OASYS; a tool for the confirmation of occupational asthma in the lung function laboratory

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Abstract

We have developed a method for the objective confirmation of occupational asthma which is suitable for implementation in all lung function and occupational health departments. It has been provided free of charge to 351 users worldwide and is supported by our website www.occupationalasthma.com. The method is called Oasys (1) and analyses 2-hourly measurements of PEF at home and at work. It has an independently validated sensitivity of 78% and specificity of 92% (2), better than any other independently validated test for occupational asthma.

Introduction

Occupational asthma is the commonest lung disease caused by current occupational exposures and stops skilled people working mid-career. The Health and Safety Executive estimate the cost to the UK economy at £1.1 billion over the next 10 years. About 15% of adult onset asthma is caused by exposures at work. Affected workers often lose their jobs and livelihood without a confirmed diagnosis, which is likely to be incorrect in around 45% based on history alone. The diagnosis of occupational asthma is difficult and previously beyond the resources of most lung function and occupational health departments. A recent survey showed that only 15% of departments were able to offer diagnostic tests complying with the new BTS standards of care for occupational asthma (3) (based on the evidence-based BOHRF guidelines (4)). Nationally less than 50% of workers diagnosed with occupational asthma have any type of validating test (SWORD (5)); our services validates around 80% of the 70 workers with occupational asthma seen annually (results reported in our web-based annual report www.occupationalasthma.com/shield.aspx) and helps many others seen elsewhere.

1. Gannon PF, Newton DT, Belcher J, Pantin CF, Burge PS , **Development Of OASYS-2: A System For The Analysis Of Serial Measurement Of Peak Expiratory Flow In Workers With Suspected Occupational Asthma**, Thorax , 1996 ; 51 : 484-489

2. Anees W, Gannon PF, Huggins V, Pantin CFA, Burge PS , **Effect of peak expiratory flow data quantity on diagnostic sensitivity and specificity in occupational asthma**, Eur Respir J , 2004 ; 23 : 730-734

3. Barber CM, Naylor S, Bradshaw L, Francis M, Harris-Roberts J, Rawbone R, Curran A, Fishwick D , **Facilities for investigating occupational asthma in UK non-specialist respiratory departments**, Occup Med , 2007 ; - : -

4. Nicholson PJ, Cullinan P, Newman Taylor AJ, Burge PS, Boyle C , **Evidence based guidelines for the prevention, identification, and management of occupational asthma**, Occup Environ Med , 2005 ; 62 : 290-299

5. Meyer JD, Holt DL, Chen Y, Cherry NM, McDonald J C , **SWORD 99: Surveillance Of Work-Related And Occupational Respiratory Disease In The UK**, Occup Med (London) , 2001 ; 51 : 204-208

Aims

To separate workers with occupational asthma from those with air flow obstruction from other causes.

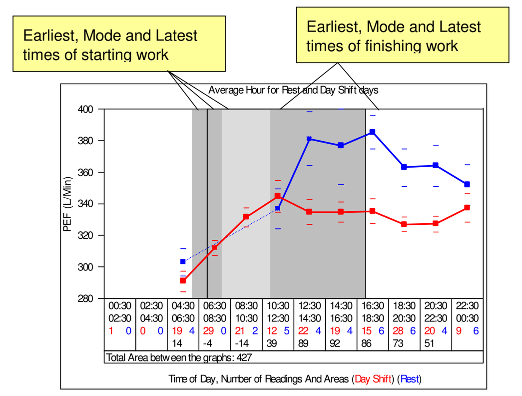
Hypothesis

If asthma is due to workplace exposures, lung function must be measurably worse following workplace exposure

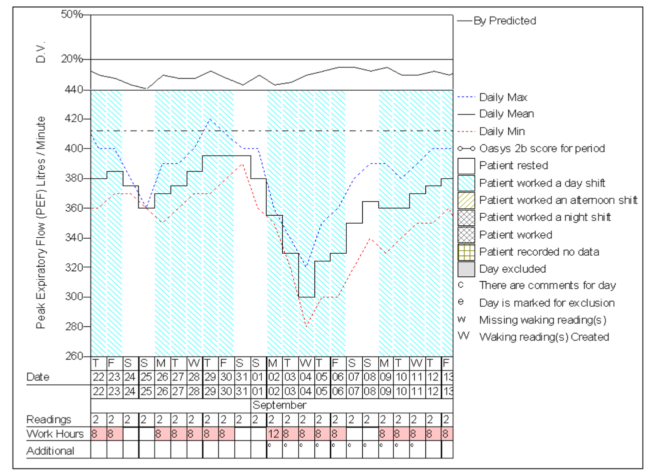
Problems

- Asthmatic reactions may be immediate or delayed for up to 12 hours.
- Spontaneous diurnal variation in asthmatics is superimposed on any changes related to work.
- Workers with occupational asthma react to non-specific triggers such as exercise, cold air etc in a similar way to non-occupational asthmatics.
- More treatment may be taken on work days. Increased treatment may mask occupational affects.
- An upper RTI may cause more prolonged falls in PEF simulating occupational asthma
- Not everybody records PEF reliably.

A plot showing a patient with occupational asthma with an improvement during the working day.



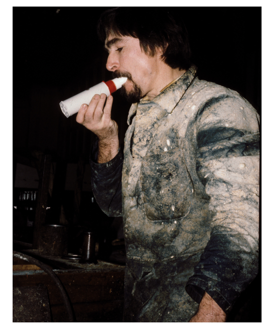
A plot showing effect from an upper respiratory tract infection.



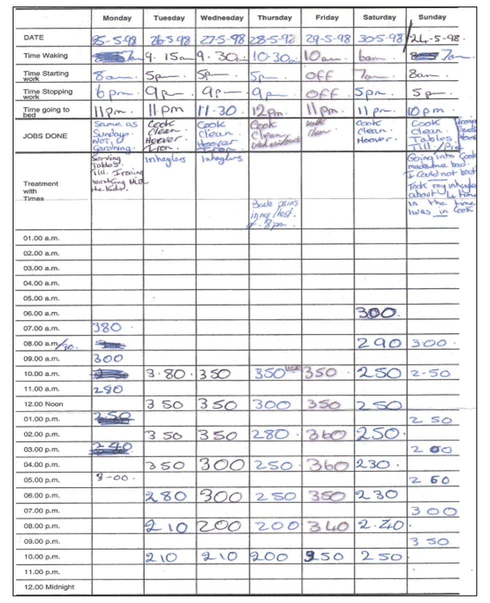
Solutions

- More prolonged recordings of serial PEF. Most confounding factors should be evenly distributed between work and rest days.
- Specific identification of uRTI and exclusion of this part of the record.
- Treatment to be kept constant on work and rest days
- Training and supervision of workers in the performance and reading of PEFs and the use of logging meters.
- Plotting in a manner which aids expert analysis

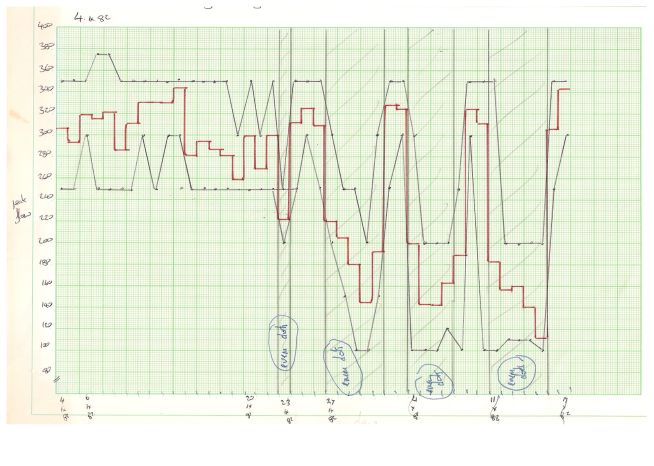
In the beginning



Patients fill in specialised serial peak flow entry forms. This one shows significant number preference which is an indication of fabrication and / or rounding to the nearest 50.

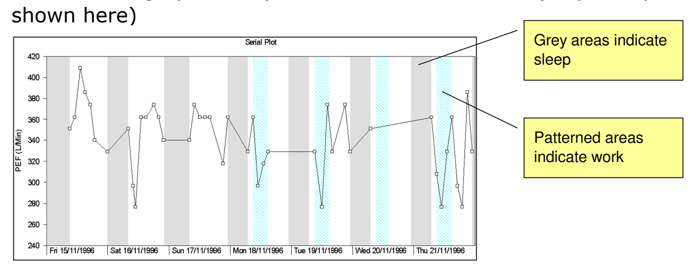


As an aid to diagnosis, plots of the maximum, mean and minimum peak flow were created from these, by hand, using graph paper.

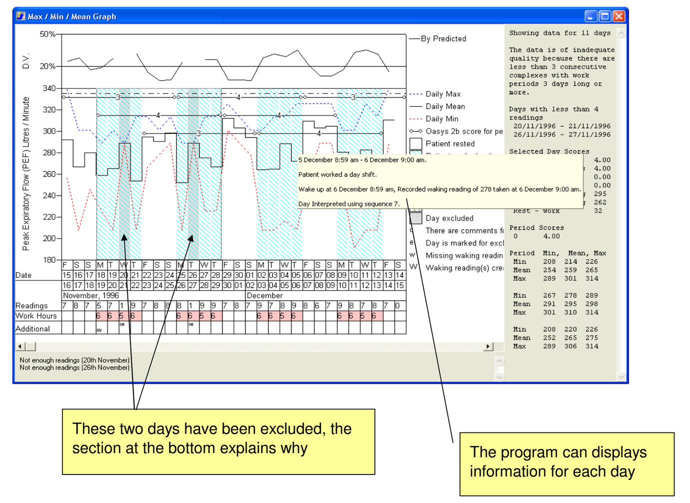


Plotting and analysis

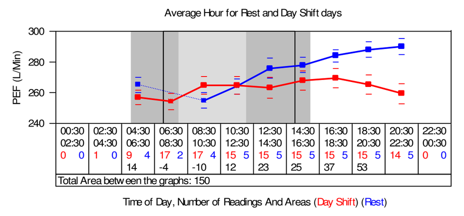
It is more difficult to diagnose occupational asthma from the traditional serial plot of a peak flow, as shown below. Late reactions, progressive daily deterioration and confoudning factors are all easily missed and it is not easily possible to see much of the graph at any one time due to its size (only 7 days shown here)



Occupational effects are much clearer on the graph showing the daily maximum, mean and minimum (now happily produced automatically in Oasys). The next plot is of the same data.

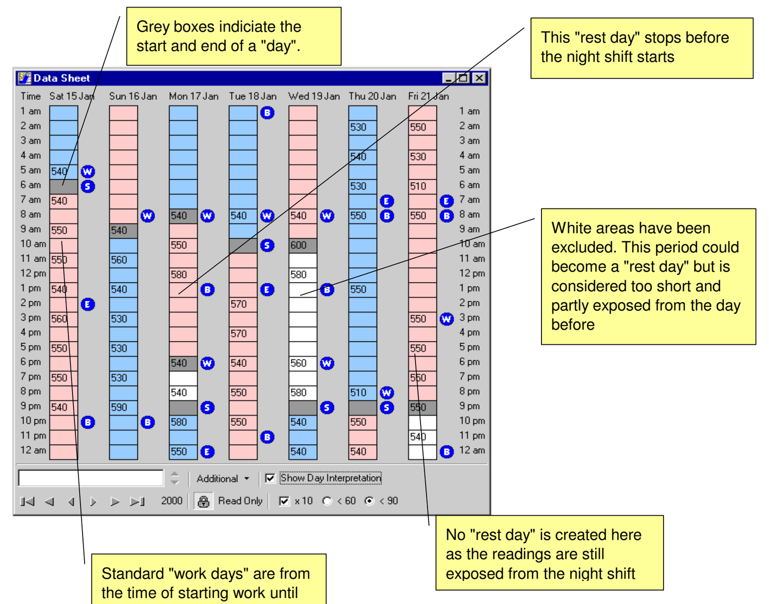


The graph below of all work and rest readings averaged by the time of day shows a mild but definite 12 hour delayed reaction. This improves recognition of such mild and complicated effects.



Oasys-2 uses a discriminant analysis to score the record between 1 and 4 using a cutoff of 2.5. Scores above this have a 94% specificity for occupational asthma and a 75% sensitivity when using independent methods of diagnosis.

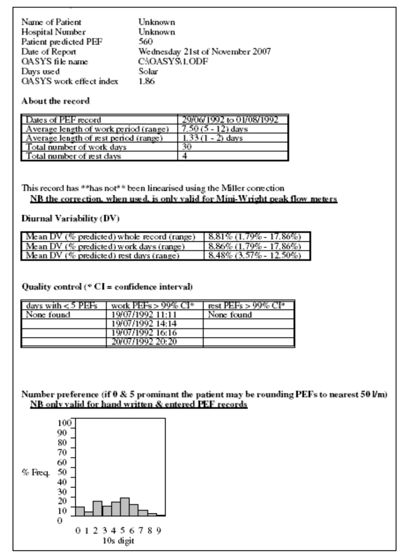
Peak flows are "day interpreted", so that all exposed readings are analysed as "work days" and all unexposed as "rest days". Thus any readings before work are not included in that "work day".



Good quality data:
≥ 3 separate periods of work and rest days
≥ 4 readings per day for 75% of the record
≥ 3 consecutive work days in any work period

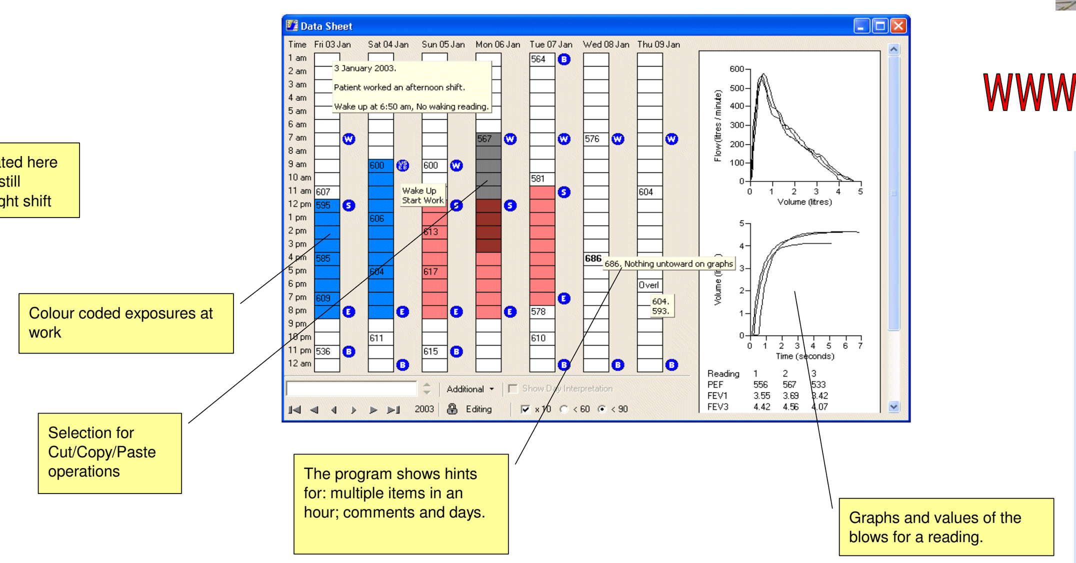
	Sensitivity	Specificity
Good quality PEF	78.1 %	91.7 %
Lesser quality PEF	63.6 %	83.3 %

This screenshot shows the results of an Oasys-2 analysis in the beta version of the program, which is available for free (the other screenshots come from out latest version). The score is 1.86 (negative), there are only a small number of rest days, all days have a good number of readings and there is no obvious fabrication or rounding.



We have developed a more modern version of the program which can: integrate with the electronic patient record, analyse other spirometry measures such as FEV1; analyse the hourly graph; identify and remove suspected infections; automatically read electronic meters; store and display flow/volume and volume/time graphs; analyse multiple work exposures and report quality criteria.

Our newer version uses the same algorithms but is much more adaptable; it awaits a comercial sponsor to guarantee sustainability. This screenshot shows the data entry window.



Oasys Availability

The basic version of the Oasys program is currently available free of charge to anyone who requests it. It should easily be implemented into all lung function laboratories where occupational asthmatic clinics take place. It is a quick and easy tool to use and is constantly being updated and developed to keep up with new technology available.

Oasys Team

www.occupationalasthma.com

A combined plot showing the daily mean relative peak flow for all workers making records at a factory. This was used to investigate a major outbreak and look at the effectiveness of cleaning and respiratory protective equipment.