The feasibility of using commercial multiple breath nitrogen washout devices in school-aged children

**Methods**
Patients with CF and controls performed MBW on three devices; the Exhalyzer®D (ECO MEDICS AG); the EasyOne Pro®LAB (ndd Medizintechnik AG) and the MS system (AMIS 2000, Innovision ApS) on the same test occasion (order randomised). Attempts were made to obtain 3 technically acceptable runs/device (maximum 8 attempts on each).

During testing children watched a DVD and were encouraged to breathe normally. Data were analysed using the ‘clinical application’ setting for both commercial devices, and customised software for the MS. Quality control was in accordance with the ATS/ERS consensus statement and manufacturers’ guidelines.

**Results**
14 control (mean [range] age: 15.0 [12.5–16.7] yrs) and 18 children with CF (13.5 [7.8–17.4] yrs) were assessed. The median (range) number of runs attempted were: MS 3 (3–8), Exhalyzer®D 4 (3–6), EasyOne Pro®LAB 4 (3–8). Average calibration time was shorter for EasyOne Pro®LAB (5 min) than either MS (11 min) or Exhalyzer®D (12 min). Total test duration was similar between devices and dependent on disease severity.

3 acceptable MBW runs were achieved in all children using the MS, 75% with the EasyOne Pro®LAB, and 47% on the Exhalyzer®D system (see Table). Reasons for failure with Exhalyzer®D were usually due to technical/equipment problems, whereas for the EasyOne Pro®LAB these were generally associated with marked changes of breathing pattern at commencement of washout, leading to exclusion of one or more runs.

**Discussion**
Despite use in an experienced MBW centre, our initial attempts to implement commercial MBW devices according to manufacturers’ guidelines resulted in a relatively low success rate in schoolchildren when compared to MS. Subsequent feedback to manufacturers has led to further adaptations which should improve feasibility in future, although this has yet to be assessed in very young children.

**REFERENCE**
1 Aurora et al. Am J Respir Crit Care Med. 2011;183:752–8

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**Abstract P100 Table 1**

<table>
<thead>
<tr>
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<th>MS</th>
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**Poster sessions**

**P101**

**EFFECTS OF USING A MASK VS. MOUTHPIECE ON THE MULTIPLE BREATH INERT GAS WASHOUT TECHNIQUE**

Assessment of ventilation inhomogeneity using the multiple breath washout (MBW) technique has been shown to be more sensitive than spirometry in detecting early cystic fibrosis lung disease throughout childhood. The current “gold standard” interface for school age children and adults is a mouthpiece. Although masks are better tolerated by infants and younger children, their use increases equipment deadspace-which could influence measured values and hence interpretation of results. The aim of this study was to examine the effect of using a mask vs mouthpiece on values of functional residual capacity (FRC) and the lung clearance index (LCI) derived from MBW.

**Method**
Comparisons were performed in healthy adults. The study design incorporated repeated measures as well as interface comparison. The mask was selected to mimic measurement conditions in infants, the deadspace of 85 mL being approximately 1–2 ml/kg in adults. Mouthpiece (MP) deadspace was ~5 mL. Subjects were randomly allocated to group A (Mask-Mouthpiece-Mouthpiece) or group B (Mouthpiece-Mouthpiece-Mask) protocols. Each subject performed a total of 9 MBW runs, in 3 sets, each consisting of 3 runs, with a 5-minute break between each set. MBW was performed using a mass spectrometer as described previously (Aurora 2005 AJRCCM). Paired t-tests with 95% limits of agreement were used to establish repeatability (MP1 vs. MP2) and any differences between Mask vs. Mouthpiece. This study was approved by the local research ethics committee and written consent obtained from subjects.

**Results**
Technically satisfactory comparative data were obtained on 15 occasions in 14 adults (36% males; age: 22–36 years). Respiratory rate and tidal volume were similar using either approach. Repeatability: Both FRC and LCI were repeatable using the mouthpiece [p(Mean (95% CI) diff: FRC: 0.012L (-0.05;0.07); LCI: -0.1(-0.3; 0.1)]; Figure 1A and B. Mask vs. Mouthpiece: FRC and LCI were both significantly higher when assessments were made using a mask compared with a mouthpiece: FRC: 0.101L (0; 0.202); LCI: 0.4 (0.2;0.7); Figure 1C and D.

**Conclusion**
The increase in LCI when using a facemask exceeded normal within test variability in adults and could
the first clinically diagnosed pulmonary exacerbation treated with intravenous antibiotics. The best FEV\textsubscript{1} in the 3 months after treatment and at 12 months was compared to the best FEV\textsubscript{1} in the 12 months before treatment (baseline). Recovery to baseline was defined as any FEV\textsubscript{1} after treatment that was greater than or equal to 90% of the baseline FEV\textsubscript{1}.

**Results** Of the 30 children treated for pulmonary exacerbations, 77% recovered to baseline lung function within 3 months and 73% at 12 months. There were no significant differences between the responders and non-responders in terms of age, sex, ethnicity, BMI, baseline FEV\textsubscript{1}, persistent sputum infection or use of antibiotic prophylaxis or mucolytic agent (Table).

**Conclusions** Similar to findings in CF, around 25% PCD patients fail to recover to baseline lung function after treatment of a pulmonary exacerbation with intravenous antibiotics. Better treatment strategies are needed, and the results also suggest that prevention of exacerbations would be a useful end-point in clinical trials.

**P103**

DO CHILDREN WITH PRIMARY CILIARY DYSKINESIA HARBOUR THE SAME PATHOGENS IN THE UPPER AND LOWER AIRWAY?

GS Marsh, NL Collins, A Bush, C Hogg, SB Carr. Royal Brompton Hospital, London, UK

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**Background** Primary ciliary dyskinesia (PCD) is characterised by chronic nasal discharge and lower respiratory tract infections. We aimed to assess the prevalence and concordance of pathogens present in samples from the upper (UA) and lower airway (LA) of children with PCD.

**Method** Microbiology samples from UA (naso-sinal lavage or nasal swab) and LA (sputum or cough swabs) were taken at the same time from children attending a specialist PCD centre, diagnosed on standard criteria (Eur Respir J 2009:34:1264–1276).

**Results** 70 children (30 male), median age 10.7 yrs (range 1–18), were studied. 36/70 were prescribed long term prophylactic oral antibiotics. 42 (60%) of UA samples were culture positive compared to 21 (30%) positive LA samples. The UA positive group were not statistically different in age or FEV\textsubscript{1} % pred (11.1 vs 10 yrs and 78% vs 75%). 14 patients were culture positive in both UA and LA, 10 of which had matched pathogens and 4 were unmatched. 20 were matched culture negative. The range of pathogens and where they were isolated are shown in the Table, some samples had more than one isolate.

**Note** The Table shows concordance for same pathogens

**Conclusion** In PCD, pathogens are isolated far more commonly from the UA than the LA. The clinical impact of these pathogens in the long term is unknown. 11 (16%) had PA in UA with only 2 of these having PA in their LA. We speculate that the UA may be, at least in some children, the source of LA infection. Clinical trials of eradication therapy after positive nasal cultures are indicated.