Laboratory Animal Allergy
Mouse Urine Protein as an Indicator

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LABORATORY ANIMAL ALLERGY (LAA)

- Significant Occupational Health Problem
- Approximately 2 million workers in the U.S. have jobs with routine contact with animals.
  - 33% of animal handlers will develop allergic symptoms
  - 10% of animal handlers will develop animal induced asthma

- 1998 NIOSH issued an Alert entitled:
  - Preventing Asthma in Animal Handlers DHHSNIOSH 97-116

- Using proper protective equipment
  - Gloves, Particulate respirators, Face shields
- Training for workers about animal allergies
- Modifying ventilation & filtration systems
- Providing health monitoring of exposed workers
LABORATORY ANIMAL ALLERGY (LAA)

- Classified as immediate hypersensitivity reactions or Type I
  - Involves production of Immunoglobulin E (IgE)
  - Forming a complex cascade of reactions leading to allergic inflammation

- Contact with animal allergens
  - Inhalation (Primary source)
  - Direct Skin contact
LABORATORY ANIMAL ALLERGY

- Onset can range from minutes to hours after exposure with mild to severely debilitating reactions
  - Skin
    - Hives
    - Rashes
    - Watery Eyes
  - Respiratory
    - Sneezing
    - Coughing
    - Wheezing
    - Asthma
ANIMAL POPULATION

- Johns Hopkins University
  - 90% of the animal population for JHU are Mice
  - Concern over allergen in laboratory animal facilities
  - Source
    - Urine-Major source due to persistent proteinuria
    - Hair
    - Dander
Mouse Urine Protein Study

Purpose

- Determine airborne concentrations of Mouse Urinary Protein (MUP) in close proximity to animal holding areas
- Determine the effectiveness of various types of engineering controls
- Determine what are the levels of MUP in various locations throughout the Institution
MOUSE URINARY PROTEIN
Particle Size

- Current literature reports that mouse allergens can reside on particles ranging
  - >0.5um to <10um
  - **Respirable**
    - Particles less than 10 microns are considered respirable.
    - Can easily enter the lower portion of the respiratory tract
    - More likely to cause an adverse effect.
      - Particles between 10-100 microns are trapped by the upper respiratory tract (nose, throat) and removed from body
      - Particles above 100 microns are not considered an inhalation risk.
ENGINEERING CONTROLS

● Containment
  - The animal holding area is negatively pressurized to the surrounding areas, preventing allergens from entering other areas
  - The animal cage is maintained under control ventilation to prevent release of allergen into the work area

● Engineering Control Data
  - Open Wire Cage
  - Micro Isolated Cage
  - Ventilated or Exhausted Rack
  - Integrated Cage Rack System
# Engineering Controls Effectiveness

<table>
<thead>
<tr>
<th>Engineering Controls</th>
<th>Mean / range (MUP ng/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cage design</td>
<td></td>
</tr>
<tr>
<td>Wire top cage no controls</td>
<td>96.0 / 8.1 - 464.0</td>
</tr>
<tr>
<td>Cage with microisolator cover</td>
<td>2.6 / 0.2-12.2</td>
</tr>
<tr>
<td>Wire top cage on rack with negative exhaust</td>
<td>1.4 / 0.1-3.6</td>
</tr>
<tr>
<td>Cage with integrated supply and exhaust</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Ventilation design</td>
<td></td>
</tr>
<tr>
<td>Older cage wash facility with limited ventilation</td>
<td>12.3 / 6.5-90.0</td>
</tr>
<tr>
<td>New cage wash facility with ventilation control</td>
<td>1.0 / 0.5-4.8</td>
</tr>
</tbody>
</table>
AIRBORNE CONCENTRATION RECOMMENDATIONS

- According to S. Gordon
  - Suggested risk of sensitization & development of symptoms to mice is increased MUP concentrations >5ng/m³

- Great Britain Recommendations
  - Exposure in Animal Work Area
    - <3ng/m³

- Johns Hopkins University/Department of HSE
  - Exposure in Non-Animal Work Area
    - <1ng/m³
<table>
<thead>
<tr>
<th>SITE</th>
<th>RANGE (MUP ng/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted employee Access</td>
<td>0.199-0.975</td>
</tr>
<tr>
<td>Animal Transportation Hallways-</td>
<td>0.452-2.78</td>
</tr>
<tr>
<td>General Service Hallways</td>
<td>&lt;0.05-0.05</td>
</tr>
<tr>
<td>General Service Hallways-</td>
<td>&lt;0.05-0.532</td>
</tr>
<tr>
<td>General Service Hallways-</td>
<td>&lt;0.05-0.172</td>
</tr>
<tr>
<td>Hallway Outside of Research Lab</td>
<td>0.0820-0.696</td>
</tr>
<tr>
<td>Service Elevator Stop-</td>
<td>&lt;0.05-0.340</td>
</tr>
<tr>
<td>General Office Area</td>
<td>&lt;0.05-0.05</td>
</tr>
<tr>
<td>Restricted Animal Holding Areas</td>
<td>0.2-2.8</td>
</tr>
</tbody>
</table>
SUMMARY

- Effective engineering controls with respect to the housing of mice can reduce exposure significantly (greater than 90%)
- Effective ventilation control can reduce exposure to those in common areas (corridors)
- Effective ventilation design can reduce worker exposure to Mouse Urine Protein while performing cage washing duties
The Johns Hopkins University
Center for Excellence in Healthcare Safety and Environmental Health
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Thank You

QUESTIONS ?