

**Results** At baseline noise levels exceeded the recommended guidelines by >25 dB (mean noise in day 65.0 dB (SD  $\pm$ 1.31), mean noise at night 62.5 dB (SD  $\pm$ 0.9)). Following interventions, mean noise levels at night fell significantly to 61.6 dB (SD  $\pm$ 1.1,  $p=0.04$ ). We significantly reduced the amount of time that noise levels exceeded 60 dB at any time from 82% to 76% ( $p=0.04$ ), with the greatest impact at night (75% to 59%  $p=0.02$ ). Patients reported a strong trend towards less disruption from visitors and a trend towards improved sleep quality following the intervention. Thematic analysis identified noise from mobile telephones as a particular issue.

**Conclusions** We determined that noise levels on a medical ward exceed recommended guidelines and that this has a negative impact on the patient experience. We have shown that simple, cost-effective measures result in quieter wards, especially at night.

## Causes and outcome in cough

### S23 INFLUENCES OF SMOKING AND COPD ON OBJECTIVE COUGH FREQUENCY

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**Introduction** Patients with chronic obstructive pulmonary disease (COPD) complain of cough and mucus hypersecretion. The mechanisms underlying cough are likely to be multifactorial and are poorly understood. We aimed to investigate the effect of smoking on objective cough frequency in both patients with COPD and healthy volunteers.

**Methods** We studied 68 patients with COPD from the ECLIPSE cohort (median age 66 years (interquartile range (IQR) 61–71), median forced expiratory volume in 1 s (FEV<sub>1</sub>) 59.5% predicted (IQR 44.3–75.3), 22 female, 23 current smokers), 12 healthy smokers (median age 60 years (IQR 57–60), median FEV<sub>1</sub> 91.6% predicted (IQR 43.7–71.0), 7 female) and 12 healthy non-smokers (median age 58 years (IQR 43–68), median FEV<sub>1</sub> 117.0% predicted

(IQR 103.0–122.8), 8 female). All subjects underwent 24 h objective cough monitoring (Vitalojak, Vitalograph), spirometry and capsaicin cough reflex sensitivity testing.

**Results** Significant differences in 24 h cough rates were seen between subject groups ( $p<0.001$ ). COPD current smokers had the highest cough rates (median 9.0 coughs/h (IQR 4.3–15.6)); COPD ex-smokers and healthy smokers had similar cough rates (median 4.9 coughs/h (IQR 2.3–8.7) and 5.3 cough/h (IQR 1.2–8.3),  $p=0.60$ ) which were about half those of COPD current smokers ( $p=0.018$  and  $p=0.03$ ). Healthy volunteer cough rates (median 0.7 coughs/h (IQR 0.2–1.4)) were lowest. Objective cough rates were not influenced by age or gender. Cough reflex sensitivity was not significantly different between groups (logC5  $p=0.35$ , logC2  $p=0.36$ ) but was weakly correlated with cough frequency (logC5  $r=-0.36$ ,  $p=0.004$  and logC2  $r=-0.31$ ,  $p=0.001$ ). Smoking history and FEV<sub>1</sub> % predicted also correlated with cough frequency ( $r=0.49$ ,  $p<0.001$  and  $r=-0.40$ ,  $p<0.001$ ). In a linear regression model 47.7% of the variance in cough frequency (across all subjects) could be explained by smoking history ( $p=0.002$ ), current smoking status ( $p=0.002$ ), FEV<sub>1</sub> % predicted ( $p=0.002$ ) and cough reflex sensitivity (logC5  $p=0.016$ ).

**Conclusion** Ambulatory objective monitoring provides novel insights into the relative effects of smoking and airflow obstruction on the symptom of cough.

On behalf of the ECLIPSE Investigators.

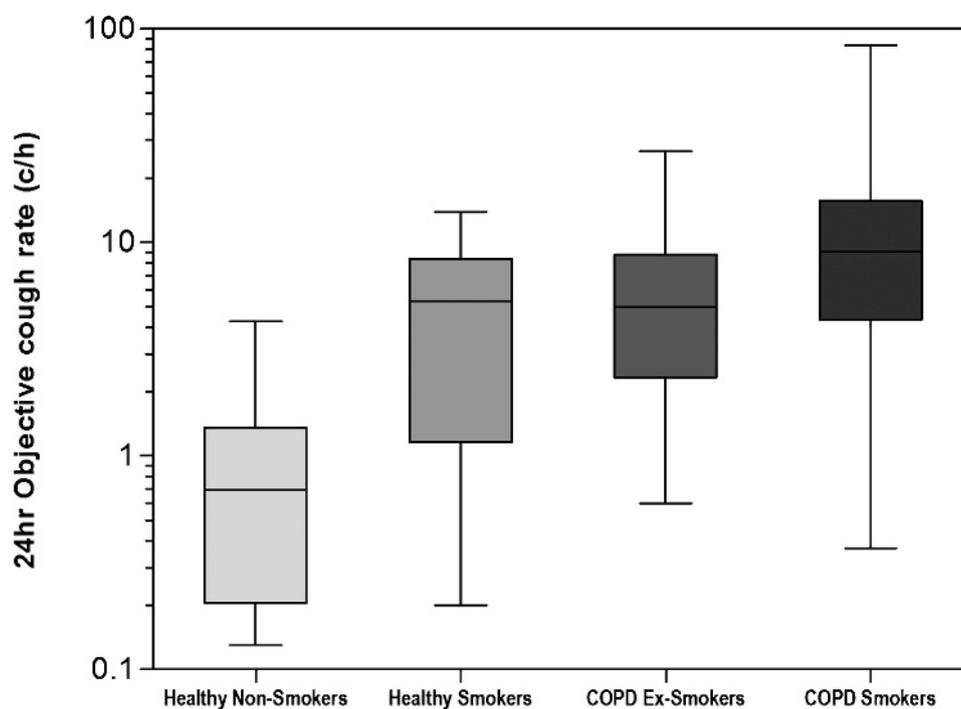
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### S24 COUGH, AIRWAY INFLAMMATION AND ASTHMA CONTROL

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**Rationale** There is evidence to suggest that subjectively scored cough is related to asthma control. This study aimed to explore the relationships between objective cough rates, airways inflammation and disease control in asthma.



Abstract S23 Figure.

**Methods** 89 subjects with physician-diagnosed asthma were studied (mean age 57.4 ( $\pm$ 12.0) years; 57.3% female; 7.9% smokers; 39.3% ex-/52.8% non-smokers; median asthma duration 29.0 years (10.0–68.0); mean forced expiratory volume in 1 s (FEV<sub>1</sub>) % predicted 86.4% ( $\pm$ 22.1); median dose response ratio (DRR) to methacholine 24.5 (0.0–1970.1); median inhaled corticosteroid (ICS) dose 800.0  $\mu$ g (0.0–4000.0); median sputum eosinophils 2.0% (0.0–26.0)). Subjects underwent 24-hour ambulatory cough monitoring with the Vitalojak cough monitor; coughs were manually counted and expressed as number of explosive cough sounds per hour (cs/h). In addition, subjects completed the Juniper Asthma Control Questionnaire (ACQ) and underwent sputum induction.

**Results** Cough recordings were obtained in 96.6% and sputum samples in 61.8% of subjects. Median cough rates were higher by day (3.7 cs/h (0.2–41.3)) than by night (0.5 cs/h (0.0–29.6)) ( $p < 0.001$ ) and median ACQ score was 1 (range 0–4.4). Objective cough rates correlated with ACQ scores by day ( $r = 0.28$ ;  $p = 0.008$ ), night ( $r = 0.24$ ;  $p = 0.027$ ) and over 24 h ( $r = 0.33$ ;  $p = 0.003$ ). However, there were no significant correlations between cough rates and either sputum eosinophils (%:  $r = 0.16$ ;  $p = 0.26$ ; cells  $\times 10^6$ /g sputum:  $r = 0.14$ ;  $p = 0.31$ ) or neutrophils (%:  $r = -0.09$ ;  $p = 0.50$ ; cells  $\times 10^6$ /g sputum:  $r = -0.06$ ;  $p = 0.66$ ). Similarly there were no significant correlations between ACQ scores and sputum eosinophils (%:  $r = 0.20$ ;  $p = 0.15$ ; cells  $\times 10^6$ /g sputum:  $r = 0.26$ ;  $p = 0.054$ ) and neutrophils (%:  $r = 0.02$ ;  $p = 0.90$ ; cells  $\times 10^6$ /g sputum:  $r = 0.07$ ;  $p = 0.61$ ). In a linear regression model, the percentage of eosinophils ( $p = 0.005$ ), smoking pack year history ( $p = 0.005$ ) and overall cough rate ( $p = 0.008$ ) explained 38% of the variance in ACQ scores ( $p < 0.001$ ; adjusted R<sup>2</sup>). In a similar regression model, eosinophils  $\times 10^6$ /g sputum ( $p < 0.001$ ), smoking pack year history ( $p = 0.005$ ) and overall cough rate ( $p = 0.002$ ) explained 47.9% of the variance in ACQ scores ( $p < 0.001$ ).

**Conclusions** Higher cough rates indicate poor asthma control. Sputum eosinophils, 24 h cough rate and smoking history independently predict asthma control, and number of eosinophils corrected for sputum weight explains more of the variance in ACQ scores than percentage eosinophils.

## S25 THE LONG-TERM OUTCOME OF PATIENTS WITH UNEXPLAINED CHRONIC COUGH

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**Background** Up to 40% of patients seen in a cough clinic have unexplained chronic cough. The long-term outcome of these patients is uncertain.

**Objective** To determine the long-term outcome in patients diagnosed with unexplained chronic cough.

**Methods** We have performed a longitudinal study of symptoms, airway inflammation and spirometry in a cohort of patients with unexplained chronic cough diagnosed  $>7$  years ago. Cough was assessed using a 100 mm visual analogue scale (VAS). At the final visit cough reflex sensitivity was assessed as the concentration of inhaled capsaicin at which the volunteer coughed two (C2) and five times (C5).

**Results** We identified 42 patients (32 females) with unexplained chronic cough who had been assessed at least twice over at least 7 years. The mean (SD) duration of cough was 11.5 (4.5) years at the time of their final assessment. Nine patients (21%) had organ-specific autoimmune disease and 20 (48%) had a peripheral blood lymphopenia. Six (14%) patients had complete resolution of symptoms and 17 (40%) had a significant  $>15$  mm improvement in their cough VAS during follow-up. Longitudinal spirometry data were available in 30 patients. The geometric mean rate of forced expiratory volume in 1 s (FEV<sub>1</sub>) decline was 63 ml/year and four

(13%) patients developed a postbronchodilator FEV<sub>1</sub>/forced vital capacity (FVC) of  $<0.7$ . Log C2 and log C5 at the time of final assessment were significantly correlated with the log rate of FEV<sub>1</sub> decline ( $-0.71$ ,  $p = 0.014$  and  $-0.70$ ,  $p = 0.018$ ). FEV<sub>1</sub> decline was similar in patients with persistent cough and those whose cough improved. No other independent predictors of FEV<sub>1</sub> decline were identified. There were no independent predictors of improvement in cough.

**Conclusions** Cough improves over time in the majority of patients with unexplained chronic cough. However, patients have an increased rate of decline in FEV<sub>1</sub> which is associated with a heightened cough reflex.

## S26 FUNDOPLICATION FOR CHRONIC COUGH: SIX YEARS EXPERIENCE

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**Introduction and Objectives** Extraoesophageal reflux is a common cause of chronic cough. This is often refractory to medical therapy. Surgical treatment in the form of a Nissen fundoplication (NF) can be potentially curative. There is paucity of data regarding response to NF in patients with chronic cough.

**Methods** We retrospectively reviewed the case notes of patients from our Cough Clinic who had undergone NF over the past 6 years. Demographic details, duration of symptoms, presence of other symptoms, results of oesophageal studies, outcome and complications were recorded.

**Results** 49 patients (mean age 54 years, females 37) underwent NF from May 2003 to April 2009. The average duration of cough was 8 years. Gastrointestinal symptoms were present in the majority; however, they were mild in most and not an indication for NF by themselves. Seventeen patients were on "asthma" treatment as well. All patients had oesophageal pH and manometry studies performed prior to surgery. 35 patients had significant acid reflux and 2 had severe oesophageal dysmotility. 31 (63%) patients had a response to treatment, 21 good and 10 partial. 10 of 17 with asthma felt that the asthma had improved as well. Mild dysphagia or bloating was seen in 17 patients following surgery. Five patients needed repeat surgical intervention for modification of NF. One patient with severe chronic airways disease and occult cardiac disease developed aspiration pneumonia 8 weeks following surgery and died.

**Conclusion** Our response rate of 63% is consistent with that observed by others. Our cohort of patients had cough as the indication for surgery. These patients were otherwise refractory to multiple medical therapeutic trials. Surgical treatment in refractory disabling cough is a valid option. Surgical treatment does have significant associated complications and patients should be carefully selected. This is a controlled study and hence a placebo effect cannot be ruled out.

## S27 LONG-TERM LOW DOSE ERYTHROMYCIN FOR UNEXPLAINED CHRONIC COUGH: A DOUBLE-BLIND, RANDOMISED, PLACEBO-CONTROLLED TRIAL

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**Introduction** Unexplained chronic cough is a common condition with no satisfactory treatments. We have previously shown that the induced sputum neutrophil count is independently associated with cough frequency and have speculated that cough is causally linked to