Occupational Asthma
Cased-based discussion

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Disclosures

Dr. Cowl has no financial or other COI disclosures related to the material in this presentation. There will be no discussion of off-label use for any drugs or devices.

Learning Objectives

- Recognize the complexity of assessing occupational lung disease in terms of addressing exposure, and in handling administrative aspects involved
- Explain factors involved with diagnosing and treating work-related asthma
- Recognize key features of various exposures

Which of the following data sources are most important in the assessment of patients with suspected occupational or environmental illness?

A. Detailed occupational & environmental history
B. Spirometry
C. Radiographic imaging
D. Functional/exercise testing
E. Material Safety Data Sheets (MSDS)

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Assessing Occupational or Environmental Lung Disease

Most environmentally-induced illness is recognized only after a detailed history is obtained

- Items vital for an Occupational Health History include:
  - Temporal association with work?
  - Other workers affected?
  - Was there a first report of injury (incident report) filed?
  - Current and past occupations?
  - Personal protective equipment used?
  - Any secondary or other part-time jobs?
  - Hobbies, military service or other exposures?
  - Current and past working hours?
  - Any change in the process or nature of the job?

Assessing Occupational or Environmental Lung Disease

- Diagnosing an occupational or environmental illness will almost always introduce administrative issues
- The administrative aspects of OLD are typically foreign to many providers and involve recognition of a variety of terms and compensation systems that may be outside your practice scope:
- One source of reference is:
  - **MSDS (Material Safety Data Sheets)** - A form listing data regarding the properties of a particular substance (e.g. melting point, boiling point, flash point, toxicity, health effects, first aid, spill-handling procedures, etc.) intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner.

CHEST Supplement

DIAGNOSIS AND MANAGEMENT OF WORK-RELATED ASTHMA: ACCP CONSENSUS STATEMENT

Diagnosis and Management of Work-Related Asthma*

American College of Chest Physicians Consensus Statement

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CHEST September 2008; Vol. 134(3): Suppl 1S-41S.

Background: A previous American College of Chest Physicians Consensus Statement on asthma in the workplace was published in 1995. The current Consensus Statement updates the previous one based on additional research that has been published since then, including findings relevant to preventive measures and work-exacerbated asthma (WEA).
Methods: A panel of experts, including allergists, pulmonologists, and occupational medicine physicians, was convened to develop this Consensus Document on the diagnosis and management of work-related asthma (WRA), based in part on a systematic review, that was

Eur Respir J 2012; 39: 529–545
DOI: 10.1183/09031936.00096111

ERS TASK FORCE REPORT

Guidelines for the management of work-related asthma

X. Baur, T. Sigsgaard, T.B. Aasen, P.S. Burge, D. Heederik, P. Henneberger, P. Maestrelli, J. Rooyackers, V. Schlünssen, O. Vandenplas and D. Wilken on behalf of the ERS Task Force on the Management of Work-related Asthma

ABSTRACT: Work-related asthma, which includes occupational asthma and work-aggravated asthma, has become one of the most prevalent occupational lung diseases. These guidelines aim to upgrade occupational health standards, contribute importantly to transnational legal harmonisation and reduce the high socio-economic burden caused by this disorder.

A systematic literature search related to five key questions was performed: diagnostics; risk factors; outcome of management options; medical screening and surveillance; controlling exposure for primary prevention. Each of the 1,329 retrieved papers was reviewed by two experts, followed by Scottish Intercollegiate Guidelines Network grading, and formulation of statements graded according to the Royal College of General Practitioners' three-star system.

Recommendations were made on the basis of the evidence-based statements, which comprise the following major evidence-based strategic points. 1) A comprehensive diagnostic approach considering the individual specific aspects is recommended. 2) Early recognition and diagnosis is necessary for timely and appropriate preventative measures. 3) A stratified medical screening strategy and surveillance programme should be applied to at-risk workers. 4) Whenever possible, removing exposure to the causative agent should be achieved, as it leads to the best health outcome.

AFFILIATIONS
Author affiliation details and a list of the Task Force members can be found in the Acknowledgements section.

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Work-related asthma (Definitions)

Work-related asthma

Broad term that refers to asthma that is exacerbated or induced by inhalation exposures in the workplace.

Work-exacerbated asthma

Asthma triggered by various work-related factors in workers with pre-existing asthma

Occupational asthma

Asthma triggered de novo induced by sensitization to a specific substance

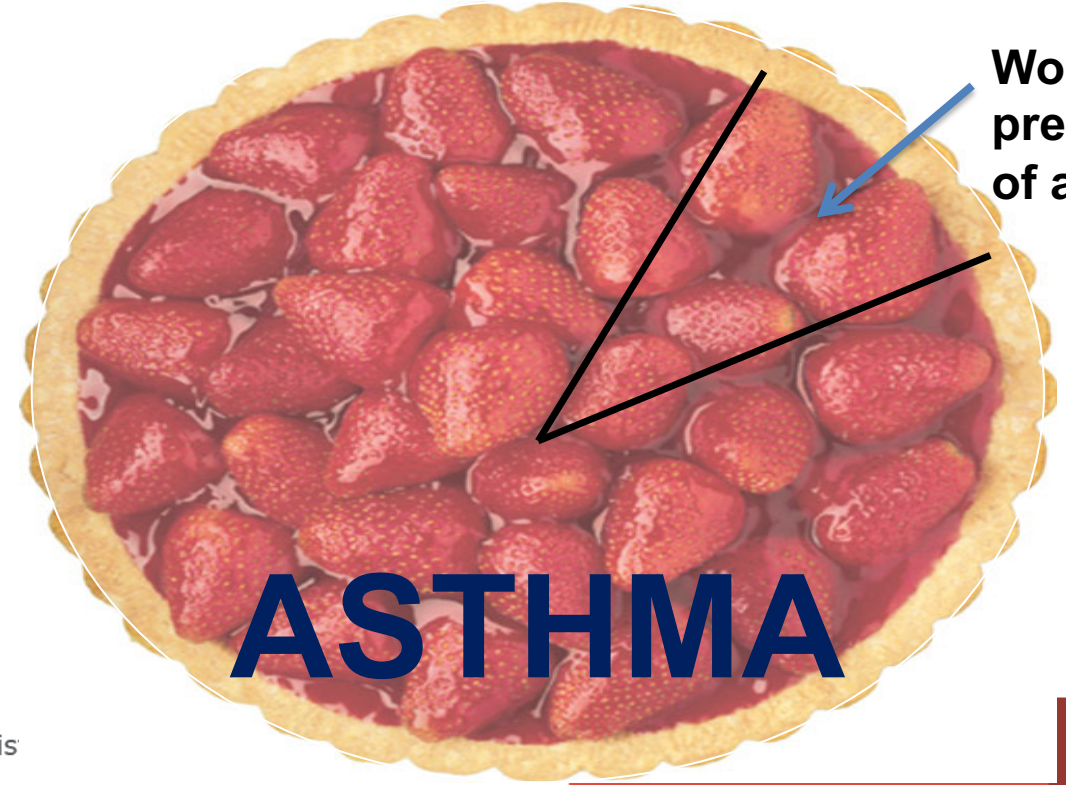
Consensus reached on several topics on Work-Related Asthma (WRA)

- Take a history to screen for WRA in all new onset or worsening asthma patients
- In all patients suspected with WRA, obtain a history of job duties, exposures, use of protective devices, presence of respiratory disease in co-workers, etc.
- For individuals with suspected sensitizer-induced occupational asthma (OA), carefully document history and use objective testing to improve diagnostic probability (e.g. serial peak flow readings, serial methacholine challenge, immunological assessments, induced sputum testing, etc.)
- In patients suspected with WRA who are continuing to work, record serial measurements of peak flow as part of the diagnostic evaluation (minimum 4x/day for at least 2 weeks)

Consensus reached on several topics on WRA (cont.):

- Focus on exposure control and remove patients from exposure in sensitizer-induced asthma
- An individual diagnosed with OA represents a potential sentinel event, so the workplace may need to be evaluated to identify and prevent other cases of OA -- and if sensitizer present, implement secondary prevention (e.g. questionnaires, screening spirometry, etc.)

Work-related asthma epidemiology



Work-related asthma has a prevalence of 9-15% of all forms of asthma

Balmes J. *Am J Respir Crit Care Med. 2003; 167(5):787-97.*

Work-related asthma

Immunologic-induced asthma

- High-Molecular Weight Antigens
- Low-Molecular Weight Antigens

Asthma with latency

Asthma without latency

Irritant-induced asthma

(RADS)

Inhalation of irritants, gases, fumes

Work-related asthma prevalence may vary by….

- Specific agent of exposure

  Example: 1-5% of workers exposed to TDI develop asthma

  20% of workers exposed to acid anhydrides develop asthma

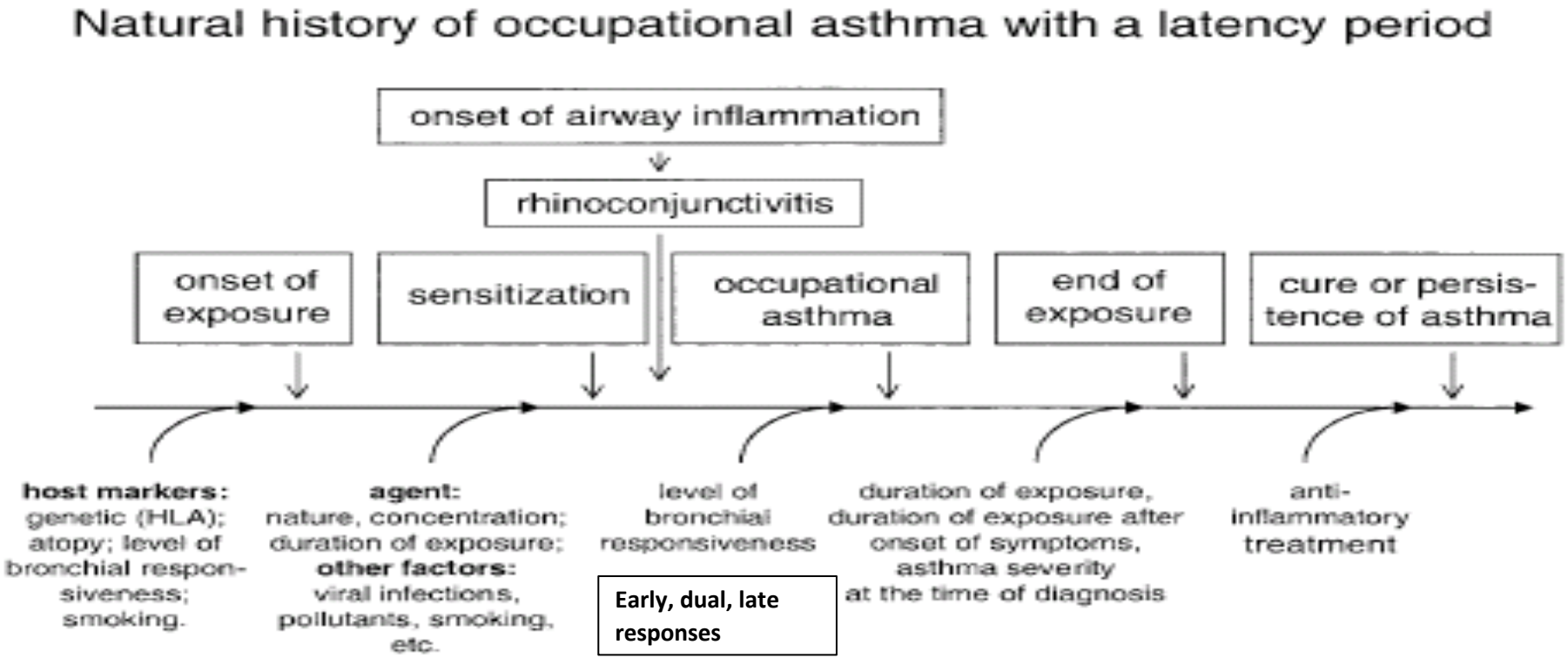
  40% of workers exposed to allergens in flour in baking industry develop asthma

- Type, source and concentration of exposure

- Host susceptibility factors (e.g. HLA haplotypes and other genetic polymorphisms)

Malo, Chan-Yeung. *J Allergy Clin Immunol* 2001; 108:317.

Work-related asthma with latency period



Agents associated with causing Occupational Asthma

There are more than 400 known causes of work-related asthma.

Rabatin and Cowl. *Mayo Clinic Proc* 2001; 76(6): 633-40.

Table 1. **Examples of Selected Agents Associated With Occupational Asthma***

Agents	Industry or occupation	Skin test reaction	Specific IgE antibodies
Isocyanates			
Toluene diisocyanate	Polyurethane foam manufacturing, paint application, plastics	CD	CD
Diphenylmethane	Core production in foundries, paint application	–	+
Anhydrides			
Trimellitic anhydride	Plastics, epoxy resins	+	+
Phthalic anhydride	Plastics, epoxy resins	+	+
Amines			
Ethanolamines	Soldering, paint application, machining metal products	–	CD
Other chemicals			
Formaldehyde	Hospital personnel, laboratory technicians, chemical production	–	–
Metals			
Nickel	Metal plating	+	CD
Cobalt	Hard metal manufacturing	+	ND
Chromium salts	Leather tanning	CD	+
Vanadium	Hard metal manufacturing	ND	ND
Zinc	Metal plating	CD	–
Platinum salts	Platinum refining	+	–
Vegetable and wood products			
Grain	Grain processing	+	–
Wheat/rye flour	Baking, food processing	+	+
Castor beans	Castor oil production	–	+
Raw tobacco	Tobacco production	+	+
Coffee beans	Coffee production, processing	+	+
Western Red cedar	Logging, lumber processing, home building, cabinet production	+	+
Colophony (pine resin)	Electronics manufacturing	CD	+
Gum acacia	Printing	+	–
Natural rubber latex	Health care	ND	+
Animals			
Pigeons	Pigeon breeding	+	–
Chickens	Poultry production/processing	+	+
Crabs	Crab production/processing	+	CD
Oysters	Oyster production/processing	+	+
Mice	Animal handling, laboratory technicians	+	CD

Categories of Sensitizer-induced Asthma (with latency period)

High Molecular Weight Antigens (>5,000 Daltons)

- More common
- Plant, animal proteins
- Ig-E mediated allergic response
- Skin prick testing or RAST testing available for many substances
- Immediate asthmatic response most common
- Atopy a risk factor
- Model of “extrinsic” asthma

Low Molecular Weight Antigens (<5,000 Daltons)

- Less common
- Industrial chemicals, metals (e.g. platinum, nickel, TMA)
- Non-IgE mediated
- No specific tests available
- Delayed asthmatic responses are more frequent
- Atopy not a risk factor
- Bind to native protein carrier and LMW molecule acts as a hapten

High Molecular Weight Antigens

- Flour and grain dust allergens in bakers
- Animal protein antigens in laboratory workers (murine urine)
- Natural rubber latex proteins in health care workers with gloves

Low Molecular Weight Antigens

- Metal salts (nickel, chromium, platinum)
- Isocyanates (TDI, HDI)
  - Can cause severe sensitivity without history of atopy
- Plicatic acid in Western Red cedar dust exposure
- Acid anhydrides in epoxy manufacturing (e.g. trimellitic anhydride)
- Colophony in solderers

Reactive Airways Dysfunction Syndrome (RADS)

Reactive Airways Dysfunction Syndrome (RADS)

An asthma-like illness that occurs after a single exposure to high levels of a respiratory irritant (vapor, fume, smoke) frequently occurring after a workplace accident or spill.

- Symptoms develop within hours of exposure and are associated with methacholine challenge responsiveness.
- Symptoms and airway responsiveness often persist longer than one year and may be permanent.

Brooks SM, Lockey J. *Am Rev Respir Dis* 1981;123:A11.

Which of the following patients is most likely to be diagnosed with RADS (reactive airway dysfunction syndrome)?

A. 22-year-old forklift operator with atopic asthma who experiences cough and chest pain while at work

B. 52-year-old research technician who 6 months prior took a position in a lab analyzing mouse excrement and now wheezes at night

C. 44-year-old painter who develops dyspnea and cough eight hours after applying a new two-coat paint to a large commercial truck

D. 62-year-old laborer on a cotton farm who has wheezing and chest tightness on Mondays that improves throughout the week

Which of the following patients is most likely to be diagnosed with RADS (reactive airway dysfunction syndrome)?

A. 22-year-old forklift operator with atopic asthma who experiences cough and chest pain while at work in a grain warehouse

B. 52-year-old research technician who 6 months prior took a position in a lab analyzing mouse excrement and now wheezes at night

C. 44-year-old painter who develops dyspnea and cough eight hours after applying a new two-part paint with hardener to a large commercial truck

D. 62-year-old laborer on a cotton farm who has wheezing and chest tightness on Mondays that improves throughout the week

Work-related asthma diagnosis

- Confirm the presence of asthma
- If sensitizers suspected, obtain immunologic results (e.g. skin prick, RAST, etc.) – but remember that these only document exposure & not a causal relationship
- Consider PEF monitoring and non-spec inhalation challenge like methacholine (if non-spec challenge is negative within 2 weeks of last exposure, OA often can be ruled out)
- Specific inhalation challenge
    - Few locations available
    - Can be risky in those with dramatic responses
    - Can be very effective in identifying a specific causal agent in a complex environment
- Site visit

Work-related asthma diagnosis

- An early recognition of WRA with removal from the causative agent improves probability of recovery
- Suspect work as a cause of asthma and obtain detailed history
    - Early, late and dual response patterns may be noted
    - A latent period is typically required for airway sensitization
    - Symptoms may progress throughout the workweek
    - Sequential clinical decline may occur week by week resulting in persistent airway hyperresponsiveness
    - Immunologic response develops in a small percentage of those exposed (otherwise consider irritant-induced asthma if multiple workers affected)

Work-related asthma diagnosis (cont.)

- Unfortunately, in the “real world” patients often have left work and recovered, and secondary gain issues occasionally arise (e.g. “retrospective symptomatology”)
- Consider other possibilities if the diagnostic workup is negative for asthma:
  - Hyperventilation syndrome
  - Vocal cord dysfunction
  - Cardiac-related abnormalities
  - Post-nasal drip with cough
  - Medication-induced cough
  - Chronic bronchitis

Work-related asthma management

- Therapy parallels standard asthma treatment with an emphasis on environmental controls (e.g. removal from proposed inciting exposure)
- For workers exposed to sensitizers or poorly controlled levels of irritants, primary prevention through control of exposures using:
    - Elimination
    - Substitution
    - Process modification
    - Respirator use
    - Engineering controls

What Things Do I Need to Consider in Assessing the Patient?

- Physical Properties of Gas
- Acute Clinic Findings as an Assessment of Injury Severity

- **Common Types of Toxic Inhalations**
  - Ammonia
  - Cadmium
  - Mercury
  - Zinc chloride
  - Mace & Tear Gas
  - Hydrogen sulfide
  - Ozone
  - Sulfur dioxide
  - Chlorine Derivatives
  - Phosgene
  - Nitrogen oxides

Physical Properties of Toxic Irritants

- Size of particles
- Water solubility
- Concentration of substance in ambient air
- Density of substance
- Duration of exposure
- Presence or absence of ventilation
- Host factors
  - Age, smoking status, co-morbidities
  - Respiratory protection

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