD, MPH
Principal Investigator

Jim Krieger, MD, MPH
Co-Principal Investigator

Funded primarily by US Dept. of Housing and Urban Development
Better Homes for Asthma
Project Overview

• Compare marginal value of adding remediation to the community health worker intervention
• Remediate 70 substandard homes with conditions associated with asthma and other health risks:
  ★ improve ventilation
  ★ remove old carpet
  ★ eliminate water intrusion
• Randomized controlled trial of asthmatic children:
  Assess impact of remediation on asthma-related health outcomes, FEV1 & FVC, and exposures to asthma triggers including total fungal loading.
Better Homes for Asthma
Structural Interventions

• Randomly assign households to early vs. late remediation
• Average $3000/unit, range $1500-$9000
• Include units if
  ✷ Damaged roof, siding, evidence of moisture intrusion
  ✷ Mold
  ✷ Plumbing leaks
  ✷ Carpet moist or poor condition
  ✷ Pests and structural defects permitting egress

• Exclude units if
  ✷ none of these conditions
  ✷ condition so poor that remediation beyond scope
Community Health Workers Serve All Participants

- Provide services similar to Healthy Homes
- Provide resources
  - Allergy control covers for bedding
  - Vacuum and bags
  - Cleaning Kit
  - Door mats
  - Injury prevention (outlet protectors, stair guards, smoke detectors and batteries, locked gun storage boxes, cabinet safety locks, CO detector)
Healthy Communities/Healthy Homes: High Point

• Redevelop 1600 units
• Included in demonstration project
• Incorporate features to promote health
  • Network of open spaces and trails
  • Increase access to transit
  • Develop spaces for social interaction
  • Incorporate healthy homes approaches into construction of new units
  • Low-allergen landscaping
  • Designate tobacco-free units and zones
  • Neighborhood market providing healthy, affordable food
  • Community gardens
• Promote community organizations
High Point
Project Overview

• Assess impact of community redevelopment
  ♦ health
  ♦ social capital, community power and cohesion
  ♦ physical activity
  ♦ physical security and safety
  ♦ illicit substance availability

• Assess impact of new housing
  ♦ general health status
  ♦ asthma-related health status

• Funding: HUD and NIEHS
Evaluation for Asthma Families

• Modified Case-Control
  ✦ Cases evaluated over 1 yr. prior to move with CHW intervention.
  ✦ Cases evaluated over 1 yr. in new units
  ✦ Controls randomly selected from standard new units

• Outcome Measures
  ✦ changes in asthma-related health outcomes, FEV1 & FVC
  ✦ changes in home environment
  ✦ changes in participant behaviors and knowledge
High Point
Features of All New Units

• Advanced framing with increased energy efficiency
• Airtight drywall installation
• Energy Star compliant argon-filled windows (U<0.35)
• Low VOC finishes
• Sealed cabinets to decrease emissions
• Cement board exterior siding
High Point
Additional Features Breathe Easy Units

• Slab: sealed, insulated to keep warm and dry
• Blown-in insulation, rain screen
• Exterior grade plywood (no OSB)
• Cement board siding with house wrap
• Airtight drywall with low-emission joint compound
• Windows: Argon, U<0.35, water-tight flashing
• Low emission doors, trim, cabinets, finishes, adhesives
• No carpeting
High Point
Additional Features Breathe Easy Units

- Heating and ventilation:
  - Air handler w/ HEPA filter
  - Fresh air to bedrooms and living rooms
  - Continuous fan with constant air regulator (1/3 ACH)
  - Airtight ducts
  - Radiant/Hydronic baseboard heat
  - Humidity-controlled kitchen fan
  - timed bath fan
- Hard surface floors (linoleum or VCT)
Public Health Practice in Housing for Asthma Morbidity Reduction

• Increase availability of healthy housing for low income families

• Educate primary care providers on linkage of IEQ efforts to clinical asthma management

• Promote Insurance coverage of exposure control resources and Community Health Worker driven interventions
Public Health Practice in Housing for Asthma Morbidity Reduction

- Provide evidence for building guidelines for healthy homes construction and renovation
- Convene consensus conference to develop such healthy homes guidelines
- Review of local housing codes
  - Assess for inclusion of healthy homes specs
  - Develop model language to address gaps
  - Promote adoption of healthy housing codes
  - Train housing inspectors, housing advocates, designers, builders, contractors.
International Burden of Asthma
3 Billion People Use Biomass

The health effects of indoor air pollution exposure in developing countries
Healthy Homes Other Partners

- King County Housing Authority
- Youthbuild
- Healthy Buildings, Inc.
- The King County Asthma Forum
- Seattle Partners for Healthy Communities
- Seattle Tenants Union
- Group Health Cooperative of Puget Sound
- Engineering Plus
- Community clinics, hospitals and emergency departments
- Seattle Public School District
- Rental Housing Association of Puget Sound
- Hoover Vacuum Company
- Seattle Solid Waste Utility
- Horn of Africa Services
- International District Housing Authority
- Puget Sound Neighborhood Health Center
- Centers for Disease Control and Nesholm Foundation
- Safe Futures Youth Centers
Estimate of Costs and Savings

• Program costs per client
  ✷ High Intensity: $1345
  ✷ Low intensity: $222

• Program 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