National Collaborating Centre for Environmental Health

Intervention Strategies to Reduce Residential Pesticide Exposures
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Objectives

• To identify:
  – The current state of knowledge about residential pesticide exposures
  – Intervention strategies to reduce pesticide exposure
Outline

• Residential pesticide use
• Take-home exposures
• Intervention strategies
  – Reduction of residential pesticide use
  – Reduction of take-home exposures
  – Integrated Pest Management (IPM)
Pesticides

- Pesticides:
  - Toxic to organisms: plants, insects, rodents, mold
  - Different toxicological characteristics
  - Heterogeneous group of chemicals
- Commonly used residential pesticides:
  - Herbicides: 2,4-D, glyphosphate, diacamba, Mecoprop
  - Combination: fertilizer-pesticide: ‘Weed and Feed’
  - Insecticides: carbaryl, diazanon, malathion
- Sources: recreational areas and fields, yards, golf courses, schools and day care facilities
Residential pesticide use

- 74% of US households used pesticides in 2002 (US EPA)
- 2,4-D most used active ingredient
- Seven of the top ten in the home and garden sector are herbicides and three are insecticides
- Insecticides comprised nearly 60% of all expenditures in the home and garden sector

Residential pesticide use

Outdoors
Residential pesticide use

• Assessing organophosphorus (OP) pesticide exposure among children living in two Seattle metropolitan area communities
• Measured urinary metabolites; 110 children, 96 households
• Identified possible exposure risk factors through a parental interview
• Urine samples were analyzed for six diakylphosphate (DAP) compounds, the common metabolites of the OP pesticides

Ref: Lu et al., 2001
Residential pesticide use

• At least one of the DAP metabolites was measured in 99% of the children
• Higher DAP concentrations for children who
  – Lived with a garden (diethyl DAP)
  – Lived in households where garden pesticide use was reported (both dimethyl and diethyl DAP)
  – Had pets in the households (dimethyl DAP) but no association for use of pesticides on pets.

Ref: Lu et al., 2001
Residential use of pesticides and the distribution of dimethyl dialkylphosphate concentrations (µmol/L) in children living in the Seattle metropolitan area. *Significantly higher dimethyl DAP concentrations were found in children whose parents reported use of pesticides in their gardens, Mann-Whitney U-Wilcoxon rank-sum $W$ test, $p = 0.05$.

Ref: Lu C, Knutson DE et al., Environmental Health Perspectives 2001
Pesticides indoors

Pesticide application indoors
Tracking of pesticides from outdoors
Indoor environment

- On average, people in moderate climates are assumed to spend up to 95% of their time indoors
- 87% in enclosed buildings, 6% of their time in enclosed vehicles
- Home environment source of exposure to pesticides
Residential pesticide use

• Over-use is common in poorly-maintained multi-unit dwellings

• OP pesticides most heavily applied throughout New York State in 1997
  – Heaviest use of OP pesticides in Manhattan and Brooklyn

• Often banned or restricted-use pesticides used *(tres pasitos a carbamate, tiza china, and methyl parthion)*

References:
Other exposure pathways

• Important pathway for residential contamination of homes of agricultural workers
  – Spray drift, volatilization, soil/foliar resuspension, track-in on shoes, and transport on clothing

• Only a couple of studies of track-in in urban or non-agricultural settings
  – 2,4-D
  – Organophosphate application of orchards – pesticides detected in non-applicator homes 50 feet from orchard

Ref Nishioka et al.,2001 Morgan et al.,2008
Factors that affect exposure

- The application: e.g. amount used, application method, personal protective equipment
- Ambient conditions: temperature, humidity, wind
- Post-application interventions: removing shoes, storing clothes outside
- Population exposed: applicator (professional, residential), resident, neighbours, children etc.

• Lawn application of 2,4-D
• Dislodgeable 2,4-D turf residue and correlation to carpet dust
• Collected indoor air, surface wipes and floor dust samples
  – 2 year study
  – 13 homes
  – 1 week before application
  – 1 week after
Main findings

- Track-in dominant contributor to floor loadings
- Spray drift and foliar resuspension accounted for only 1% of 2,4-D on floors
- Bare floors 5-20x lower loading than carpet
- Highest loading at entry ways
- Entry mats decreased carpet dust residue by average of 33%
Main findings

- Higher air levels associated with active children (esp w/ shoes) and pets
- Assumption 2,4-D on floors is resuspended to tables and sills through high activity
- Estimated non-dietary ingestion (1-2 yr olds) from contact with floors post-application
  - Median 1 μg/day (max 6.7 μg/day) vs. 1.3 μg/day from diet
  - 10 x higher than pre-application exposures
Main findings

• Amount sprayed externally was not related to amount of residue inside homes
  – Track-in and high activity more important than any application factor
Intervention strategies

Reduction of residential pesticide exposure
Reduction of take-home exposures
Integrated Pest Management (IPM)
Reduction of residential pesticide exposure

- Bans or restrictions on use on public, municipal and/or private property
- Alternatives to pesticides
- Production of locally grown organic produce
Reduction of take-home exposure

- Remove shoes
- Replace carpet with bare floors
- Use entry mat
- Reduce track in by active pets, homeowner applicator
- Increase vacuuming (entry)
Integrated Pest Management (IPM)

• Method of pest control based on modifying the physical environment and reducing the use of chemicals
• Common components
  – Repair, sealing of entry points
  – Least toxic pest control application
  – Professional cleaning
  – Education
# Intervention Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention</th>
<th>Location</th>
<th>N</th>
<th>Methodology</th>
<th>Duration</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campbell et al., 1999</td>
<td>IPM (cockroach)</td>
<td>Apt complex</td>
<td>80</td>
<td>Educational session, booklet, Questionnaire before and after</td>
<td>8 mo</td>
<td>Improvement of: Knowledge, Attitudes, Practices</td>
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<tr>
<td>Brenner et al., 2003</td>
<td>IPM (cockroach)</td>
<td>Urban households</td>
<td>131</td>
<td>Monitoring biweekly (2mo), then monthly (4 mo)</td>
<td>6 mo</td>
<td>Decline from 80.5 to 39% in households with cockroaches</td>
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<tr>
<td>Gergen, 1999</td>
<td>House-cleaning and professional extermination (cockroach)</td>
<td>Inner-city dwelling</td>
<td>48</td>
<td>Measured Bla g1 in settled dust in 48 homes, 0, 2, 6, 12 mo</td>
<td>1 year</td>
<td>No difference.</td>
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<tr>
<td>Williams et al., 2006</td>
<td>IPM (reduce prenatal exposure)</td>
<td>Inner city homes New York City</td>
<td>25</td>
<td>2-week integrated indoor air samples before and after, 21 maternal blood and umbilical cord</td>
<td>1 mo</td>
<td>IPM is effective</td>
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</tbody>
</table>
Conclusions

• Limited # of intervention studies
• Track-in and household activity levels more important than application factors for take-home exposures
• IPM is effective for reducing pesticide exposure in residences
Questions?

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