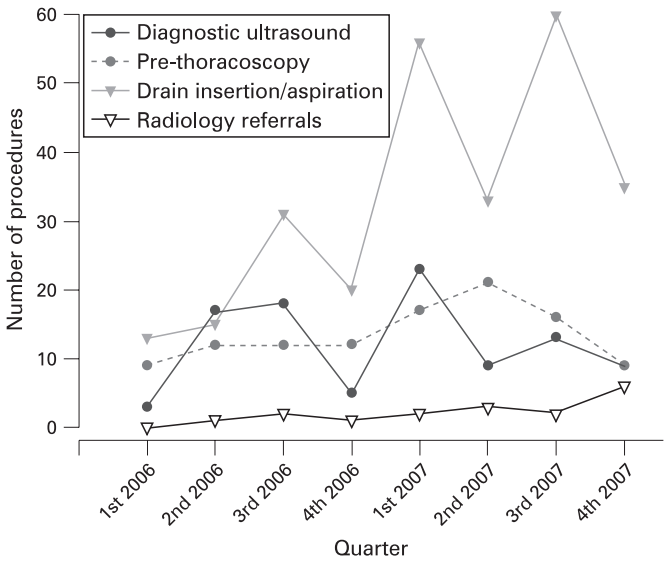

Abstract S29 Figure Thoracic ultrasound activity over time by procedure type.

cases, including 8/204 (3.9%, 95% CI 1.7 to 7.6) for intervention and 9/97 (9.3%, 95% CI 4.3 to 16.9) for diagnostic interpretation. The proportion of referrals increased over time (c^2_{trend} 1 df 4.0, p = 0.045; fig). A single complication (intrapleural bleed) occurred in the ultrasound intervention group (excluding thoracoscopies, n = 263), giving a complication rate of 1/263 (0.4%, 95% CI 0.0 to 2.1). This rate is comparable to the rate reported in published series of ultrasound-guided pleural procedures, whether conducted by physicians or radiologists (24 studies combined, 97 complications in 3920 interventions, rate 2.5%, 95% CI 2.0 to 3.0).

Conclusions: Respiratory physician-based thoracic ultrasound is safe after level I RCR training. It is associated with a complication rate comparable to that seen in the published literature. Continuing close liaison with radiologists is required for a physician-based service.

Chronic obstructive pulmonary disease: exercise and rehabilitation

S30 PROVISION OF PULMONARY REHABILITATION IN THE UK: RESULTS FROM THE NATIONAL CHRONIC OBSTRUCTIVE PULMONARY DISEASE AUDIT 2008

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Background: Pulmonary rehabilitation has been established as an important therapy for chronic obstructive pulmonary disease (COPD) patients. However, not all patients who may benefit from pulmonary rehabilitation have access to it. We examined the availability of pulmonary rehabilitation and the standards of care for patients in respiratory medicine departments in the UK.

Methods: As part of the national COPD audit 2008 we surveyed 239 units in the UK using an online questionnaire to assess access to pulmonary rehabilitation and assess the standard of pulmonary rehabilitation programmes that exist.

Results: In 58% of units all eligible patients had access to pulmonary rehabilitation, in 32% of units only some patients were offered pulmonary rehabilitation and in 10% of units there was no access at all. In a similar survey undertaken in 2003, 64% of units had a formal pulmonary rehabilitation programme. The majority of programmes are funded by primary care organisations (43%), with 24% hospital funded, 18% joint funded and 14% not funded at all. We examined a number of standards for the pulmonary rehabilitation programmes offered. Staffing: the majority of programmes were delivered fully by a multidisciplinary team (71%) and 68% had a designated lead clinician and coordinator. However, only 41% of programmes had staff supervising the exercise component fully trained in advanced life support (ALS). Content of programmes: 63% had written inclusion and exclusion criteria for patients and 62% measured spirometry, exercise and health status before and after rehabilitation. The majority of programmes (79%) lasted a minimum of 6 weeks; however, only 30% had a continuation phase. The majority of programmes included education about living with COPD (73%) and provided written educational resources (77%). A minority of units (49%) fully audited their pulmonary rehabilitation service annually.

Conclusions: There has been some increase in units in the UK offering pulmonary rehabilitation programmes since 2003 and many are now community based. In nearly a half of units, however, access to pulmonary rehabilitation is restricted or unavailable. The majority of units are run by multidisciplinary teams and have a designated lead clinician. Further improvements are needed in the assessment of patients before commencing pulmonary rehabilitation, in training staff in ALS and providing continuation phases.

S31 IS A SHORTENED COURSE OF PULMONARY REHABILITATION EFFECTIVE FOLLOWING A HOSPITALISATION FOR AN EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE?

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Introduction: The benefits of pulmonary rehabilitation are now firmly established. However, less is known about the provision and efficacy of pulmonary rehabilitation immediately after an acute exacerbation of chronic obstructive pulmonary disease (COPD). A randomised controlled trial (Man *et al*, 2004) suggested that a 7-week course of pulmonary rehabilitation following an exacerbation improved exercise capacity, health status and reduced healthcare utilisation. We have previously established the effectiveness of a 4-week programme in stable patients (Sewell *et al*, 2006) and propose to explore the effectiveness of this shortened course following an acute exacerbation of COPD.

Methods: Patients were assessed and commenced pulmonary rehabilitation within 4 weeks of discharge from hospital. Patients attended a twice weekly, 4-week hospital-based programme (exercise and education) followed by 3 weeks of unsupervised home exercise. Outcome measures included: the incremental shuttle walking test (ISWT), endurance shuttle walking test (ESWT), chronic respiratory questionnaire self-reported (CRQ-SR) and the hospital anxiety and depression scale (HADS). Patients were assessed at baseline and at 7 weeks (after the supervised and unsupervised components).

Results: 110 patients were assessed for pulmonary rehabilitation (61 men, mean (SD) age 70.25 years (9.10), FEV_1 0.98 litres (0.38), ISWT 169.27 m (123.26), ESWT 151.86 s (116.73). 78 patients were assessed after 7 weeks (16 dropped out, six had a further exacerbation of COPD and 10 failed to attend the discharge appointment). A paired t test and Wilcoxon signed rank test were completed for parametric and non-parametric data, respectively, and are detailed in the table. ISWT and ESWT showed statistically significant improvements ($p<0.001$). There were also statistically ($p<0.001$) and clinically significant improvements in all domains of the CRQ-SR. HAD scores improved for both anxiety and depression ($p<0.01$).

Conclusions: Exercise capacity and health status improves following a shortened course of pulmonary rehabilitation in

Abstract S31 Table Mean changes post-pulmonary rehabilitation

N = 78	Mean change (95% CI)
ISWT (m)	56.28 (43.30 to 69.27)***
ESWT (s)	392.51 (308.80 to 476.24)***
CRQ-SR dyspnoea	0.75 (0.42 to 1.10)***
CRQ-SR fatigue	1.00 (0.66 to 1.34)***
CRQ-SR emotion	0.90 (0.60 to 1.20)***
CRQ-SR mastery	1.09 (0.73 to 1.46)***
HADS anxiety	−1.94 (−0.82 to −3.07)**
HADS depression	−1.30 (−0.40 to −2.22)**

***p<0.001; **p<0.01. CRQ-SR, chronic respiratory questionnaire self-reported; ESWT, endurance shuttle walking test; HADS, hospital anxiety and depression scale; ISWT; incremental shuttle walking test.

patients who have had an acute exacerbation of COPD. It should be considered as an effective treatment option for patients who have had an acute exacerbation of COPD.

S32 DOES THE ADDITION OF STRENGTH TRAINING TO AN ENDURANCE-BASED PULMONARY REHABILITATION PROGRAMME LEAD TO INCREASED DAILY ACTIVITY?

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Background: Combined endurance and resistance training improves muscle strength and mass, but does not translate to greater improvements in exercise capacity or health status than endurance training alone.[1] We investigated whether combined training leads to increased levels of activity compared with endurance training alone using the pulmonary functional status and dyspnoea questionnaire modified version (PFSDQ-M).
Methods: This is a retrospective analysis combining data from two concurrent studies. For both studies, patients with chronic obstructive pulmonary disease (COPD) attended the traditional, predominantly, endurance-based, pulmonary rehabilitation programme (ET). The second study included the addition of prescribed resistance training (ERT). The outcome measures used were the PFSDQ-M, the chronic respiratory questionnaire (CRQ), the incremental shuttle walking test (ISWT), endurance shuttle walking test (ESWT) and isometric quadriceps strength and were performed before and after 7 weeks of training. The PFSDQ-M has three main components the change in activity, dyspnoea with activity and fatigue with activity.
Results: 55 patients were recruited to ET and 50 patients to ERT; 62% male, mean (SD) age 68.5 years (8.7), FEV_1 percentage predicted 43 (17), body mass index 26.8 (6.0), ISWT 228 m (127) and quadriceps peak torque 122 nm (45). There were no differences between the baseline demographics, except there were more men in the ERT group. 44 patients completed ET and 42 patients completed ERT. See table for the results of pulmonary rehabilitation. No differences were seen between the two groups in the improvements in the CRQ. The results were unchanged after multivariate analysis was performed for any baseline differences.
Conclusions: The addition of prescribed strength training to an endurance-based pulmonary rehabilitation programme did not result in additional improvements in activity assessed by the PFSDQ-M. Quadriceps strength was only increased with combined training, but did not lead to greater improvements in exercise performance or health status in this study.

1. **Ries,** *et al*. Pulmonary rehabilitation. *Chest* 2007;**131**(Suppl 5):4S–42S.

S33 EFFECT OF REPETITIVE MAGNETIC STIMULATION TRAINING OF THE QUADRICEPS, COMPARED WITH EXERCISE THERAPY, ON QUADRICEPS STRENGTH IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction: Quadriceps muscle weakness is a poor prognostic factor in chronic obstructive pulmonary disease (COPD). Exercise increases quadriceps strength in some COPD patients, but is difficult to sustain for some. Repetitive electrical stimulation of the intramuscular branches of the femoral nerve increases quadriceps strength in research studies; repetitive magnetic stimulation (rMS) works on the same principle and appears better tolerated.
Aim: To investigate the effect of rMS versus exercise and no active treatment on quadriceps strength in COPD.
Methods: 58 GOLD grade I–IV COPD patients were randomly assigned to 8 weeks of either rMS of the quadriceps, exercise or no active treatment. Two weeks before and in the week following completion of the 8-week period, measurements of lung function, fat-free mass (FFM) using bioelectrical impedance and quadriceps strength (isometric maximal voluntary contraction (MVC) and twitch force (TwQ) using magnetic stimulation) in one leg in the exercise and control groups and in both legs in the rMS group, were made. Physical activity over 12 h/day for 2 days was assessed with the Dynaport ADL accelerometer; results were averaged to give locomotion time (Lo_t) and movement intensity (M_i). rMS involved stimulating the intramuscular branches of the femoral nerve of one leg (at 40 Hz, 1 s on, 4 s off) for 3 h twice a week using a rapid rate stimulator and mat coil. The exercise group performed a supervised 2-h resistance and endurance exercise programme twice a week. The ''no active treatment'' group continued their normal activities. 35 patients completed 8 weeks without severe exacerbations. In these, quadriceps strength change was calculated as the percentage change in twitch force (or MVC if twitch force was not supramaximal); in the rMS group, change in the untrained leg was subtracted from change in the trained leg.
Results The rMS group had greater increases in quadriceps strength than the exercise and control groups (see table).
Conclusions: 8 weeks rMS increases quadriceps strength in COPD patients who do not suffer an intervening exacerbation. The effect of rMS on quadriceps strength appears larger and more consistent than the effects of exercise. rMS may have potential as a clinical treatment for quadriceps weakness in COPD.

Abstract 32 Table

Mean (95% CI)	ΔCA	ΔDA	ΔFA	ΔISWT	ΔESWT	ΔPT
Resistance (ERT)	−0.81 (−1.32 to −0.29)†	−0.50 (−0.86 to −0.15)†	−0.44 (−0.88 to −0.01)†	60 m (42 to 77)†	487 s (367 to 708)†	13 nm (9 to 17)†
Endurance (ET)	−0.60 (−1.15 to −0.04)†	−0.33 (−0.84 to 0.17)	−0.38 (−1.02 to 0.25)	68 m (50 to 85)†	348 s (249 to 447)†	2 nm (−6 to 10)
p Value*	0.567	0.572	0.867	0.509	0.074	0.015

*p for intergroup differences. †p<0.05 intragroup differences. CA, change in activity; DA, dyspnoea with activity; ERT, endurance-based, pulmonary rehabilitation programme with prescribed resistance training; ESWT, endurance shuttle walking test; ET, endurance-based, pulmonary rehabilitation programme; FA, fatigue with activity; ISWT; incremental shuttle walking test; PT, peak torque.

Abstract S33 Table

	Controls (n = 9)	rMS (n = 15)	Exercise (n = 11)
Age in years and sex (% male)	67 (7) 78%	68 (9) 53%	71 (9) 64%
BMI (kg/m^2)	26.3 (5.3)	25.2 (3)	25.1 (4.4)
FFM index (kg/m^2)	16.3 (2.1)	16.1 (1.5)	15.8 (1.8)
FEV_1 (% predicted)	44 (17)	54 (18)	56 (15)
MVC at start of trial (kg)	31 (11)	26 (7)	28 (12)
TwQ at start of trial (kg)	9 (1.8)	6.6 (2)*	8 (2.4)
Lo_t at start of trial (min/12 h)	43 (26)	42 (27)	44 (33)
M_i at start of trial (m/s^2)	1.8 (0.5)	1.7 (0.3)	1.7 (0.3)
Change in quadriceps strength (%)	−5 (13)	14 (10)**°	−1 (17)
	Range −30 to +16	Range −2 to +33	Range −35 to +20

BMI, body mass index; FFM, fat-free mass; Lo_t, locomotion time; M_i, movement intensity; MVC, maximal voluntary contraction; rMS, repetitive magnetic stimulation; TwQ, twitch force.

S34 INPATIENT PULMONARY REHABILITATION DURING ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE: EFFECTS ON QUADRICEPS STRENGTH AND EXERCISE CAPACITY

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Purpose: Patients with chronic obstructive pulmonary disease (COPD) have reduced skeletal muscle strength following hospitalisation (Spruit *et al*, 2003). The impact of an inpatient pulmonary rehabilitation programme on quadriceps peripheral muscle strength, in patients during an acute exacerbation of their COPD was therefore evaluated.

Methods: 90 patients with COPD were admitted with an acute exacerbation of their disease. Thirty-four were considered appropriate for a gym-based endurance and strength training (resistance equipment) programme, (21 men, mean (SD) FEV_1 1.04 litres (0.79), age 68.23 years (11.05), body mass index (BMI) 25.13 (6.16)). The remaining 56 patients received a bedside strength and endurance programme on an acute therapy unit, (22 men, mean FEV_1 0.83 litres (0.40), age 71.9 years (9.75) and BMI 22.73 (4.73)). Before commencing the programme the quadriceps muscle strength was measured (strain gauge at 90° flexion) as well as the 10-m incremental and endurance shuttle walking tests (ISWT, ESWT) were taken. These were repeated at the time of discharge from hospital.

Results: An independent t test determined significant between-group differences in the baseline ISWT, ESWT and the strain gauge results but not in any of the other baseline characteristics. The results of a paired t test are shown in the table. These demonstrate statistically significant improvements in all of the outcome measures for those patients attending a gym-based programme. The patients who received a bedside programme did not show a statistically significant change in the quadriceps strength (strain gauge). An independent t test was then carried out to look at the between-group differences for the shuttle walking test and strain gauge results. No significant difference was found between the two groups after training in quadriceps strength; however, there was in exercise capacity, $p = 0.017$ and $p = 0.004$ for the ISWT and ESWT, respectively.

Conclusions: Both strategies appear to improve exercise performance, although the group using resistance equipment also shows a trend towards greater improvements in quadriceps strength but this is not statistically significant.

S35 REDUCED QUADRICEPS STRENGTH IN EX-SMOKERS WITHOUT CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction: Reduced maximum voluntary quadriceps contraction strength (QMVC) is commonly observed in chronic obstructive pulmonary disease (COPD) and independently predicts mortality. Normal isometric QMVC strength has previously been related to body weight; however, fat-free mass (FFM) declines with age.

Hypothesis: We wished to explore if QMVC normalised for body weight (or FFM) changed with age and whether a smoking history in the absence of COPD had additional influence.

Methods: Isometric QMVC measurements of normal healthy volunteers aged 40–90 years, made between 2002 and 2008, were analysed. Healthy subjects were classified as ''never'' or ''ex-smokers''. All had FEV_1 >80% predicted (FEV_1/FVC ratio >70%), no dyspnoea (MRC scale 1 equivalent), no chronic cough and no history of cardiac disease or chronic organ failure. FFM was measured by electrical bioimpedance. Isometric quadriceps twitch tension (TwQ) was measured following magnetic femoral nerve stimulation.

Results: 239 QMVC records were identified (mean (SD) age 65 years (9), 46% male). 212 and 109 subjects had parallel measurement of FFM and supramaximal TwQ. 132 had a smoking history with a mean (SD) of 20 (18) self-reported pack years. Mean (SD) QMVC for all subjects was 39.5 kg (12.1). Reduced QMVC correlated with lower body weight and height and increased age. Men demonstrated greater quadriceps strength than women. Allowing for the dependence of QMVC on these factors, multiple linear regression analysis (see table) suggested that quadriceps

Abstract S34 Table

	Gym strength training			Bedside strength training		
Mean (SD)	ESWT (s) n = 34	ISWT (m) n = 34	SG (kg) n = 33	ESWT (s) n = 56	ISWT (m) n = 56	SG (kg) n = 45
Pre PR	63.71 (71.96)	78.24 (95.20)	22.92 (10.01)	15.48 (43.39)	17.86 (34.67)	16.18 (7.29)
Mean change	218.52 (272.94)	68.2 (83.13)	3.58 (6.34)	77.55 (177.28)	31.78 (58.40)	1.58 (5.44)
95% CI	123.29 to 313.76	39.22 to 97.24	1.33 to 5.83	30.07 to 125.03	16.14 to 47.72	−0.54 to 3.21
p Value	<0.001	<0.001	0.003	0.002	<0.001	0.058

ESWT, endurance shuttle walking test; ISWT; incremental shuttle walking test; PR, pulmonary rehabilitation; SG, strain gauge.

Abstract S35 Table Multiple linear regression analysis of QMVC (dependent variable, n = 239)

	Coefficient (95% CI)	p Value
Sex (F–M)	−8.7 (−12.0 to −5.3)	<0.001
Weight (kg)	+0.2 (0.1 to 0.3)	0.001
Height (m)	+14.9 (−2.4 to 32.2)	0.09
Age (years)	−0.4 (−0.5 to −0.3)	<0.001
Ex-smoker (Y–N)	−3.5 (−5.8 to −1.2)	0.003

Model r^2 = 0.47. Regression coefficients (95% CI) describe the change in maximum voluntary quadriceps contraction strength (QMVC) per unit change in the group or covariable.

strength was significantly reduced in ex-smokers (−3.5 kg, 95% CI −5.8 kg to −1.2 kg, p = 0.003). The influence of sex was removed if FFM was substituted for weight (model r^2 = 0.54). Sex (p<0.001) and smoking history (p = 0.028) were also found to be independent predictors of TwQ. QMVC/weight and QMVC/FFM fell with increasing age (see fig); QMVC normalised by either method was lower in ex-smokers (p = 0.001 and p = 0.007, respectively) across the age range studied. Neither QMVC nor TwQ exhibited a linear relationship with self-reported pack years.

Conclusions: QMVC normalised for weight or FFM falls with increasing age and is lower in individuals with a smoking history, in the absence of dyspnoea, obstructive spirometry or COPD. The underlying mechanism and functional significance of this observation are unclear, but may be relevant to future research.

Clinical aspects of asthma

S36 WRITING ABOUT EMOTIONAL EXPERIENCES TO IMPROVE LUNG FUNCTION AND QUALITY OF LIFE IN PATIENTS WITH ASTHMA: 3-MONTH FOLLOW-UP OF A RANDOMISED CONTROLLED TRIAL

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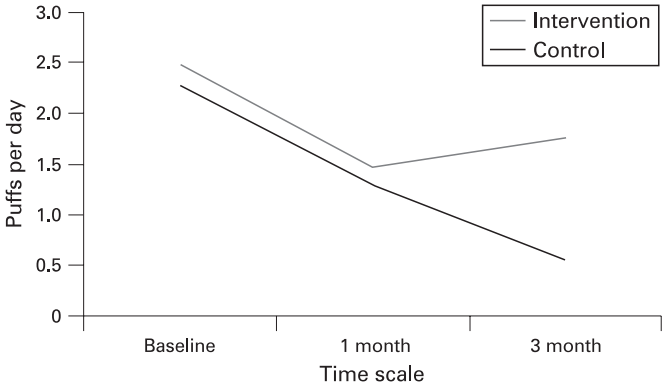
Introduction: Stress has been associated with the exacerbation of asthma symptoms. Written emotional disclosure encourages people to write about their most stressful experiences facilitating cognitive and emotional processing. When conducted partly in a research laboratory, written emotional disclosure was found to yield a 12% increase in FEV_1 percentage predicted in people with asthma. Given the link between stress and asthma, this trial was aimed at exploring the effectiveness of a 3-day written emotional disclosure intervention on lung function and quality of life for adults with asthma in a community setting.

Methods: A randomised controlled trial was carried out on 138 adults with asthma aged between 18 and 45 years who were recruited through 32 general practices. Participants were randomly allocated to receive the emotional disclosure or the non-emotional control writing instructions. Participants completed the writing in their own home without researcher supervision for 20 minutes over three consecutive days. Assessments of lung function (FEV_1 % predicted) using spirometry and questionnaires measuring quality of life, asthma symptoms, subjective asthma control and medication use were conducted at baseline, 1 and 3-month follow-up (see fig).

Results: Baseline analysis showed a significantly higher proportion of smokers in the control condition but no differences in lung function. Controlling for smoking status, no significant findings for lung function, quality of life or asthma symptoms were found. At 3-month follow-up, participants in the intervention condition



Abstract S36 Use of β-agonists for intervention and control participants at baseline, 1-month and 3-month follow-up.

reported significantly better subjective control of their asthma (as defined by the asthma control test): odds ratio (OR) 3.01, 95% CL 1.30 to 6.94 and reported significantly better objective control of their asthma (defined as using their β-agonist less than once a day): OR 2.96, 95% CL 1.38 to 6.33 (see fig).

Conclusions: Participants receiving the emotional disclosure intervention were more likely to demonstrate good control of their asthma both by self-report and a reduction in use of β-agonist. Although there was no effect of written emotional disclosure on lung function, this could be due to the observed reduction in β-agonist use. These reductions are in line with the National Heart, Lung and Blood Institute guidelines, which state that effective management of asthma should involve a reduction in β-agonist use.

S37 SUPERVISED STEP-DOWN IN A COMMUNITY SETTING DOES NOT INCREASE AIRWAYS INFLAMMATION IN MILD-TO-MODERATE ASTHMATIC PATIENTS

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Introduction and Objectives: Current BTS guidelines recommend step-down of inhaled corticosteroids to the minimum dose required for the control of symptoms. However, this is rarely performed in a clinical setting, potentially resulting in over-treatment of many asthmatic patients. We performed a controlled community-based step-down with surrogate measures of airways inflammation.

Methods: 119 patients with a diagnosis of persistent asthma underwent progressive step-down of therapy until they were on 200 μg BDP or equivalent per day or became clinically unstable. Once unstable, participants stepped back up to the last stable dose of inhaled corticosteroids (to determine the ''lowest dose required for stability''). Exhaled tidal nitric oxide and mannitol challenge were recorded at the start and end of step-down as surrogates of airways inflammation. Clinical stability was assessed using AQLQ and spirometry.

Results: The mean (SEM) dose of BDP or equivalent was significantly higher pre step-down than post step-down: 636.0 (35.7) versus 357.2 (18.9) μg/day (p<0.001). Mannitol PD_{10} was higher after step-down by 0.46 doubling dilutions (95% CI 0.02 to 0.89; p = 0.04). For nitric oxide the geo mean fold difference was 0.96 (0.87 to 1.06; p = 0.43). The mean (SEM) FEV_1 (% predicted) pre and post step-down were 86.2 (1.51) versus 84.5 (1.46), p = 0.041. There was no significant difference in FVC or PEF pre versus post step-down. The mini AQLQ scores pre and post step-down were 81.60 (1.50) versus 87.40 (1.38), ie, a mean improvement