113. "Going with the flow": assessment and evaluation of airway function and its role in patient management

P1124

Rate of change of FEV₁ and VC in adults with chronic airflow obstruction Andrew Robson^{1,2}, Alastair Innes^{1,2}. ¹Respiratory Function Service, Western General Hospital, Edinburgh, United Kingdom; ²Respiratory Function Service, Royal Infirmary of Edinburgh, United Kingdom

We have investigated the rate of change in post-bronchodilator FEV₁ and VC in patients with chronic airflow obstruction by retrospective analysis of data in our clinical database. One thousand and forty-four patients (633 females) fulfilled the study criteria, namely two sets of measurements with a minimum of six calendar months between measurements. Measurements of FEV₁ and VC were made before and 20 minutes after administration of 2.5 mg nebulised salbutamol. Only patients with an FEV₁/VC ratio below the lower limit of normal after administration of 2.5 mg nebulised salbutamol were included in the study. Rate of change in FEV₁ was calculated in litres/year. Smoking status (smoker, ex-smoker or non-smoker) was recorded at each visit, but the number of cigarettes smoked was not recorded. Patients were only identified as smokers if the same status was recorded at both measurements. The rate of change in post salbutamol FEV₁ and VC in all patients and in the subgroup of smokers are shown in Table 1. Values shown are mean \pm SD.

Table 1

Rate of change (L/yr)	All males	Smoking males	All females	Smoking females
	(N=411)	(N=141)	(N=633)	(N=231)
FEV ₁	-0.070±0.142**	-0.102±0.143** [†]	-0.036±0.131	-0.040±0.155
VC	-0.097±0.284**	-0.117±0.293**	-0.047±0.180	-0.045±0.197
**P<0.01 compared to corresponding female value. [†] P<0.05 compared to all males value.				

1 < 0.01 compared to corresponding remaie value. 1 < 0.05 compared to an males value.

The rate of change in FEV_1 and VC in patients is significantly higher in males when compared to females. Males who continue to smoke have a greater rate of change in both FEV_1 and VC than females who smoke. Further investigation into these gender differences is warranted.

P1125

Economic impact analysis of a tele-medicine program to improve the quality of apirometry in primary care

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Introduction: The tele-spirometry (TS) procedure consists in a computer application (*espiro.osasunet*) which allows the control and improvement of the quality of the spirometry (S) carried out in primary care centers (PCC), leading a continuous training of professionals that perform the technique.

Aim: To calculate the economic impact of a procedure of TS in the Basque Health Service.

Methods: The study was based on the impact in the funder of the Public Health System and a time horizon of 5years: 2010-2014.We compared the TS with the usual procedure and calculated the direct costs of the test, the computer platform, training and staff for their handling. The population was calculated using the prevalence of COPD in Spain (Soriano ERJ 2009). Effectiveness was measured as the average of S with quality A+B (ATS).

Results: The COPD population who will perform a S goes from 32.850 to 35.207 (2010-2014). At present (2011) 53 PCC have been involved and 1500 S have been done. At the end of 2014, 275 will be included and, with inicial data (Marina 2011 ERS Congress) 35000 S will be done yearly. The cost of one S for the procedure of TS, in 2010, was 48,17€ with an effectiveness of 83%; while for the usual procedure was 37,95€ and 57%. The budget impact analysis, at the end of the year 2014, reflected a decrease of 132.438€, with the assumption that the S of poor quality should be repeated.

Conclusions: The TS procedure involves an increase in the initial budget but produces a saving of the 6.3% (€ 132.438) in the medium term. For subsequent studies we will have to know the economic impact that this improvement in the quality of the S may have on the diagnosis and prognosis of COPD patients.

P1126

Telemedical care concept for patients with advanced chronic obstructive

pulmonary disease (COPD) <u>Keywan Ali Sohrabi</u>⁴, Andreas Weissflog³, Michael Scholtes¹, Lothar Leiche⁵, Henning Schneider², Ulrich Koehler⁴, Volker Gross¹. ¹*TH Mittelhessen* University of Applied Sciences, Biomedical Engineering, Giessen, Germany; ²TH Mittelhessen University of Applied Sciences, Medical Informatics, Giessen Germany; ³ThoraTech GmbH, Research, Giessen, Germany; ⁴Philipps University of Marburg, Interdisciplinary Sleep Disorders Centre Hessen, Marburg, Germany; ⁵Ingenieurbuero fuer Medizintechnik GmbH, Research, Wettenberg, Germany

Providing health care services via telemedicine opens new possibilities and offering cost efficient solutions for monitoring, assistance, and even training for COPD patients. An acute exacerbation is a sudden worsening of COPD symptoms. As the disease progresses, exacerbations tend to become more frequent. For the successful long-term treatment of COPD, it is necessary to optimize the management of acute exacerbation.

Patients with severe COPD benefit physical and physiological from moderate fitness training, as it is shown in our rehabilitation program for COPD patients in Marburg. A good understanding of their disease and communication from and to the therapist will improve therapy compliance and patients self-management abilities. Finally patients get more sensitive for symptoms of early stages of exacerbations. The new telemedical care concept referred to as Tele-Therapist, is taking these experiences into account. The conception comprises automatic examination of explicit COPD vital signs by a mobile device, which can measure and transmit appropriate vital data securely from patients home to a clinic or another location. Data sets can be studied online and compared with e.g. patients fitness data by specialists. An innovative locomotion recognition system will be a part of the Tele-Therapist and allows the monitoring of the rehabilitation & training@home, and furthermore it also will provide the feedback & education@home system for patients. By using the platform of the Tele-Therapist, the specialists can give therapy recommendations and can even communicate with the patients. The concept of the Tele-Therapist has good chances to improve the care of severe COPD patients at home.

P1127

Inspiratory capacity measurement in primary care centers to evaluate bronchoditation response in COPD patients

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Spirometry can be considered a key element in the assessment of COPD patients in primary care centers (PCC). The slow maneuver is not a common practice in such environment. Bronchodilator respose (Bd) could be understimated if IC is not evaluated

Aim: Assessing the usefulness of the measurement of inspiratory capacity (IC) in the evaluation of response bronchodilator in COPD patients in primary care centers

Material and methods: Transversal, multicenter, descriptive study performed in eight PCC. 113 COPD patients were included. Spirometries were carried out by eight techniciens who performed a two days training program in the slow maneuver (IC). We considered as acceptable maneuvers a coefficient of variation in the CI lower 10% and 150 ml in two maximum values of 3 with a maximum of eight maneuvers. The slow maneuver was performed prior to the forced manaeuver Results: 113 patients, 99 H and 14 M, age 65±9,6 with a FEV1 1476±0, 53 $(49\% \pm 14)$ and FVC 2910 ± 0 , 85 (72 $\% \pm 17$). Globally we observed an increase post BD of 13% CI, 8.1 FEV1 and 8.3% FVC. In 56% (66/113) of patients the increase was > 250 ml in the IC. Evaluating patients according to severity, severe patients (FEV1 37% \pm 7.4) BD response was 13.3% CI, 9.1% FEV1 and 10.7% FVC. In59% (37/60) the increase was > 250 ml in the IC. In the group of not severe patients (FEV1 61% \pm 7.7) the increase post BD was 10.8% CI, 7.4% FEV1 and 6.8% FVC.49% (24/53) increased >250 ml in the IC

Conclusions: The IC is a parameter that can be obtained in patients studied in primary care and that allows to identify the BD response in COPD patients improving the evaluation of BD response performed by the forced maneuver.

P1128

Quality of forced spirometry in primary care practice - Are start of test, end of test and repeatability goals met? <u>Mats Arne^{1,2}</u>, Hans Carlsson³. ¹County Council of Värmland, Primary Care

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Optimal performance of spirometry is essential and quality indicators are established in guidelines. In the present study 22 primary care centres in a region in Sweden were investigated. Identical spirometry software has been implemented in all the examined centres

Subjects and methods: All forced spirometry tests in patients >18 years were collected for a period of two years during the years 2009-2011. Available indicators of performance quality in the spirometry databases were analysed. All indicators complied with the 2005 ATS/ERS recommendations. The indicators were backextrapolated volume (BEV) <150 mL as start of test criterion, forced expiratory time (FET) ≥ 6 s as end of test criterion and in addition repeatability of the FEV₁ and FVC (the highest value minus the second highest value) of ≤150 mL.

Results: 4 678 spirometry sessions were analysed. Mean age of the patients was 55.3 years (SD 17.5), and 43% were female. Mean BMI was 27.3 kg/m² (SD 6.3), and 24% were smoking. The following results are presented as the percentage of all tests meeting the goals per centre: Start of test; BEV <150 mL, varied from 74% to 95% (mean 86%), end of test; FET $\geq\!\!6$ s, from 33% to 90% (mean 66%). Repeatability of FEV₁ pre bronchodilator (≤150 mL) varied from 73% to 97% (mean 89%), and post bronchodilator from 79% to 98% (mean 91%). Repeatability of FVC pre bronchodilator varied from 53% to 96% (mean 77%) and post bronchodilator from 56% to 91% (mean 78%).

Conclusion: Achievement of quality goals varied considerably between the centres. These data will be further analysed and establish an initial status to compare quality of spirometry after a Spirometry Driving License training.

P1129

Spirometry training courses are not enough to achieve quality spirometry in the community

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Community diagnostic spirometry should be performed at the same standard as a respiratory laboratory. In 2008 our 10-year-old training course was altered to include a post-course quality review to qualify for spirometry certification Aim: To review the effectiveness of a quality review after spirometry training.

Methods: We audited attendees at our spirometry courses and portfolio submissions. The portfolio required 10 tests and technical comments; spirometry pattern; and quality control logs. We required 90% in all criteria and those who failed could resubmit.

Results: 2-day and refresher spirometry courses were reviewed including 107 practice nurses, 59 occupational health nurses and 27 regional hospital technicians. We found similar trends for the three groups. The portfolio first submission (22%, 30%) and pass rate (33%,62%) for the 2- and 1-day courses respectively were low.

Portfolio submissions

	1st	2nd	3rd
2-day course (124 attended)	27 (9 passed)	11 (4 passed)	2 (2 passed)
1-day refresher (69 attended)	22 (14 passed)	2 (1 passed)	1 (1 passed)

Discussion: The number seeking feedback on spirometry practice was low with 24% submitting portfolios. Poor compliance was probably because spirometry certification is not compulsory in New Zealand. This review suggests a spirometry course alone is insufficient to achieve quality spirometry, or there are deficiencies in our course content or delivery. A failed portfolio provided additional learning because some resubmissions were successful. The low submissions and passes for the portfolios are a concern. We need to encourage excellence in community spirometry and maybe legislation to make spirometry certification compulsory is the way forward.

P1130

Spirometric data quality as assessed by repeatability in COPD exacerbations <u>Aleck Harrison</u>¹, Hardip Kaur Nagra², Grant Sowman², Deidre Price³, Matthew Brown³, Paul Ford³. ¹Clinical Research, AJH Partners, Wallingford, Oxon, United Kingdom; ²Clinical Trials, Vitalograph Ltd, Maids Moreton, Buckingham, United Kingdom; ³Translational Sciences, Novartis International AG, Horsham, West Sussex, United Kingdom

Pharmaceutical trials are reliant on accurate data to meet endpoints and eventual registration. Using standardised equipment, well trained technicians [1] and overreaders [2] can improve data quality: however the patient factor is significant when low values are expected for COPD patients struggling with an exacerbation.

In an international multicentre trial, 91 COPD patients (Gold II-IV) with an exacerbation were enrolled into the trial. Spirometry was performed at both the initial emergency admission and subsequent sessions using the Vitalograph Spirotrac Spirometry System with trial specific software and over-reading.

The repeatability for both FEV1 and FVC was calculated as the difference between the two highest acceptable readings from a total of 672 sessions. The mean figures for each country's repeatability (Fig. 1) are within the ATS/ERS recommendation of both 100ml and 150ml.



Figure 1. Mean repeatablilty in ml (all seasons).

Overall the majority of the manoeuvres met the ATS/ERS 150 ml criteria FVC 96% and FEV1 99% with just 4% FVC and 1% FEV1 of the manoeuvres outside the limit.

With standardised equipment, well trained technicians and independent overreaders, patients with COPD exacerbations and low volume manoeuvres were able to produce accurate and reliable data in this clinical trial.

References:

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- AJ Harrison et al. Quality control of respiratory measurements in global trials. [2] ERJ 2006;28:S50,984.

P1131

Physician's mistakes in the interpretation of spirometry

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Background: The most recent ATS/ERS recommendations on lung function testing include a definition of airflow obstruction based on lower limit of normal (LLN) of FEV1/FVC and suggest to measure total lung capacity (TLC) in suspected cases of "pseudo-restriction" (normal FEV1/FVC ratio because of concomitant reductions in FEV1 and FVC), that can conceal airflow obstruction if the subject does not exhale long enough.

Aims: To evaluate the skill of physicians in the interpretation of spirometry. Methods: A questionnaire focusing on the interpretation of five spirograms was administered to 127 physicians (aged 25-67yrs; 39% pulmonologists, 20% geriatrics).

Correlates of spirometric misinterpretation were assessed by logistic regression. Results: Overall, 31% of physicians made at least one mistake in the interpretation of the spirograms administered. The percentage decreases to 15% among pulmonologists (OR=3.7; p=0.005). One quarter of physicians wrongly diagnosed airflow obstruction in a 75yrs old subject with FEV1/FVC<70% but FEV1 and FEV1/FVC>LLN.

About 1 out of 5 physicians did not recognize a mixed ventilatory defect (obstruction + restriction), while less than 15% (45% of pulmonologists) highlighted the need to measure TLC in suspected pseudo-restriction.

Factors significantly associated with a lower amount of mistakes included higher n° of test performed, scientific articles read, respiratory congress attended, COPD and asthma patients visited in the last year.

Conclusions: Inappropriate spirometric interpretation is not rare among physicians and airway obstruction is still frequently overdiagnosed among elderly. Diagnosis by pulmonologists and scientific update of physicians allow to reduce spirometric interpretative errors.

P1132

Finding the missing millions with COPD - Does it work?

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Introduction: Many COPD patients do not receive a diagnosis until it is relatively

advanced. It is estimated that for every one patient that has been diagnosed there are four that are not known to the health service. In conjunction with World COPD Day in 2011, our COPD Outreach team promoted this event by performing spirometry on patients, staff and visitors at the main hospital entrance, to raise public awareness and to find the 'missing millions'.

Aims and objectives: To raise public awareness of COPD and to detect people with undiagnosed COPD.

Method: The day was advertised in the Trust Talking Point and the Trust Press release. Flyers were posted around the hospital. 4 stands were set up in the main atrium of the JCUH, with spirometers and COPD nurse specialists to perform spirometry. Volunteers completed a questionnaire focussing on their smoking history, symptoms of COPD, history of comorbidities and contraindications to performing spirometry. Individuals with abnormal spirometry were provided a letter for their primary care physicians, to undergo repeat testing or further investigations if appropriate.

Results: Out of the 75 volunteers tested, only 9% (n=7) were noted to have abnormal spirometry results. 5% (n=4) of the volunteers had a prior history of air flow obstruction. Therefore only 4% (n=3) of the volunteers screened were found to have abnormal recordings.

Conclusion: Random screening doesn't capture a large population of people with abnormal spirometry. Screening needs to be more selective e.g.individuals over the age of 35 with a smoking history or symptoms suggestive of COPD. Where our screening did raise awareness of COPD within the general public, it didn't diagnose a large number of people with COPD.

P1133

Irreversible airways obstruction on spirometry, does it equate to a diagnosis of COPD?

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Introduction: Irreversible airways obstruction and a post-bronchodilator FEV1/FVC ratio of <70% on spirometry is diagnostic of chronic obstructive airways disease (COPD). Using the above criteria to make clinical diagnosis may potentially overlook other obstructive lung diseases.

Aims: To study the prevalence and characteristics of lung diseases in patients with irreversible airways obstruction.

Methods: The diagnosis of all patients with irreversible airways obstruction seen in our service between August 2011 and January 2012 seen respiratory physicians was retrospectively reviewed. Respiratory diagnosis was made based on clinical history, physiology testing and radiology.

Results: There were a total of 486 referrals; 446 (92%) have COPD and 40 (8%) have bronchiectasis. No other obstructive lung diseases were diagnosed. There are no significant differences between the demographics of the COPD and bronchiectasis groups.

Baseline characteristics of patients with COPD and bronchiectasis

	COPD	Bronchiectasis
Number of patients	446	40
M:F ratio	1:1.6	1.2:1
Age, years (range)	65.5 (39-89)	71.3 (45-86)
FEV1, % predicted	64.3	59.0
FEV1/FVC ratio, % predicted	56.4	51.7
MRC dyspnoea score	3.00	2.75
Pack years of smoking	48.2	46.5

All data expressed as means.

Conclusions: Current guidelines define irreversible airways obstruction as COPD and many of the therapeutic management strategies for COPD are based on the degree of airway obstruction. We have shown that a proportion of patients with irreversible airways obstruction have bronchiectasis. Hence any patients with irreversible airways diseases who are refractory to maximised COPD management should prompt a review of the diagnosis.

P1134

The value of additional testing in physician diagnosed asthma: A prospective pilot study

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Introduction: Asthma is a common, chronic inflammatory airway disease. Signs and symptoms of asthma are not specific, leading to under and overdiagnosis. In the Zwolle area, general practitioners can refer patients suspected of asthma to

the Isala klinieken for spirometry or methacholine provocation testing. Aims: To investigate whether in patients with physician diagnosed asthma, but a negative methacholine provocation test, additional tests were valuable to establish asthma.

Methods: Primary care patients with a physician diagnosis of asthma but a negative methacholine test were asked to fill out 2 questionnaires (Asthma Control Questionnaire and Bronchial Hyperresponsiveness Questionnaire) at home. In addition, they underwent a mannitol provocation test and fractional exhaled

nitric oxid (FeNO) was measured. A priori, a diagnostic yield of \geq 20% was considered as valuable. The study was approved by the local ethics committee (NL37979.075.11).

Results: 160 patients were eligible and 51 were interested. Eventually, 36 subjects underwent the research protocol. Three participants had a positive mannitol provocation test (8.3%), only one (2.8%) subject had a FeNO-value of >30 ppb. Mean sum scores for the BHQ were 30.0 (\pm 30.3) in the positive mannitol group versus 36.5 (\pm 28.6) in the negative group. Mean ACQ sum scores were respectively 4.7 (\pm 2.5) and 4.0 (\pm 3.6). A significant correlation was found between the ACQ and BHQ (r_s =0.80). After assessment of the results, three participants received the diagnosis of asthma.

Conclusion: In view of the low diagnostic yield found in this study, additional tests did not seem to have significant impact on the diagnostics of asthma.

P1135

Bronchial asthma: New approach to airways functional diagnostics

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It's known that bioelectrical impedance value depends on electrical current path length and diameter. The aim of the study was to investigate electrical impedance of airways and lung by new technique of polyfrequent electrical impedance analysis using "BIA-lab" software. 39 asthmatics and 20 healthy people at the age of 19-45 years old were examined. There were 24 females in asthmatic group and 11 ones among healthy people. Of the asthmatic patients 10 had a severe asthma, 15 suffer from moderate and 9 ones were with mild form of disease. All patients were examined with physical methods and spirometry tests performed. The polyfrecuent electrical impedance technique demanded of 0.9% NaCl airsole inhalation for 1-2 minit to load the airways. The results revealed elevated electrical impedance module values on diapasons of frequencies: 20, 98, 1000, 5000, 10000 and 20000 Hz in asthmatic patients.

But we didn't registered angle φ changes. There was a significant correlation between FEV1 and electrical impedance module IZI of airways (r=-0,57; p=0,032). Conclusion: Polyfrequent electrical impedance analysis, which caracterize the diameter of airways as the main electrical current condacter loaded by 0,9% NaCl airsole, get adiquit essessment of bronchial obstruction in any severety asthmatic patients.

P1136

Acoustic analysis of respiratory sounds in infants with wheezing

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The aim of the study was to determine functional acoustic characteristics of breath by bronchophonographic method (BPG) in infants with wheezing.

Methods: We observed 24 children (2 month-3 years) with wheezing. The patients were divided into two groups (Gr), the Gr1 (n=14) - atopic children and Gr2 (n=10) - non-atopic children. The control group (C) included 27 healthy non-atopic children (2 month - 3 years of age). Computerized BPG by computer diagnostic complex "Pattern" (MEI, Russia) (0,2-12,6 kHz) before and after inhalation of salbutamol (BTS) was provided all patients after the disappearance of wheezing. It were used coefficients of the general acoustic breath work (ABW) – ϕ 1 (0,2-1,2 kHz), ϕ 2 (1,2-5,0 kHz), ϕ 3 (5,0-12,6 kHz), representing relation of level ABW in a given frequency range of the level general ABW.

Results: There were significantly more high parameters of general ABW, ϕ_2 , ϕ_3 in the patients of Gr1 and Gr2 in comparison with Gr3 (p<0,05). Patients of Gr1 showed more high general ABW then Gr2 (p1-2 <0,01). The patients of Gr1 and Gr2 also showed the most high amplitude of sounds in high frequency zone (5,0-12,6 kHz) in comparison with Gr3 (p<0,05). After BTS for the most part of children of the Gr1 (2/3) and 1/2 of the Gr2 showed significant decreasing ϕ_3 ; the level of ϕ_3 in the Gr1 decreased significantly more in comparison with Gr2 (accordingly $64,4\pm7,7\%$; $40,0\pm10,3\%$; p<0,05).

Conclusion: These preliminary results showed that the infants after the disappearance of wheezing still demonstrate the significant functional acoustic disorders. It was more expressed at atopic children then non-atopic. It can be important in relation of early debut of bronchial asthma.

P1137 Effect of patient age on response to nebulised salbutamol or ipratropium bromide

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In order to investigate the effects of a patient's age on their response to nebulised bronchodilators we have carried out a retrospective analysis of our clinical results database. Inclusion criteria for the study were: Age >20 at time of measurement and the presence of airflow obstruction (FEV₁/VC ratio below the lower limit of normal) at baseline measurements. Patients were excluded from the analysis if they were hospital inpatients at the time of measurement, or if they were on oral steroid treatment. After baseline spirometry had been measured, patients received either 2.5mg of salbutamol (SALB) or 0.25mg ipratropium bromide (IPB) via a nebuliser. Spirometry measurements were repeated at 20 minutes (SALB) or 60 minutes (IPB) post administration of bronchodilator. A patient was considered to have shown a positive response to a bronchodilator of there was an increase in FEV₁ >200ml above baseline which was also an increase of >12%. Patients were (Table 1).

Table 1. Change in FEV1 expressed as a percentage of the patient's predicted FEV

Age range		Salbutamol		Ipratropium bromide		
	Ν	Change in FEV ₁	Ν	Change in FEV ₁		
20-40	182	16.4 (7.57)	12	12.8 (4.73)		
40-60	1191	13.8 (6.19)	103	14.2 (7.55)		
60-80	1913	13.5 (5.49)	185	12.8 (4.50)		
80+	196	15.5 (6.15)	17	11.5 (3.71)		

Results expressed as mean (±SD).

There were no statistically signifierent differences between responses to SALB or IPB in any age group. These results demonstrate that increasing patient age does not diminish the magnitude of a patient's response to nebulised SALB or IPB.

P1138

Characterization of bronchodilator response by spirometry and plethismography

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Background: The bronchodilator response criterion is defined by ATS/ERS as an increase of FEV1 and/or FVC $\geq 12\%$ and 200 mL. However, there are other criteria that should be evaluated in order to better characterize the bronchodilator response

Objectives: To determine lung function (LF) parameters obtained by spirometry and plethysmography, that have significant changes with the administration of bronchodilator; to quantify changes of LF parameters between pre and post bronchodilator; to characterize the response to bronchodilator according to different criteria.

Methods: We studied 52 consecutive subjects who performed LF tests, in which was detected airway obstruction with subsequent administration of bronchodilator. The sample was divided in accordance with the presence or absence of pulmonary hyperinflation (PL).

Results: All parameters increased or reduced after administration of the bronchodilator (p<0.05). Raw and the FEF's had the largest percentage of differences between the pre and post bronchodilator. For the totality of the sample, the criteria which were able to detect the largest number of subjects with a positive response to the bronchodilator were the increase of FEF_{25.75%} ≥10% (63.5%), FEF_{25.75%} ≥20% (46.1%), IC≥10% (34.6%) and the reduction of Raw≥10% (32.7%). For the group without PL the best criterion was the increase of FEF_{25.75%} ≥10% (66.7%) and the reduction of RV≥10% (66.7%).

Conclusion: This study couldn't define a single parameter that was considered "the best" to characterize a positive bronchodilator response, but suggested a combination of several parameters for a correct characterization of airway reversibility.

Abstract P1135 - Table 1. The estimation of IZ, Ohml in asthmatic patients by polyfrequent electrical impedance analysis

		Electricul current frequenses (Hz)				
	20	98	1000	5000	10000	20000
Asthmatics (M±o)	122523,4±105285,8	96121,6±113934,6	59719,4±42653,4	44128,3±56246,9	34758,7±41439,1	20903,2±10325,0
Healthy people (M $\pm \sigma$)	73822,2±14522,60	34055,7±3888,56	18816,8±3410,69	16072,6±3586,58	15254,4±3837,93	$14741,5\pm 3848,31$
р	<0,0001	0,0185	0,0001	0,0305	0,0410	0,0128

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P1139

Pressure supported nasal inhalation improving penetration of particles into the human lung

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We here report on a new method to facilitate the pressure supported nasal long-term inhalation. The method is developed and technically realized by company NLI GmbH, Germany.

We examined the efficacy of the method by screening the deposition in nasal and thoracic airways. We used 99mTc-nanocoll to identify the activity scintigraphically in various respiratory sections.

This study included 10 patients (f = 5, m = 5), age range 49 to 75 years, presenting several COPD stages (GOLD I-III). The NLI system generated particle sizes from 1-2 μ m. The pressure support was adjusted to 10 mbar.

We could show that deposition in the lung periphery by using the pressure supported transnasal application will increase significantly compared with conventional methods. The usual method produced an average nasal deposition of 5.9 MBq and a periphery deposition of 9.6 MBq, whereas NLI method results in an average nasal deposition of 4.2 MBq and a periphery deposition of 12.9 MBq, respectively.

Our study showed that it was possible to penetrate even in periphery pulmonary tissue in COPD patients by using the NLI system. In additon, we achieved an enhancement of the thoracic deposition of 99mTc-nanocoll, when recorded a reduction of activity in the nasopharyngeal zone. Further clinical trials with drug applications will be necessary to confirm the clinical relevance.

P1140

Is the portable NIOX MINO reliable for screening nasal nitric oxide levels in primary ciliary dyskinesia?

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Background: Nasal nitric oxide (nNO) levels are very low in patients with PCD. nNO is used as a screening test for PCD. The portable NIOX MINO (Aerocrine, Sweden), is now able to make nasal measurements. This study aimed to assess the usability and reproducibility of the NIOX MINO measurements and comparison of MINO measurements with the 'standard' NIOX Flex.

Methods: Paired MINO and Flex readings were taken from 22 participants (3 PCD, 5 asthma +/- rhinitis, 12 healthy, 1 CF, 1 nonCF/nonPCD lung disease; age 5-64years) nNO was measured using Flex.during breath holding, and using the Niox MINO using nasal aspiration at 2 and 5ml during mouth breathing, three times for each measurement

Results: One participate was unable to use Flex or MINO, one participant was able to obtain acceptable readouts using the MINO at 5ml/sec but not at 2ml/sec nor Flex. Younger children were able to obtain measurements at 5ml/sec but not 2ml/sec. Within-method there was good inter-patient reproducibility using the Flex and MINO. Between method, nNO levels using the MINO at 2ml/sec were comparable with Flex (p=0.098) but readings using the MINO at 5ml/sec were significantly lower than Flex (p<0.001). PCD patients had extremely low levels of nNO (<50ppb) independent of method. A patient with CF had very low nNO (<50ppb) using Flex and MINO (5ml/sec).

Conclusions: Patients who were able to use Flex could also provide nNO measurements using the MINO at 5ml/sec; younger children were unable to use it at 2ml/sec. Reproducibility of nNO within method was acceptable. Measurements using the MINO at 5ml/sec were low in comparison to Flex, but would still differentiate patients with PCD from healthy controls.

P1141

Effect of airflow obstruction on the measurement of lung volumes

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Effective alveolar volume (VA) is considered as a representative of Total Lung Capacity (TLC) in subjects without airflow obstruction. In the presence of airflow obstruction, physiological changes can give rise to discrepancies between TLC and V_A

Aim: To assess whether VA correlates with TLC and ascertain whether these differences are amplified in relation to the increase in severity of airflow obstruction. Method: Data was analysed retrospectively and divided into 2 groups based on TLC measured by either body plethysmography (pleth) or helium dilution (He). Results were classified by FEU; using the NICE COPD guidelines 2010¹. Data was analysed using regression, Bland-Altman and ANOVA.

Results: The magnitude of TLC - VA increased significantly (p < 0.001) in relation to the severity of airflow obstruction. Bland-Altman gave a bias of 1.38 and 1.39

for helium and pleythsmography respectively. A single equation was derived to predict the differences between TLC and VA: $(TLC_{XX} - V_A) = 2.98 - 0.024 \text{ FEV}_1\%$ Pred

Table 1. TLC and VA difference in relation to severity of airflow obstruction as classified by the COPD guidelines

	Mild	Moderate	Severe	Very Severe
N	5	23	28	8
TLCPleth-VA (L)	0.8±0.3	1.3 ± 1.1	1.8 ± 1.1	3.1±1.6
N	20	46	47	26
TLCHe–VA (L)	$0.9{\pm}0.4$	$1.5 {\pm} 0.9$	1.8 ± 1.1	2.9±1.3

Conclusion: 1. VA underestimates TLC

2. As severity of airflow obstruction increases, the magnitude of discrepancy between TLC_{pleth} and V_A and TLC_{He} and V_A increases 3. Overall, VA is unable to substitute TLC in subjects with COPD, particularly

those with more severe airflow obstruction

1. National Clinical Guideline Centre, 2010. Chronic Obstructive Pulmonary Disease in adults in primary and secondary care. London: National Clinical Guideline Centre.

P1142

Rate and depth of breathing affect multiple-breath N₂ washout (MBNW) indices

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Introduction: MBNW requires little cooperation beyond steady breathing, but some subjects (eg. children) may breathe irregularly. Historical studies examining the effect of changing respiratory rate and depth on ventilation distribution indices^{1,2} have contradictory findings. We aimed to examine the impact of rate and depth of breathing on Lung Clearance Index (LCI), and 2 indices of ventilation inhomogeneity (Scond and Sacin).

Methods: Each subject performed at least 3 MBNW tests at each of 3 breathing patterns (BP). A visual signal provided a frequency target and an auditory signal guided tidal volume (Vt). We compared mean LCI, Scond and Sacin between the different BP using repeated measures ANOVA. Sensitivity analyses were performed with and without outliers for validation.

Results: We studied 19 healthy adults but excluded 2 for technical reasons. There were significant differences in LCI and S_{acin} with BP (p < 0.01), but no significant differences in Scond (p=0.117). Increasing Vt from 0.6 to 1.0L reduced LCI and Sacin. Increasing frequency from 15 to 30bpm increased LCI and Sacin.

Table 1. Mean (SD) for indices of ventilatory inhomogeneity

BP (Vt, f (bpm))	LCI	Scond	Sacin
1.0L, 15	7.29 (0.80)	0.011 (0.015)	0.088 (0.037)
1.0L, 30	7.95 (0.66)	0.016 (0.013)	0.115 (0.056)
0.6L, 15	8.18 (1.00)	0.021 (0.016)	0.241 (0.208)

Discussion: We confirmed an earlier report on 4 adults that increasing Vt reduces ventilation inhomogeneity within acinar airways1; in contrast we found no effect on S_{cond}. Frequency also influenced some indices of ventilatory homogeneity. We recommend that both Vt and frequency are controlled. **References:**

[1] Crawford A et al., 1986. Respir Physiol 66(1):11-25.

[2] Bouhuys AA et al., 1961. J Appl Physiol 16:I039-I042.