Abstract P121 Table

	Baseline	Change from baseline after prednisolone trial
JACQ score (±SEM)	2.74 ± 0.13	−0.24 ± 0.10 (range −2–+2.2)
Post-bronchodilator FEV_1 (% predicted ±SEM)	75.1% ± 3.4	+8.5% ± 3.06 (range −24–+123)
Sputum eosinophil count (GM% ± SD)	6.6% ± 0.66	–0.85 log fold (SD 0.81)
$FeNO_{50}$/ppb (GM ± SD)	38.9 ± 0.40	–21.9 ± 5.5

−0.5 in JACQ score and 17 patients (28.3%) achieved a 12% improvement in post-bronchodilator FEV_1. Elevated body mass index (BMI >28 kg/m^{-2}) was associated with a significantly impaired response of symptoms to prednisolone ($p = 0.02$), independent of the baseline sputum eosinophil count. There was no difference in the degree of suppression of sputum, bronchial wash or lavage eosinophils between high and low BMI subgroups. Discriminant function analysis identified baseline FeNO ($p = 0.03$) and the change in JACQ score ($p = 0.02$) to be the only parameters predictive of sputum eosinophilia >3% at baseline.

Conclusion: Corticosteroid responsiveness in refractory eosinophilic asthma exhibits marked clinical heterogeneity. Clinically significant improvements in either symptoms or FEV_1 are only achieved in a minority, despite eosinophilic airway inflammation. Obesity is associated with significantly impaired corticosteroid responsiveness of symptoms, implying a multifactorial aetiology for symptoms in this subgroup.

P122 EARLY ASSISTED DISCHARGE OF PATIENTS ADMITTED WITH AN ACUTE EXACERBATION OF ASTHMA: AN AUDIT OF CURRENT PRACTICE

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The BTS asthma guidelines advise that patients admitted with acute severe asthma should only be discharged when they have been stable on their discharge medication for 24 h and their PEFR is >75% of best or predicted (unless discharged earlier in agreement with a respiratory physician).

Our unit has been running an early supported discharge scheme for selected patients admitted with acute asthma since 2000 with no evidence of an increase in adverse events. We have performed a 6-month prospective audit of outcomes of this scheme.

Patients who fulfil the programme criteria are discharged with a nebuliser and written management plan and followed up by telephone or ward visit by a nurse specialist at 24–48 h and reviewed at the nurse-led clinic at 4 weeks. Patients are seen more frequently if required.

Over the audit period 41 patients were admitted with acute asthma. 21 (51%) were discharged on the early supported discharge scheme. Sixteen (76%) of these patients fulfilled the definition of an acute severe attack and 24% a moderate attack.

Fourteen (68%) of the patients were discharged within 24 h of admission, the remainder within 48 h. The mean FEV_1 of patients at discharge was 54% of predicted (range 27–106%) and at follow-up 68% of predicted (33–115%). At the time of follow-up 61% had improved their FEV_1 by ≥20% while 20% had improved by ≥40%.

There were two readmissions within one month of discharge, one was inappropriate, the other a protocol failure.

Our audit confirms our belief that early supported discharge of selected symptomatic asthma patients with suboptimal improvement in lung function is safe and feasible.

Although this audit includes only a small number of patients it does reflect our practice over 8 years. There is limited evidence in the literature to support this practice (Lim TK *et al*. *Respir Med* 2000;**94**:1234–40) and a randomised controlled trial is warranted.

Respiratory physiology

P123 WHAT HAPPENS TO THE DISTRIBUTION OF THE LUNG PERFUSION AFTER UNILATERAL LUNG VOLUME REDUCTION SURGERY?

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Objective: Having demonstrated the comparative benefits of staged bilateral over one stage bilateral video assisted thoracoscopic lung volume reduction surgery (LVRS), it is now our policy to perform two-stage bilateral LVRS. The timing of the second operation is determined by the patients' perception of their symptoms after which the patients are reassessed using standard selection criteria. We wanted to study the changes in the relative quantitative perfusion of lungs after unilateral LVRS by comparing the quantitative perfusion on preoperative and postoperative radioisotope perfusion scans. We also wanted to study if waiting for the second side operation risks deterioration and becoming inoperable.

Method: We retrospectively analysed the preoperative and post-operative technetium-99m labelled macro-aggregate perfusion scans of 25 patients who underwent unilateral right sided LVRS and were investigated for second stage procedure.

Results: 25 patients (14 male, 11 females, median age 39 years (46–70)) were reassessed for the second stage procedure of staged LVRS. All these patients had right upper zone LVRS as first operation of their two-staged LVRS. The median time interval between the surgery and second radioisotope perfusion scan was 43 months (5–78). Two-thirds of the patients (n = 15) had a 5% (2%–70%) increase in the perfusion of the operated lung ($p<0.05$, Student's t test) and the remaining one-third of patients had a 3.2% (2%–20%) reduction in perfusion of the operated lung. Although there were changes in the total perfusion of non-operated lung (median −02% (−17%–+23%)) these were not statistically significant. There was no statistically significant change in the perfusion of target area of non-operated lung. Thirteen patients proceeded to the second stage procedure and the rest were not offered surgery due to reasons such as malignancy, recurrent chest infections and increased severity of disease but not due to unfavourable perfusion of target area in the non-operated lung.

Conclusion: Unilateral lung volume reduction surgery increases the perfusion of the operated lung and waiting does not risk the patient becoming inoperable. We conclude that a staged operation does not compromise the overall strategy.

Abstract P123 Table Percentage change in perfusion of non-operated lung post-unilateral LVRS (median value)

Zones on perfusion scan	Non-operated lung
Upper zone	−0.13%
Middle zone	+5.70%*
Lower zone	−10.0%**

*$p<0.05$; **$p<0.01$. LVRS, lung volume reduction surgery.

P124 MEASUREMENT OF FUNCTIONAL RESIDUAL CAPACITY AND VENTILATION HETEROGENEITY FROM MULTIPLE BREATH INERT GAS WASH-IN AND WASHOUT IN HEALTHY VOLUNTEERS

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Introduction: Multiple breath washouts using sulphur hexafluoride (SF_6) allow the determination of functional residual capacity (FRC) and indices of ventilation heterogeneity such as lung clearance index (LCI). We set out to explore whether test time could be reduced by obtaining this information from the wash-in phase.
Methods: Eight healthy adult volunteers breathed 0.2% SF_6 in air through a non-rebreathe valve (NRBV); gas flow and SF_6 concentrations were measured using a modified Innocor gas analyser, ''wash-in'' continuing until end-inspiratory and end-expiratory SF_6 concentrations reached equilibrium. The SF_6 was then disconnected and the subjects breathed room air through the NRBV until end-expiratory SF_6 concentration fell to 1/40th initial concentration (washout). Three wash-in/washouts were performed per subject. FRC during wash-in and washout was calculated by integration of the net inspired and expired SF_6 volumes, respectively, correcting for the respiratory exchange ratio and the effects of warming and humidification of exhaled gas. LCI was determined from the washout phase by dividing the total volume expired during washout by FRC. By analogy with LCI in multiple breath washout, we defined a novel index, ''lung wash-in index'' (LWI), as the total volume expired from the start of wash-in to the point at which end-tidal SF_6 concentration had risen to 39/40ths of inhaled concentration, divided by FRC.
Results: FRC derived from wash-in (FRC_i) was highly correlated with FRC derived from washout (FRC_o) ($r^2 = 0.904$, $p = 0.001$). The mean difference between a subject's FRC_i and FRC_o was 0.03 ± 0.22 litres (mean $\pm$ SD). Mean LWI was 6.38 ± 0.45. Mean LCI was 6.75 ± 0.30. The mean difference between a subject's LWI and LCI was 0.37 ± 0.35.
Conclusions: These preliminary data show that FRC may be derived from wash-ins in healthy volunteers using the SF_6/Innocor system, and suggests the possibility of deriving information about ventilation heterogeneity from the wash-in phase alone, without needing to continue to washout, shortening the time required for each test by approximately 50%. These findings must be confirmed in greater numbers of healthy volunteers and in conditions known to increase ventilation heterogeneity such as cystic fibrosis.

P125 EFFECT OF BREATHING PATTERN AND TYPE OF VENTILATORY CONSTRAINT ON HYPERCAPNIC AIR-HUNGER INDUCED IN HEALTHY VOLUNTEERS

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Introduction and Objectives: A previous study in healthy subjects indicated that dyspnoea is influenced by overall ventilation not the pattern of breathing (Remmers *et al*. *Respir Physiol* 1968;**4**:78–90). However, there is a prevailing view that adopting particular breathing patterns is beneficial for clinical dyspnoea. Taking advantage of recent advances in experimental dyspnoea techniques, we re-tested the hypothesis that breathing pattern influences air hunger (AH), a particularly unpleasant form of dyspnoea. We also tested the hypothesis that chest wall tension in response to ventilatory constraint contributes to AH.
Methods: AH was induced in seven healthy men (aged 22 ± 1 years) by raising inspired CO_2 ($PETCO_2$ 53 ± 3 mm Hg). Ventilation was constrained (9.8 ± 1.4 l/min) by breathing to a metronome and either breathing from a bag with limited flow of fresh gas, or voluntary matching of tidal volume to a visual target. For each method, three breathing patterns were imposed: a baseline breathing pattern (pattern 1; 12 breaths/minute and naturally adopted V_T); faster, shallower breathing (pattern 2; 15 breaths/minute, $80\%V_T$) and slower, deeper breathing (pattern 3; 10 breaths/minute, $120\%V_T$). Subjects rated AH every 20 s using a 100 mm visual analogue scale (VAS). Peak inspiratory airway pressure was measured breath-by-breath at the mouthpiece as an index of chest wall tension during ventilatory constraint.
Results: Changes in breathing pattern in either direction from baseline did not produce significantly different AH irrespective of the breathing constraint method (46 ± 18, 60 ± 15 and 59 ± 19 mm VAS for patterns 1, 2 and 3 with ''bag limit''; 48 ± 22, 61 ± 18 and 56 ± 20 mm VAS for patterns 1, 2 and 3 with ''voluntary targeting''). The tendency for AH to be lowest with baseline breathing pattern was not significant. AH levels were no different between methods of constraint, although inspiratory pressures were markedly lower with ''voluntary targeting'' (1.5 ± 0.3 versus 5.5 ± 3 cm H_2O). Inspiratory capacity did not change with breathing pattern, indicating that end-expiratory lung volumes remained constant.
Conclusions: For a given level of hypercapnia, AH is unaffected by a change in breathing pattern or by the generation of respiratory muscle tension. This is consistent with the notion that afferent feedback from pulmonary mechanoreceptors encoding overall ventilation is the key factor in mitigating hypercapnic AH.

P126 BRONCHODILATOR REVERSIBILITY AND REPEATABILITY OF LUNG FUNCTION TESTS IN PRESCHOOL WHEEZERS

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Background: Preschool lung function tests (LFT) are becoming increasingly popular. However, few data exist on bronchodilator reversibility (BDR) and the short-term repeatability of LFT in preschool wheezers.
Methods: Multiple breath washout (lung clearance index (LCI), conductive airways inhomogeneity (S_{cond}), acinar airways inhomogeneity (S_{acin}) and functional residual capacity (FRC)); followed by whole body plethysmography (specific airways resistance (sR_{aw})) measurements were performed on clinically stable preschool children with recurrent doctor diagnosed wheeze, on two different test occasions. On one occasion repeatability was assessed by performing measurements at baseline and after 20 minutes without bronchodilator administration, from which thresholds for reversibility were determined. On a separate occasion BDR was assessed by performing measurements at baseline and 20 minutes after inhaled salbutamol 200 μg. Statistical analysis was by Bland–Altman plots to calculate thresholds for reversibility and the Wilcoxon signed rank test.
Results: Thirty preschool wheezers (22 boys), median age 4.76 years (range 4.05–6.93) underwent LFT on two different occasions, median time apart 5 months (range 1–18). All LFT showed good short-term repeatability with no significant difference between baseline and post-20 minute measurements except S_{cond} (see table). Although significant BDR was seen only with sR_{aw} but not with any of the other measurements, only eight (27%) sR_{aw} measurements met the threshold for reversibility (see table).
Conclusions: sR_{aw} and MBW indices have good short-term repeatability except S_{cond}, which can be variable suggesting ventilation heterogeneity in the conducting airways of wheezy children. MBW indices are not ideal to assess BDR because of high intra-subject variability in wheezers. Although sR_{aw} appears to be a good tool to assess BDR, the majority of preschool wheezers do not meet the threshold for reversibility. The thresholds described here will facilitate the interpretation of BDR in future studies and also in clinical practice.

Abstract P126 Table Repeatability and BDR data

	First test occasion (repeatability)			Second test occasion (BDR)		
LF	Baseline median (range)	After 20 minutes median (range)	Threshold for reversibility	Baseline median (range)	After bronchodilator median (range)	Significant BDR (n/30)
LCI (l^{-1})	6.9 (6–11.8)	6.9 (5.9–11.6)	0.63	6.9 (6.4–11)	6.9 (6.09–9.06)	5
S_{cond} (l^{-1})	0.017 (−0.014–0.084)	0.026 (−0.014–0.084)*	0.035	0.026 (−0.015–0.155)	0.025 (−0.009–0.120)	2
S_{acin} (l^{-1})	0.049 (0.009–0.174)	0.051 (−0.005–0.158)	0.089	0.059 (−0.012–0.197)	0.053 (−0.002–0.203)	1
FRC (l)	0.72 (0.5–1.2)	0.71 (0.48–1)	0.12	0.68 (0.45–1.4)	0.65 (0.42–1.3)	3
sR_{aw} (kPa l^{-1}/s)	1.12 (0.76–2.57)	1.07 (0.84–2.36)	0.23	1.08 (0.82–1.82)	1.03 (0.65–1.83)†	8

*Significant difference from baseline (p = 0.024); †significant difference from baseline (p<0.001). BDR, bronchodilator reversibility; FRC, functional residual capacity; LCI, lung clearance index; LF, lung function.

P127 NEURAL RESPIRATORY DRIVE MEASURED BY INSPIRATORY MUSCLE EMG ACTIVITY AT REST AND DURING HYPERVENTILATION IN NORMAL SUBJECTS

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Introduction: Measurement of neural respiratory drive (NRD) derived from using the electromyogram (EMG) of the respiratory muscles can provide useful information on the load on and the capacity of the respiratory muscles. The aim of this study was to examine NRD to the diaphragm (EMGdi), the parasternal intercostal muscles (EMGpara) and sternocleidomastoid (EMGsterno), at rest and during increased ventilation induced by carbon dioxide (CO_2) breathing in healthy subjects.
Methods: Nine healthy volunteers mean (SD) 26 years (6) took part in this study. The EMGdi was measured using a custom made oesophageal electrode. The EMGsterno (positive electrode at midpoint of right sternocleidomastoid) and EMGpara (positive electrode in 2nd right intercostal space, 3 cm from sternum) were obtained from surface recordings. The CO_2 breathing protocol involved increasing the inspired CO_2 by 1% every 5 minutes to a maximum of 5%. Breathlessness was quantified by Borg score. Five subjects were studied on two separate days to assess the reproducibility of the EMG techniques.
Results: EMGdi and EMGpara increased in parallel with increases in ventilation. EMGsterno became discernable above backround, when ventilation reached approximately 30 l/minute, thereafter increasing progressively. A high degree of within-subject, inter-session repeatability was observed for both EMGdi and EMGpara (95% of the sample differences were within 2 SD of the mean of the differences).The intraclass correlation coefficient for EMGdi (r^2 = 0.99, p<0.001), EMGpara (r^2 = 0.98, p<0.001) and EMGsterno (r^2 = 0.45, p<0.012) was calculated as an index of reliability. The Borg score was strongly correlated with both EMGpara (r^2 = 0.938, p<0.018) and EMGdi (r^2 = 0.921, p<0.018).
Conclusion: This study illustrates that EMGdi and EMGpara are reliable and reproducible methods for the measurement of NRD. EMGpara has a potential advantage of being non-invasive. EMG measures may have direct clinical application in the monitoring of patients with respiratory disease.

P128 NEURAL RESPIRATORY DRIVE ASSESSED BY PARASTERNAL EMG ACTIVITY IN CYSTIC FIBROSIS PATIENTS DURING EXERCISE

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Introduction: Neural respiratory drive (NRD) measured using electromyography (EMG) of the diaphragm is a marker of disease severity in chronic obstructive pulmonary disease (COPD) and other respiratory diseases and is related to breathlessness. NRD has not been studied in cystic fibrosis (CF). The measurement of diaphragm EMG (EMGdi) is invasive, which limits its application. Parasternal EMG (EMGpara), however, can be recorded using surface electrodes and could provide a non-invasive method.
Hypothesis: We hypothesised that EMGpara would reflect EMGdi and be related to breathlessness in patients with CF.
Aim: Our aim was to measure EMGpara and EMGdi during exercise and relate these measures of NRD to breathlessness.
Methods: Five subjects, mean (SD) age 25 years (5) with moderate to severe CF (see table) performed an incremental cycle exercise test to exhaustion. Respiratory flow, volume and timing variables were recorded using a pneumotachograph and custom written software. Metabolic data were acquired using a Meta Max ergospirometry system. Oesophageal and gastric pressures were recorded with a dual transducer catheter. EMGdi was measured using a custom made multipair EMG oesophageal catheter and EMGpara was measured from surface electrodes (positive electrode in the second intercostal space, 3 cm from the sternum). Surface electrodes were also used to record sternocleidomastoid activity (EMGsterno) (positive electrode middle right sternocleidomastoid). For EMG analysis the root mean square was calculated and expressed as a percentage of maximum (%EMGmax) obtained during inspiratory capacity manoeuvres performed prior to exercise. Borg breathlessness scores were recorded after each minute of exercise.
Results: EMGdi and EMGpara were strongly correlated (r^2 = 0.998). Breathlessness correlated with leg fatigue (r^2 = 0.99), respiratory exchange ratio (r^2 = 0.996) and both %EMGdimax (r^2 = 0.984) and %EMGpara (r^2 = 0.98).
Conclusion: The EMGpara provides a non-invasive method to assess NRD in patients with CF. This technique may provide us with useful information on disease severity and the effectiveness of treatments.

Abstract P128 Table

Subject	Sex	Age	BMI	FEV_1	$FEV_{1\%}$pred.	VC	$VC_{\%}$pred	FEV_1/VC	TLC	$TLC_{\%}$pred	RV	$RV_{\%}$pred
1	M	22	22.6	2.4	55	3.4	65	71	7.1	100	3.3	206
2	M	29	25.2	2.6	62	5.2	104	50	7.7	112	2.8	165
3	M	33	21.5	1.7	41	2.5	51	68	5.7	85	3.4	200
4	F	21	21	1.7	61	2.4	75	71	4.3	100	1.9	158
5	M	20	19.6	1.1	25	2.7	52	41	6.2	7.1	3.5	219

BMI, body mass index.

P129 WHAT IS THE OXYGEN SATURATION RANGE OF STABLE HOSPITAL PATIENTS AGED OVER 70 YEARS?

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Background: Elderly people may have lower blood oxygen saturation than young adults. Crapo reported a gradual decline of arterial oxygen saturation (SaO_2) with age from a mean of 96.9% in adults aged 18–12 years to a mean of 95.5% in 22 healthy subjects aged over 64 years (*AJRCCM* 1999;**160**:1525). Hardie reported a mean value of 95.3% in 79 men and 94.8% in 67 women aged >70 years (*Chest* 2004;**125**:2053).
Subjects and Methods: We audited the three most recent pulse oximetry measurements (SpO_2) at two university hospitals of 320 stable hospital patients aged ⩾71 years without acute or chronic lung disease or heart failure (120 men, 200 women). All patients had been breathing air for at least 48 h.
Results: The mean SpO_2 was 96.7% (SD 1.9) in 127 patients at one hospital and 96.7% (1.7) in 193 patients at the other hospital and the data were pooled. The mean saturation was 96.7% (1.8) for 120 men and 96.7% (1.8) for 200 women. The results for each age group are shown in the table, there was no fall in SpO_2 with age. Only 23 of 960 SpO_2 measurements (2.4%) were below 94% and only one was below 90%. A separate audit of 27 simultaneous arterial blood gas and SpO_2 measurements within SaO_2 range of 94–98% showed that the mean SpO_2 was 0.47% above the mean SaO_2, giving an estimated mean SaO_2 of 96.2% for our healthy elderly subjects, which is higher than that reported by Crapo and Hardy who studied smaller numbers of subjects.
Conclusions: The mean oxygen saturation of stable hospital patients aged ⩾71 years is only slightly below the reported values for young adults and did not fall further with age in this study. The new BTS guideline for emergency oxygen therapy will specify a target saturation of 94–98% for patients in all age groups, which will achieve a normal saturation for most people of all ages.

Abstract P129 Table

	Age 71–75 years	Age 76–80 years	Age 81–85 years	Age >85 years
Number	56	70	81	113
Mean SpO_2	96.8	96.4	96.7	96.7
SD	1.6	2.1	1.8	1.7
2 SD range	93.6–100	92.2–100	93.1–100	93.3–100

P130 THE RESPONSE TO BRONCHODILATOR USING MULTIFREQUENCY IMPULSE OSCILLOMETRY IN HEALTHY VOLUNTEERS

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Background: Impulse oscillometry (IOS) is a non-invasive technique of measuring complex respiratory impedance by sending an oscillatory test signal to the respiratory system. Normal ranges for resistance and reactance have been defined; however, their response to bronchodilator in healthy volunteers is unknown. We sought to establish whether total airway impedance, large airway impedance and small airway impedance change significantly post-bronchodilator in healthy volunteers.
Methods: 30 healthy volunteers were recruited from staff and local advertising at the Tayside Institute for Child health (Dundee). All volunteers were free of respiratory symptoms, had normal spirometry and a smoking history of <10 pack years. Input impedance measurements were recorded across the frequency range of 5–35 Hz in an IOS system that had been calibrated using Jaeger 0.2 and 0.4 Kpa/l/s meshes. Impulses were triggered every 0.5 s with a measuring time of 16 s and analysed using fast Fourier transformations and 32 bit sampling. The mean of three impedance measurements was recorded for each frequency before and after 400 μg inhaled salbutamol.
Results: The responses to bronchodilator of respiratory impedance (resistance and reactance) at 5 and 20 Hz (measures of total and central airway impedance, respectively) and R5–R20 (a measure of small airway resistance) are shown in the table. There was a significant association between the change in FEV_1 post-bronchodilator and the change in resonant frequency ($r = -0.54$; $p = 0.003$).
Conclusions: In healthy volunteers IOS measurements of both small and large airway resistance and resonant frequency change significantly post-bronchodilator in contrast to airway reactance. Improvements in FEV_1 post-bronchodilator are associated with a fall in the resonant frequency.

Abstract P130 Table

	Pre-BD	Post-BD
R5 (KPa/l/s)	0.37(0.16)	0.31(0.11)**
R20 (KPa/l/s)	0.31(0.12)	0.27(0.09)**
R5-R20 (KPa/l/s)	0.059(0.055)	0.044(0.036)**
X5 (KPa/l/s)	−0.129(0.07)	−0.110(0.07)
X20 (KPa/l/s)	0.094(0.05)	0.114(0.05)
Resonant frequency (Hz)	11.35(3.4)	10.12(2.2)**
FEV_1 (l)	3.02(0.85)	3.08(0.86)**

Data presented as mean (SD). X, reactance; R, resistance.
**p<0.05; paired t test pre versus post-bronchodilator (BD).

P131 VALIDITY AND RELIABILITY OF VENTILATION MEASURED BY THE LIFESHIRT: A POTENTIAL OUTCOME MEASURE FOR CLINICAL TRIALS

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Introduction and Objectives: The LifeShirt is an ambulatory system that may provide the opportunity to gain a greater depth of information on cardiorespiratory parameters during field fitness tests. The aim of this study was to assess the validity and reliability of ventilation measured by the LifeShirt compared with laboratory equipment over multiple assessments.
Methods: A peak treadmill test (15 stage STEEP protocol) was performed on four occasions (⩾48 h apart), the LifeShirt and COSMED system recorded simultaneously. The LifeShirt was calibrated using two methods: 800 ml fixed volume bag (VE-FV) and a spirometer (VE-SP). Both methods were compared with COSMED (VE-CM). When systems were compared, differences (residual errors) were found to be associated with the size of measurements (heteroscedasticity) therefore all data were log transformed before being assessed for validity and reliability using repeated-measures analysis of variance. Within-subject mean square errors are reported as coefficients of variation (CV%).
Results: 16 young adults participated (six male; 10 female), mean ± SD age 23 ± 3 years. All reached at least stage 11 (mean VO_2/kg 29 ml/min/kg, mean R 1.02). Data were matched breath-by-breath and mean values of the final 30 s of each stage extracted. There was a significant bias between VE-FV and VE-CM ($p = 0.002$) (LifeShirt underestimating) with the difference increasing with exercise intensity ($p = 0.001$) (CV 10.4%). There was no significant overall bias between VE-SP and VE-CM ($p = 0.055$); however, there was significant bias from stage 7 (4.0%) to stage 9 (9.5%) ($p = 0.001$) (CV 3.4%). For reliability there was no significant bias

over days for VE-FV, VE-SP or VE-CM ($p = 0.350$; $p = 0.724$; $p = 0.972$). There was a larger unexplained within-subjects variation for VE-FV (CV 10.4%) compared with VE-SP (CV 6.2%) or VE-CM (CV 6.4%). Other measures recorded (eg, HR, VT, RR, etc) showed mostly similar results.

Conclusion: The LifeShirt provided valid and reliable data across multiple assessments; however, it tended to underestimate VE. Calibration by spirometer improves the accuracy of VE compared with fixed-volume bag calibration. When calibrated appropriately, the LifeShirt is likely to be a useful outcome measure in clinical trials.

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P132 INITIAL EXPERIENCE USING AN ELECTRONIC NOSE FOR ANALYSIS OF EXHALED BREATH

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Introduction and Objectives: There is increasing interest in the use of breath analysis as a means of diagnosing and monitoring lung disease, in particular, exhaled nitric oxide and exhaled breath condensate. Electronic noses (e-noses) have been trialled to analyse patients' breath in lung cancer and asthma. Using a nano-composite array of organic polymer sensors, the e-nose can detect volatile organic compounds and, using on-board pattern-recognition algorithms, identify patterns that may be discriminatory. We investigated the feasibility of using an e-nose (Cyranose C320, Smiths Detection, Pasadena, California, USA) to distinguish the breath of smokers from non-smokers.

Methods: Smoking and non-smoking subjects exhaled from total lung capacity into a 2 litre Mylar bag. Samples were introduced to the e-nose in random order. Exhaled breath was drawn into the e-nose and examined by online principal component analysis (PCA) and canonical discriminant analysis; data were digitally filtered using a Savitzky–Golay filter to improve signal-to-noise ratio. Samples identified as outliers by virtue of high Euclidean distance were censored. Cross-validation was then performed.

Results: PCA of 16 subjects was able to show excellent discrimination of smokers from non-smokers, with cross-validation of 100% and interclass Mahalonobis distance of 84.07.

Conclusion: The e-nose is simple to use in clinical practice and can differentiate the breath of smokers from non-smokers. It may prove to be a useful, non-invasive tool for further breath assessment.

P133 NON-INVASIVE ASSESSMENT OF CARDIAC OUTPUT USING AN INERT GAS REBREATHING DEVICE: REPEATABILITY AND REPRODUCIBILITY IN NORMAL CONTROLS

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Background: A reliable non-invasive measure of cardiac output (CO) is desirable for the management of patients with cardiorespiratory disease. CO may be indirectly assessed by the measurement of pulmonary blood flow by inert gas rebreathing techniques. Respiratory mass spectrometers (with acetylene) have been used for this purpose, but in practice are difficult, bulky and costly machines to maintain. The newer Innocor™ device (Innovision, Denmark) uses photoacoustic spectroscopy for rapid analysis and is portable and convenient to use.

Aim: We study the intra-session repeatability and inter-session reproducibility of the Innocor™ device for the measurement of CO in normal volunteers.

Methods: Twenty-three normal volunteers (eight men, mean age 34 ± 8 years) had lung volume measurements by constant-volume body plethysmograph. On the same day, subjects underwent three consecutive CO measurements with the Innocor™ device. Twenty subjects returned for repeat assessment (1–13 weeks later). The intra-session repeatability and inter-session reproducibility of this CO measurement was assessed and the coefficient of variation reported.

Results: Baseline parameters as assessed by the Innocor device included: CO 5.24 ± 1.21 l/minute, cardiac index 2.91 ± 0.49 l/minute/m^2, heart rate 75 ± 12 bpm and oxygen saturation 98.5 ± 0.5%. Mean total lung capacity was 101.5 ± 14.0% and vital capacity was 102.2 ± 14.9%. Two subjects were ex-smokers and one had mild asthma. CO measurements showed good intra-session repeatability with a coefficient of variation of 6.57%. Inter-session reproducibility was high with a mean CO difference of 0.13 and a single determinant standard deviation of 0.49. The inter-session coefficient of variation was 9.7%.

Conclusion: Non-invasive CO as measured by the inert gas rebreathing Innocor™ device has good intra-session repeatability and inter-session reproducibility. It may be a useful clinical marker for the assessment and follow-up of patients with cardiorespiratory disease.

Chronic obstructive pulmonary disease: exacerbations and hospital admissions

P134 SPECIALIST CHRONIC DISEASE MANAGEMENT FOR CHRONIC OBSTRUCTIVE PULMONARY DISEASE REDUCES ADMISSIONS IN A SEMI-RURAL SETTING

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Background: Homecare for chronic obstructive pulmonary disease (COPD) has had mixed results depending on the setting and model applied.

Aim: To see if a specialist team, working in the community under clinical supervision by secondary care respiratory consultants, impact on COPD admissions.

Setting: Two UK district general hospitals serving a semi-rural population of 190 000.

Personnel: Two nurses and a respiratory physiotherapist, employed by the local health board (PCT) and coordinated by a manager whose background is specialist respiratory nursing. Each covers a geographical area of our county.

Criteria: They accept referrals from primary and secondary care if a COPD diagnosis is confirmed by spirometry, patients are on optimal therapy as per NICE guidelines but have any of: continued symptoms; recent admission from COPD; multiple exacerbations in the previous 12 months.

Process: Referrals are prioritised and seen by the team within 1 to 28 days, but not out-of-hours. The team has weekly meetings with rotating respiratory consultants, supported by direct access to the multidisciplinary hospital respiratory team for clinical advice, medicines prescription and radiology. They provide home visits (a clinical assessment and basic observations) and can bring prescribed medication to homes to treat exacerbations promptly; they provide telephone contact, education on COPD for patients/carers/relatives,

Abstract P134 Table

	Pre-CDM	Post-CDM	Z score	p Value*
3 Months	0.60 (0–6)	0.22 (0–4)	−5.58	<0.001
6 Months	0.86 (0–10)	0.44 (0–5)	−5.23	<0.001
12 Months	1.14 (0–13)	0.79 (0–9)	−2.82	<0.005

*Wilcoxon rank. CDM, chronic disease management.