Learning Objectives:

• Understand the link between asthma and the work environment
• Identify strategies for recognizing and managing work-related asthma
• Familiarize yourself with the clinical resources related to work-related asthma
Personnel
- Carolina Espineli (research assistant)
- Jennifer Flattery (epidemiologist)
- Eleana Martysh (research assistant)
- Debbie Shrem (health educator)
- Justine Weinberg (industrial hygienist)

Personnel
- Margaret Filios
- Patricia Schleiff

Pizza Worker
Pizza Worker

Pizza Worker
Clinical definition of WRA

- Variable airflow limitation and/or airway hyperresponsiveness due to exposure to a specific agent or conditions in the work environment
- Sensitizer and irritant-induced asthma

Clinical classification

![Diagram](image)

These groupings are not mutually exclusive; e.g., OA can be followed by WEA

Tarlo et al; Chest 134: 1S-41S; 2008
Surveillance case definition

- Health care professional diagnosis consistent with asthma, AND
- An association between symptoms of asthma and work
- Includes both new onset (OA, RADS) and work-aggravated asthma

New onset asthma (I)

Occupational asthma
- Workplace exposure to an agent previously associated with occupational asthma? “Yes” or “No”

AND

- Objective evidence of work-relatedness?: “Yes” or “No”
New onset asthma (II)

• Reactive airways dysfunction syndrome (RADS)
  • New asthma symptoms within 24 hours after one-time high-level exposure, persists > 3 months

Work-aggravated asthma

Preexisting asthma that was symptomatic and/or treated with asthma medication within 2 years prior to entering the occupational setting
Epidemiology

• > 250 agents reported to cause OA (Chan-Yeung 1994)
• Most common type of occupational lung disease in population based studies (McDonald 2000)

Epidemiology

• Median PAR = 17.6% (Toren and Blanc, 2009)
• Occupations at high risk: painters, bakers, woodworkers, welders, chemical workers
• Most common exposures: isocyanates, flour/grain, wood, latex, glutaraldehyde, lab animals
Classification of Confirmed Cases
Work-related asthma in California, 1993-2012 (N=2,991)

Top Industries with Highest Rates of Work-related Asthma
California Work-related Asthma Prevention Program (WRAPP) Surveillance Data, 1993-2011 (N=6,577)
Occupational Health Branch, California Department of Public Health

- Transit and Ground Passenger Transportation: 16.9
- Hospitals: 13.5
- Parks, Zoos, Museums: 9.5
- Utilities: 8.4
- Wood Product Manufacturing: 6.1
- Heavy and Civil Engineering Construction: 5.4
- Electrical Equipment and Appliance Manufacturing: 4.4
- Waste Management and Remediation Services: 4.3
- Telecommunications: 4.0
- Food Manufacturing: 3.8
- Social Assistance: 3.7
- Nonmetallic Mineral Product Manufacturing: 3.7
- Chemical Manufacturing: 3.7
- Transportation Equipment Manufacturing: 3.5
- Beverage and Tobacco Manufacturing: 3.2

Rate per 100,000 Workers
Select occupation with highest rate of WRA.

**Top Occupations with Highest Rates of Work-related Asthma**  
California Work-related Asthma Prevention Program (WRAPP) Surveillance Data, 1993-2011 (N=6,577)  
Occupational Health Branch, California Department of Public Health

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Rate per 100,000 Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefighting Occupations</td>
<td>27.5</td>
</tr>
<tr>
<td>Misc. Science Technicians</td>
<td>16.3</td>
</tr>
<tr>
<td>Correctional Officers and Bailiffs</td>
<td>13.3</td>
</tr>
<tr>
<td>Medical Assts and Healthcare Support</td>
<td>11.6</td>
</tr>
<tr>
<td>Respiratory Therapists</td>
<td>11.1</td>
</tr>
<tr>
<td>Police Officers</td>
<td>11.1</td>
</tr>
<tr>
<td>Medical Records and Health Info Technicians</td>
<td>10.6</td>
</tr>
<tr>
<td>Chemical Technicians</td>
<td>10.3</td>
</tr>
<tr>
<td>Government Program Eligibility Interviewers</td>
<td>9.8</td>
</tr>
<tr>
<td>Lifeguards and Other Protective Services</td>
<td>9.6</td>
</tr>
<tr>
<td>Telephone Operators</td>
<td>9.6</td>
</tr>
<tr>
<td>Chemical Process Machine Operators</td>
<td>8.5</td>
</tr>
<tr>
<td>Registered Nurse</td>
<td>8.0</td>
</tr>
<tr>
<td>Diagnostic Related Technicians</td>
<td>7.8</td>
</tr>
<tr>
<td>Emergency Medical Tech and Paramedics</td>
<td>7.8</td>
</tr>
<tr>
<td>Clinical Laboratory Technician</td>
<td>7.5</td>
</tr>
</tbody>
</table>
Exposures among Occupations with the Highest Rates

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Most Common Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firefighters</td>
<td>Smoke</td>
</tr>
<tr>
<td>Science Technicians</td>
<td>Acids, chemicals, indoor air, rat antigens, glues, dust</td>
</tr>
<tr>
<td>Medical Assistants &amp; Support</td>
<td>Glutaraldehyde, chemicals, smoke, latex, dust, perfume, paint</td>
</tr>
<tr>
<td>Correctional Officers &amp; Bailiffs</td>
<td>Smoke, chemicals, pepper spray, mace, cleaning chemicals</td>
</tr>
<tr>
<td>Respiratory Therapists</td>
<td>Cleaning chemicals, latex, pharmaceuticals</td>
</tr>
<tr>
<td>Medical Records Technicians</td>
<td>Dust, smoke, perfume</td>
</tr>
<tr>
<td>Police Officers</td>
<td>Smoke, pepper spray, dust, indoor air, mold, animal antigens</td>
</tr>
<tr>
<td>Telephone Operators</td>
<td>Chemicals, perfume, paint, carpet dust</td>
</tr>
<tr>
<td>Chemical Technicians</td>
<td>Solvents, acids, chemicals</td>
</tr>
<tr>
<td>Govt Program Eligibility Workers</td>
<td>Roofing tar, chemicals, indoor air, toner, perfume, dust</td>
</tr>
</tbody>
</table>

15 Most Common Exposures Reported by Cases

- Dust
- Unspecified Chemicals
- Smoke
- Mold
- Indoor Air Pollutants
- Cleaning Agents
- Paint
- Indoor Air Pollutants from Building Renovation
- Perfume
- Pesticides
- Glues
- Bleach
- Diesel Exhaust
- Asphalt
- Cigarette Smoke
Most Common Asthmagens

Pathogenesis: sensitizer-induced

High molecular weight (≥ 5,000 Da)
- IgE-mediated (ex: flour dust, latex)
- Bind to specific IgE on mast cells, basophils
- Act as complete antigens
Pathogenesis: sensitizer-induced

High molecular weight [continued]

- Release of cytokines/chemokines
- Activation of inflammatory mediators (histamine, leukotrienes, prostaglandins)
- Antibodies detected by circulating IgE (RAST) or skin prick testing

Pathogenesis: sensitizer-induced

Low molecular weight

- IgE-mediated (Ex: acid anhydrides, platinum) or non IgE-mediated (ex: isocyanates)
- React with proteins to produce complete antigen, mechanism poorly characterized
- Key role for T lymphocytes in inflammatory process
Pathogenesis: sensitizer-induced

- Effector cells (eosinophils, mast cells, epithelial cells, neutrophils) cause smooth muscle contraction, mucus hypersecretion, airway inflammation, and epithelial injury
- Genetic polymorphisms for major histocompatibility complex class II proteins may determine specificity of response

Pathogenesis: irritant-induced

- Localized inflammatory response with subepithelial fibrosis, eosinophils and T cells infiltration
- Activation of nonadrenergic, noncholinergic pathways via axon reflexes and mast cell degranulation
- Recruitment of inflammatory cells
- Altered epithelial permeability
Risk factors for WRA

Duration of exposure (sensitizer induced)

Atopic history and cigarette smoking (IgE-dependent)

Level of exposure to irritant

Diagnosis of WRA

- Asthma = intermittent respiratory symptoms and reversible/variable airways obstruction
- Cough, chest tightness, shortness of breath, dyspnea on exertion
- Rhinocconjunctivitis (more common with HMW substances)
Diagnosis: sensitizer-induced

Symptoms occur months to years after exposure onset
- Early, late or biphasic responses
  - HMW: early and biphasic
  - LMW: late and biphasic

Which of the following tests is LEAST useful for the diagnosis of work-related asthma?
Flour dust in bakery

Red cedar dust – pencil manufacturing plant
Isocyanate exposure

Packing Department

Isocyanate exposure

Packing Department
Egg protein exposure - breaking room

Cleaning agent exposure - hospital
Diagnosis: irritant-induced

Symptoms occur promptly following exposure

May be preceded by “chemical bronchitis”

Bus cleaner removing graffiti
Medical history

- Asthma, allergies, atopic dermatitis, cardiac history
- Tobacco and medication use
Occupational factors

- Temporal relationship between work and symptoms
- Identification of work processes, job duties, chemicals (MSDS), PPE

Physical examination

nasal polyps, wheezing, crackles, rhonchi
Objective tests

- CXR: bronchial wall thickening
- Spirometry: >12% improvement or absolute increase > 200 ml in FEV$_1$ after bronchodilator (ATS 1991)

Diagnosis of WRA

- Decrease of 10% in FEV$_1$ across work shift
- > 20% diurnal variability in peak expiratory flow (PEF)
- Airway hyperresponsiveness with inhalation challenge testing (histamine or methacholine)

Tarlo et al; Chest 134: 1S-41S; 2008
Diagnosis of WRA

Objective tests [continued]

- Specific inhalation challenge tests (precise etiology, test new agent)
- Skin prick tests for HMW aeroallergens
- Specific IgE antibodies against HMW and some LMW sensitizers (ex: diisocyanates, acid anhydrides)

After the diagnosis of work-related asthma, what is the BEST management strategy?
Management of WRA

• Prompt diagnosis and removal from exposure (especially in sensitizer-induced asthma)
• Follow published guidelines for asthma management ([NHLBI](#))
• Inhaled corticosteroids improve outcome following removal from exposure (Malo 1996)

Management of WRA

• Incomplete recovery common with sensitizer-induced asthma (Chan-Yeung 1999)
• Early removal increases likelihood of recovery (Cote 1990)
• Improved PFTs 1-2 years following removal from sensitizer exposure
• Persistent sx(s) > 2 years following irritant-induced asthma (Bherer 1994)
WRA and disability

• High rates of job loss/job change determined by working conditions (Blanc 1996)
• Substantial income reduction after 3 years in >50% affected (Ameille 1997)
• Impaired quality of life: increased symptoms, activity limitation, emotional dysfunction (Gassert 1998)

Preventing WRA

• Primary prevention
  • Substitute with less hazardous substances
  • Change work processes
  • Reduce exposure: engineering controls, PPE as last resort
  • Worker education and training
Preventing WRA

Secondary prevention

• Detect early to minimize severity and duration

Tertiary prevention

• Provide appropriate health care: workers compensation claims
• Early removal from exposure
• Permanent impairment guidelines (ATS 1993)
• Long-term follow-up

When is illness or injury work related?

Any injury or illness resulting from or sustained in the course of any occupation or employment.

More than 50% likely due to work

USE THESE WORDS:

• “More likely than not” due to work
• Work “most likely” cause of the condition
• “But for the work” the condition would not exist
Preventing WRA: workplace surveillance

• Early detection works to prevent morbidity and disability (Tarlo 1999)
• Medical surveillance: symptom questionnaires, spirometry, PEF records, skin-prick testing for HMW antigens (flours, proteolytic enzymes, animal proteins)
• Exposure monitoring of hazards

Chemical policies

• “Green chemistry” initiatives
• “cradle to grave” or “life cycle” and the workplace
• Occupational and environmental advocacy
Is it easy to be green?

Green Seal – third party certification for cleaning
Before

After

You can report a case!

http://tinyurl.com/WorkRelatedAsthma
800-970-6680
Robert Harrison, MD MPH
California Department of Public Health
Occupational Health Branch
and
University of California, San Francisco
Division of Occupational and Environmental Medicine

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