

*Practical Issues in
Asthma Management*

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OCCUPATIONAL ASTHMA

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THE PROBLEM

Occupational exposures account for about 10% of adult asthma. Unfortunately, many affected individuals remain undiagnosed as the diagnosis of occupational asthma remains one of the most difficult in respiratory medicine [1]. Early diagnosis is important because recovery is enhanced when an affected worker is removed from exposure within 12 months of first symptoms. Many individuals lose their jobs and the average financial loss several years later is about 50% of previous income [2]. Since childhood asthma is increasing, occupational asthma becomes important to paediatricians as well; many guidelines preclude the employment of asthmatics in high-risk jobs.

INTRODUCTION

Sherwood Burge is trained in respiratory medicine, occupational medicine and allergy and immunology. These three disciplines meet in occupational asthma. He runs the Regional Occupational Lung Disease Centre in Birmingham UK, which hosts Shield, a voluntary surveillance scheme for occupational asthma in the region which can link cases reported by different clinicians to the same workplace. He also developed the Oasys analysis system for documenting occupational asthma from serial peak expiratory flow measurements.



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A stylized blue ink signature of Peter J. Barnes.

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DEFINITIONS OF OCCUPATIONAL ASTHMA

Most clinicians include all patients who have asthma made worse by their work. Some of these patients have true occupational asthma; others may have had asthma even before starting work. It has yet to be shown whether it makes any long-term difference which mechanism is involved, and both categories of patients do badly from the point of view of continued employment and wealth. The distinction between these two groups has more to do with compensation schemes than with symptoms and treatment.

Allergic occupational asthma

This is a type of occupational asthma clearly due to IgE-mediated reactions (such as in laboratory animal workers with sensitisation to rat or mouse urinary proteins). There is a latent interval from first exposure to first symptoms; once sensitised, reactions may occur to very low exposures (the eliciting dose), such that contact with even the hair or clothes of those handling the animals may cause an attack.

Occupational asthma may also be caused by small molecular weight chemicals where IgE sensitisation cannot be demonstrated. Features similar to IgE-mediated asthma, such as latent interval and low-dose elicitation, are nevertheless present. Isocyanates are the best example of small molecules leading to occupational asthma without IgE sensitisation.

Presumed irritant-induced occupational asthma

A latent interval and low-dose elicitation can occur in situations where the causative agent works as an irritant at high concentrations (causing non-specific reactions), but where individuals have only been exposed to low-level non-irritant concentrations. Examples include formaldehyde, glutaraldehyde and chloramines in swimming pools and workplaces with high levels of bacterial and fungal contamination.

While any of these may be the primary cause of the asthma, it can also develop against a background of previous non-occupational asthma (the latter group is sometimes said to suffer from 'work-associated' asthma).

Irritant-induced asthma (reactive airways dysfunction syndrome)

Asthma can follow a single large exposure to a respiratory irritant (or sensitiser). Someone without asthma may develop the disease within a few hours of a massive exposure to a fire or a chlorine leak, for example. They may then suffer from asthma, associated with increased non-specific bronchial hyper-responsiveness, for more than three months. Subsequent low-level exposure to the same agent does not elicit an asthmatic response, showing that sensitisation has not occurred. Irritant-induced asthma is a separate entity to occupational asthma, as there is usually no threat to the long-term career prospects of affected individuals (occa-

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sionally a single large exposure, for instance to an isocyanate, results in sensitisation and low-dose elicitation; in which case the disease involved is occupational asthma without a latent period).

Common causes of occupational asthma

There are several hundred agents described as causes of occupational asthma and it is often easier to diagnose occupational asthma than to find the precise cause. Agents vary from industry to industry. The Shield voluntary reporting system covers a working population of 2.2 million in the West Midlands region of the UK, an area concentrating on automotive and metalworking industries [3]. The commoner causes are shown in *Table 1*.

The following agents top the lists elsewhere: cows (Finland), Western Red Cedar (British Columbia), aluminium potrooms (Norway) and latex (South Africa). Bakers are the most commonly compensated group in a number of countries, particularly those requiring evidence of IgE sensitisation (for instance in Germany).

Who should be investigated for occupational asthma?

Occupational asthma should be suspected in all adults who present with airflow obstruction, whether the primary diagnosis is thought to be asthma or COPD.

Table 1. Most common causes in the Shield reporting scheme 1995-1999

Agent	Number
Total	460
Isocyanates	80
Latex	41
Glutaraldehyde	34
Flour	23
Coolant oils	20
Epoxy resins	16
Woods	16
Welding fumes	9

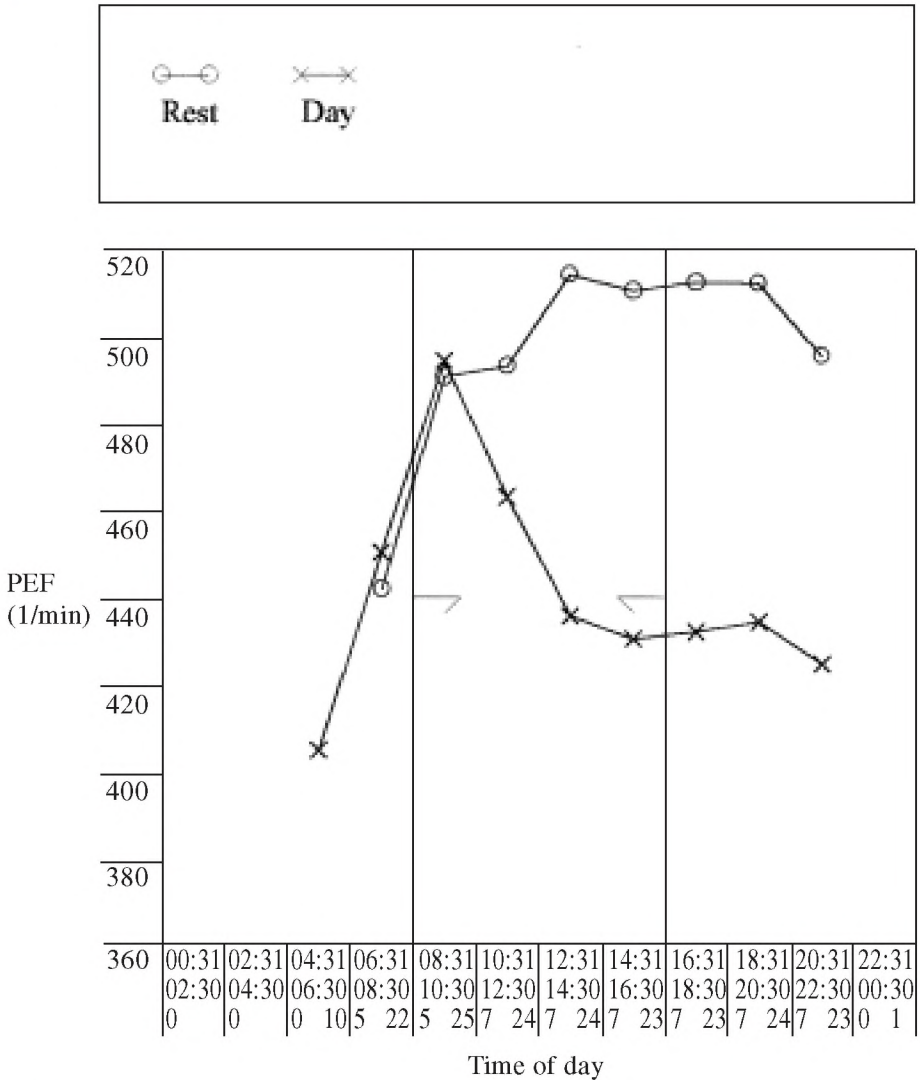


Figure 1.
A carpenter exposed to wood dusts kept 2-hourly PEF measurements over a 4-week period. The plot shows the mean PEF for all days off work (open circles) and at work (crosses), averaged for each 2-hour period from the Oasys plot. The period at work (8am to 4pm) is marked. On days away from work the PEF is low on waking, and rises to reach its best level in the afternoon. On workdays there is an initial rise in PEF when starting work, with a delayed fall in PEF which is at its worst in the evening at home.

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Many workers with occupational asthma are initially thought to have COPD, as the airflow obstruction appears to be relatively fixed and many are smokers. Once the cause is removed, the asthmatic nature of the disease becomes more apparent. The best way to screen for this is to ask workers whether their symptoms improve on days away from work, or while they are on holiday. Occupational asthma can be documented in the majority of those with rest day improvement and in about half of those who improve on holiday but not on rest days. Recovery can take several days to become evident. It is less useful to ask whether asthma is worse at work, as many patients with occupational asthma only develop symptoms after work and at night (*Figure 1*).

Baseline tests

Spirometry and bronchodilator response may confirm asthma, but normal spirometry or lack of bronchodilator response does not exclude occupational asthma. There are individuals with occupational asthma who have normal non-specific responsiveness so metacholine response measurement is not suitable for excluding occupational asthma. In those with measurable responsiveness on a workday, a fourfold improvement away from work documents occupational asthma. However, the sensitivity is low at 40%. If a suitable antigen is available, skin prick tests or measurement of specific IgE can determine the cause in somebody whose occupational asthma has been documented. For instance, a baker with work-related changes in PEF, a negative RAST to flour and a positive RAST to fungal amylase can be assumed to have occupational asthma due to amylase, and should be employable in types of baking which do not involve enzymes (such as patisseries).

Serial measurements of PEF [4]

Not all workers with work-related respiratory symptoms have occupational asthma; it is necessary to document the diagnosis with objective tests. It is important to decide when referral to a specialist in occupational asthma is appropriate. Most clinicians should be able to organise serial measurements of PEF or FEV₁, which is the most appropriate first step. It is important to make these measurements as early as possible while the worker is still employed and exposed. They can be organised pending specialist referral. Simple attention to detail is important. The worker should be instructed and checked in PEF measurement or, alternatively, a logging meter can be used. PEF should be measured on waking, and at approximately 2-hour intervals until bedtime. The exact timing is not material, most workers can manage a further reading on arrival at work, measurement during each break, on leaving, in mid-evening and at bedtime. The best of at least three readings, the best two within 20 litres/min of each other, is recorded. The times of waking and sleeping, and starting and stopping work are also recorded. It is important to keep any treatment constant during days on and off work, as changes in PEF rather than treatment is being monitored. I usually start with a four-week record, and emphasise that readings on days off work are even more important than days

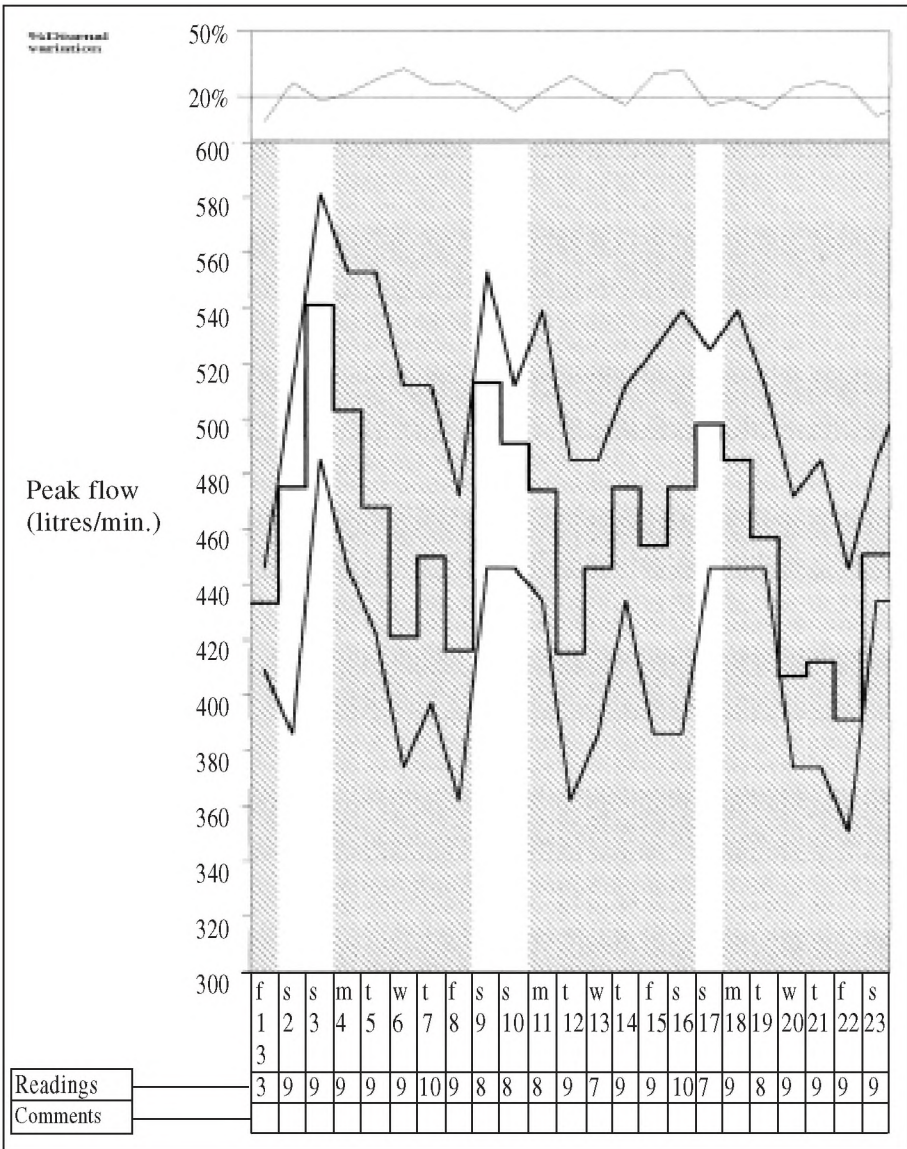


Figure 2. The Oasys plot of the carpenter whose mean PEF values are shown in Figure 1. The upper panel shows the daily diurnal variation. The middle panel shows the daily maximum (top line), mean (middle line) and minimum (bottom line) PEF. Days at work have a shaded background, days away from work a clear background. There is recovery during each period off work, with variable deterioration on workdays which is likely to reflect variable daily exposures to wood dust. Oasys-2 generates a score of between 1 and 4 for the probability of workdays being worse than rest days. Scores over 2.5 have a 92% specificity for occupational asthma and a sensitivity of 70%. The score here is 3.93 confirming occupational asthma. The bottom panel shows the date and the number of readings made each workday.

at work. The resulting plots should be analysed by an expert, or with an expert system (*Figure 2*). The website www.occupationalasthma.com has downloadable record entry forms and information about the Oasys expert diagnostic aid. Using Oasys-2, the records have a sensitivity of 70% and a specificity of at least 92%. Some workers fabricate at least part of the record, the sensitivity quoted above includes these probably fabricated readings.

Specific challenge tests

Controlled exposures to specific agents in a laboratory setting are the gold standard test for occupational asthma. They should only be done in laboratories that have regular experience with occupational agents. One test should be done each day, with monitoring of exposure levels during the challenge and lung function for a least eight hours after each exposure. Control challenges should take place on separate days. In addition, it is not always possible to reproduce complex work exposures in the challenge chamber, non-specific positive reactions can occur if exposure levels are too high, and false negatives occur when the work exposures are not correctly reproduced in the challenge chamber. Most measure non-specific reactivity as well. Tests are performed most frequently in Finland and Quebec, usually for compensation reasons (and at the expense of an insurance company). It is usually possible to manage individual cases without specific challenges. We perform them in around 10% of cases, particularly for new agents, for workplaces where there are multiple possible causes, and when specific IgE measurements are unhelpful. We are less keen to test workers who have already lost their job and where re-employment with similar exposures is unlikely.

Management post diagnosis [5]

The aim is to remove the worker from exposure to the causative agent within 12 months of the first symptoms and to maintain employment in an equivalent job. This requires employer co-operation. Unless the worker has been referred by the employer, the employer can only be contacted with the worker's consent, which should be documented in the medical record. The employer should review the risk assessment, and preferably substitute the offending agent or, if this is not possible, at least reduce exposures. Similarly exposed workers should be monitored, and the index worker should be relocated completely away from exposure. The success should be monitored with symptoms, repeated serial PEF records, and methacholine reactivity if originally abnormal. If specific IgE was present, the titres can also be monitored. Most have a half-life of 6-12 months so the removal from exposure should result in falling titres.

CONCLUSIONS

1. Occupational asthma is common and underdiagnosed, accounting for about 10% of adult asthma.
2. Every worker with airflow obstruction should be asked whether their symptoms improve on days away from work or on holiday.
3. Those with rest day improvement should be investigated to confirm or exclude occupational asthma. It may be appropriate to refer the individual in question to a specialist in occupational asthma at this stage if you do not have the time or resources to investigate further.
4. Serial measurement of PEF at home and work, with 2-hourly measurements for 4 weeks is the most appropriate investigation to confirm or exclude occupational asthma. The plots should be analysed by an expert (or with an expert system).
5. Specific occupational-type bronchial provocation testing is the gold standard. It should only be done in centres with particular expertise. The diagnosis can often be made satisfactorily without specific provocation testing.
6. Once occupational asthma has been diagnosed, the affected worker should be removed from further exposure within 12 months of the first symptoms, to maximise the chance of recovery. The worker's permission should be sought for the diagnosis to be communicated to others in the workplace. Affected individuals should be monitored to ensure that relocation has been successful.
7. The employer should revise the risk assessment for the offending job, substitute where possible or otherwise reduce exposures and check others similarly exposed. The affected employee should be relocated to an area without exposure to the identified cause.

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The website www.occupationalasthma.com has details of peak flow monitoring in the diagnosis of occupational asthma, and a question-and-answer facility on any aspect of occupational asthma.

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