**The System at Work: Tailored Environmental Interventions**

**Question:** Which of these areas do I feel most prepared to champion in my program?

1. Leveraging community assets
2. Integrated health care services
3. Tailored environmental interventions
4. Evaluation
5. Creating conversations of opportunity

**Question:** Which of these areas do I feel ready to take action on and want to learn more about?

1. Leveraging community assets
2. Integrated health care services
3. Tailored environmental interventions
4. Evaluation
5. Creating conversations of opportunity
Communities in Action

V. CHANGE CONCEPT – TAILOR ENVIRONMENTAL INTERVENTIONS TO THE INDIVIDUAL, THE SETTING AND THE COMMUNITY

Customize environmental interventions to meet individual health and education needs; provide counseling and tools to manage environmental triggers in all of the environments where patients spend time.

Strategies for Action:

• Educate clinical care teams and individual patients on environmental asthma triggers
• Assess patients for allergies and triggers and provide tailored environmental education and counseling during the clinical visit
• Provide tools and training to manage environmental asthma triggers at home, at school, at work, and in the outdoor environment

The Effectiveness of Tailored Asthma Interventions:

NIAID Inner-City Asthma Studies

EPA National Asthma Forum

June 3, 2009

Herman E. Mitchell, PhD
Rho, Inc. Chapel Hill, NC
NIAID Inner City Asthma Studies

- National Cooperative Inner City Asthma Study (NCICAS)
  - 1990 - 1997
- Inner City Asthma Study (ICAS)
  - 1996 - 2004
- Inner City Asthma Consortium (ICAC)
  - 2003 - 2010

Generalized vs Individualized

- Both general and individualized interventions can be effective
- General interventions have limited effectiveness
- Need to be combined with individualized treatment or intervention

Generalized Interventions

- General public health warnings, e.g., HIV awareness, smoking, obesity
- Disease specific interventions often are based upon general disease risks
- Medications and treatment based upon the “typical” person
Individualized Interventions

- Physician-patient interaction
- Case management
- Patient specific medications
- Interventions tailored to patient specific risks

Traditional Asthma Interventions

- Asthma interventions, as most interventions, are typically general in nature
- Interventions focus on the disease and the factors related to that disease
- Often a one-size-fits-all approach

Asthma Interventions

General
- General in nature
- Focused on the disease
- Everyone gets the same intervention

Tailored
- Specific to the child
- Disease X Child Interaction
- The intervention is customized to the specific circumstance or risks
Individualizing Asthma Interventions

NCICAS

Asthma Counselor Intervention

National Cooperative Inner-City Asthma Study

Broad epidemiologic study of 1528 children with asthma in 8 major urban areas

Results:

Asthma a multifaceted problem

No "silver bullet"
Among the Risk Factors Found to Affect Asthma...

• **Medical Risk** – continuity of care, ED use, communication with PCP
• **Adherence** – correct medication use, barriers to adherence
• **Asthma Responsibility** – shared, diffused responsibility
• **Psychosocial Factors** – caretaker and child psychological status
• **Attitudes** – ability to control symptoms, attitude toward health care, medications
• **Allergies and exposures** – skin test sensitivities, environmental triggers, ETS exposure

---

**NCICAS Phase 2 Intervention Study**

• **Phase 2 – Intervention Study**
  - Purpose was to intervene on the factors identified in the Phase 1 epidemiology study
  - 1033 Children at 8 Research Centers randomized to a tailored Asthma Counselor intervention or control condition

---

**NCICAS: Intervention**

• **Asthma Counselors** regular meetings with families to address the multitude of risk factors identified in Phase I
• **Intervention** was tailored to each family's individual risks based upon an extensive baseline assessment
• **CARAT** – Child Asthma Risk Assessment Tool
Purpose of the CARAT

1. Identify individual asthma risks
2. Provide summary of the risks
3. Guide initial conversations
4. Personalize asthma education
5. Guide intervention activities

Among the Risk Factors Found to Affect Asthma...

- **Medical Risk** – continuity of care, ED use, communication with PCP
- **Adherence** – correct medication use, barriers to adherence
- **Asthma Responsibility** – shared, diffused responsibility
- **Psychosocial Factors** – caretaker and child psychological status
- **Attitudes** – ability to control symptoms, attitude toward health care, medications
- **Allergies and exposures** – skin test sensitivities, environmental triggers, ETS exposure

Child Asthma Risk Assessment Tool
ICAS: Study Design

- Multi-center, randomized, controlled trial of physician feedback and environmental remediation in seven inner-city environments
- 2 x 2 design powered for both interventions
- One year of intervention followed by one year of observation
**ICAS: Study Population**

- 937 children aged 5 to 12 with moderate asthma enrolled from inner-city census tracts
- Severity in last 6 months:
  - One overnight hospitalization for asthma
  - or
  - Two unscheduled clinic visits for asthma
- Positive skin test to $\geq 1$ indoor allergen
- Sleep at one address $\geq 5$ nights per week
Allergen Sensitivity by Skin Prick Test

- Roach
- Dustmite
- Any Mold
- Cat
- Mouse
- Dog
- Rat

Percent

Home Environmental Exposures

- Tobacco smoking (≥ 1 smoker): 47%
- Dampness, water leaks, mildew: 70%
- Cockroaches: 73%
- Rodents: 49%
- Furry pet: 30%

Environmental Intervention

- Modules presented by an environmental counselor during 5-7 home visits over 12 months
- Modules included:
  - Education
  - Demonstration of remediation activities
  - Provision of supplies, equipment, and services
- Dust mite and ETS: All subjects
- Other allergens: Based on allergy testing and home environment assessment
### ICAS Modules

<table>
<thead>
<tr>
<th>Module</th>
<th>% Assigned Module by ERAT</th>
<th>% Completing Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Sleeping Zone</td>
<td>100.0</td>
<td>98.1</td>
</tr>
<tr>
<td>ETS</td>
<td>100.0</td>
<td>95.3</td>
</tr>
<tr>
<td>Cockroach</td>
<td>67.6</td>
<td>98.1</td>
</tr>
<tr>
<td>Rodent</td>
<td>33.5</td>
<td>94.9</td>
</tr>
<tr>
<td>Pets</td>
<td>47.8</td>
<td>96.9</td>
</tr>
<tr>
<td>Mold</td>
<td>51.2</td>
<td>94.7</td>
</tr>
</tbody>
</table>

### Tailoring ICAS Modules

<table>
<thead>
<tr>
<th>Modules Delivered per Household</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>1.7</td>
</tr>
<tr>
<td>One</td>
<td>1.5</td>
</tr>
<tr>
<td>Two</td>
<td>4.9</td>
</tr>
<tr>
<td>Three</td>
<td>31.8</td>
</tr>
<tr>
<td>Four</td>
<td>29.9</td>
</tr>
<tr>
<td>Five</td>
<td>19.2</td>
</tr>
<tr>
<td>Six</td>
<td>11.1</td>
</tr>
</tbody>
</table>

Mean length in minutes of each visit (±SD) 73.6 (±27.69)
Mean number of visits per household (± SD) 4.7 (±1.09)

### Outcome Monitoring

- Phone calls every 2 months by a centralized telephone interviewer system
  - 2-week recall for asthma medications and morbidity including symptoms, missed school, and impact of child’s asthma on caretaker
  - 2-month recall for healthcare utilization
  - Home environmental evaluation including allergen measurement every 6 months
### Maximum Symptom Days

<table>
<thead>
<tr>
<th>Study Month</th>
<th>Days per 2 Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>B 2 4 6 8 10 12 14 16 18 20 22 24</td>
<td></td>
</tr>
</tbody>
</table>

**Year 1 = Intervention**  
**Year 2 = Follow-up**

#### Control

#### Environmental Intervention

### Environmental Intervention Outcomes

- **Days with Wheeze or Cough**

<table>
<thead>
<tr>
<th>Days per 2 Weeks</th>
<th>Control Group (N=468)</th>
<th>EI Group (N=469)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
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<tr>
<td>3.0</td>
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<td></td>
</tr>
<tr>
<td>4.0</td>
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<td></td>
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<tr>
<td>5.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **p = 0.0001**

### Environmental Intervention Outcomes

- **Missed School (Days per Year)**
- **Unsched Visits (# per Year)**

<table>
<thead>
<tr>
<th># of Events</th>
<th>Control Group (N=468)</th>
<th>EI Group (N=469)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
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<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
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</tr>
<tr>
<td>4.0</td>
<td></td>
<td></td>
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<tr>
<td>5.0</td>
<td></td>
<td></td>
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<tr>
<td>6.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **p = 0.002**  
- **p = 0.037**
Change in Allergen Levels - Child's Bed -

- Control
- Environmental Intervention

<table>
<thead>
<tr>
<th>Allergen</th>
<th>Percent Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bla g 1</td>
<td></td>
<td>p = 0.001</td>
</tr>
<tr>
<td>Der p</td>
<td></td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Der f</td>
<td></td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Fel d</td>
<td></td>
<td>p &lt; 0.005</td>
</tr>
</tbody>
</table>

Change in Allergen Levels - Child's Bedroom Floor -

- Control
- Environmental Intervention

<table>
<thead>
<tr>
<th>Allergen</th>
<th>Percent Change</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bla g 1</td>
<td></td>
<td>p = 0.0001</td>
</tr>
<tr>
<td>Der p</td>
<td></td>
<td>p = 0.11</td>
</tr>
<tr>
<td>Der f</td>
<td></td>
<td>p &lt; 0.005</td>
</tr>
<tr>
<td>Fel d</td>
<td></td>
<td>p = NS</td>
</tr>
</tbody>
</table>

Days of Wheeze

- Control
- Environmental Intervention

<table>
<thead>
<tr>
<th>Year</th>
<th>Days per 2 Weeks</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>(N=869)</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Year 2</td>
<td>(N=821)</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>
Unscheduled Asthma Visits (Clinic or Emergency Department)

- **Control**
- **Envt Intervention**

**Year 1** (N=869)
- **Year 2** (N=821)

**P < 0.05**

**P = 0.07**

**Environmental Intervention - Conclusions -**

The EI had a beneficial impact on subject health and healthcare utilization

- 22% reduction in days with wheeze leading to 20 more days per year without wheeze
- 22% decrease in missed school days
- 12% reduction in unscheduled visits

**ICAS Conclusions**

- A one-year environmental remediation strategy resulted in sustained reductions in indoor allergen levels and improvements in asthma morbidity
- Improvements in asthma morbidity were significantly correlated with reductions in bedroom allergen exposure
- Home-based environmental remediation programs offer an effective means of reducing asthma morbidity in children living in an inner-city environment
Acknowledgements

ICAS subjects and their families

ICAS research teams

Home-Based Environmental Interventions to Reduce Asthma Morbidity

The Community Guide Asthma Review

2009 National Asthma Forum

June 4-5, 2009

Deidre Crocker| David Hopkins| Stella Kinyota| Gema Dumitru
Colin Ligon| Briana Lawrence| Theresa Sipe

Disclaimer

The findings and conclusions in this presentation should not be construed to represent any Task Force on Community Preventive Services or CDC determination or policy.
The Community Guide

- Established in 1996 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
- http://www.thecommunityguide.org

Coordination Team

<table>
<thead>
<tr>
<th>Task Force Member</th>
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<tbody>
<tr>
<td>Diedre Crocker</td>
<td>Task Force Member</td>
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<td>Stella Kinjota</td>
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<tr>
<td>David Hopkins</td>
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<td>Briana Lawrence</td>
<td>Task Force Member</td>
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<tr>
<td>Sarah Merkle</td>
<td>Task Force Member</td>
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<td>Ned Calonge, CO Dept of PH</td>
<td>Task Force Member</td>
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<td>Denise Dougherty, AHRQ</td>
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</tr>
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<td>Katherine Pruitt, ALA</td>
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<td>Task Force Member</td>
</tr>
<tr>
<td>Kurt Elward, MD, AAFP</td>
<td>Task Force Member</td>
</tr>
</tbody>
</table>

Consultants

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Public Health - Seattle and King County

Megan Sandel, MD, MPH
Assistant Professor of Pediatrics
Boston University School of Medicine

David Jacobs, PhD
Director of Research
National Center for Healthy Housing

Darryl C. Zeldin, M.D.
Environmental Diseases & Medicine Program
Division of Intramural Research
National Institute on Environmental Health Sciences (NIEHS)
Why Asthma?

>20 million Americans
$37.2 billion/yr
1.8 million ED visits

~500,000
Hospitalizations
4.7 million office visits
~14 million missed
school days

Why Home-Based Asthma Interventions?

Dust Mites
Mold
Cigarette Smoke

Goal of This Review

To systematically review the effectiveness of multicomponent, multi-trigger home-based environmental interventions in improving asthma morbidity.
Analytic Framework

Home-Based Environmental Interventions

Two Major Pathways: Environmental and Behavioral Change
Environmental Change

- Physical Environment Change
  - Living space (home, school, work)
  - Environmental assessment

- Change in levels of asthma triggers
  - Change in allergens
  - Change in tobacco smoke
  - Change in particulate matter

- Change in asthma control
  - Change in levels of asthma triggers
  - Change in allergens
  - Change in tobacco smoke
  - Change in particulate matter

Behavior Change

- Physical Environment Change
  - Living space (home, school, work)
  - Environmental assessment

- Education (ranging from allergen avoidance to self-management)

- Persons (households, schools, work)

- Change in levels of asthma triggers
  - Change in allergens
  - Change in tobacco smoke
  - Change in particulate matter

- Change in asthma knowledge, attitudes, skills

- Change in asthma management behaviors

- Change in clinical interactions

- Change in use of rescue medications

- Change in asthma exacerbations

Environmental and Behavioral Change Should Impact "Control"

- Physical Environment Change
  - Living space (home, school, work)
  - Environmental assessment

- Education (ranging from allergen avoidance to self-management)

- Persons (households, schools, work)

- Change in levels of asthma triggers
  - Change in allergens
  - Change in tobacco smoke
  - Change in particulate matter

- Change in asthma control
  - Change in levels of asthma triggers
  - Change in allergens
  - Change in tobacco smoke
  - Change in particulate matter

- Change in asthma knowledge, attitudes, skills

- Change in asthma management behaviors

- Change in clinical interactions

- Change in use of rescue medications

- Change in asthma exacerbations

- Change in asthma maintenance (i.e., controller medications, asthma action plans)
Which Results in Reductions in Health Care Utilization

- Educational (ranging from avoidance measures to self-management)
- Physical Environment (e.g., improving indoor air quality)
- Environmental Remediation

Change in levels of asthma triggers, including allergens, particulates, tobacco smoke, viruses.

Change in Asthma Control

Change in Asthma Environment

Change in Asthma Management (i.e., controller medications, asthma action plans)

Change in Asthma Interactions

Change in Asthma Maintenance

Change in Health Care Utilization

Fewer Days Missed from School or Work (Productivity)

Change in Asthma Environment

Change in Asthma Interactions

Change in Asthma Maintenance

Change in Use of Rescue Medications

Change in Asthma Exacerbations

Change in Asthma Maintenance

Change in Productivity

Change in academic performance

Change in missed school days

Change in missed work days

Change in Health Care Utilization

Changes in Symptoms and Activity Levels

Change in Asthma Environment

Change in Asthma Interactions

Change in Asthma Maintenance

Change in Use of Rescue Medications

Change in Asthma Exacerbations

Change in Asthma Maintenance

Change in Health Care Utilization
...and May Improve Physiologic Measures of Asthma

Intervention Criteria

- Home visit
- Multi-component
  - > 1 component towards home environment
    - Environmental assessment
    - Environmental remediation
    - Environmental education
  - +/- Efforts to improve asthma management behaviors
    - Self-management, social services, coordinated care
- Multi-trigger
  - Environmental component addresses two or more potential asthma triggers

Environmental Remediation Intensity

- Minor
  - Environmental assessment
  - Pillow/mattress covers
- Moderate
  - Pest management
  - HEPA/filters
  - Vaccums
  - Vent/filters
- Major
  - New form of ventilation/heating
  - Re-roofing
  - Insulation
  - Removal of water-damaged materials
**Search Results: 1966–February 2008**

| Duplicates | 606 |
| Excluded based on title/abstract | 9374 |
| Articles not available | 10 |
| **Full Text Review** | 760 |
| Articles excluded after full review | 729 |
| Studies that met inclusion criteria | 32 |
| Studies included in analyses | 29 |
| Children | 20 |
| Children and adults | 2 |
| Adults | 1 |

**Study Results: Children**

**Quality of Life: Symptom Days**

- **Overall Median Change**: -0.8 days (IQI: -0.9, -0.6)
- Favors intervention

<table>
<thead>
<tr>
<th>Author (N)</th>
<th>Overall Median Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evans, 99 (1533)</td>
<td>-0.7</td>
</tr>
<tr>
<td>Krieger, 05 (274)</td>
<td>-0.9</td>
</tr>
<tr>
<td>Krieger, 08 (368)</td>
<td>-0.6</td>
</tr>
<tr>
<td>Morgan, 04 (937)</td>
<td>-0.8</td>
</tr>
<tr>
<td>Thyne, 05 (46)</td>
<td>-0.9</td>
</tr>
</tbody>
</table>

**Absolute Mean Difference in Symptom Days/2 wk period**
### Health Care Utilization: Acute Care Visits/yr

- **n=10 studies**
- **Overall Median Change:** -0.57 visits/yr (IQR: -1.71, -0.33)
- **Favors Intervention**

#### Authors and n:
- Morgan, 04 (1937)
- Almeida, 06 (1808)
- Carter, 01 (156)
- Kazarov, 06 (163)
- Hughes, 01 (95)
- Shafiee, 05 (148)
- Heaton, 03 (142)
- Oatman, 07 (67)
- Stout, 98 (24)
- Shelledy, 05 (18)

### Productivity: School Days Missed/Year

- **n = 5 studies**
- **Overall Median Change:** -12.3 days (IQR: -24.7, -6.5)
- **Favors Intervention**

#### Authors and n:
- Morgan, 04 (1937)
- Oatman, 07 (64)
- Shelledy, 05 (18)
- Somerville, 00 (114)
- Others

### Physiologic Outcomes

- **n= 7 studies**
- All RCTs
- All with different measurements
- Overall, no significant improvement in pulmonary function
Summary: Outcomes in Children

- Quality of Life
  - Asthma symptom days reduced by 21 days/year

- Health care utilization
  - Acute care visits reduced by 0.6 visits/year

- Productivity
  - School days missed due to asthma reduced by 12.3 days/year

- Physiologic
  - Overall, no significant improvement in pulmonary function

Summary Outcomes: Adults

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Studies</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Life</td>
<td>2</td>
<td>Improvement in QoL scores</td>
</tr>
<tr>
<td>Health Care Utilization</td>
<td>1</td>
<td>Reduction in acute care visits</td>
</tr>
<tr>
<td>Productivity</td>
<td>1</td>
<td>No improvement</td>
</tr>
<tr>
<td>Physiology</td>
<td>0</td>
<td>Not Reported</td>
</tr>
</tbody>
</table>

Task Force Recommendation

Children and Adolescents

The Task Force recommends the use of home-based multicomponent, multi-trigger environmental interventions for children and adolescents 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 multicomponent, multi-trigger environmental interventions in adults with asthma due to a small number of studies with inconsistent results.

Economic Review

Economic Evaluation Search Results
(1950–June 2008)
Economic Findings

- Program costs: $231 to $1,720 per participant (12 studies)
- Benefit-cost ratio ranging from 5.3 to 14.0 (3 studies)
- Cost-effectiveness ranging from $12 to $57 per SFD (3 studies)

Based on this evidence, the Task Force found that home interventions with the combination of minor to moderate environmental remediation with an educational component provides good value for the money invested.

Additional Findings
Number of Home Visits

Impact of Tailoring

Additional Benefits of These Interventions

- Improved caregiver support
- Caregiver smoking cessation
- Health benefits for parents and siblings of study children
- Identifies additional public health concerns in the home
Challenges/ Barriers to Implementation

- Expense of interventions to participant
  - Major remediation
- Inability to maintain follow up
- Sustainability
- Personnel to conduct home visits
- Acceptability of home visit
  - privacy issues
- Insurance issues

How to Use Recommendations

- Funding
  - Site as Evidence of Effectiveness and Cost Effectiveness
- Insurance
- Communication/translation
- Policy Development

Take Home Points

Home-based multi-trigger, multi-component, environmental interventions are

1) **Effective** in reducing symptom days, school days missed, and acute asthma visits

2) **Good value** for the money invested for programs with minor or moderate environmental remediation

3) **Tailoring** intervention towards environmental exposure and client sensitivity may improve effectiveness and reduce cost
Questions

Thank you!

Question: Does your program have a home environmental intervention component?

1. Don’t have it
2. Under development
3. In place, adequate
4. Very well developed, a model for others
5. N/A
Breaking-In

• Megan Sandel and Margaret Reid, Boston Medical Center and BPHC

• Dr. Tyra Bryant-Stevens, Children’s Hospital of Philadelphia