Abstract P187 Table

	%PPD CD4 IFN-γ response in induced sputum		
	Baseline	1–2 Weeks	1–4 Months
1 Pulmonary	3	5.2 PR present	0.51
2 Pulmonary	0.99	8.9 PR present	.82
3 Pulmonary	4.6	7.57 PR present	1.2
4 Pulmonary	6.3	4.1	0.5
5 Pulmonary	0.0	0.6	0.0
6 Pulmonary	2.6	2.1	3.96
7 Renal	36.38	24.5	2.5
8 Pulmonary	2.52	1.18	0.8
9 Pulmonary	0.52	1.94	0.6

PPD, purified protein derivative; PR, paradoxical reaction.

antigen-specific responses above 5%. One patient without PR had an initial huge response (36% of all cells) that decreased with treatment. There appeared to be no consistent pattern to changes in memory T-cell populations between those with and without PR.
Conclusion: Our data support the hypothesis that tuberculosis-related PR is associated with increases in lung antigen-specific CD4 responses. However, this is not present in paired blood samples, suggesting activation of a compartmentalised, specific immune response.

Sleep disordered breathing and respiratory failure

P188 HIGH TIDAL VOLUME VENTILATION INDUCES RECRUITMENT OF ACTIVATED LEUCOCYTES TO EXTRAPULMONARY ORGANS IN AN IN-VIVO MOUSE MODEL

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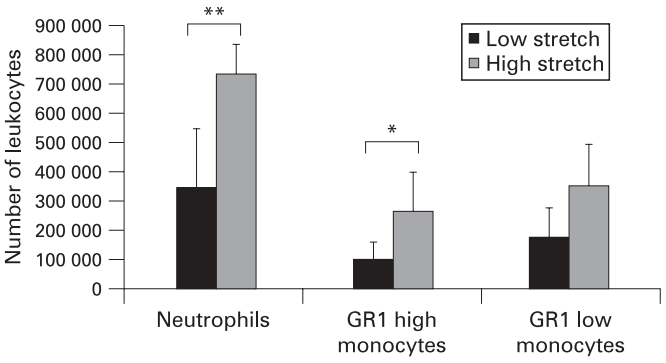
Background: Acute respiratory distress syndrome (ARDS) and acute lung injury (ALI) have a high mortality of up to 50%. The most effective supportive therapy is mechanical ventilation but this can exacerbate underlying lung injury, a phenomenon known as ventilator-induced lung injury (VILI). The majority of patients with ARDS die from multiple system organ failure (MSOF) rather than respiratory failure, but the mechanisms are poorly understood and the role of ventilation in this is unclear. Neutrophils and inflammatory Gr-1^{high} monocytes play an important role in the pathogenesis of lung dysfunction in VILI and ALI. However, the role of leucocytes in the dysfunction of other organs during VILI is largely unknown. Our objective was to investigate whether leucocytes were activated and recruited to non-pulmonary organs due to injurious mechanical ventilation.
Methods: Anaesthetised C57BL6 mice were ventilated for 2 h with low (7–9 ml//kg) or high (33–37 ml/kg) tidal volume (V_T) ventilation. Flow cytometric analysis of cell suspensions from liver, kidney and blood samples was undertaken to quantify neutrophils, Gr-1^{high} and Gr-1^{low} monocytes in each tissue, and assess cellular activation in terms of surface L-selectin and CD11b expression.
Results: High V_T ventilation resulted in recruitment of both neutrophils and Gr-1^{high} monocytes to the liver (see fig) compared with low V_T ventilation. In addition, liver-recruited neutrophils had significantly higher surface CD11b expression, indicative of greater activation ($p<0.05$). There was a trend for Gr-1^{high} monocytes to marginate to the kidney with high V_T, whereas neutrophil numbers were increased in the blood with high V_T ventilation ($p<0.05$ vs low V_T).
Conclusion: These results demonstrate for the first time that pure high V_T ventilation per se causes recruitment of leucocytes to extrapulmonary organs. Increased numbers of leucocytes in the liver, kidney and blood suggest that high stretch ventilation may induce mobilisation of cells from the bone marrow. These data support the possibility that altered leucocyte trafficking may be an important component by which VILI promotes progression to multisystem organ failure.



Mean±SD. n=3–7. *$p<0.05$, **$p<0.01$

Abstract P188 Figure

P189 SURVEILLANCE OF NON-DIRECTED BRONCHIAL LAVAGE IN THE MANAGEMENT OF VENTILATOR-ASSOCIATED PNEUMONIA

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Introduction: Ventilator-associated pneumonia (VAP) is an important healthcare-associated infection that arises at least 48 h after endotracheal intubation. VAP is associated with a mortality of between 33% and 50% and prolongs intensive care unit (ICU) stay. Surveillance cultures allow early focused antimicrobial therapy to target organisms thus reducing the unnecessary use of broad-spectrum antibiotics. Concern surrounding tracheal colonisation has increased enthusiasm for more distal sampling with non-directed bronchial lavage (NBL) offering a less invasive option to bronchoalveolar lavage. A service evaluation of the utility of surveillance NBL and semiquantitive culture in the management of critically ill ventilated patients was performed.
Method: Antibiotic choice, microbiological data and patients' modified clinical pulmonary infection score (mCPIS) were collected prospectively between March 2007 and January 2008. The units' antibiotic policy is tazocin as first-line treatment of VAP with meropenem reserved for those with penicillin allergy. NBL are taken routinely three times a week and then subjected to semi-quantative culture. Patients initiated on antibiotics in keeping with the unit protocol were grouped into a "standard regime" group, whereas patients whose treatment was tailored by surveillance microbiology were allotted to a "focused regime" group.
Results: 41 consecutive patients at high risk of VAP using the mCPIS were identified. The table shows the baseline demographics from each group. Over 85% of patients in each group were admitted to the ICU with a neurosurgical diagnosis, most commonly traumatic brain injury. The "standard regime" group consisted of 29 patients for whom NBL culture results became available during the treatment of 16 leading to an antibiotic change in four patients. In the "focused regime" group (n = 12) the NBL was collected a mean of 2 days prior to starting antibiotics. NBL samples provided information on seven of the 12 patients, tracheal aspirate providing information on a further two, while no positive microbiology was available on the remaining three patients. Overall, in a population of patients at high risk of VAP, 50% of NBL samples taken provided positive microbiological data.

Abstract P189 Table

	Number	Age	Male	Male (%)	Deaths	Deaths (%)	LOS (days)
All	41	45.4	27	65.9	12	29.3	18.9
Focused	12	46.9	10	83.3	1	8.3	23.5
Standard	29	44.8	17	58.6	11	37.9	17.0

LOS, length of stay.

Conclusion: The pilot data presented here suggest that surveillance NBL and semiquantitative culture allows the prescription of early focused therapy, subsequent confident continuation of broad-spectrum antibiotics or de-escalation to more focused therapy.

P190 VENTILATORY INDEX: A SIMPLE BEDSIDE MEASURE OF VENTILATION (PAIRED I OF II)

P Sinha, N Soni, N Fauvel, S Singh. *Chelsea and Westminster Hospital, London, UK*

Measures of oxygenation are traditionally used to monitor the progress of patients on positive pressure ventilation. Although carbon dioxide (CO_2) elimination depends on fewer variables, measures of CO_2 elimination are comparatively overlooked except when monitoring patients who are difficult to ventilate.

We begin by stating: CO_2 elimination is dependent upon CO_2 production and alveolar ventilation, which together determine $PaCO_2$. Alveolar ventilation is the ''efficient'' portion of minute ventilation, with deadspace ventilation the remaining portion. In the clinical setting, problems with CO_2 elimination are observed as rising $PaCO_2$, rising minute ventilation, or both. This reflects increasing CO_2 production or decreasing ventilatory efficiency, or both. In conventional tests of respiratory function, actual measurements are frequently compared with predicted measurements. However, this approach has rarely been applied to the measurement of ventilatory efficiency.

We have used the above concepts to develop an index that compares actual measurements and predicted values of minute ventilation and $PaCO_2$, the ventilatory index (VI):[i]

$$VI = \frac{\dot{V}_{E\,measured} \times PaCO_{2\,measured}}{\dot{V}_{E\,predicted} \times PaCO_{2\,predicted}}$$

where $\dot{V}_{Epredicted}$ is taken to be 100 (ml/kg)/minute (based on ideal body weight) and $PaCO_{2predicted}$ is taken to be 5 KPa.

[i]The mathematical derivation will be presented as a paper/presentation.

Inspection shows VI to be a unitless ratio that can be easily calculated at the bedside. We suggest that it provides a simple guide to changes in ventilatory efficiency (typically due to changing dead-space ventilation) or CO_2 production, or both. A value close to 1 is predicted for normal individuals and an increasing value would correspond with worsening ventilation.

VI is mostly independent of oxygenation variables. It serves as a new tool providing additional information for clinicians managing ventilated patients.

P191 RELATIONSHIP OF VENTILATORY INDEX AND PAO_2/FIO_2 RATIO IN MECHANICALLY VENTILATED PATIENTS (PAIRED II OF II)

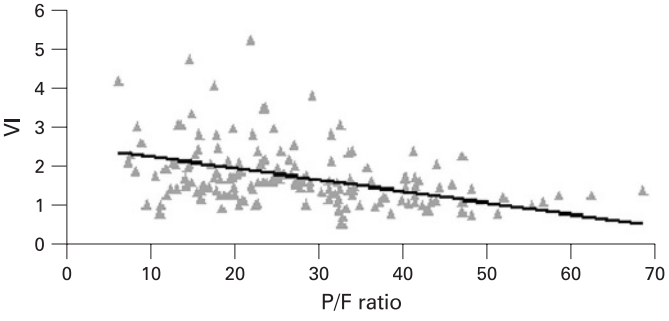
P Sinha, N Soni, N Fauvel, S Singh. *Chelsea and Westminster Hospital, London, UK*

Introduction: As described elsewhere the ventilatory index (VI) is a novel method to assess ventilatory function. The PaO_2/FiO_2 (P/F) ratio is a well-established index utilised in the critical care setting to assess ventilatory function in mechanically ventilated patients. We were interested in studying the relationship of the two indices in a sample of ventilated patients in the intensive care unit (ICU) and under general anaesthesia.

Method: We reviewed the ICU and anaesthetic charts of 100 ventilated patients. VI and P/F ratios were calculated twice daily, after interventions (eg, bronchoscopy) and after a change of ventilation settings. We analysed the lowest P/F ratio and the paired VI, and the highest VI and paired P/F ratio for each patient. We further stratified the patients by underlying previous lung disease, primary admission diagnosis of pulmonary insufficiency, P/F ratio <26.7, P/F ratio 26.7–40 and P/F ratio >40. Additional demographic and physiological parameters were also collected. The Mann–Whitney U-test was used to analyse the different subgroups and Spearman's correlation analysis was used to evaluate correlation between the two indices.

Results: Overall there was significant negative correlation between VI and the PF ratio in both the high VI and the low PF groups ($p<0.001$). In both these groups greater divergence was observed in VI values in P/F ratio <26.7 group (median 2.34, interquartile range (IQR) 1.51–2.36), compared with P/F ratio 26.7–40 group (median 1.41, IQR 1.01–1.61) and P/F ratio >40 group (median 1.12, IQR 1.02–1.52). Patients with pulmonary insufficiency as their admitting diagnosis had significantly higher VI (median 2.192, $p = 0.001$). Patients with underlying lung disorders were also found to have significantly higher VI (median 2.883, $p<0.001$). Compared with peri-operative patients all critically ill patients had significantly higher VI (see fig).

Conclusion: Although negatively correlated, we have observed from our study that at lower values of the P/F ratio there is increased variation in VI. This suggests that the two indices are measuring different components of the respiratory system in mechanically ventilated patients. VI therefore adds additional information for the clinician, providing a more detailed reflection of the ventilatory process. The importance of having a simple numerical value reflecting CO_2 elimination/dead space ventilation could have numerous applications such as aiding in monitoring ventilatory progress, in weaning, and diagnostic categorisation.



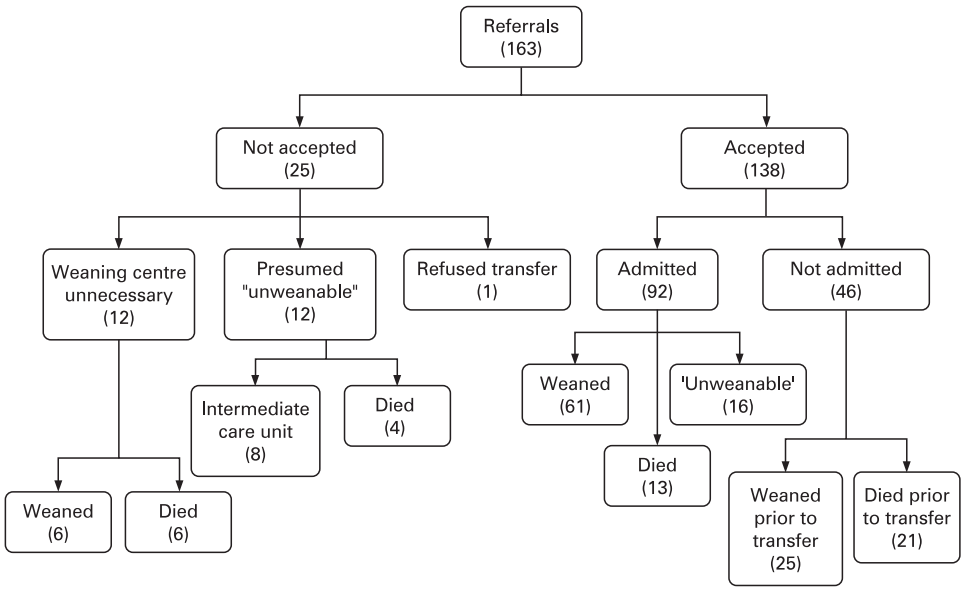
Abstract P191 Figure PF ratio against V1.

P192 REASON FOR NON-ADMISSION TO A UK REGIONAL WEANING CENTRE

D Field, S Harmer, AJ Williams, N Grey, AC Davidson, N Hart. *Lane Fox Respiratory Unit, Department of Critical Care, Guy's and St Thomas' NHS Foundation Trust, London, UK*

Background: Weaning failure occurs in up to 10% of patients weaning from mechanical ventilation. These patients are transferred to our centre to ascertain if successful weaning can be achieved. Previous data detailed the outcome of patients referred (*Thorax* 2005;**60**:187–92). However, these and other similar published data have not reported on the patients who are referred but not transferred.

Abstract P192 Figure



Method: We prospectively collected data using a purpose-designed database from January 2006 to January 2008 to coincide with the introduction of a consultant nurse outreach weaning service that provides onsite assessment and advice and arranges transfer to our unit as necessary.
Results: There were 163 referrals (102 men). 85% of these referrals were accepted for admission and 15% were declined admission. 67% of those accepted were admitted. We divided the patients who were not transferred into four groups: (1) weaning centre unnecessary; (2) patient ''unweanable''; (3) weaned prior to transfer; (4) died prior to transfer. Patient flow is shown in the fig. Of 25 patients declined admission, 12 (48%) were identified as ''weanable'' in their referring unit and six (50%) of these died. 12 (48%) were ''unweanable'' with eight (67%) of these patients transferred to intermediate care facilities; the remainder died. Of 46 patients accepted but not admitted, 25 (54%) were weaned awaiting transfer and 21 (46%) died. The reason for transfer delay was limited bed availability resulting from a combination of discharge delay following successful weaning (11.3 ± 5.8 days) and discharge delay of tracheostomy ventilated patients out of our unit (93 ± 5.8; range 26–208). Consequently, the mean delay in transfer into our unit was 18 ± 16 days (1–65).
Conclusion: This is the first report detailing reasons for non-transfer to a regional weaning centre. As expected, patients were declined admission when identified as requiring long-term tracheostomy ventilation or identified as ''weanable''. However, half of these ''weanable'' patients died in the referral unit prior to transfer, which highlights the difficulty in predicting weaning outcome. More importantly, of those patients accepted, but not transferred, almost 50% died prior to transfer. The reason for non-transfer was lack of level 3 bed availability.

P193 OUTCOME OF PATIENTS REFERRED TO A UK REGIONAL WEANING CENTRE

D Field, CE Robertson, AJ Williams, N Grey, AC Davidson, N Hart. *Lane Fox Respiratory Unit, Department of Critical Care, Guy's and St Thomas' NHS Foundation Trust, London, UK*

Background: Patients with weaning failure are transferred to our centre as a step-down facility to ascertain if successful weaning can be achieved. Previously presented data detailed the demographics of the patients referred and reported on their outcome and survival data (*Thorax* 2005;**60**:187–92). From these data, we identified a unit mortality rate of 27%, with approximately 50% of the patients achieving ventilator independence. In the intervening period, a number of changes to the facility, staff and referral practice have been made.
Method: We prospectively collected data using a purpose-designed database of admissions from January 2006 to January 2008.
Results: Results are shown in the table. There were 163 referrals (102 men). 92 were admitted with an average age of 61 ± 17 years. 39.1% of referrals were received from our own critical care unit, whereas 60.9% of referrals were received from external intensive care units. Neuromuscular disease was the main diagnosis group for referral and had the best in-hospital survival with the worst in-hospital survival observed in chronic obstructive pulmonary disease. The overall proportion of patients that achieved ventilator

Abstract P193 Table Outcome of patient groups

Diagnosis	Total	Ventilator independence	NIV dependent	TV dependent	TTW (days)	Mortality
COPD	17.4 (16)	50.0 (8)	12.5 (2)	6.3 (1)	15 ± 21	31.0 (5)
NMD	40.2 (37)	37.8 (14)	27.0 (10)	29.7 (11)	27 ± 31	5.4 (2)
Post-surgical	18.5 (17)	47.1 (8)	11.8 (2)	(0)	11 ± 10	29.4 (5)
Other respiratory	16.3 (15)	53.3 (8)	26.7 (4)	13.3 (2)	37 ± 38	6.7 (1)
Miscellaneous	7.6 (7)	14.3 (1)	57.1 (4)	28.6 (2)	31 ± 20	0 (0)
Mean		42.4 (39)	23.9 (22)	17.4 (16)	24.2 ± 10.8	14.1 (13)

% (n); mean ± SD. COPD, chronic obstructive pulmonary disease; NIV, non-invasive ventilation; NMD, neuromuscular disease; TTW, time to wean; TV, tracheostomy ventilation.

independence was 42%, with 24% of patients requiring nocturnal non-invasive ventilation. The average time to wean on the unit was 24 days, with 17% of patients remaining tracheostomy ventilator dependent. Although there were only six patients admitted aged >80 years they required longer to wean and had a mortality of 50%. Overall unit mortality was 14%.

Conclusion: When compared with the previous data from 1997–2000 (*Thorax* 2005;**60**:187–92), we observed an absolute reduction in unit mortality of 13%, with similar proportions requiring long-term non-invasive ventilation and reaching ventilator independence. The average age and diagnostic groupings were similar to previous data, but these new data demonstrate that weaning patients >80 years has a poorer outcome compared with those who are younger. In the intervening period, there have been a number of service changes, including increasing the critical care skill mix of the nursing team and the appointment of an outreach weaning team led by a nurse consultant.

P194 OUTCOME OF PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE ADMITTED TO THE INTENSIVE THERAPY UNIT AND REQUIRING VENTILATION IN MORRISTON HOSPITAL, SWANSEA, UK

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Introduction and Objectives: Chronic obstructive pulmonary disease (COPD) is a chronic respiratory illness with significant morbidity and mortality. An acute exacerbation with respiratory failure carries a poor prognosis. Lack of predictors of outcome measures and therapeutic nihilism are still major obstacles in deciding suitability for ventilation, despite evidence to suggest favourable outcomes.[1 2] Our aim is to evaluate the rate of invasive ventilation/non-invasive ventilation (NIV) and the hospital mortality of these category patients admitted to the intensive therapy unit (ITU) in Morriston Hospital.

Methods: A retrospective survey of the Medicus database was performed for the years 2005–7. This was cross-checked with discharge summaries from intensive care.

Results: The total number of patients admitted to Morriston Hospital ITU during this period was 3277. Out of these, 138 (4.2%) patients had a diagnosis of COPD. The mean age was 70.5 years (range 48–91) and the mean APACHE II score was 21.8. COPD was documented to be severe in 46% of patients and 51% had significant co-morbidity other than COPD. These included right ventricular dysfunction, ischaemic heart disease and renal failure. 83% were alive at ITU discharge and 65% at hospital discharge. 87.7% had respiratory support. 59 patients (42.7%) had invasive ventilation (31 immediately and 28 failing NIV). Our hospital survival rate for the NIV-only group was 66.1% and for the invasive ventilation group was 59.3% (see table)

Conclusions: Our data are comparable to the ICNARC UK study,[3] despite the fact that our patients had more co-morbidity and higher APACHE scores. This survey suggests that even when patients with severe COPD and extensive co-morbidity are intubated on ITU the overall outcome can be favourable. We conclude that therapeutic nihilism in this patient population is not warranted.

Abstract P194 Table

	Overall survival rate	NIV alone	Invasive ventilation	No ventilation
At ITU discharge	83.3%	83.9%	76.3%	100%
At hospital discharge	65.2%	66.1%	59.3%	88.2%

ITU, intensive therapy unit; NIV, non-invasive ventilation.

1. **Plant PK,** *et al*. *Lancet* 2000;**355**:1931–5.
2. **Wilderman MJ,** *et al*. *BMJ* 2007;**335**:1132–4.
3. **Wilderman MJ,** *et al*. *Crit Care* 2005;**9**:S38–48.

P195 HOW EFFECTIVE IS THE MODIFIED EARLY WARNING SYSTEM SCORE IN IDENTIFYING CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS REQUIRING NON-INVASIVE VENTILATION?

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Introduction and Objectives: The "modified early warning system" (MEWS) allows the recognition of ill patients based on their clinical parameters. Goldhill *et al*[1] found that an increasing early warning score was associated with statistically significantly increased hospital mortality. The MEWS used in our hospital consists of: heart rate, systolic blood pressure, respiratory rate, oxygen saturation, Glasgow coma score and urine output (each given a score of 0–3). Chronic obstructive pulmonary disease (COPD) patients with respiratory acidosis are at higher risk of death compared with normal pH. Currently doctors are informed when the MEWS score is ⩾3. This study aims to assess how effective the current MEWS is in identifying ill COPD patients requiring non-invasive ventilation (NIV).

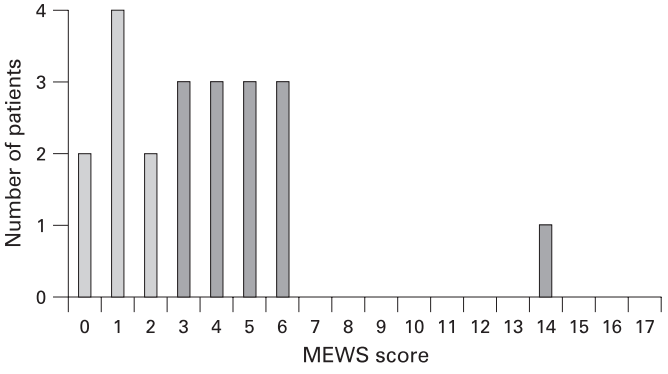
The Null Hypothesis: Every admission in this study population has a MEWS score ⩾3.

Methods: All patients with an acute exacerbation of COPD and identified by blood gases as requiring NIV treatment were selected for this retrospective study. Twenty-one consecutive patients were identified over the 2-month study period (men 12, age range 53–94 years; mean age 68 years). Admission notes for patients were manually searched to collect data on the MEWS variables recorded prior to the patient being commenced on NIV and the MEWS score was calculated for each patient.

Results: In this study, 38% of the study population had a MEWS score <3 just prior to being commenced on NIV. None of the patients in this study population had their urine output recorded (see fig).

Conclusions: The MEWS is a useful tool in the assessment of sick patients; however, more than a third of patients in this study were not identified as requiring an urgent review by a doctor. A specific MEWS validated for acute COPD patients is needed, which should incorporate, for example, recording the FiO_2 required to maintain oxygen saturations between 88% and 92%, and questioning the relevance of measuring urine output in COPD patients. This would increase the sensitivity of the MEWS in unwell COPD patients.

1. **Goldhill DR,** McNarry AF, Mandersloot G, *et al*. *Anaesthesia* 2005;**60**:547–53.



Abstract P195 Figure Spread of MEWS scores.

P196 BTS NATIONAL SURVEY OF KNOWLEDGE OF HEALTHCARE PROFESSIONALS MANAGING PATIENTS WITH ACUTE HYPERCAPNIC EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE REQUIRING NON-INVASIVE VENTILATION

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Background: A detailed practical knowledge of non-invasive ventilation (NIV) is needed to manage acutely ill chronic obstructive pulmonary disease (COPD) patients with hypercapnic respiratory failure. It is essential that the physicians and allied healthcare professions involved with these patients have an in-depth knowledge of indications, technical and practical aspects of delivering NIV as well as understanding the published evidence. Previously (Ballard *et al*, 2007), we carried out a local survey to assess the knowledge of staff managing these patients. This demonstrated a wide spread of knowledge across the multi-disciplinary groups and the conclusion from these data was that further educational support was needed for all the groups, but especially for the nursing group as the major group that manage NIV following initiation.

Method: The previous questionnaire was redesigned following feedback and analysis and to take into account new published evidence. Again, it was designed specifically to assess knowledge in four main areas: indications, technical, practical and published evidence. Eight centres from around the UK delivering an acute NIV service were enrolled and the questionnaires were distributed in each centre by the local investigator by e-mail or in person to all relevant staff and returned anonymously. Completed questionnaires were received from 394 individuals and scored with weighting towards clinical relevance and current evidence base. To generate comparative analysis the groups were compared with a control group that was made up by general medical physicians, nurses and physiotherapists who were all working outside critical care or respiratory medicine.

Results: See the table.

Conclusion: In comparison with the control group, and in correlation with our previous local data, there is a wide spread of knowledge across the multidisciplinary group. The R&CC senior 1 and 2 physiotherapists, ST1-2, ST3/SpR and consultants were significantly better than the control group in all areas tested. The R&CC junior and senior nurses and the FY1–2 doctors all showed equivalence to the control group across all areas examined. These data highlight not only the need for both local and national educational support, but also the groups and areas that need attention.

Abstract P196 Table

Control group (n = 118) vs	n	Indications	Technical	Practical	Published evidence
Junior R&CC nurse	37	0.6	0.1	0.5	0.4
Senior R&CC nurse	39	−0.2	−0.2	−0.5	0.0
Senior 2 R&CC physiotherapist	29	−1.1*	−3.7*	−2.4*	−0.9*
Senior 1 R&CC physiotherapist	28	−1.6*	−3.1*	−2.5*	−1.1*
R&CC FY1-2	12	−0.8	0.4	−0.6	−0.6
R&CC ST1-2	30	−1.1*	−2.1*	−1.8*	−0.7*
R&CC ST3/SpR	47	−2.0*	−3.1*	−2.8*	−1.1*
R&CC consultant	53	−2.2*	−2.8*	−3.0*	−1.2*

Mean difference between control group and other groups surveyed (*$p<0.05$). FY, foundation year; R&CC, respiratory and critical care; SpR, specialist registrar; ST, specialist trainee.

P197 ARE WE MEETING THE STANDARDS FOR PROVISION OF NON-INVASIVE VENTILATION SERVICES IN THE UK? RESULTS FROM THE NATIONAL COPD AUDIT 2008

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Background: Non-invasive ventilation (NIV) is an established treatment for ventilatory failure in chronic obstructive pulmonary disease (COPD) exacerbations.[1] The 2003 UK national audit of acute COPD care highlighted marked variability in acute NIV provision, with observed outcomes for patients treated with NIV worse than in randomised controlled trials.[2] The 2008 national audit has looked at key services in more detail. 239 UK hospital units completed an organisation of care proforma, whereby data were collected on key services, including NIV provision. This was examined against 13 service quality indicators as used in the 2007 NCROP survey of 100 UK trusts.[3] Lead clinicians from each unit were asked if their NIV services met these quality indicators in full, partly, or not met at all.

Results: 79% units provided NIV for all eligible persistently hypercapnic COPD patients, but five units did not provide NIV at all. 80% were always able to deliver NIV in suitable settings. 71% had a designated consultant lead for NIV. When asked if staff outside specialist respiratory wards knew how to manage COPD and were aware of indications for NIV, only 34% responded met in full. Only 52% provided an ongoing training programme for all staff involved in delivering NIV. 79% had written management protocols for NIV, but only 46% provided protocols in all areas where NIV was administered and 47% fully met the provision of clear individualised written instructions for patients including escalation plan. Only 24% of units conduct a comprehensive annual audit of their NIV service, whereas 24% perform no audit at all. Provision of patient information was poor. Only 14% fully met the provision of written information for patients on NIV and only 4% had a policy to provide information to patients when in a stable clinical state.

Conclusions: Although a high proportion of UK hospitals now provide NIV, quality standards are not met by the majority. Shortfalls of most concern include non-specialist staff, poor knowledge of NIV, lack of training programmes, provision of patient information and failure to audit the NIV services.

1. **BTS**. *Thorax* 2002;**57**:192.
2. **Price L,** *et al*. *Thorax* 2006;**61**:837.
3. **Roberts CM,** *et al*. *Thorax* 2007;(Suppl III):153.

P198 INTEGRATED VENTILATORY CARE FOR RESPIRATORY FAILURE IN ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Introduction and Objectives: Historically, access to intensive care for invasive mechanical ventilation (IMV) in respiratory failure complicating chronic obstructive pulmonary disease (COPD) has been limited in the UK. Poor survival expectation may underlie this (Wildman, *BMJ* 2007). We have reviewed the ventilatory management of COPD in a hospital in which access to both non-invasive ventilation (NIV) and IMV is through an integrated critical care service and report on outcome and change in practice over the years.

Methods: Retrospective cohort study of all patients admitted to the intensive care unit (ICU) 2003–7 with a primary diagnosis of

COPD and respiratory failure requiring ventilatory support. We also reviewed prospectively collected audit data on acute NIV in COPD from January 2006 to December 2007.

Results: 158 patients were admitted to ICU and 75 patients received acute NIV in the high dependency unit (HDU). For patients admitted to ICU, the median length of ICU and hospital stay was 6 days (range 1–31) and 18 days (range 1–189), respectively. 14 (9%) patients were managed by NIV alone in the ICU, whereas 54 (34%) who failed a trial of NIV were intubated. In total, 132 patients were managed by IMV. The median time on IMV was 4.5 days (range 1–41). 41 (26%) patients were converted to tracheostomy at 6 days (range 1–14). 45 (35%) patients were extubated onto NIV and this occurred more frequently after 2004. 14 patients failed extubation and were reintubated. Of these, six were converted to a tracheostomy. The overall survival to discharge from ICU and hospital were 92% and 85%, respectively. 6 months survival was 74% after hospital discharge. For patients receiving NIV in the HDU, it was successful in 58 (77%) and failed in 17, of whom six (8%) were intubated. In the remaining 11 (15%), NIV was employed as ''ceiling'' therapy. 85% of HDU patients survived to hospital discharge.

Conclusion: COPD patients had good short-term survival, generally wean quickly and can be managed by extubation onto NIV to avoid prolonged tracheostomy ventilation. Even survival following failed NIV managed aggressively by intubation is to be expected in the majority. Our data demonstrate the importance of integrating decision making and care provision between acute medicine and critical care.

P199 DO MORE REFERRALS MEAN LESS SEVERE DISEASE? A RETROSPECTIVE AUDIT OF A SLEEP SERVICE IN A UK TEACHING HOSPITAL 1999–2007

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Introduction: The hospital sleep service receives more referrals for overnight oximetry each year. Our main objective was to investigate whether the increasing number of referrals was due to greater awareness of obstructive sleep apnoea within the medical profession and hence the referral of less severe disease. We also looked for a relationship between the demographics of the referred population and test outcome.

Methods: We examined records of every patient referred for overnight oximetry in the first 6 months of alternate years between 1999 and 2007. Data collected included age at presentation, sex, Epworth sleepiness score (ESS) and hourly dip rate. We also recorded whether the patient became established on and tolerant of continuous positive airways pressure (CPAP) at one year. Subjects were excluded if they were aged less than 16 years, or if the oximetry was performed on CPAP.

Results: 511 subjects were identified for inclusion. 66 case notes were unobtainable (the majority of these from 1999), leaving 445 for analysis. There was no statistically significant change in dip rate or ESS in patients referred for overnight oximetry between 1999 and 2007 (median dip rate 5.6 per hour (interquartile range (IQR) 2.2–15.1) vs 3.9 per hour (IQR 1.0–15.8) $p = 0.12$; mean ESS 11.8 (95% CI 10.1 to 13.4) vs 10.9 (95% CI 10.0 to 11.8) $p = 0.18$). All the data were subsequently analysed by gender and age, with the results presented in the table. Men had significantly higher hourly dip rates and were more likely to become established on CPAP at one year than women, despite having similar levels of daytime somnolence. This gender difference persisted after stratification for individuals with a higher ESS. There was a significant difference between reported levels of daytime somnolence when groups were stratified by age, with younger patients having a higher ESS with a lower (but not significant) hourly dip rate on the ensuing overnight oximetry.

Conclusion: Despite increasing numbers of sleep studies requested, we demonstrated no significant change in disease severity or daytime somnolence over the years studied. However, this audit does demonstrate significant gender and age differences within this population.

P200 HOME SET-UP POLYSOMNOGRAPHY IN THE ASSESSMENT OF SUSPECTED OBSTRUCTIVE SLEEP APNOEA

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Home set-up polysomnography has advantages over other portable measurement devices but is not endorsed by professional guidelines despite excellent utility in the Sleep Heart Health Study (SHHS). This study aims to determine the technical reliability and diagnostic accuracy of home set-up polysomnography in consecutive clinic patients without significant medical co-morbidity with suspected obstructive sleep apnoea (OSA).

Methods: After initial laboratory polysomnography (Compumedics, S-Series) patients were randomly assigned to home set-up polysomnography (Siesta) or further laboratory polysomnography. Studies were scored blinded to subject. Primary outcome variables were: study success, signal loss, likelihood ratios for OSA diagnosis (apnoea hypopnoea index (AHI) >10/h) and patient preference.

Results: Thirty of 31 subjects (mean age 49 $\pm$ 13.8 years, body mass index 31 $\pm$ 6.1 kg/m^2 completed investigations. SHHS technical

Abstract P199 Table Characteristics and outcome of patients referred for overnight oximetry

	Mean age (95% CI)	Mean ESS (95% CI)	Median dip rate per hour (IQR)	CPAP at 1 year (%)
Gender				
Male (n = 317)	53 (51.8 to 54.7)	10.8 (10.1 to 11.4)	4.9* (2.1 to 16.4)	40.4**
Female (n = 128)	54 (50.9 to 56.5)	11.4 (10.4 to 12.4)	3.2* (1.1 to 8.2)	29.7**
ESS >10				
Male (n = 170)	51 (49.4 to 53.2)	14.9 (14.4 to 15.4)	5.8* (2.1 to 26.5)	50.6**
Female (n = 80)	52 (48.7 to 55.8)	14.5 (13.7 to 15.3)	3.2* (1.4 to 10.8)	35.0**
Age stratified, years				
<55 (n = 232)	43 (41.4 to 43.7)	11.6*** (10.9 to 12.4)	3.8 (1.4 to 14.8)	37.9
>55 (n = 213)	65 (64.2 to 66.3)	10.2*** (9.5 to 10.9)	5.3 (2.3 to 15.0)	36.6

*$p<0.01$ Mann–Whitney U test; **$p<0.05$ χ^2 test; ***$p<0.01$ Student's t test. CPAP, continuous positive airway pressure; ESS, Epworth Sleepiness Score; IQR, interquartile range.

Abstract P200 Table

Study site	Lab PSG1	Lab PSG2	Home PSG	Lab PSG1–2	Home–Lab2
AHI/h mean (SD)	35.3 (27)	33.5 (27)	28.3 (25)	1.7 (7.9)	–4.9 (10.4)

AHI, apnoea hypopnoea index; PSG, polysomnography.

acceptability criteria met by all laboratory polysomnographies and 90% of home polysomnography (93% clinically acceptable). Signal loss was higher at home, thoracic effort most often lost (11.1% home study time vs 1% laboratory). Sleep efficiency was similar (82% home vs 80% laboratory, $p = 0.43$) but patients preferred study at home. No evidence of a first night effect (see table). The AHI was significantly different if initial AHI was >27/h. In those studies meeting acceptability criteria the likelihood ratio to "rule-in" OSA was 10 and to rule-out OSA 0.

Conclusion: Home set-up polysomnography is technically reliable and achieves excellent diagnostic utility providing the technical reliability criteria are met. A failure rate of 6% is similar to the SHHS but superior to studies in which home polysomnography is set up distant from the home. Signal loss is higher at home but was mitigated by multisignal redundancy and probably accounted for the slightly lower AHI.

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Conflicts of interest: None.

P201 LIVING WITH OBSTRUCTIVE SLEEP APNOEA SYNDROME: A PATIENT PERSPECTIVE

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Background: The number of patients being referred to sleep services with suspected obstructive sleep apnoea syndrome (OSAS) is increasing. The recent NICE recommendations should promote prompt diagnosis and increased use of continuous positive airway pressure (CPAP) therapy. This study explores patient views on CPAP as a life-long therapy for OSAS.

Methods: Sequential CPAP follow-up patients (1 month, annual or trouble shooting appointments) completed an anonymous questionnaire relating to OSAS and CPAP therapy. The questionnaire covered support and information issues, whether patients consider CPAP a life-long therapy, partner experiences and suggestions for follow-up services.

Results: 75 patients completed the questionnaire (90.3% response rate, 57 men, mean age 53.7 ± 13.1 years). Mean time since starting CPAP was 26.3 months (range 0.25–180). 96% reported that they were given enough support/information when starting CPAP. 74.7% patients acknowledged CPAP to be a life-long therapy. Negative themes that emerged included stigma associated with the mask and apparatus, using CPAP with new partners or sleeping away from home and disturbing partner's sleep. Positive themes related to improved vitality, better sleep, less daytime sleepiness, partner delight with effects of CPAP and improved sex life. Time taken to get used to CPAP ranged from never (9.3%) to 24.1% taking 1–6 months. Results suggested that annual follow-up encouraged adherence to therapy in 64% and most thought sleep services should offer problem (73.3%) and annual (76%) appointments. Fewer people thought that problem (P) or annual (A) follow-up should be offered by: telephone (P 52%, A 45.3%), or GP (P 37.3%, A 38.7%) or private healthcare (P 28%, A 25.3%). The most common alternatives to CPAP tried were weight loss (60%) and sleeping on the side (70.7%). 18.7% reported they would consider bariatric and 20% mandibular advancement surgery, if appropriate.

Conclusion: This study has highlighted positive and negative themes associated with CPAP use. Whereas the majority of respondents consider CPAP to be a life-long therapy and believe access to follow-up care to be important, some were keen to explore alternatives to CPAP such as bariatric and mandibular advancement surgery. Gaining feedback from patients about CPAP services helps to provide a patient-responsive service.

P202 A PROSPECTIVE STUDY OF PRE-FLIGHT ASSESSMENT IN OBESITY HYPOVENTILATION SYNDROME AND OBSTRUCTIVE SLEEP APNOEA

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The degree of risk of air travel for patients with obesity hypoventilation syndrome (OHS) and obstructive sleep apnoea (OSA) is unknown. The British Thoracic Society (BTS) guidelines recommend that patients with sea level oxygen saturation (SpO_2) of >95% do not require supplementary oxygen but those with SpO_2 92–95% and an additional risk factor should be assessed with a hypoxic challenge test (HCT). Supplementary oxygen is not recommended if PaO_2 is >7.4 kPa on HCT.

This prospective study was approved by our regional ethics committee. Patients with chronic obstructive pulmonary disease (COPD) and any other significant lung disease were excluded. Recruitment continues but we present our preliminary results.

Twenty-six patients (mean age 57 years (SD ± 13)) have been recruited in the following three groups: seven with OHS: established on non-invasive ventilation (NIV) for ⩾12 weeks, mean body mass index (BMI) 49 (SD ± 13), mean daytime PaO_2 10 kPa and mean daytime pCO_2 5.2 kPa on room air; seven with untreated

Abstract P202 Table

Study group	Mean FVC-L (SD)	Mean PaO_2 before HCT-kPa (SD)	Mean PaO_2 at the end of HCT-kPa (SD)	Mean distance walked during ISWT-metre (SD)	Mean minimum SpO_2 during ISWT % (SD)
OHS (n = 7)	2.4 (0.7)	10 (0.2)	6.3 (0.5)	151 (141)	93 (1.8)
Untreated OSA (n = 7)	4.1 (0.5)	10.8 (1.5)	7.9 (1)	407 (169)	93 (3.8)
Treated OSA (n = 12)	4.3 (1)	10.2 (1)	8.3 (1.6)	451 (181)	91 (4.7)

HCT, hypoxic challenge test; ISWT, incremental shuttle walk test; OSA, obstructive sleep apnoea.

OSA: awaiting CPAP, mean BMI 43 (SD ± 7), mean apnoea hypopnoea index (AHI) 42/h; 12 with treated OSA: on CPAP for ≥12 weeks with compliance ≥4 h/night, mean BMI 37 (SD ± 4), mean AHI on CPAP 2/h.

All participants had clinical assessment, lung function tests, incremental shuttle walk tests (ISWT) and HCT (breathing 15% FIO_2 from Douglas bag for 20 minutes). 12 out of 26 had PaO_2 of <7.4 kPa on HCT. According to the BTS recommendations, in the OHS group three qualified for supplementary O_2 and two had borderline HCT; in the untreated OSA group one qualified for supplementary O_2 and one had borderline HCT; in the treated OSA group five had borderline HCT but none qualified for supplementary O_2. Two patients had baseline SpO_2 of 97% but qualified for supplementary O_2 on HCT, which would not have been picked up if the BTS guidelines were followed. These results suggest that patients with OHS may be at risk of significant hypoxaemia during air travel even if their daytime ventilatory failure is well controlled with NIV. However, most OSA patients were not found to be at this risk.

P203 PARADOXICAL MOVEMENT OF THE ABDOMEN IN MORBIDLY OBESE PATIENTS WITH OBSTRUCTIVE SLEEP APNOEA

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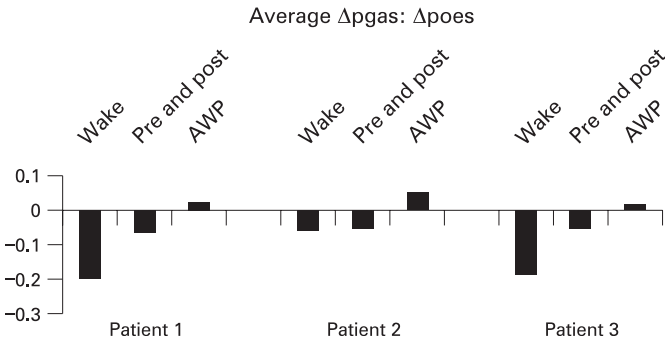
Introduction: Intermittent paradoxical motion of the rib cage is an expected finding in patients with obstructive sleep apnoea (OSA). However, paradoxical motion of the abdominal wall (abdominal wall paradox, AWP) is more commonly reported in patients with severe diaphragm weakness and paralysis. One group has also reported that AWP can be induced in normal subjects with high inspiratory loads.[1] AWP has not been previously reported as a finding in OSA.

Aim: To provide a physiological description of AWP in morbidly obese patients with OSA.

Methods: Three patients selected from clinical sleep studies revealing AWP underwent an overnight sleep study. All had normal awake diaphragm studies. The overnight study comprised full nocturnal polysomnography with oesophageal (Poes) and gastric pressure monitoring (Pgas). Thoracic and abdominal movements were monitored using respiratory impedance plethysmography bands.

Results: The ages of the patients were 42, 50 and 53 years; apnoea hypopnoea indices were 98.8, 71.9 and 23.1 and body mass indices were 41.3, 41.9 and 48.6. A 10-breath period of awake supine breathing (wake in fig) and a representative example of AWP (including normal breaths pre and post-AWP) during NREM sleep were analysed for each patient. The ratio of the average ΔPgas : ΔPoes per inspiration was used to represent the relative contributions of the diaphragm and extra diaphragmatic muscles. A positive value indicates that the Poes and Pgas are both negative in deflection and the greater the positive value the greater the recruitment of the extra diaphragmatic contribution to breathing. During periods of AWP Pgas decreased during inspiration giving a ratio of above 0 (see fig).



Abstract P203 Figure

Conclusion: During obstructive events, in three morbidly obese patients with OSA, the abdomen, as opposed to the chest, moves paradoxically. The results would suggest that the accessory and rib cage muscles generate greater force during these events, resulting in paradoxical motion (upwards) of the diaphragm during inspiration and hence inward movement of the abdominal wall. This has not been described as a feature of OSA before.

1. **Tobin MJ,** Perez W, Guenther SM, *et al*. Does rib cage-abdominal paradox signify respiratory muscle fatigue? *J Appl Physiol* 1987;**63**:851–60.

Education and training

P204 SURVEY OF RESPIRATORY PATIENT INFORMATION RESOURCES: ARE THEY READABLE?

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Introduction and Objectives: Leaflets and health-related websites are important sources of information for patients and should be readily available to help them understand their clinical condition. Well-written information leaflets have been shown to reduce levels of anxiety and result in fewer treatment-related side effects. Health information is best understood by a majority of adults when written for a reading age of 10 years. We aimed to review a large number of commonly available respiratory information resources and to assess their readability.

Methods: Respiratory patient information leaflets and patient-targeted websites were chosen to reflect a full range of respiratory diseases. All reviewed leaflets and websites are current (2008). Two readability tests were used: the SMOG index (simple measure of gobbledegook, McLaughlin, 1969) and the FRE index (Flesch reading ease, Flesch 1948). Such readability formulae use sentence and word length to determine a readability score. The scores have been validated against reading age and can therefore be used to estimate the level of education required in order to understand the information. As a comparator, tabloid leader articles published on one day were also reviewed.

Results: Forty-seven respiratory information sheets, 14 patient-targeted respiratory websites and eight tabloid leaders were evaluated. The median (range) readability scores and reading ages are given in the table. When either readability tool was used, not one source of information corresponded to the recommended reading age of 10 years or less. The median FRE index value for leaflets and websites corresponded to the "fairly difficult" category. The SMOG and FRE scores were highly negatively correlated ($R^2 = -0.71$, $p<0.001$). The greatest difference between groups was seen between the websites (most difficult) and tabloids (easiest) (SMOG Kruskal–Wallis χ^2 16.8, $p<0.001$).

Conclusions: Respiratory patient information resources are written with a reading age above the recommended level. None of the evaluated patient resources were written at the appropriate adult reading age. In order for patients to make informed decisions about their health, information needs to be presented at a level that they can understand.