chronic respiratory disease dyspnoea domain; CRQ-D) pre and post-PR. Secondary outcomes were take-up rates (the percentage of appropriate patients who started a PR programme) and completion rates (the percentage of patients starting PR who completed a minimum of eight sessions).
Results: Take-up rates were similar between community and hospital (67% vs 62%, respectively), as were completion rates (83% vs 77%). In total, 630 patients completed PR (community n = 505; hospital n = 125). Both community and hospital PR led to improvements in ISWD and CRQ-D (see table).
Conclusions: Supervised community PR programmes result in clinically significant improvements in exercise capacity and breathlessness.

Cystic fibrosis: clinical aspects

P53 MECHANISMS OF GLUCOSE INTOLERANCE IN CYSTIC FIBROSIS

K Mohan, H Miller, P Dyce, R Grainger, R Hughes, MJ Ledson, MJ Walshaw. *The Liverpool Heart and Chest Hospital, Liverpool, UK*

Introduction: The pathogenesis of cystic fibrosis-related diabetes (CFRD), a poor prognostic factor in cystic fibrosis (CF), is poorly understood. To look at this further we studied the role of insulin secretion and resistance in adult CF patients and correlated glycaemic parameters with clinical status.
Methods: A standard 2-h oral glucose tolerance test was performed in 60 stable adult CF patients not known to have CFRD. Blood samples for plasma glucose and insulin were collected before and at 30, 60, 90 and 120 minutes after glucose ingestion. Insulin secretion and sensitivity were determined by homeostatic model assessment (HOMA 2), Stumvoll and oral glucose insulin sensitivity (OGIS) indices.
Results: 42 (70%) had a normal glucose tolerance (NGT), 10 (17%) impaired glucose tolerance (IGT) and eight (13%) diabetes mellitus (CFRD). Fasting plasma glucose and insulin levels were similar among the CF subgroups. Beta cell function (HOMA 2: CFRD 50% + 14 vs NGT 67% + 20; $p<0.05$) and first phase insulin secretion were reduced in CFRD (250 + 116 vs NGT 509 + 292; $p = 0.004$). First phase insulin secretion was inversely correlated with 1 and 2-h glucose levels ($r = -0.74$, $p<0.001$ and $r = -0.34$, $p<0.05$, respectively). The time to reach peak insulin was delayed in both IGT and CFRD (99 and 101 minutes; both $p<0.01$ vs NGT 75). There was no difference in insulin sensitivity among the three groups (HOMA 2: NGT 280 + 130, IGT 250 + 107, CFRD 339 + 160; $p = 0.42$; Stumvoll: NGT 0.128 + 0.017, IGT 0.126 + 0.016, CFRD 0.129 + 0.012; $p = 0.76$; OGIS: NGT 515 + 68, IGT 472 + 62, CFRD 472 + 52; $p = 0.12$). Although there was no difference in body mass index, there was a trend towards poorer lung function (FEV_1: CFRD 54 + 13% vs NGT 65 + 24%; $p = 0.43$) and increased hospital admissions in the diabetic group (CFRD 3 vs NGT 1 per patient per year; $p<0.05$).
Conclusion: Glucose intolerance in CF is characterised by qualitative and quantitative defects in insulin secretion and not insulin resistance and is associated with increased hospital admissions for pulmonary exacerbations.

P54 HOW COST EFFECTIVE IS REGULAR ORAL GLUCOSE TOLERANCE TEST IN ADULT PATIENTS WITH CYSTIC FIBROSIS?

SA Srivastava, JC Burgess, KM Gyi, ME Hodson. *National Heart and Lung Institute, Imperial College and Royal Brompton Hospital, London, UK*

Introduction: As patients with cystic fibrosis (CF) have increased survival, the prevalence of cystic fibrosis-related diabetes (CFRD) has risen. The onset of CFRD is associated with reduced survival and therefore early diagnosis is paramount. Current UK CF trust guidelines recommend annual oral glucose tolerance tests (OGTT) in all adult CF patients. However, the outcome follows World Health Organisation (WHO) criteria, which may not be appropriate, as CFRD is a different disease entity from insulin-dependent and non-insulin-dependent diabetes mellitus.

At Royal Brompton Hospital, a selective approach to OGTT for adult CF patients has been used following work by Yungin 1999. The decision for OGTT is based on one or more of the following: random blood glucose ⩾11.1 mmol/l; glycosylated haemoglobin ⩾6.1%; clinical symptoms (polydipsia, polyuria, nocturia, unexplained weight loss >5%, unexplained pulmonary decline >10%). The cost of an OGTT is £25, but this does not include nursing time, a bed, or the patient's time and the need to be starved and have two blood tests.
Aim: To review the results of OGTT and determine a cost benefit.
Methods: All patients who had an OGTT from 2003 until 2007, inclusive, were identified. Fasting and 2-h blood glucose results were used to determine outcome, as per WHO criteria.
Results: A total of 207 OGTT was performed. Four were incomplete and three were done elsewhere. From the 200 OGTT available, 63 (31.5%) had a diabetic profile, 42 (21%) had an impaired profile and 95 (47.5%) had a normal profile. Of these 200, six had three OGTT and 30 had two OGTT. Of those with repeat OGTT, 55.6% showed no change, 27.8% showed deterioration to either impaired or diabetic profile and 16.6% showed an improvement to either normal or impaired diabetic profile.
Conclusion: Despite this approach, the development of CFRD remains unpredictable and further work is needed to improve the sensitivity of diagnostic tests. By using a selective process for OGTT, the cost of this test was £5000 over 5 years. If annual OGTT were to be performed on all our patients, the cost would be approximately £75 000 over 5 years.

P55 REPEAT MEASUREMENTS OF BREATH GLUCOSE AND BREATH TO BLOOD GLUCOSE RATIO IN ADULT PATIENTS WITH CYSTIC FIBROSIS

[1]SA Srivastava, [2]KM Gyi, [2]ME Hodson, [1]EH Baker. *[1]St George's, University of London, London, UK; [2]National Heart and Lung Institute, Imperial College and Royal Brompton Hospital, London, UK*

Introduction: Glucose concentrations in normal human lung secretions are ~12.5 times lower than blood glucose concentrations (Baker *et al*, *J Appl Physiol* 2007;**102**:1969–75). In adult patients with cystic fibrosis (CF), lung luminal glucose concentrations are elevated 4–8 times, with lung glucose concentrations being 2–4 times lower than blood. Elevated glucose concentrations in lung secretions could therefore be a marker for or contribute to the pathogenesis of CF lung disease. We therefore determined the effect of repeated measurement on lung glucose concentrations.
Methods: Adult CF outpatients (>18 years) with stable disease, defined as >6 weeks without pulmonary exacerbations, extra/change in antibiotics or steroids and without glucose intolerance or diabetes were recruited. All participants gave written informed consent and the study was approved by Wandsworth Research Ethics Committee. Participants were nil by mouth for 2 h, then underwent capillary blood glucose measurement and 10-minute exhaled breath condensate collection three times over the next 60 minutes. Condensate samples were lyophilised, resuspended and glucose concentration measured by high performance anion exchange chromatography. Dilution correction was performed using total cation concentration calculated from sample conductivity to obtain breath glucose, an estimate of glucose concentration of lung secretions.
Results: Three repeat samples were available for 17 patients (eight female, mean age 29 years (range 20–46)). Breath glucose was:

measurement 1, 0.61 mmol (0.21–1.78; median (interquartile range)); measurement 2, 0.19 mmol (0.10–0.77); measurement 3, 0.22 mmol (0.14–0.94; p = 0.019, Freidman test). Blood glucose was: measurement 1, 4.8 + 0.9 mmol (mean + SD); measurement 2, 4.8 + 1.0 mmol; measurement 3, 4.8 + 0.9 mmol (p = 0.982, analysis of variance). Breath to blood glucose ratio was: measurement 1, 0.144 (0.051–0.385); measurement 2, 0.052 (0.029–0.161); measurement 3, 0.081 (0.029–0.217; p = 0.017).

Conclusions: Breath glucose concentrations fell between first and subsequent condensate samples collected from adult CF patients over 1 h, despite stable blood glucose concentrations. Breath glucose did not fall with repeat measurement in consecutive samples in healthy volunteers (Baker *et al*, *J Appl Physiol* 2007;**102**:1969–75). Possible mechanisms underlying this could include differences in lung secretions sampled with repeat collection. These results will inform design of future studies of breath glucose in CF when repeat measurements are required.

P56 OXYGEN THERAPY FOR CYSTIC FIBROSIS

[1]HE Elphick, [2]G Mallory. *[1]Sheffield Children's Hospital, Sheffield, UK; [2]Texas Children's Hospital, USA*

Background: The most serious complications of cystic fibrosis (CF) relate to respiratory insufficiency. Oxygen supplementation has been a standard of care for individuals with chronic lung diseases associated with hypoxaemia for decades. Physicians commonly prescribe oxygen therapy for people with CF when hypoxaemia occurs. However, it is unclear if empiric evidence is available to provide indications for this therapy with its financial costs and often profound impact on lifestyle.

Objectives: To assess whether oxygen therapy improves the longevity or quality of life of individuals with CF.

Search Strategy: We searched the Cochrane Cystic Fibrosis and Genetic Disorders Group Trials Register, comprising references identified from comprehensive electronic database searches and hand searches of relevant journals and abstract books of conference proceedings.

Selection Criteria: Randomised controlled trials comparing oxygen, administered at any concentration, by any route, in people with documented CF for any time period.

Data Collection and Analysis: Authors independently assessed study quality and extracted data.

Results: Eleven published studies (172 participants) are included, of which only one examined long-term oxygen therapy (28 participants). There was no statistically significant improvement in survival, lung, or cardiac health. There was an improvement in regular attendance at school or work in those receiving oxygen therapy at 6 and 12 months. Four studies examined the effect of oxygen supplementation during sleep by polysomnography. Although oxygenation improved, mild hypercapnia was noted. Participants took less time to fall asleep, but there were no demonstrable improvements in qualitative sleep parameters. Six studies evaluated oxygen supplementation during exercise. Again, oxygenation improved, but mild hypercapnia resulted. Participants receiving oxygen therapy were able to exercise for a significantly longer duration. Other exercise parameters were not altered by the use of oxygen.

Conclusions: Short-term oxygen therapy during sleep and exercise improves oxygenation but is associated with modest and probably clinically inconsequential hypercapnia. There are improvements in exercise duration, time to fall asleep and regular attendance at school or work. There is a need for larger, well-designed clinical trials to assess the benefits of long-term oxygen therapy in people with CF administered continuously or during exercise or sleep or both.

P57 A NATIONAL AUDIT OF THE HOME INTRAVENOUS ANTIBIOTIC SERVICE AVAILABLE TO PAEDIATRIC PATIENTS WITH CYSTIC FIBROSIS

FJ Gilchrist, W Lenney. *University Hospital of North Staffordshire, Stoke-on-Trent, UK*

Background: Intravenous antibiotics are one of the cornerstones in the management of patients with cystic fibrosis (CF). Intravenous antibiotics administered at home have been shown to be as effective as when they are given in hospital and have the advantage of reducing disruption to patient's lives as well as cost. We were interested in auditing how the home intravenous antibiotic service available to paediatric patients with CF varied across the country.

Methods: An audit questionnaire was designed to assess practice against the CF Trust Guidelines on home intravenous antibiotics. The questionnaire was sent to the 30 tertiary paediatric CF centres in Great Britain.

Results: All 30 centres replied and all provide a home intravenous antibiotic service. Five do not have set criteria for the selection of patients and four are limited as to how many patients can use the service at any one time. Antibiotics are prepared by parents in 14 centres, by a commercial company in eight centres and by a combination of both in eight centres. Antibiotics are administered solely by parents in 22 centres and by parents with nursing support in eight centres. Twenty-seven centres give antibiotic infusions at home, 17 use self-infusion devices and 10 use syringe drivers. Eighteen centres routinely monitor weight and spirometry during the antibiotic course, five centres monitor just spirometry, one centre just weight and six centres perform no monitoring. Only nine centres audit the outcome of their home intravenous antibiotic service. All centres use tobramycin; 23 once a day and seven three times a day. 14 centres use gentamicin; 10 use once a day and four three times a day. 10 centres routinely provide an anaphylaxis kit. Funding mechanisms vary according to location.

Conclusions: Practice associated with home intravenous antibiotic services available to paediatric patients with CF appears to vary widely across the country. Most of these differences do not affect the quality of the service but there are areas in which practice is not in keeping with CF Trust guidelines. These include lack of monitoring during intravenous antibiotic courses, not auditing outcomes and not routinely providing anaphylaxis kits.

P58 CARDIORESPIRATORY RESPONSES TO EXERCISE DURING INTRAVENOUS ANTIBIOTIC THERAPY IN CYSTIC FIBROSIS: ASSESSMENT USING THE LIFESHIRT

[1]JM Bradley, [1]L Kent, [1]B O'Neill, [2]L Boyle, [3]AM Nevill, [4]A Derchak, [5]JS Elborn. *[1]University of Ulster, Newtownabbey, UK; [2]Belfast Health and Social Care Trust, Belfast, UK; [3]University of Wolverhampton, Wolverhampton, UK; [4]VivoMetrics, Inc, California, USA; [5]Queen's University Belfast, Belfast, UK*

Introduction: Previous research has shown that the LifeShirt can reliably measure cardiorespiratory responses during rest and activity in cystic fibrosis (CF). The aim of this study was to use the LifeShirt to evaluate changes in cardiorespiratory responses to exercise during intravenous antibiotic therapy.

Methods: 12 adults with CF undergoing intravenous antibiotic therapy for an acute exacerbation of respiratory disease were recruited. Following spirometry (FEV_1) and a blood test (C-reactive protein; CRP), patients wore the LifeShirt on two occasions during a 6-minute walk test (6MWT) (time 1: beginning intravenous therapy and time 2: end intravenous therapy or prior to discharge on home intravenous therapy). The LifeShirt was calibrated using a 800 ml fixed volume bag. A $p<0.05$ was considered significant.

Results: 12 adults participated (six men; six women), mean: FEV_1 45 (19)%, length of stay 13 (4) days. Lung function and exercise performance improved from time 1 to time 2: FEV_1 7 (9)%; 6MWT 61 (81) metres ($p<0.05$). CRP decreased from time 1 to time 2: 5.9

(11.3) mg/l ($p<0.05$). Patients significantly improved their exercise distance between time 1 and 2 without a significant change in ventilation (mean difference (SD), −1.6 (13.6) l/min, $p = 0.69$) or breathing rate (mean difference (SD), −0.8 (3.2) breaths/min, $p = 0.37$); however, there was a trend towards an increased heart rate (mean difference (SD), −6.6 (12) beats/min, $p = 0.083$).
Discussion: Submaximal exercise performance improves following intravenous therapy in CF. LifeShirt measurements indicate that these improvements are achieved by improved respiratory mechanics and efficiency. Increasing heart rate may reflect an increased work capacity via reduced respiratory load or improved gas exchange.
Funding: Supported by Northern Ireland R&D Office and Vivometrics Inc, USA

P59 AUDIT OF THE DIAGNOSIS AND MANAGEMENT OF ALLERGIC BRONCHOPULMONARY ASPERGILLOSIS IN PATIENTS WITH CYSTIC FIBROSIS

[1]CF Ramsay, [2]N Wilson-Baig. *[1]Norfolk and Norwich University Hospital, Norwich, UK; [2]University of East Anglia, Norwich, UK*

Background: Allergic bronchopulmonary aspergillosis (ABPA) may complicate cystic fibrosis (CF). Overlap between signs and the results of investigations of the two conditions makes diagnosis difficult. We performed an audit on adult patients with CF attending the Norfolk and Norwich University Hospital (NNUH) for the diagnosis of ABPA and the response to therapy.
Methods: A retrospective review of the notes of all adults (42) who had attended the adult CF service at NNUH between 2002 and 2007 was performed. The clinicians' diagnosis of ABPA was correlated with the results of investigations relevant to the diagnosis of ABPA in three published criteria (Laufer *et al*, ESCF and Llynn *et al*). The clinical response to treatment for exacerbations was correlated with treatment received.
Results: Seven patients (17%) had a confirmed clinical diagnosis of ABPA and nine patients (21%) had a diagnosis of possible ABPA, which correlates well with previous published estimates. The percentage correlations between investigations and a clinical diagnosis of ABPA were in descending order: (1) evidence of >10% variability in FEV_1 (100% correlation); (2) elevated specific IgE/IgG to *Aspergillus fumigatus* (100%); (3) elevated total IgE (86%); (4) precipitating antibodies to *A fumigatus* (86%); (5) *A fumigatus* in sputum culture (71%); (6) peripheral blood eosinophilia (29%); (7) pulmonary infiltrates on chest *x* ray (14%); (8) central bronchiectasis on computed tomography scan (14%). In 21 exacerbations in patients with a diagnosis of definite or possible ABPA, 92% had a clinical response to oral steroids alone and 95% a response to oral steroids with oral antifungal medication but only 40% responded to oral antifungal therapy alone.
Conclusions: Reversible airflow obstruction and *A fumigatus* serology showed the best correlations with the clinicians' clinical diagnosis of ABPA. Oral steroids were almost invariably (>90%) successful in producing a clinical improvement, whereas oral antifungal therapy alone produced improvement in only 40% of exacerbations.

P60 AMINOGLYCOSIDE-INDUCED OTOTOXICITY IN ADULTS WITH CYSTIC FIBROSIS

[1]NK Payne, [2]AE Camilleri, [3]G Day, [4]S Mulrennan, [4]AK Webb, [4]RJ Bright-Thomas. *[1]Manchester Medical School, University of Manchester, Manchester, UK; [2]Department of Otolaryngology, University Hospital of South Manchester NHS Foundation Trust, Manchester, UK; [3]Department of Audiology, Withington Community Hospital, University Hospital of South Manchester NHS Foundation Trust, Manchester, UK; [4]Manchester Adult Cystic Fibrosis Centre, University Hospital of South Manchester NHS Foundation Trust, Manchester, UK*

Background: Aminoglycosides are highly active against *Pseudomonas aeruginosa* but are known to be nephro and ototoxic. With increasing cystic fibrosis (CF) life expectancy, the frequency of aminoglycoside exposure is increasing with the possible increased risk of ototoxic side effects. There are no recent data describing the prevalence of ototoxicity in CF populations and no published UK guidance suggesting how to screen for or manage ototoxicity in CF patients.
Aims and Objectives: To examine whether ototoxicity is a clinical problem in patients attending a large regional adult CF centre. To examine the association of ototoxicity with intravenous aminoglycosides, nebulised TOBI and the m1555A>G mutation (a mitochondrial mutation implicated in the development of aminoglycoside-induced ototoxicity.)
Materials and Methods: We conducted a retrospective audit of all audiograms performed in adult CF patients over an 11-year period. All audiograms were reviewed by a consultant ENT surgeon and results were compared with those of normal subjects from the National Study of Hearing. The association between audiogram results and intravenous aminoglycoside and TOBI exposure was examined at different hearing frequencies (2, 4 and 8 kHz). Results of the m1555A>G screening test were collected from 23 patients studied.
Results: 51 patient audiograms were identified and examined. Of these, 27 (53%) patients reported inner ear symptoms prior to their audiogram. 17 (33.3%) were clinically abnormal requiring specialist ENT intervention. Analysis demonstrated that CF patient audiometry was significantly worse than that of normal subjects. There was a statistically significant positive relationship between cumulative intravenous aminoglycoside exposure and hearing loss at all frequencies (2 kHz: $r = 0.609$, $p \leqslant 0.001$; 4 kHz: $r = 0.572$, $p \leqslant 0.001$; 8 kHz: $r = 0.549$, $p \leqslant 0.001$.) No relationship with TOBI was identified. One patient tested positive for the m1555A>G mutation.
Discussion: Hearing loss is a significant issue in adults with CF and is correlated with intravenous aminoglycoside exposure. Whereas a larger prospective study is required in patients receiving regular intravenous aminoglycosides, audiometry should be performed routinely and testing for the m1555A>G mutation considered.

Management and assessment of cough

P61 A WEB-BASED CLINIC "COUGH CLINIC"

[1]H Fathi, [2]PW Dettmar, [2]V Strugala, [2]H Dettmar, [1]C Wright, [1]AH Morice. *[1]Department of Academic Medicine, University of Hull, Castle Hill Hospital, Cottingham, UK; [2]Technostics Ltd, The Deep Business Centre, Hull, UK*

Background: Cough is a very common symptom prompting a medical opinion. In the absence of other obvious chest disease, chronic cough is a diagnostic challenge. Online clinics aim to help by providing targeted information in response to specific answers to an online questionnaire. We aimed to make the European Respiratory Society guidelines on the management of cough more practical, while at the same time providing information about the condition for both patients and physicians at the distance of a click!
Methods: On a secure provider, patients were required to complete a questionnaire if over 18 years of age. A normal chest *x* ray within a year was necessary and history of haemoptysis was an exclusion criterion. An algorithm was applied after assigning weighting factors to the patients symptoms, to give a percentage of the maximum probability of having the three main causes of chronic cough: reflux, asthma or rhinitis. Based on guidelines, the best approach was suggested to the patient in a letter to their GP. The patient was asked to complete a follow-up questionnaire at 2 months to assess the current situation and response.
Results: Up until July 2008, 14 037 patients (58% women, mean age of 45 years) registered with the site. 8884 patients completed the questionnaire. 46.48% were diagnosed with reflux, 38.31% and