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Introduction

Welcome to the 2008 ACPRC Journal. The ACPRC mission is focused on promoting best practice in respiratory physiotherapy for the benefit of patients. The ACPRC Journal promotes the exchange of ideas in respiratory care and provides a forum for the discussion of research findings and developments in respiratory physiotherapy.

This year we were delighted to receive submissions from a range of sources including students undertaking PhDs, clinicians undertaking elements of research as part of a Masters programme, and also clinicians involved in service development projects. These submissions have culminated in 5 publications that will be of interest to those involved in both acute and chronic disease management.

As many of you read these papers you may think of a project that you have been involved in that would be relevant to the readership of this journal. We would like to take opportunity to encourage all of you to consider submitting your work; we would also encourage academic staff involved in the organisation of Masters modules/courses to facilitate colleagues to submit suitable projects/dissertations for consideration. The new ACPRC website provides the authors guidelines and as part of the peer review process contributors will receive expert feedback on submissions prior to acceptance for publication.

The deadline for submission of articles for the next journal is Jan 31st 2009 so start planning!

Best regards

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Does physiotherapy led early mobilisation affect length of stay in ICU?

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Summary

The negative effects of mechanical ventilation and the associated bed rest are well documented. This study aimed to determine the effect of early mobilisation on length of stay in ICU. The study was carried out on 65 patients admitted to ICU for >48 hours over a three month period. A target of day 5 was set for mobilisation. For those not mobilised by this point limiting factors were identified via a retrospective analysis of the patients' notes. 26% of patients were mobilised by day 5 in ICU and had a median length of stay of 4 days. Patients who met the criteria for mobilisation but were not mobilised for staffing reasons had a significantly increased length of stay of 9 days (p< 0.001). Those who did not meet the criteria for mobilisation who had a median length of stay of 16.5 days. Early mobilisation can significantly decrease length of stay in ICU, although adequate staffing is required in order to maximise the effectiveness of these interventions.

Keywords:
Physiotherapy, ITU, rehabilitation, mobilisation

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Introduction

The negative effects of mechanical ventilation and the associated bed rest are well documented. Muscle wasting and weakness are prominent, which may take months to recover and is more likely with prolonged ICU stays and longer hours of ventilation (Jones & Griffiths 2000). Combined with other factors such as malnutrition, this disuse leads to general muscle atrophy and weakness (Bruton et al 2002), particularly affecting anti gravity muscles in the lower limbs (Morris & Herridge 2007). A study by Kashihara et al (1994) demonstrated a reduction in VO_2 max following a period of bed rest, whilst other studies have demonstrated an associated bone demineralisation as a result of decreased activity levels (Zerwekh 1998). Following a period of inactivity patients also demonstrate joint soreness, decreased proprioception and problems with balance (Jones & McDermott 2004).

Extended stays in ICU are also recognised to have psychological implications on patients, with high levels of depression and anxiety still present up to two years following discharge from hospital (Hopkins et al 2005). Patients also demonstrate

decreased quality of life (Eddlestone et al 2000), inability to maintain their roles and reduced energy levels (Orme et al 2003).

The problems associated with mechanical ventilation and the related prolonged periods of bed rest, both physical and psychological, often lead to prolonged periods of in patient rehabilitation (Jones & McDermott 2004). With the average cost of an ITU bed at approximately £1700 per day, this can therefore prove very costly and demanding on available resources in an already stretched national health service (NHS). It is estimated that 1-2% of the hospital budget of the United Kingdom is being spent treating critically ill patients (Bion 1995). These factors have led to a government initiative to push forward early rehabilitation and weaning (Department of Health 2000). This in turn has led to the commissioning of NICE guidelines for Critical Illness Rehabilitation set for publication in Spring 2009.

To counteract the negative effects of prolonged inactivity there has been an increasing move towards early rehabilitation in intensive care, although very little evidence exists to prove the efficacy of these interventions. However, there is evidence to suggest ventilated patients do show a normal response to exercise, allowing the theory to be considered that they have the potential to be retrained. Zafiropoules et al (2004) demonstrated ventilated patients showed sequential increases in tidal volume and respiratory rate in response to increasing levels of exercise, which then returned to baseline on cessation with no adverse effects. Weissmann and Kemper (1993) also found patients to have the ability to increase cardiac output, systolic BP as well as VO_2, DO_2 and minute volume in response to exercise or increased activity. Chang et al (2006) found significant improvements to respiratory and general muscle strength in response to structured rehabilitation programmes for ventilated patients. This was also observed with significant improvements to functional independence. These findings provide some rationale for investigating which patients would benefit from the introduction of early and structured rehabilitation programmes.

Aims

- To identify whether mobilisation, defined as sitting patients on the edge of the bed or out in a chair within the first five days of admission to ITU, affects length of stay in ICU
- To identify what are the limiting factors to early mobilisation.

Methods

Subjects

The study was carried out on all patients admitted to intensive care in a large teaching hospital in the North West over a three month period, from 20th June 2005 to 20th September 2005. Patients who were in ICU for less than 48 hours were excluded from the study.

Data Collection

Following each treatment session physiotherapists were asked to document each patient's rehabilitation status on the rehab monitoring form (Appendix 1) which was kept at the front of the ward physiotherapy folder. This form allowed identification of which day patients began mobilisation, defined as sitting on the edge of the bed or out in a chair. For those who were not 'mobilised' by day 5 the limiting factor was obtained via a retrospective audit of the patients notes. Total length of stay in ICU was documented on patients discharge. The physiotherapists involved in the study were asked to continue their treatments as normal and to begin mobilisation when they deemed it appropriate, no targets for mobilisation were given so as not to bias any results obtained. The decision to mobilise patients was therefore based on the clinical reasoning of the physiotherapist following initial assessment and handover from the nursing staff.

Analysis

Demographic data was obtained to allow comparison between groups. This included APACHE II scores for illness severity and predicted mortality, both of which are used nationally to categorise the severity of illness of those patients admitted to ICU (Knaus et al 1985). Length of stay was calculated from data collected for those patients mobilised by day five and those who were not. Statistical analysis was performed using SPPS 10.1 software for windows (SPSS®, Chicago, Illinois, USA) Data was found to be not normally distributed therefore non parametric analysis was completed using the Wilcoxon signed ranks test. Limiting factors to mobilisation were then listed and grouped into similar themes for analysis where appropriate. An example of this process is a patient who was in fast AF and another patient who did not mobilise as they had suffered a cardiac event with a raised Troponin level. Both of these would then be grouped into the theme cardiovascular instability.

Ethical approval was not sought as this study constituted a service evaluation and not

the implementation of any new services or protocols.

Results

During the study period 118 patients were admitted to ICU. 49 of these were excluded from analysis as they were in ICU for less than 48 hours. A further 4 subjects were excluded as there notes were lost to follow up so unavailable for analysis. This left 65 patients who were eligible for inclusion in the study (39 male/ 26 female) with a median age of 60 years (Table 1). Of these subjects 17 (26%) were mobilised by their 5th day in ICU, with a median LOS of 4 days (Range 2-18 days) (Table 1). The other 48 subjects who had not mobilised had a significantly increased stay with a median LOS of 15 days (Range 3-86 days) ($p<0.01$) (Table 1).

Limiting factors to mobilisation were grouped into 9 different themes, the percentage of each being shown in table 2. It was identified that the largest limiting factors to early mobilisation was the sedation status of patients or those who were considered too unwell (48%), although 14 patients (25%) were not mobilised secondary to decreased staffing including weekend services. On retrospective analysis it was discovered these 14 patients were deemed appropriate to mobilise, with the only limitation being the number of staff available or that it was a weekend where rehabilitation is not routinely performed due to prioritisation of respiratory care. On analysis of those patients mobilised and those who were deemed ready to mobilise but weren't due to staffing reasons, no significant differences were found with regards to age or APACHE illness severity and predicted mortality scores. The only direct difference was that by day five on ICU one group had commenced mobilisation whereas the others had not.

Table 1. Subject demographics and length of stay in ICU – Median (Range)

	N (%)	Age Years	APACHE II Illness severity	APACHE Predicted Mortality	Median LOS (inter quartile range)
Mobilised by day 5	17 (26%)	63 (26-82)	16 (6-27)	20 (6-60)	4 (2-18)
Deemed ready but not mobilised by day 5	14 (22%)	61.5 (29-83)	17.5 (10-31)	19.5 (7-66)	9 (3-29)*
Not appropriate to mobilise	34 (52%)	59.5 (21-80)	16.5 (3-37)	18 (2-86)	16.5 (5-86)*
All subjects	65	60 (21-83)	17 (3-37)	19 (2-86)	

** Significant ($p<0.001$) increase in LOS compared to those mobilised by day 5*

Table 2. Patients not mobilised by day 5

Reason for not mobilising	Number of cases	Percentage
Too unwell/ sedated/ paralysed	22	46%
Decreased Staffing	10	17%
Fractures	4	8.5%
Weekend Service	4	8.5%
Decreased GCS	2	4%
On Noradrenaline	2	4%
CVS Instability	2	4%
Agitation	1	2%
Deranged Clotting	1	2%

**14 patients (25%) were not mobilised secondary to decreased staffing including weekend services*

Those subjects who had not mobilised for staffing reasons had a median LOS of 9 days (range 3-29 days) which was significantly longer ($p<0.001$) than those patients who had mobilised

Discussion

Historically the principle of early mobilisation has been a difficult one to address. Ideally a study would be performed directly analysing the effects of these interventions against a control group who received no rehabilitation. However, advances in knowledge of the benefits of structured rehabilitation and exercise

in this area would make such a study unethical. This study aimed to identify any apparent differences in LOS of patients depending on a mobilisation target of day 5 in ICU. To this end a significant difference was found between the two groups of patients analysed, with those patients who had mobilised demonstrating a significantly reduced LOS in comparison to those who had not. However, it would appear that those patients who were likely to show faster recovery would be able to mobilise sooner and also demonstrate a shorter LOS. This would therefore limit any conclusions which may be drawn from this data.

During the limiting factor analysis a sub group of patients were identified who were deemed ready to mobilise by the physiotherapist, with the only limiting factor being one of staffing levels. On comparative analysis no other significant differences in terms of age or APACHE scores were identified, with the only apparent difference being the fact one group had mobilised and the other had not (Table 1). On analysis of this sub group it was found they had a significantly increased length of stay in comparison to subjects who were mobilised, with a median level of 5 extra days in ICU ($p<0.001$). Although not constituting a true control group, this is very interesting data and suggests that early mobilisation could have a significant effect on decreasing length of stay for patients admitted to intensive care. This principle could have major implications for the future of rehabilitation in ICU, going some way to supporting the effectiveness of physiotherapy led early mobilisation in this patient group. By decreasing length of stay in ICU, the associated detrimental effects outlined earlier could be reduced leading to improved patient outcomes in terms of physical ability, psychological health and cost to the NHS.

As stated previously, it could be argued that the less critically ill patients will have shorter stays in ICU regardless of early mobilisation and thus provide a large skew in data obtained. However, ventilated and critically ill patients have been proven to demonstrate a normal physiological response to exercise (Weissmann & Kemper 1993), in which case they have the potential to be trained. Improvements have also been demonstrated in terms of respiratory function and lung physiology suggesting some benefit in weaning patients from mechanical ventilation (Zafiropoules 2004; Chang et al 2006). This would therefore allow the hypothesis to be generated that a programme of early mobilisation would facilitate the process of weaning and allow earlier discharge from intensive care.

A number of limiting factors were identified to early mobilisation (Table 2). Although some of these were irreversible such as patients being too unwell or sedated, a number of factors may be addressed to allow a larger proportion of patients to be mobilised earlier in ICU. In fact, 1 in 4 patients were not mobilised by their fifth day in ICU due to staffing reasons. Given the potential decreased length of stay associated with early mobilisation it could therefore be suggested that better staffing in ICU is economically justified to facilitate a reduction in length of stay. When you put these findings into perspective, a difference of 5 days was identified between those patients mobilised and those who were not due to reduced staffing levels. Looking at the mean daily cost of an ICU bed at £1700 per day this could equate to a cost saving of £8500 for each of the 14 subjects across the 3 month study period if they had been mobilised. This could suggest potential cost benefits of nearly £500,000 per year. Obviously a large number of assumptions are made on this calculation but when you consider the cost of one extra physiotherapist it provides a very strong argument for increased staffing levels in ICU. This would also need to be coupled with appropriate education for both physiotherapists and the MDT to ensure maximal compliance with these interventions.

A major limiting factor of this study is the lack of a true control group, although as discussed previously the nature of this work would make any such study unethical to complete. Another limitation was the relatively small sample size which may limit how generaliseable these results are to a wider ICU population. Further research is needed on this subject, with comprehensive analysis of structured rehabilitation programmes a high priority in this area. Due to the restrictions on an appropriate control group one option may be for further research in this area to allow comparison with other ICU's which may have different policies or criteria for early mobilisation. It may also be beneficial to develop standardised criteria to decrease any inconsistencies between staff members to ensure patients are mobilised as early as possible but also as appropriately early as possible. With the results obtained by this study indicating favourable results it may also be suggested that it is time for research to start challenging the traditional barriers to early mobilisation. One example of this may be patients receiving low doses of noradrenaline, with evidence to suggest CVS responses to increased levels of activity creating the theory that a programme of CVS training may

actually speed the process of weaning cardiovascular support.

Conclusion

The findings of this study suggest early mobilisation could significantly decrease length of stay in ICU. This could point to significant cost savings as well as improved patient outcomes such as shortened weaning times and a reduction in the associated physical and psychological complications of mechanical ventilation and prolonged periods within ICU. However, adequate staffing is required in order to maximise the effectiveness of these interventions.

Key points

- The negative effects of mechanical ventilation and the associated bed rest are well documented, and there is little evidence relating to interventions which could reverse these effects.
- Early mobilisation may decrease the length of stay in ICU and improve patient outcomes.
- Adequate staffing is required in order to optimise the timing of mobilisation in ICU.

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Appendix 1. Rehab Monitoring Form

		Week Beginning:						
Patient Name	**Prev week score**	**M**	**T**	**W**	**T**	**F**	**S**	**S**

Key

1 – Passive Movements
2 – Active/ Active assisted movements
3 – Chair position in bed
4 – Sit on edge of bed
5a – Hoisted out in chair
5b – Transfers with standing hoist
5c – Transfers with 2
5d – Transfers with 1
6a – Mobilised to end of bed
6b – Mobilised 10M
7 – Independently Mobile
R – Patient Refused
U – Patient too unwell for rehab

Prone positioning for acute respiratory distress syndrome (ARDS)

A review of the literature

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Summary

Prone positioning has been proposed and investigated as a management strategy for hypoxic patients with acute respiratory distress syndrome (ARDS). It has been shown to improve oxygenation in some cases, but not all. ARDS is a complex disease in which physiological presentation may depend on aetiology or time since onset. This review of published research examining the physiology underpinning prone positioning suggests that prone positioning improves oxygenation in the majority of extra-pulmonary ARDS patients, with lower percentages of pulmonary ARDS patients responding. Prone should be started promptly after diagnosis and for >12 hours to provide patients with the greatest oxygenation benefit. Patients with the lowest PaO_2/FiO_2 ratios prior to turning prone, potentially show a mortality benefit, as do those patients who show improvements in both oxygenation and $PaCO_2$.

Keywords
Prone Positioning, ARDS, Oxygenation

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Introduction

Acute Respiratory distress syndrome (ARDS) is characterised by parenchymal lung injury and disruption of the alveoli-capillary interface, resulting in protein rich oedema leaking into the alveolus, causing gaseous exchange failure and hypoxia (Lumb 2005; Ware & Matthay 2000). The American-European Consensus Conference Committee in 1994 standardised the diagnosis of ARDS as acute onset respiratory failure, bilateral infiltrates on chest x-ray, and no evidence of heart failure (pulmonary capillary wedge pressure <18mmHg), PaO_2/FiO_2 ratio <200mmHg (Bernard 1994). There are three key stages of ARDS: the acute phase lasting 3-5 days is characterised by disruption of the alveolar-capillary interface, leaking of protein rich fluid into the interstitial and alveolar space, and extensive release of cytokines and migration of neutrophils (Ware & Matthay 2000). A later reparative phase, 5-7 days after onset is characterised by fibro-proliferation and organisation of lung tissue (Ware & Matthay 2000). If resolution does not occur, disordered collagen deposition leads to extensive lung scarring and fibrosis, from day 14 onwards.

ARDS can be further sub-classified as pulmonary, associated with direct lung injury from conditions such as aspiration pneumonia or ventilator associated lung injury (VALI) and extra-pulmonary, caused by indirect lung injury from conditions such as sepsis syndrome and pancreatitis (Ware & Matthay 2000). The sub-classification of ARDS is made according to the underlying condition responsible. Pulmonary ARDS is associated predominantly with consolidation; extra-pulmonary ARDS has predominantly interstitial oedema and alveolar collapse (Gattinoni et al 1998).

Maintaining adequate oxygenation in the acute phase of ARDS may require very high ventilator pressures and oxygen concentrations, both of which are associated with potential lung damage. VALI occurs due to alveolar over-distension (volutrauma), de-recruitment (atelectrauma), and biochemical injury to lung parenchyma (bio-trauma) (Gattinoni 2003(a)). Clinicians strive to correct the life threatening hypoxia and improve respiratory mechanics while minimising the potential for VALI. In the last decade, the ARDSnet group provided evidence of a mortality benefit when using 'lung protective' ventilation strategies, including 6ml/kg tidal volume and plateau pressures <35cmH_2O (ARDSnet 2000).

Prone positioning was first proposed by Bryan (1974) as a therapeutic positioning strategy for mechanically ventilated patients. Several complex physiological changes occur and interact to improve oxygenation when patients are positioned prone. These include changes in alveolar inflation, ventilation and perfusion.

Alveolar inflation in ARDS patients is influenced by extra-vascular lung water, the cardiac mass and cephalic displacement of the diaphragm (Pelosi et al 2002). CT scans in early ARDS patients show radiographic densities in dependant regions. When patients are turned prone, these densities move from dorsal to ventral regions, resulting in a more homogeneous distribution of alveolar re-inflation than those positioned supine (Guerin et al 1999, Gattinoni et al 1991). In late ARDS, this response is not observed as fibrosis predominates (Ware & Matthay 2000).

The cardiac mass in supine compresses the lung under it, decreasing aeration and worsening alveolar collapse (Malbouisson et al 2000). In the prone position, the weight of the heart is transferred to the sternum, relieving the compressive force (Albert & Hubmayr 2000, Malbouisson et al 2000).

In supine, the diaphragm moves uniformly but it is pushed cephalad by the abdominal content due to sedation and paralysis decreasing the diaphragms resting muscle tone (Warner 2002). This increases the pleural pressure, resulting in dependant atelectasis around the diaphragm. In prone, the diaphragm moves most in the non-dependant (dorsal) region (Krayer et al 1989), which coupled with the unloading of the diaphragm, results in greater resting volumes and improved regional inflation (Mure et al 1997). CT scans of ARDS patients in the prone position have shown improved lung volumes and alveolar recruitment, but only in extra-pulmonary ARDS; pulmonary ARDS patients show no improvement (Pelosi et al 1998, Gattinoni et al 1991).

Pulmonary perfusion in ARDS is influenced by hypoxic vasoconstriction, vascular

Table 1. Characteristics of included studies

Reference	Number of subjects	Type of study	Pulmonary ARDS (N)	Extra-pulmonary ARDS (N)
Blanch et al 1997	23	Prospective	14	9
Nakos et al 2000	20	Prospective	7	13
Lim et al 2001	47	Prospective	31	16
Papaziam et al 2001	49	Prospective	40	9
Gattinoni et al 2001	304	RCT	229	73
Pelosi et al 2002	73	RCT	51	22
L'Her et al 2002	51	Prospective	46	5
McAuley et al 2002	11	Prospective	4	8
Gattinoni et al 2003b	225	Retrospective	143	63
Guerin et al 2004	791^	RCT	413*	
Voggenreiter et al 2005	40	RCT	0	40
Lemmasson et al 2006	791	Retrospective	413*	
Mancebo et al 2006	136	RCT	84	52

*^study participants mixed etiology of respiratory failure *studies did not distinguish between*

obliteration and extrinsic vessel compression. Nyren et al (1999) demonstrated a uniform distribution of perfusion in ARDS patients positioned prone, supported by Pelosi et al (2002) and Jones et al (2001).

Prone positioning increases alveolar inflation and ventilation, which combined with homogenous perfusion improves oxygenation via improved ventilation ($\dot{V}$) and perfusion ($\dot{Q}$) matching. This could allow ventilator pressures and inspired oxygen concentrations to be weaned down, theoretically lowering the risk of VALI (Guerin 2005).

The aim of this review is to summarise the evidence relating to the use of prone positioning in the management of patients with ARDS. The literature will be reviewed with the specific objectives of assessing the effect of prone positioning on oxygenation and the different response of patients with pulmonary and extra-pulmonary ARDS. The effect on oxygenation when prone positioning is used early in the course of ARDS, and for different lengths of time, will also be reviewed. Finally the literature will be reviewed to see if prone has any effect on mortality, as well as the published rate of complications.

The ability to assess patients who may respond to prone utilising their ARDS stage and sub-classification would enable clinicians to select patients who will benefit most from prone positioning. This is important because if prone positioning improves oxygenation, there could be an effect on mortality.

Methods

A detailed literature search for articles, published from 1997 onwards using clinical databases (Medline, AMED, Cinhal, Embase) and Google Scholar was initially undertaken in January 2007, and repeated in March 2008. Search terms used were: Prone positioning, Acute Respiratory Distress Syndrome, ARDS and Oxygenation. Searches were limited to human adult reviews and studies that compared prone with supine, without the use of other ventilatory strategies such as inhaled nitric oxide and high frequency oscillatory ventilation. The search resulted in 13 eligible studies, which are shown in Table 1.

Results

Number and types of trials

There were 13 trials selected which met the inclusion criteria. Six were prospective studies: Blanch et al (1997), Nakos et

Early ARDS (N)	Late ARDS (N)	Time prone	Increase in P/F ratio to assess response	Positive response to prone positioning (%)
12	11	90 minutes	>15%	70%
11	9	6 hours	>20%	75%
47	0	2 hours	>40%	63% Extra-pulmonary
				29% Pulmonary
Not reported		6 hours	>20%	76%
304	0	6 hours	>10%	73%
73	0	6 hours	>20 mmHg	85%
51	0	12 hours	>20 mmHg	94%
8	4	18 hours	>20%	100%
225	0	6 hours	Post-Hoc analysis of Gattinoni et al. 2001	
413	0	8 hours	Not reported, trial assessing mortality	
40	0	8 hours	71mmHg mean increase in P/F ratio[$]	
413	0	8 hours	Post-Hoc analysis of Guerin et al. 2004	
136	0	20 hours	Not reported, trial assessing mortality	

causes of ARDS [$]data not reported for percentage response in subjects

al (2000), Lim et al (2001), Papazian et al (2001), L'Her et al (2002) and McAuley et al (2002). Five were randomised controlled trials (RCTs): Gattinoni et al (2001), Pelosi et al (2002), Guerin et al (2004), Voggenreiter et al (2005) and Mancebo et al (2006). Two were retrospective, post-hoc analyses: Gattinoni et al (2003b) and Lemasson et al (2006). One meta-analysis was also retrieved and the results from the individual trials from it are included in this review (Alsaghir et al (2008)). The number of participants recruited ranged from 11-791.

Oxygenation

All 13 trials reported on the oxygenation response when prone positioning was used. In the trials presented in Table 1, 29% - 100% of patients responded to prone positioning with an improvement in their oxygenation, assessed by the PaO_2/FiO_2 ratio (P/F ratio). Five trials, Gattinoni et al (2001), Guerin et al (2004), Mancebo et al (2006), Papazian et al (2005), Voggenreiter et al (2005) showed a significant and persistent improvement in oxygenation at three different time points, early (12 hours to 2 days), intermediate (4 days), late (10 days).

Pulmonary vs. Extra-pulmonary

Five trials investigated the different response of pulmonary and extra-pulmonary ARDS. Nakos et al (2000) studied patients with both pulmonary and extra-pulmonary ARDS, dividing them into early and late ARDS depending on time between clinical presentation and diagnosis. They found a favourable response to prone positioning in early extra-pulmonary ARDS. To further assess pulmonary and extra-pulmonary ARDS patients' response to prone positioning, Lim et al (2001) recruited patients with pulmonary and extra-pulmonary ARDS, within 3 days of onset of ARDS. The extra-pulmonary ARDS group showed a statistically significant increase in P/F ratio at 30 minutes maintaining their improvement at 2 hours. In pulmonary ARDS patients, there was no statistically significantly difference in oxygenation until prone had been maintained for 2 hours. Pelosi et al (2002), L'Her et al (2002) and McAuley et al (2002) all showed greater improvements in oxygenation in the extra-pulmonary compared to pulmonary ARDS patients. Voggenreiter et al (2005) showed a statistically significant positive response in P/F ratio in extra-pulmonary ARDS when managed prone, with a 71mmHg mean increase in P/F ratio in prone compared with 27mmHg in the supine group ($p=0.03$).

Time from onset to prone

Nine trials investigated the time from onset of ARDS to initiation of prone. Blanch et al (1997) showed that those who responded to prone were the patients who were ventilated sooner after the onset of ARDS. Those who had had ARDS for longer were significantly less likely to respond. The statistically significant difference observed illustrates the potential for an enhanced response in patients during the acute phase of ARDS. Nakos et al (2000) studied patients with early and late ARDS depending on time between diagnosis and a turn into prone. An improved oxygenation response to prone positioning in patients who were ≤36 hours from diagnosis of ARDS to turning prone was shown, with 66% of responders being classified as early. Gattinoni et al (2001), Pelosi et al (2002), Guerin et al (2004) and Mancebo et al (2006) all studied patients who were less than 24 hours from the diagnosis of ARDS and randomisation to prone positioning.

Time in prone

Ten trials investigated the response in oxygenation when different lengths of time in prone are used. The different lengths of time are seen in Table 1. In 2001, Papazian et al published a prospective clinical trial to assess if a one-hour trial was sufficient to assess response to prone. Patients were studied over 6 hours, with 76% showing a positive response. Of these, 73% responded at 1 hour, and 27% at 6 hours. No significant difference was seen between those who responded at 1-hour and those who responded at 6-hours, suggesting that a 1-hour trial does not identify all potential responders.

L'Her et al (2002), McAuley et al (2002) and Mancebo et al (2006) investigated early and prolonged prone positioning in ARDS. L'Her et al (2002) utilised 12 hours, McAuley et al (2002) 18 hours, and Mancebo et al (2006) 20 hours. They showed that the greatest improvements in oxygenation occurred in these elongated prone periods compared to the shorter 6-hour episodes.

Mortality

Three trials investigated the effects of prone positioning on mortality. In 2001, Gattinoni et al published a large RCT. This multi-centre multi-national trial set out to investigate if a predefined strategy of prone positioning would influence mortality of ARDS patients. No statistically significant difference in mortality was shown between the prone and

supine groups. A sub-group of patients with the lowest P/F ratios, ≤ 88mmHg in supine pre-turn who were then positioned prone, had a 24% lower mortality than those managed supine.

The largest RCT published to date by Guerin et al (2004), randomised prone positioning amongst a large cohort with acute respiratory failure. Prone positioning did not show a statistically significant reduction in mortality in a mixed aetiology group. Mancebo et al (2006) showed subjects treated in prone had a 14% decrease in mortality, from 57% mortality in supine group and 43% in prone group, but this was not shown to be statistically significant.

CO_2 clearance

Two trials further investigated the mortality benefit of prone positioning by investigating the CO_2 clearance during prone positioning. Gattinoni et al (2003b) completed a retrospective analysis of the prone arm of their trial Gattinoni et al (2001). Detailed cut-offs were set to assess the $PaCO_2$ response to prone positioning following the first procedure, with non-responders being those patients with no change or an increase in $PaCO_2$ at 6 hours. These different response rates were assessed against mortality at 28-days. No difference in 28-day mortality was seen at different levels of P/F ratio response, but an increase in $PaCO_2$ during the first prone session was an independent risk factor of mortality, with relative risk of death 1.48 (Confidence Interval (CI) 1.07-2.05). $PaCO_2$ responders' mortality rate was 35%; $PaCO_2$ non-responders mortality rate was 52%. Lemasson et al (2006) carried out a retrospective post-hoc analysis of the Guerin et al (2004) data. They assessed if the response in gaseous exchange during the first episode of prone positioning predicted mortality. Mortality rates differed significantly, with risk of death increasing by 20% in those who showed an improvement in P/F ratio but not a decrease in $PaCO_2$. In the patients whom had neither a P/F ratio nor $PaCO_2$ response, risk of death increased by 82.5%.

Complications

Seven trials reported complications from prone positioning. Accidental extubation occurred in 0.4%-10% of patients (0.4% Pelosi et al (2002), <1% L'Her et al (2002) and McAuley et al (2002), 2.6% Gattinoni et al (2001), 4.7% Voggenreiter et al (2005), 7.9% Mancebo et al (2006), 10% Guerin et al (2004)). Pressure sores occurred in high numbers in all the trials, with between 43-90% of all patients who were positioned prone being affected. Pressure sores where more likely to occur on the bony surfaces that weight-bear whilst the patients are prone. In Pelosi et al (2002), 76% of patients developed pressure sores, of which 63% were severe, with the majority located on the pelvis (46%) and thorax (21%). Gattinoni et al (2001) also showed a significant increase in the rate of pressure sores to weight-bearing surfaces, particularly the cheekbones, iliac crests and knees.

Discussion

Evidence from this review suggests that prone positioning improves oxygenation in the majority of extra-pulmonary ARDS patients. Lower percentages of pulmonary ARDS patients respond to prone positioning. It suggests that the timing of prone should be promptly after the diagnosis and for >12 hours to provide patients with the greatest oxygenation benefit. Patients with the lowest P/F ratios pre-turning prone potentially show a mortality benefit when positioned prone. This mortality benefit is also shown in the two post-hoc analyses, using data from the largest RCTs, but only when improvements in oxygenation and $PaCO_2$ are observed.

The studies discussed all have limitations. The majority have very small sample sizes and no control groups making analysis of their results difficult. Two of the larger RCTs, Gattinoni et al (2001) and Mancebo et al (2006), have not achieved their recruitment targets as clinicians did not want their patients to forgo prone positioning in the later stages of recruitment.

Different research groups evaluating prone positioning have used different levels of P/F ratio change to indicate response; some use percentage change, others absolute change. There is also poor standardisation between trials as to the time between diagnoses and initiating prone positioning. The largest trials have agreed that 'the earlier the better' and therefore randomised patients to commence prone within 24 hours of diagnosis. The final conflicting variable is the time the patient remains in prone, as trials have published the benefits of longer periods prone subsequent trials have integrated this into their protocols.

All these differences make combining a number of trials into a meta-analysis difficult. The meta-analysis by Alsaghir & Martin (2008) includes five of the trials included in this review, Gattinoni et al (2001), Guerin et al (2004), Mancebo et al (2006), Papazian et al (2005), Voggenreiter et al (2005), who all used ≥6 hours prone. They did not all investigate prone positioning alone; one trial used had prone combined with High Frequency Oscillatory Ventilation. This meta-analysis

corroborate the oxygenation results of the trials listed in Table 1, as well as showing the possible mortality benefit of prone when used in the most severe cases. This is because early ARDS, with its increase in lung oedema, responds very differently to late ARDS with it characteristic fibrosis.

Accidental extubation, which critical care staff are most concerned about, occurred rarely, suggesting that prone is a safe therapeutic position. However, it does carry a significant risk of pressure sores to anterior bony surfaces that weight-bear in prone. An association between pressure sore severity and frequency of prone positioning episodes does also exist in the literature (Pelosi 2002).

Some studies identified the potential for prone positioning to decrease VALI but this has not yet been adequately investigated. The ARDSnet (2000) trial showed that lowering peak pressure improved mortality. Whether prone positioning allows a further decrease in ventilator pressures and therefore VALI, improving survival remains unanswered. Most studies set out to assess how oxygenation improved in prone, so maintained a static oxygen concentration. A large multi-centre randomised trial of prone positioning with a specific protocol for utilising improvements in oxygenation by lowering ventilator pressures and oxygen concentrations would enhance the current evidence base, with close monitoring of the change in P/F ratio and $PaCO_2$.

Conclusion

This review has suggested that prone positioning improves oxygenation in the majority of extra-pulmonary ARDS patients, with lower percentages of pulmonary ARDS patients responding. Prone should be started promptly after diagnosis and for sessions of >12 hours to provide patients with the greatest oxygenation benefit. Patients with the lowest P/F ratios prior to turning prone potentially show a mortality benefit, as do those who show improvements in oxygenation and $PaCO_2$.

Key points

- Prone positioning improves oxygenation in ventilated ARDS patients, with a greater response in patients with early extra-pulmonary ARDS.
- Patients with the worst oxygenation and those whose $PaCO_2$ drops show a mortality benefit when managed in prone, aiding appropriate patient selection.
- Complications can occur with prone positioning such as pressure sores and extubation.

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Prioritising physiotherapy services

The development and implementation of a post-operative screening tool

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Summary

The objective of this project was to devise a safe screening tool (SPPOST) that could be applied post-operatively, which would prioritise surgical patients most likely to benefit from physiotherapy contact. The SPPOST was applied to 404 post-operative patients, screening out nearly half with no measurable detriment, thereby facilitating the targeting of higher risk patients.

Keywords:
Post-operative complications, screening tool, risk factors

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Introduction

Post-operative pulmonary complications (PPCs) contribute significantly to patient morbidity, mortality and length of stay following abdominal surgery (Mackay et al 2005). The American College of Physicians report that atelectasis, pneumonia, respiratory failure and exacerbation of underlying chronic lung disease are the most important PPCs (Mackay et al 2005). The reported incidence of PPCs varies due to difficulties in establishing a clear definition and differences in the surgical populations that have been included (Arozullah et al 2003). In a recent systematic review Pasquina et al (2006) found wide ranges for the incidence of post-operative atelectasis (15-98%) and pneumonia (0-20%),

The probability of a patient developing a PPC following major abdominal surgery is related to the presence of risk factors. Risk factors may include smoking, older age, obesity, chronic obstructive pulmonary disease (COPD), asthma and level of functional dependence (Smetana 1999). A large number of studies have been undertaken to establish which of the many risk factors can predict the occurrence of PPCs. However, the literature

is contradictory and lacks consensus on a definition for PPCs. The risk factors found to be the most frequent predictors of PPCs are: age (>60 having higher risk), level of incision (upper abdominal and thoracic surgery having the greatest level of risk), functional dependence (higher levels having higher risk), COPD and smoking history. Obesity (BMI greater than 30) and duration of anaesthesia (greater than five hours) have also been implicated in the development of PPCs. The American Society of Anesthesiologists (ASA) classification (I-V, higher ASA class being associated with higher risk) is also associated with the risk of PPCs (Qaseem et al 2006, Arozullah et al 2001, Gosselink et al 2000, Brooks-Brunn 1997, Ferguson 1999).

Traditionally, patients due to undergo major surgery were seen by a physiotherapist pre-operatively. However, in the UK increasing demand on NHS services have restricted this practice, so that the first visit is now frequently post-operative. Post-operative physiotherapy is often used prophylactically to reduce the incidence of PPCs (Denehy et al 2001, Richardson & Sabanathan 1997). However there is a lack of consensus among therapists as to what a 'physiotherapy' intervention comprises, leading to debates about the efficacy of post-operative physiotherapy. In this paper the term 'physiotherapy' is used in a broad sense to incorporate both respiratory and mobility interventions.

At the time of the project, all patients undergoing major abdominal surgery at Southampton General Hospital received post-operative physiotherapy. Only a few trials support this practice with the majority questioning the usefulness of prophylactic physiotherapy. A systematic review analysing data from 35 randomised trials concluded that the usefulness of prophylactic respiratory physiotherapy for the prevention of clinically relevant post-operative pulmonary complications after abdominal surgery remains unproven (Pasquina et al 2006). Their review supports the need for further research in this area and the potential for change in clinical practice.

Risk factors have been variously combined into pre-operative tools to predict the occurrence of PPCs following major surgery. Studies report varying degrees of success and practical usefulness for these tools. In addition to this the validity and reliability of the tools have yet to be established. There are currently no screening tools designed to target physiotherapy resources and none that focus screening solely on the post-operative period.

Aim

To develop and implement the Southampton Physiotherapy Post-Operative Screening Tool (SPPOST).

Objectives

1. To develop the SPPOST
2. To establish a threshold score for the categorisation of high and low risk of developing PCCs
3. To implement the SPPOST screening tool in clinical practice.

Methods

Development of the SPPOST

The SPPOST was developed in response to increased patient acuity, in parallel with reduced staffing levels, on the general surgical wards at Southampton University Hospitals Trust. It was also designed as part of an initiative to 'work smarter' which would permit limited resources to be directed towards patients most in need of contact time with a physiotherapist.

In order to establish the risk factors for the SPPOST, a literature review was conducted. This review focused on risk factors that predisposed patients undergoing major abdominal surgery to PPCs. Key risk factors were identified (Qaseem et al 2006, Arozullah et al 2001, Gosselink et al 2000, Ferguson 1999, Brooks-Brunn 1997) (Table 1). The complete list of factors that influence PPCs is extensive, but it was felt that only the most significant, as determined from their prevalence in the literature, should be included in the SPPOST. A matrix was created of individual risk factors on one axis and their importance, as deemed by the authors, on the other axis. Risk factors which were consistently deemed significant were included in the tool. Each factor was then allocated a numerical score according to its importance as a predictor of PPCs. Clinical expert opinion suggested that three post-operative indicators should also be included: inspired oxygen content, oxygen saturations and respiratory rate. The tool was then applied clinically to establish a threshold figure below which patients appeared less likely to develop PPCs.

Establishment of a threshold score to categorise patients as high or low risk

Prior to implementing the SPPOST it was necessary to establish a threshold score to distinguish between high and low risk patients. An initial cohort of 50 patients undergoing major abdominal surgery was screened on day one following their procedure. All 50 patients then received standard physiotherapy care. During their inpatient stay, the ward physiotherapist wrote summaries describing the patient's post-operative

Table 1. Key risk factors incorporated into the screening tool, identified from existing evidence and from expert clinical opinion

Source	Factor	SPPOST parameter
From expert opinion	Inspired oxygen	Graded from air up to 0.6 FiO_2
	Oxygen saturation	≤90% / 91% - 94% / ≥ 95%
	Respiratory rate	< 20 / 20 –25 / >25 breaths per minute
From literature	COPD	Documented diagnosis – yes or no
	Obesity / malnutrition	BMI >30 or < 20
	Functional dependence	Poor / moderate / unlimited independence
	Older age	< 40 / 40-54 / 55-64/ ≥65 years
	Smoking history	Smoker or ex smoker - yes or no
	Anaesthetic duration	< 2 hours / 2-5 hours / > 5 hours

Abbreviations: COPD: Chronic obstructive pulmonary disease; BMI: Body Mass Index; FiO2: fraction of inspired oxygen; SPPOST: Southampton Physiotherapy Post-operative Screening Tool

pathway including any respiratory events. Patients' scores were recorded in a spreadsheet alongside their post-operative summary. Comparing patient scores to the post-operative information indicated that patients scoring 10 or less on the SPPOST did not develop PPCs, as described in the physiotherapy summary, and could be deemed at 'low risk' of developing PPCs.

A score of 10 was therefore used as the threshold figure for the implementation of the SPPOST. Those scoring 10 or more would receive physiotherapy contact, while those scoring lower than 10 would theoretically not require physiotherapy. However, ethical questions were raised regarding the withdrawal of standard physiotherapy care. In response to this concern, a non-contact physiotherapy intervention comprising written information, ward based posters and ten metre-walking markers was produced. This was entitled 'Physio Lite' (further details are available on request from the first author Chantel. Ostler@porthosp.nhs.uk).

The SPPOST was discussed with surgeons whose patients would be affected, and education for the ward nursing staff was provided to encourage patient participation. The SPPOST was then implemented throughout the surgical directorate, which comprised three 25 bed wards and an eight bed surgical high dependency unit. Subsequently, an audit was undertaken to assess its impact.

Implementation of the use of the SPPOST screening tool in clinical practice

During a 10-month period, a cohort of 404 surgical patients was screened using the SPPOST.

Patients who met the inclusion criteria were screened on day one post-operatively.

Patients were then allocated to contact physiotherapy or Physio Lite according to their level of risk as indicated by the SPPOST. In an attempt to standardise the way the screening tool was completed by physiotherapy staff, a guideline was written (Guideline available on request from the first author Chantel. Ostler@porthosp.nhs.uk).

Patients were included in the project if they had undergone any of the procedures in Table 2. These procedures and incisions were included, as historically they have been routinely referred to physiotherapy for prophylactic respiratory treatment in our Trust.

Patients were not included if they fulfilled either of the following criteria:

- Their surgical procedure occurred at a weekend. This was to limit the number of different physiotherapists using the screening tool and increase consistency of implementation
- They were admitted to a ward outside the general surgical unit post-operatively. This was to limit the number of physiotherapists using the screening tool and to provide a manageable focus for nursing staff education

PPCs

Patients from the low risk Physio-Lite group could be referred back to the contact physiotherapy group if there was a suspected PPC. The Brooks-Brunn outcome measure (Table 3) was used to assess whether any low risk patients had actually developed a PPC. The medical records of the referred patients were recalled and the Brooks-Brunn PPC outcome measure was applied retrospectively to assess the

Table 2. List of surgical procedures included in the trial of the screening tool

Surgical procedures	
Abdominal aortic aneurysm repair	Oesophagogastrectomy / Oesophagectomy
Anterior or antero-posterior resection	Other laparotomy, midline incision or thoracotomy
Appendicectomy	Pancreatic necrosectomy
Cystectomy	Panproctocolectomy
Gastrectomy	Sigmoid colectomy
Hartmann's procedure	Small bowel resection
Hemicolectomy	Total colectomy
Hepatectomy	Whipple's procedure
Nephrectomy	

Table 3. Criteria defining a clinically significant PPC (Brooks-Brunn, 1997)

PPC criteria
A post-operative pulmonary complication (PPC) is deemed to have occurred if a minimum of two criteria from the following five, diagnosed by doctors, nurses or physiotherapists, must be present on two or more days within the first six postoperative days after surgery:- (1) New cough/sputum production (2) Abnormal breath sounds as compared with baseline. Baseline measures are established pre-operatively via a chest assessment (3) Temperature ≥38°C (4) Chest radiograph documentation of atelectasis or new infiltrate (5) Physician documentation of atelectasis or pneumonia

incidence of PPCs in this group. A single auditor assessed the incidence of PPCs.

Impact

Table 4 shows the numbers of patients screened in each of the clinical areas. About half of the total population of surgical patients (n=186/404, 46%) were deemed to be at low risk of developing PPCs. The breakdown into clinical areas shows that proportionally more patients in the Surgical High Dependency Unit (SHDU) were deemed high risk (107/160 SHDU patients, which is 26% of the 404 total population, compared to 63/150 of patients in the Lower Gastrointestinal ward, which is 16% of the 404 total population), which reflects the increased patient acuity present on high care units.

Only 16 of the 186 low risk patients were referred to contact physiotherapy. When the Brooks-Brunn outcome measure was applied retrospectively, three of these 16 patients had developed a measurable PPC.

Discussion

The aim of this project was to develop and implement a new screening tool for application post-operatively to surgical patients who would routinely have received contact physiotherapy in our Trust. This study has demonstrated that a screening tool based on published risk factors can be safely used to prioritise physiotherapy services. SPPOST identified 46% of routine patients to be at low risk of developing a PPC thereby allowing more intensive and immediate treatment to be delivered to the remaining 54% high risk patients. Any detrimental effect upon this low risk group appears to have been minimal as only a small number of them were re-referred to physiotherapy and only three of these were found to have developed a PPC. However, as it was felt to be inappropriate to withdraw a routine service completely, the low risk group did receive a 'no-contact' form of physiotherapy (Physio Lite), which may have had an impact on preventing PPCs in this group.

In 2006, clinical guidelines from the American College of Physicians recommended patients undergoing major surgical procedures to be evaluated using risk factors to identify patients who would most benefit from pre- and post-operative interventions to reduce the occurrence of PPCs (Qaseem et al 2006). The SPPOST uses the recommended risk factors from the literature in combination with respiratory indicators to identify low risk patients who may not require prophylactic physiotherapy, enabling staff to focus on high risk patients. The systematic review by Pasquina et al (2006) concluded that the benefits of prophylactic physiotherapy following surgery are unproven. Current practice involves the use of routine prophylactic physiotherapy for all patients undergoing major abdominal surgery. The use

Table 4. Number of patients undergoing relevant surgery divided by ward, number stratified into high and low risk categories, and number of low risk category patients who subsequently were referred for physiotherapy (chest or mobility)

Ward	High risk (>10 on SPPOST)	Low risk (≤10 on SPPOST)	Low risk Chest referral	Low risk Mobility referral
Upper Gastrointestinal n = 49	31 (8%)	18 (4%)	1	0
Lower Gastrointestinal n = 150	63 (16%)	87 (21%)	4	0
Urology n = 45	17 (4%)	28 (7%)	1	0
Surgical High Dependency Unit n = 160	107 (27%)	53 (13%)	8	2
Total n = 404	218 (54%)	186 (46%)	14	2

of the SPPOST indicated that physiotherapy could be safely withdrawn from low risk patients in this setting. The Physio Lite programme developed for low risk patients was based around early mobilisation and promoting patients' independence on the ward. MacKay et al (2005) believe that early mobilisation is the key adjunct to post-operative physiotherapy. This programme was implemented to prevent complete withdrawal of physiotherapy, as this was deemed unethical, and therefore we are currently unable to recommend withdrawing all post-operative physiotherapy from this population. The effects of the Physio Lite programme on the development of PPCs in the low risk group need to be clarified through formal research.

The SPPOST has several implications for clinical practice. Screening out patients at low risk of developing PPCs the SPPOST allows limited physiotherapy resources to be directed towards high risk patients. This supports current NHS aims and objectives to work 'smarter' and promote evidence-based changes in practice. Anecdotally, the SPPOST was reported to be quick and easy to use. In addition to this, a greater degree of patient independence was observed on the ward. The multidisciplinary team also fully supported the project as it allowed increased physiotherapy time for high risk patients. The SPPOST may act as an intermediate phase in the move towards introducing a change in physiotherapy culture. Elimination of routine prophylactic physiotherapy would bring us in line with the current evidence base. However, change needs to be managed slowly and with consultation (Moulding et al 1999). Withdrawing a routine physiotherapy service may lead to feelings of unease amongst the physiotherapy, nursing and medical professions.

The main limitations of this project result from its gradual evolution within a clinical setting, rather than being a well-defined and formally designed research study. The project arose in response to clinical imperative i.e. the need to provide a safe effective peri-operative service with reduced physiotherapy staff numbers. With hindsight, academic partners should have been involved at a much earlier stage, so that the screening questionnaire could have been formally designed and validated prior to implementation. Failure to do so has resulted in problems with the current weighting of the risk factors. The sensitivity and specificity of the tool have not yet been established, and further prospective work needs to be done. In addition the Brooks-Brunn outcome measure was applied retrospectively and was not applied to the whole sample (Brooks-Bunn 1997). It is therefore unclear if any patients in the low risk group developed signs of PPCs, but were then not referred back to physiotherapy. There is no information on the incidence of PPCs in the high risk group who received routine physiotherapy. It should also be noted that the Brooks-Brunn outcome measure itself has not yet been formally validated due to the difficulties in defining PPCs.

Conclusion

In this paper the development and implementation of the Southampton Physiotherapy Post-Operative Screening Tool has been described. This work suggests it is possible to administer this tool to stratify patients into low or high risk of developing pulmonary complications, and to withdraw routine physiotherapy from the low risk group, without detrimental affects. However, the effects of the introduction

of an alternative 'no-contact' intervention for this group have yet to be formally examined. It would therefore be premature to recommend complete withdrawal of all physiotherapy services for the group identified by our screening tool as being low risk. Further work is needed to refine the weighting system and to establish the validity and reliability of the tool.

Key points

- A screening tool may be helpful in identifying post-operative patients at high risk of PCCs
- Physiotherapy resources should be targeted towards patients at high risk of developing PPCs.

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Assessment and management of dyspnoea by physiotherapists in the acute setting: A national survey

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Summary

Physiotherapists manage patients who are dyspnoeic due to cardiovascular, respiratory, carcinogenic and/or neuromuscular causes. It is not known what tools are used to assess these patients or what methods are used to manage their dyspnoea. The aim of this study was to investigate methods used by physiotherapists in the acute setting to assess and manage dyspnoea.

Keywords:
Dyspnoea, assessment, management, physiotherapy, acute setting

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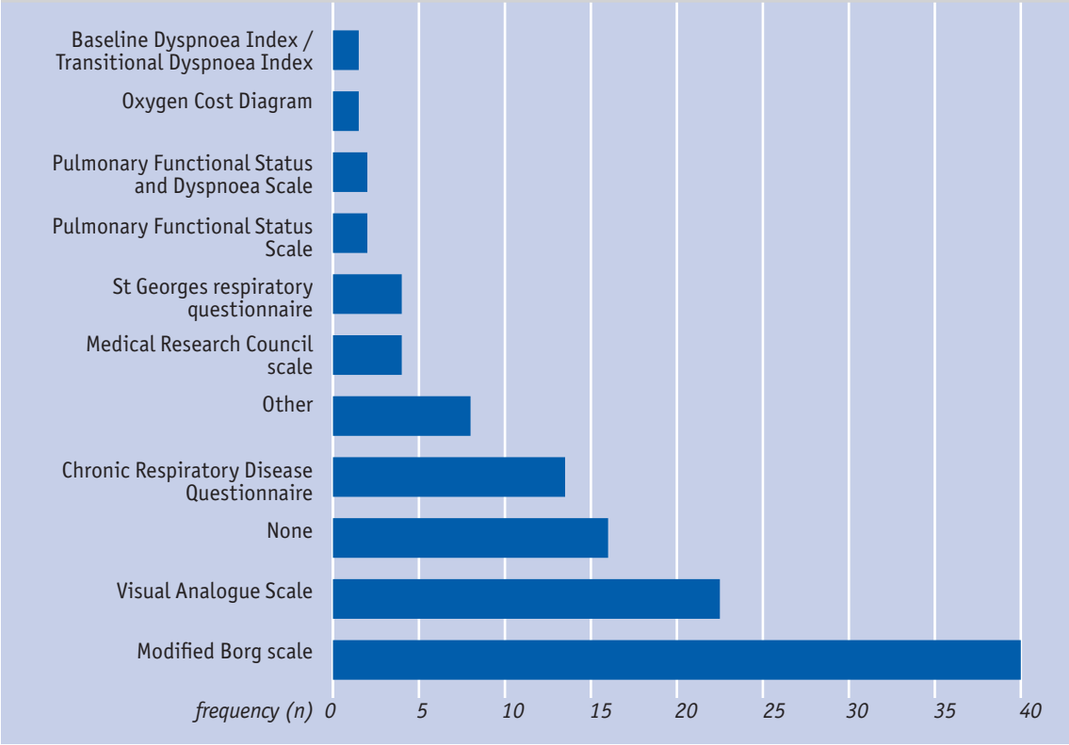
Introduction

Dyspnoea is a complex symptom and is defined by the American Thoracic Society as "a term used to characterise a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity" (American Thoracic Society 1999). Dyspnoea may arise from physiological, psychological, social and environmental factors and may be respiratory, cardiovascular, carcinogenic, and/or neuromuscular in origin (Jennings et al 2002; American Thoracic Society 1999). It is a symptom that affects levels of activity, and as such is assessed and managed by physiotherapists (Belza et al 2001; Frownfelter & Ryan 2000). Dyspnoea may be assessed by many different outcome measures (Ambrosini & Scano 2001). These include for example the Medical Research Council Scale (MRC) which is recommended by the NICE guidelines for COPD (NICE 2004) and the global measure, the Chronic Respiratory Disease Questionnaire (CRDQ) which is widely used in COPD (Gross 2005) but these instruments may have limited use in the acute setting (Meek 2004). There appears to be no clear

Figure 1. Scales used to assess dyspnoea by physiotherapists in acute setting



guidance regarding which outcome measure should be used in the assessment of dyspnoea in the acute setting.

Physiotherapists working in the National Health Service (NHS), work within specialities such as general surgery and medicine, neurosurgery, trauma and orthopaedics, cardiology and may assess and manage patients with dyspnoea in any of these settings. The aim of this study was to investigate methods used by physiotherapists in acute settings to assess and manage dyspnoea.

Methods

Thirteen physiotherapy managers agreed for their staff to be approached for the study. The managers were selected, by choosing every third entry, from the directory of hospitals and NHS trusts 2002/2003 (Hospital and Trusts Directory 2002/3) across the UK. A sample of 128 physiotherapists was identified by this method, distributed across the thirteen individual hospitals.

The questionnaire was developed based on current literature and comprised of 3 main sections with closed questions and space for additional comments. The sections were: demographics, assessment methods and management of dyspnoea.

A pilot study (n=5) evaluated the questionnaire in terms of content and ease of use. No subsequent changes were made. Subjects used in the pilot study were excluded from the main study.

Ethical approval was given by the School of Healthcare Studies Research Ethics Committee July 2003.

Data was collected and coded for entry into SPSS (version 12); descriptive statistics were used, and where indicated data is presented as means and standard deviations.

Results

66/128 questionnaires were completed and returned, a response rate of 52%.

Demographics

The results indicated that physiotherapists with widely varying experience participated in the study. Mean years qualified was 8.7 years, the majority (50/66, 76%) of respondents having worked 10 years or less; 44% (30/66) of respondents were Junior/Senior II, 35% (23/66) were Senior I, 18% (12/66) were Clinical Specialists and Superintendents, and one other respondent worked in management (the named grades of the physiotherapists were accurate at the time of data collection).

Many of the physiotherapists who replied to the questionnaire worked in two or more of the areas, for example surgical as well as ITU. 53% (35/66) of physiotherapists worked on medical wards making this the most common area; the second most frequently

reported areas were surgical wards and 18 physiotherapists reported working other areas including burns and plastics, thoracic medicine, pulmonary rehabilitation, oncology and cystic fibrosis in-patients.

Assessment methods

Respondents (n=66) were asked to choose measures which were used in the assessment of dyspnoea and therefore the data relates to the number of respondents using that particular measure. While a range of outcome measures were used, the Modified Borg Scale was the most commonly used (40/66, 61%) outcome measure in the acute clinical setting (Figure 1). 24% (16/66) of respondents identified using no outcome measure. Eight respondents identified other tools were used in the assessment of dyspnoea, for example, exercise testing and using the New York Heart Association scale.

Forty five respondents answered the question which asked them to indicate which outcome measure they used most frequently. From these 45 respondents, the most frequently used measure (27/45) was the Modified Borg Scale, with the visual analogue scale (VAS) being the second most frequently used measure (11/45).

Respondents were also asked to choose from a list of options, other signs and symptoms used in assessment of patients with dyspnoea. Table 1 indicates that physiotherapists frequently include a combination of signs and symptoms when assessing dyspnoea in the acute setting such as use of accessory muscles, increased respiratory rate and observable anxiety. Signs and symptoms included in the 'other' category included the assessment of fluid balance, speech pattern, temperature, positioning, chest x-ray, tactile vocal fremitus, sleep pattern, finger clubbing, decreased motivation and confusion.

Table 1. Signs and symptoms used to assess dyspnoea by physiotherapists in the acute setting

Physical sign/ symptom	Frequency of physiotherapists using assessment technique (%) n=66
Use of accessory muscles of breathing	65 (99%)
Increased respiratory rate	64 (97%)
Increase in observable anxiety	63 (96%)
Increased work of breathing	61 (92%)
Changes in 02 saturation levels	61 (92%)
Blood gas abnormalities	60 (91%)
Decreased exercise tolerance	58 (88%)
Patients colour	58 (88%)
Fatigue	57 (86%)
Breath sounds	56 (85%)
Heart rate	45 (68%)
Pain	45 (68%)
Mood	38 (58%)
Blood pressure changes	32 (49%)
Depression	29 (44%)
Changes in heart rhythm	28 (42%)
Other	27 (41%)

Management of dyspnoea

Respondents indicated how often they used specific strategies for the management of dyspnoea. The numbers in brackets are percentages and correspond to each management technique listed. Techniques which were used most often included education, positions of ease, breathing techniques, relaxation techniques and exercise training.

18 respondents indicated that they also used other techniques including teaching of inhaler techniques, slow one handed percussion, controlled mobilisation or paced walking supplementary oxygen, positioning for V/Q match, non-invasive ventilation and pulmonary rehabilitation.

Discussion

While the number of staff responding was low, which reduces the ability to generalise these results, there are some interesting findings from this survey. Physiotherapists in the acute setting assess dyspnoea using a combination of signs and symptoms and management of dyspnoea is predominantly through positioning, breathing techniques, education, relaxation and exercise training.

Assessment methods

The Modified Borg Scale was identified as the most commonly used outcome measure

Table 2: Management of dyspnoea by physiotherapists (n=66) in the acute setting

	Very often n (%)	Often n (%)	Seldom n (%)	Never n (%)	No answer n (%)
Positions of Ease	55 (83)	11 (17)	0	0	0
Breathing techniques	52 (79)	11 (17)	1 (2)	0	2 (3)
Education	59 (89)	3 (5)	1 (2)	0	3 (5)
Relaxation	34 (52)	20 (30)	8 (12)	0	4 (6)
Exercise training	27(41)	25 (38)	7 (11)	1 (2)	6 (9)
Positive Pressure Breathing Adjuncts	6 (9)	23 (35)	24 (36)	6 (9)	7 (11)
Use of a Fan	10 (15)	18 (27)	21 (32)	10 (15)	7 (11)
Desensitisation	8 (12)	12 (18)	15 (23)	23 (35)	8 (12)
Vibration	5 (8)	11 (17)	29 (44)	12 (18)	9 (14)
Restriction of ADL	3 (5)	14 (21)	28 (42)	13 (20)	8 (12)
Inspiratory Muscle Training	6 (9)	8 (12)	22 (33)	18 (27)	12 (18)

for dyspnoea. It is a self administered unidimensional tool, using a 0-10 scale with descriptors alongside the scale. The Visual Analogue Scale (VAS) was the second most frequently used tool and this often uses just 2 descriptors anchoring a 100mm line (Meek 2004). Both these scales measure current state of dyspnoea, and may be used across the range of specialities identified in this study, including assessing patients on mechanical ventilation (Powers & Bennet 1999). The use of the Modified Borg Scale and VAS may be appropriate in the acute setting as they are intended to measure rapid changes with treatment (Meek 2004). A small number of physiotherapists used the Medical Research Council (MRC) scale which is recommended for measurement of dyspnoea in Chronic Obstructive Pulmonary Disease (NICE 2004); the limited use may be due to the diverse patient population which physiotherapists in this study worked with or the lack of sensitivity of this scale in the acute setting (Meek 2004).

The results indicated that physiotherapists working in the acute setting used a combination of signs and symptoms that tend to be more physical than psychological in nature in the acute setting. The complexity of the pathophysiology and psychosocial elements of dyspnoea may mean that as a subjective sensation, it can only be interpreted by the person experiencing it (Nichols 2003). It remains unclear whether there are specific key measurements which should be included in the assessment of dyspnoea in the acute setting, and it is likely that a range of measurements are necessary to accurately quantify dyspnoea and evaluate physiotherapy treatment in this setting.

Management of dyspnoea

The management of dyspnoea in the acute setting was reported as being predominantly through positioning, breathing techniques, education, relaxation and exercise training. The mechanisms underlying dyspnoea are not fully understood but are thought to be based on neuro-mechanical disassociation whereby the sensation is produced through a mismatch in interpretation of outgoing motor control and incoming information form sensory receptors in the muscles, airways and lungs (American Thoracic Society 1999). Management of dyspnoea is aimed at reducing the demand on the respiratory system and/or altering the perception of dyspnoea.

Positioning in lean forward sitting may be used to improve diaphragmatic efficiency by physically pushing the diaphragm into a more mechanically advantageous position. This position may also increase the effectiveness of inspiratory muscles as they become fixed when the patient leans on their elbows (Garrod 2004). Positioning in side lying may also be used to provide support to the patient and decrease energy expenditure, however this position may reduce respiratory function (Manning et al 1999) and compromise cardiovascular stability (Jones & Dean 2004).

Physiotherapists in this study frequently used breathing

techniques in the management of dyspnoea. The questionnaire did not ask for details of which techniques were used. Evidence for the effectiveness of breathing retraining is inconclusive. Jones et al (2005) demonstrated that oxygen cost was reduced during conventional breathing exercises, which included diaphragmatic breathing, pursed lip breathing and a combination of both. A review by Gosselink (2003) states that diaphragmatic breathing is not beneficial in the management of dyspnoea whereas pursed lip breathing does improve dyspnoea and oxygen cost. Although evidence for effectiveness of positioning and breathing techniques is weak, they are being used as the main techniques in the management of dyspnoea in the acute setting.

Management of dyspnoea by education was a predominant finding of this study, with relaxation being used very often by 51.1% of respondents. Both these techniques may affect the increased load of breathing and the perception of dyspnoea. There is some evidence relating to the benefits of education and relaxation delivered in the context of pulmonary rehabilitation programme but this may not translate to similar benefits in the acute setting (Paz-Diaz et al 2007).

It is likely that physiotherapists link the selection of outcome measures and management strategies based on clinical reasoning. Assessment incorporating use of accessory muscles, measurement of increased work of breathing and increased respiratory rate and management by positioning and breathing techniques may illustrate clinical reasoning pathways based on physiological theories. Similar linkages may exist between assessment of anxiety and depression and management techniques of education and relaxation.

The study is limited by the selection process for hospitals and participants, the low response rate and the closed nature of the questions used. This reduces the external validity of the results, yet provides some support for the need for further research into assessment of dyspnoea that includes both physical and psychological parameters.

Conclusions

This small scale study has highlighted patterns of practice among physiotherapists managing patients with dyspnoea in the acute care setting. It appears that assessment of individual signs and symptoms are sometimes used in preference to dyspnoea/disease specific outcome measures and that a combination of signs and symptoms are used rather then a single measure. This may be an appropriate strategy in the management of this multidimensional symptom.

Management techniques tended to be those that can be taught to patients and incorporated into a self management plan and clearly link with the underlying problem. Further research could explore whether there are specific key measurements which should be included as a minimum standard in the assessment of dyspnoea in the acute setting and if there are disease specific tools for assessment of dyspnoea in the acute setting.

Key points

- Dyspnoea in the acute setting is assessed by physiotherapists using a combination of signs and symptoms.
- Physiotherapists in the acute setting manage dyspnoea through a range of techniques that are linked to the underlying problem.

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Is education useful in Chronic Obstructive Pulmonary Disease?

A review of the literature

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Summary

This review aims to describe the role of traditional education in COPD, to summarise the outcome measures used in studies and examine the benefit of traditional education in COPD. It provides clinicians with information about the content of education sessions, and outcomes which may be used to evaluate their educational interventions.

Introduction

Education plays an important role in the management of chronic obstructive pulmonary disease (COPD). It is proposed that through education patients gain improved knowledge of their disease and its management therefore allowing them to take better control and responsibility for its day-to-day management (Mac Intyre 2005). Traditional education teaches the patient information and technical skills related to the disease, which is based on the underlying theory that increased knowledge will improve patient behaviour and compliance (Bodenheimer et al 2002).

Education in COPD is delivered in various formats: on an individual or group basis, as traditional disease-specific information or as a component of pulmonary rehabilitation. More recently, education has been combined with behavioural interventions and delivered as self-management education.

The efficacy of traditional education programmes in COPD has been systematically reviewed (Blackstock and Webster 2006). Randomised controlled trials included in this systematic review compared the efficacy of education with a control group (n=4). A range of seven different outcomes were assessed (illness knowledge, psychosocial functioning, generic quality of life, pulmonary function, exercise capacity, cognitive functioning and cost) using 17 different instruments. The review found a significant reduction in the number of GP visits when a group receiving education was compared to a control group (Blackstock and Webster 2006); however, there was no evidence of an effect of education on any other outcomes. The primary aim of education is to improve knowledge in an attempt

Table 1: Characteristics of included studies

Reference and Country	Study Characteristics	Intervention	Participant Characteristics
Black and Mitchell 1977a USA	Design: pre and post intervention Ax times: pre and post intervention No of participants: n = 25 (25)	audiovisual education program	Mean (range) age (years): 60 (40-80) years for all three arms of study Sex (M/F): 44/21 for all 3 arms of study Mean (SD) FEV1 (%pred): not specified
Black and Mitchell 1977b USA	Design: pre and post intervention Ax times: pre and post intervention No of participants: n = 30 (30)	audiovisual education program	Mean (range) age (years): 60 (40-80) years for all three arms of study Sex (M/F): 44/21 for all 3 arms of study Mean (SD) FEV1 (%pred): not specified
Hunter and Hall 1989 USA	Design: pre and post test design Ax times: pre and post intervention No of participants: n = 8 (8)	education support program	Age range (years): 40-70 Sex (M/F): predominately male Mean (SD) FEV1 (%pred): not specified
Scherer et al 1989 USA	Design: cohort Ax times: baseline and 6 weeks No of participants: n = 17 (17)	pulmonary education program: "Help yourself to breathe program"	Age (years): < 60 years n = 2, 60-70 years n = 10, 71-78 years n = 5 Sex (M/F): 4/13 Mean (SD) FEV1 (%pred): not specified
Toshima et al 1990 Toshima et al 1992 USA	Design: cohort Ax times: baseline, 2 months, 6 months, 12 months No of participants: n = 62 (42)	education program	Mean (SD) age (years): 62.6 (7.2) for both arms of study Sex (M/F): 45/17 Mean (SD) FEV1 (%pred): 45 (SD not given) for both arms of study
Janelli et al 1991 USA	Design: pre and post intervention Ax times: baseline and 6 weeks No of participants: n = 30 (30)	"Help Yourself to Better Breathing" program	Mean (range) age (years): 67.5 (55-78) Sex (M/F): 8/22 Mean (SD) FEV1 (%pred): not specified
Scherer et al 1992 USA	Design: cohort Ax times: baseline, 6 weeks and 6 months No of participants: n = 13 (13)	"Help Yourself to Better Breathing" program	Age (years): < 60 years n = 3, 60-70 n = 5, 71-78 n = 4 Sex (M/F): 8/22 Mean FEV1 (%pred): not specified
Scherer et al 1994 USA	Design: cohort Ax times: baseline and 1 month post class No of participants: n = 28 (24)	"Help Yourself to Better Breathing" program	Age (years): < 70 years n = 9, < 70 years n = 14 Sex (M/F): 9/15 Mean (SD) FEV1 (%pred): not specified
Ries et al 1995 USA	Design: cohort Ax Points: Physiologic: baseline, 2, 12, 24, 48, 72 months; Psychosocial: baseline, 2, 6, 12, 18, 24, 36, 48, 60, 72 months No of participants: n = 62 (23)	education program	Mean (SD) age (years): 63.6 (6.3) Sex (M/F): 45/17 Mean (SD) FEV1 (L): 1.24 (0.56)
Hoberty et al 1998a USA	Design: cohort Ax times: pre and post intervention No of participants: n = 14 (14)	COPD education program	Mean (SD) age (years): 67.6 (SD not given) Sex (M/F): 9/5 Mean (SD) FEV1 (%pred): not specified

Table 1: Characteristics of included studies

Reference and Country	Study Characteristics	Intervention	Participant Characteristics
Hoberty et al 1998b USA	Design: cohort Ax times: pre and post intervention No of participants: n = 10 (10)	videotaped COPD education program followed by question and answer period with a rehabilitation specialist	Mean (SD) age (years): 60.2 (SD not given) Sex (M/F): 7/3 Mean (SD) FEV1 (%pred): not specified
Scherer et al 1998 USA	Design: pre and post test design Ax times: baseline, 2 months and 6 months post program No of participants: n = 22 (22)	education program	Mean (SD) age (years): 64 (9.39) Sex (M/F): 14/8 Mean (SD) FEV1 (%pred): not specified Perceived SOB: mild (5), moderate/moderately severe (17)
Wedzicha et al 1998 Bestall et al 2003 UK	Design: cohort Ax times: baseline, 8 weeks, 6 months, 1 year (at 1 year for MRC 3/4 group only) No of participants: MRC 3/4: 33 (21); MRC 5: 30 (28)	education program	Mean (SD) age (years): MRC 3/4: 68.6 (6.6); MRC 5: 72.0 (6.1) Sex (M/F): 70/68 of all participants Mean (SD) FEV1 (%pred): MRC 3/4: 38 (12); MRC 5: 36 (12)
White et al 2002 UK	Design: cohort Ax times: baseline and 3 months No of participants: n = 49 (43)	brief advice	Mean (SD) age (years): 67 (9) Sex (M/F): 35/14 Mean (SD) FEV1 (%pred): 27.2 (7.6)
Oh 2003 Korea	Design: cohort Ax times: baseline and 8 weeks No of participants: n = 15 (8)	educational advice	Mean (SD) age (years): 66.8 (12.29) Sex (M/F): 4/4 (of completers) Mean (SD) FEV1 (%pred): 44.91 (17.75)
Worth and Dhein 2004 Germany	Design: randomised controlled trial Ax times: not specified No of participants: I: 46 (not specified); C: 34 (not specified)	I: structured education programme C: usual care	Mean (SD) age (years): 63 (SD not given) Sex (M/F): Not specified Mean (SD) FEV1 (%pred): 65% prednisolone
Norweg et al 2005a USA	Design: randomised controlled trial Ax times: baseline, 6 weeks, 12 weeks, 18 weeks, 24 weeks No of participants: I: 14 (6), C: 13 (7)	I: exercise training plus activity training C: exercise training	Mean (SD) age (years): I: 73.5 (4.5) C: 77.1 (4), Sex (M/F): I: 4/7, C: 6/6 Mean (SD) FEV1 (L): of all participants: 1.23 (0.43)
Norweg et al 2005b USA	Design: randomised controlled trial Ax times: baseline, 6 weeks, 12 weeks, 18 weeks, 24 weeks No of participants: I: 10 (8), C: 13 (7)	I: exercise training plus lecture series C: exercise training	Mean (SD) age (years): I: 70.1 (7.3), C: 77.1 (4) Sex (M/F): I: 1/9, C: 6/6 Mean (SD) FEV1 (L): of all participants: 1.23 (0.43)

No of participants: commenced (completed last assessment)
Abbreviations: Ax: assessment; C: control; F: female; FEV1: forced expiratory volume in one second; FEV1 (%pred): percentage of the predicted FEV1; FVC: Forced vital capacity; I: intervention; L: litres; M: male; MRC: medical research council; SD: standard deviation

to improve patients control over their condition so it is notable that only one of the included studies assessed illness knowledge (n=1/4) and none assessed self efficacy.

There are a number of additional papers on the role of education in COPD which are not included in the Blackstock and Webster (2006) systematic review, and also additional papers which examine the effects of exercise alone compared to education and exercise and these have the potential to add to the existing debate with regard to the role of education in COPD. Therefore, the aim of this review is to summarise the additional evidence for "traditional" education in COPD by including studies of any methodological design.

Objectives

The objectives of this review are to:
1. To describe the educational components of the included studies
2. To examine outcome measures used to assess the efficacy of education in the COPD patient population of the included studies
3. To determine the efficacy of traditional education in COPD

Methods

An electronic search of relevant databases was conducted using key words such as chronic obstructive pulmonary disease, pulmonary disease, pulmonary rehabilitation and education. All databases were searched from the date of commencement until November 2007. The reference lists of all resourced studies and reviews in education and pulmonary rehabilitation in patients with COPD were also hand searched for additional relevant articles.

Studies of any methodological design in which one of the aims was to determine the effectiveness of education in adult patients with COPD were included in this review (education alone compared to a control group, exercise alone compared to education and exercise, education compared to exercise, cohort group studies of education).

Studies which compared different educational methods or compared education to a combination of exercise and education were also included in this review; however, only data describing the study methodology, educational intervention and, when published, the within-group results of the education groups, were extracted (these will be subsequently referred to as cohort groups).

Studies which were included in the previous review investigating the role of education in COPD were excluded to avoid duplication of their results (Blackstock and Webster 2006). Studies published as abstracts, those which were not in the English language and those which focused specifically on self-management education were excluded.

Quality Assessment

The methodological quality of the included studies was determined using quality indicators which included randomisation, blinding of assessors, description of study methodology and interventions and reporting reasons for drop-outs or withdrawals. Due to the nature of the interventions in these studies it is impossible to blind participants and therefore double blinding was not assessed.

Data relating to the study methodology, methodological quality, participant characteristics, educational interventions and outcome measures were extracted.

Results

The electronic and hand searches identified 78 potentially eligible studies. 18 studies met the inclusion criteria: one randomised controlled trial comparing education to a control group, 15 educational studies of cohort groups, and two randomised controlled trials comparing exercise to a combination of exercise and education.

Study Methodology and Participant Characteristics

The characteristics of the included studies and their participants are shown in Table 1.

Methodological Quality

Overall, the studies included in this review had reasonable quality. The quality of the randomised controlled trials (n=3) relating to randomisation was good, however, was reduced by the lack of intention-to-treat analysis. Quality relating to the description of interventions and reporting drop-outs was good for all studies (n=18), however the general quality was reduced by the lack of blinding of assessors (n=4/18). Studies were not excluded on the basis of quality.

Educational Intervention

The characteristics of the educational interventions are summarised in Table 2. The duration of the educational programmes ranged from a single one-hour lecture (Black and Mitchell 1977a; Black and Mitchell 1977b; White et al 2002) to 12 hours over a period of 8 weeks (Wedzicha et al 1998). Didactic lecture based sessions were the most common method of delivering education (n=11/18) and in two further

Table 2. Characteristics of educational interventions

Reference	Education Style	Patient Booklet	Venue	Length of education	Health Professionals delivering education
Black and Mitchell 1977a	Individual Audiovisual and Booklet	Yes	Outpatient	One hour Single session	Physician
Black and Mitchell 1977b	Individual Audiovisual and Booklet	Yes	Outpatient	One hour Single session	Physician
Hunter and Hall 1989	Group based Didactic Small group discussions	Yes	Outpatient	Two hours per week 5 weeks	Not specified
Scherer et al 1989	Group based Didactic	Yes	Outpatient	One hour per week 6 weeks	Registered nurses Physical therapists Occupational therapist Respiratory therapists Dieticians Pharmacists Pastoral care members
Toshima et al 1990	Group based Videotapes, questionnaires and lectures with question and answer period	No	Outpatient	Two hours biweekly 8 weeks	Pulmonary physician Dietitian Clinical pharmacologist Respiratory therapist
Janelli et al 1991	Group based Didactic	No	Outpatient	One hour per week 6 weeks	Registered nurses Physical therapists Respiratory therapists Dieticians Pharmacists Physician
Scherer et al 1992	Group based Didactic	No	Outpatient	One hour per week 6 weeks	Registered nurses Physical therapists Respiratory therapists Dietitians Pharmacists Physician
Scherer et al 1994	Group based Didactic	No	Outpatient	One hour per week 6 weeks	Registered nurses Physical therapists Respiratory therapists Physician

Table 2. Characteristics of educational interventions

Reference	Education Style	Patient Booklet	Venue	Length of education	Health Professionals delivering education
Ries et al 1995	Group based Videotapes, questionnaires and lectures with question and answer period	No	Outpatient	Two hours biweekly 8 weeks	Pulmonary physician Dietitian Clinical pharmacologist Respiratory therapist
Hoberty et al 1998a	Group based Didactic	Yes	Outpatient	7 sessions, duration not specified	Not specified
Hoberty et al 1998b	Individual Videotapes, followed by question and answer period	Yes	Home based	7 sessions, duration not specified	Rehabilitation specialist
Scherer et al 1998	Group based Didactic	Yes	Outpatient	Two-hours per week 4 weeks	Clinical nurse specialist
Wedzicha et al 1998	Group based: (MRC 3/4) Individual (MRC 5) Didactic	Yes	Outpatient (MRC 3/4) Home based (MRC 5)	45 minutes twice per week 8 weeks Monthly half-hour discussion sessions for 12 months	Not specified
White et al 2002	Individual Written material reinforced with session with a HP	Yes	Outpatient	One hour per week One occasion	Respiratory nurse Physiotherapist
Oh 2003	Individual Didactic	Yes	Home based	One occasion	Not specified
Worth and Dhein 2004	Group based Didactic	Not specified	Outpatient	Two hours per session Four sessions	One of the following: Doctor, specially trained nurse or physiotherapist
Norweg et al 2005a	Group based Structured bahavioural intervention emphasizing dyspnoea management	No	Outpatient	One hour per week Six weeks	Occupational therapist
Norweg et al 2005b	Group based Didactic	No	Outpatient	45 minutes Six weeks	Occupational therapist Psychologist Nutritionist

studies were used as an adjunct to videos. The majority of the studies employed group-based sessions (n=13/18). Overall, 11 different educational topics were covered (Table 3); the most common being disease education (n=16/17) and medication (n=14/17). One study did not specify the content of their educational programme (Worth and Dhein 2004). Nine studies (n=9/14) had more than one health professional involved in the delivery of educational sessions (range: 1-7). These include physicians (n=8), nurses (n=7), physiotherapists (n=6), respiratory therapists (n=6), dietitians (n=6), pharmacists (n=5), occupational therapists (n=3), psychologists (n=1), rehabilitation specialist (n=1) and pastoral care members (n=1). Four studies did not specify which health professionals were involved in their study.

Table 3. Content of educational interventions of included studies (n=17)

Education Topic	No. (%) of programmes that included the topic
Disease education*	16/17 (94)
Medication including Oxygen*	14/17 (82)
Dyspnoea/Symptom management/Chest clearance*	13/17 (76)
Energy Conservation/Stress/Relaxation*	13/17 (76)
Nutrition*	13/17 (76)
Benefit of exercise*	9/17 (53)
Smoking Cessation/Avoiding Environmental Irritants*	4/17 (24)
Recognition and management of an exacerbation	4/17 (24)
Medical tests	3/17 (18)
Travel*	3/17 (18)
Self care tips	2/17 (12)

One study did not specify the content of their educational intervention
**These educational topics were common to the studies included in Blackstock and Webster (2006) review*

Outcome Measures

There were 40 instruments used between the relevant studies (n=14) to assess the different outcomes (Table 4). Four of the studies included which compare different educational interventions or compared education to a combination of education and exercise, did not include within-group analysis and hence are not considered in the outcome measures section. The results (significant and non-significant) are reported for all outcomes at all assessment times.

Illness Knowledge

Illness Knowledge was assessed by five cohort groups. All of the knowledge tests were developed by the authors of the studies and only two of the five studies used the same instrument (Scherer et al 1992; Scherer et al 1994). There was a significant improvement in illness knowledge immediately following education ($p<0.01$) (Black and Mitchell 1977a, Black and Mitchell 1977b, Scherer et al 1992, Scherer et al 1994) and at six months ($p=0.01$) (Scherer et al 1992). Scherer et al (1989) employed a 12-item COPD knowledge test; for each question the knowledge level of the participants either improved or remained the same post-intervention, however, they did not investigate whether these changes were statistically significant.

Self-Efficacy

Self-efficacy was assessed by four studies (two cohort groups, two exercise versus education and exercise studies), three of which employed the COPD Self-Efficacy scale. One study found significant improvements at one month in the total score ($p=0.05$) and in the physical exertion ($p=0.01$) and weather/environment components ($p=0.01$) and at six months in the physical exertion component ($p=0.047$) (Scherer et al 1998). The remaining three studies found no significant short-, medium- or long-term differences either within the education group or between the exercise group and the education and exercise group (Ries et al 1995; Norweg et al 2005a; Norweg et al 2005b).

Psychosocial Functioning and Coping Strategies

Psychosocial functioning (depression, anxiety and hostility) was assessed by five cohort groups. Only two studies employed the same instrument, the Multiple Affect Adjective Checklist – General Form; one study found significant increases in depression ($p<0.05$) and anxiety ($p<0.04$) immediately post-intervention (Scherer et al 1989), while the other study found no significant differences immediately post-intervention but at six months found a significant decrease in depression ($p=0.04$) (Scherer et

Table 4. Outcome measures employed by the included studies

Illness Knowledge	Self Efficacy	Psychosocial functioning/ Coping Strategies	Quality of Life	Pulmonary function
10 item knowledge test A [Black & Mitchell 1977a]	Self efficacy for walking questionnaire [Ries et al 1995]	Profile of mood states [Hunter & Hall 1989]	Quality of Life Index [Scherer et al 1994]	DLCO [Ries et al 1995]
10 item knowledge test B [Black & Mitchell 1977b]	COPD Self-Efficacy Scale [Scherer et al 1998, Norweg et al 2005a, Norweg et al 2005b]	MAACL [Scherer et al 1989, Scherer et al 1992]	Quality of Well-being scale [Ries et al 1995]	FEV1* [Ries et al 1995, Wedzicha et al 1998]
12 item knowledge test [Scherer et al 1989]		Jalowiec Coping Scale [Janelli et al 1991, Scherer et al 1989, Scherer et al 1992]	CRDQ [Wedzicha et al 1998, White et al 2002, Norweg et al 2005a, Norweg et al 2005b]	Borg scale [Ries et al 1995]
16 item knowledge test [Scherer et al 1992, Scherer et al 1994]		CES-D* [Ries et al 1995]	SGRQ [Wedzicha et al 1998]	Shortness of breath questionnaire [Ries et al 1995]
		Hospital Anxiety and Depression scale [White et al 2002]	Short-form 36 questionnaire [White et al 2002]	FEV1 (% predicted) [Wedzicha et al 1998]
			Not specified [Worth & Dhein 2004]	FVC* [Wedzicha et al 1998]
				PaO2* [Wedzicha et al 1998]
				PaCO2 [Wedzicha et al 1998]
				TLCO [Wedzicha et al 1998]
				Not specified [Worth & Dhein 2004]

Abbreviations: CES-D: Centre for Epidemiological Studies-Depression Inventory; CRDQ: chronic respiratory disease questionnaire; DLCO: diffusing capacity for carbon monoxide; FEV1: forced expiratory volume in one second; FVC: forced vital capacity; MAACL: Multiple Affect Adjective Checklist – General Form; NEADL: Nottingham Extended activities of daily living assessment; PaCO2: arterial carbon dioxide tension; PaO2: arterial oxygen tension; PFSDQ-M: modified Pulmonary Functional Status and Dyspnoea Questionnaire; SGRQ: St. George's Respiratory Questionnaire; TLCO: lung carbon monoxide transfer factor; VO2max: maximal oxygen consumption
**These outcome measures were common to the studies included in Blackstock and Webster (2006) review*

al 1992). The remaining three studies found no significant differences in the short-, medium- or long-term using a number of instruments (Hunter and Hall 1989; Ries et al 1995; White et al 2002).

Three of the cohort groups employed the Jaloweic Coping Scale to assess the coping strategies of patients with COPD. Following education there were no significant short-term (Janelli et al 1991; Scherer et al 1992) or long term (Scherer et al 1992) differences in coping strategies. Scherer et al (1989) had insufficient data to indicate whether there was a significant difference in coping strategies post-education. They did, however, indicate that patients employed more problem-orientated coping strategies and fewer affective-orientated strategies post-intervention.

Quality of life

Quality of life was assessed by seven studies (one education versus control study, four cohort groups, two exercise versus education and exercise studies), using five different instruments. The disease-specific Chronic Respiratory

Exercise Capacity/ Functional Ability	Cost	Others
Max work [Ries et al 1995]	Days spent in hospital (n)* [Ries et al 1995, Worth & Dhein 2004]	Self-control [Worth & Dhein 2004]
Treadmill endurance [Ries et al 1995]	Mild attacks per exacerbation (n) [Worth & Dhein 2004]	Self-management [Worth & Dhein 2004]
VO2max* [Ries et al 1995]	Severe attacks per exacerbation (n) [Worth & Dhein 2004]	
Muscle fatigue [Ries et al 1995]		
Shuttle Walk Test [Wedzicha et al 1998, White et al 2002]		
NEADL [Wedzicha et al 1998]		
Six minute walk test [Norweg et al 2005a, Norweg et al 2005b]		
PFSDQ-M [Norweg et al 2005a, Norweg et al 2005b]		

Disease Questionnaire (CRDQ) was employed by four studies.

There were significant short term improvements found within the education group using the disease-specific CRDQ and St Georges Respiratory questionnaire (SGRQ); CRDQ total score ($p<0.05$) (White et al 2002), CRDQ dyspnoea component ($p<0.01$) (Wedzicha et al 1998; White et al 2002), SGRQ total score ($p< 0.05$) (Wedzicha et al 1998). Norweg et al (2005b) found a significant difference in favour of the exercise group in the emotional function component when compared to a combination of education and exercise at 12 weeks ($p = 0.03$). There were no short-term improvements found using four different generic quality of life instruments (Scherer et al 1994; Ries et al 1995; Wedzicha et al 1998; Worth and Dhein 2004). There were no medium- or long-term improvements found in either disease-specific or generic quality of life (Ries et al 1995; Wedzicha et al 1998; Norweg et al 2005a; Norweg et al 2005b).

Pulmonary Function

Pulmonary function was assessed by three studies (one education versus control study, two cohort groups) using five different values and two instruments. In general, there were no significant short -, medium- or long-term differences in pulmonary function within the education group (Ries et al 1995; Wedzicha et al 1998) or between the education and control groups (Worth and Dhein 2004).

Exercise Capacity/ Functional Ability

Exercise capacity was assessed in five studies (three cohort groups, two exercise versus education and exercise studies), using seven different instruments. The shuttle walk test and the six minute walk test were employed by two studies each. Two cohort groups found significant short-term improvements using the shuttle walk test and treadmill workload ($p<0.05$) (Ries et al 1995; White et al 2002); the remaining five studies found no significant short-, medium- or long-term improvements using a range of outcome measures (Ries et al 1995; White et al 2002; Wedzicha et al 1998; Norweg et al 2005a; Norweg et al 2005b).

Three studies (one cohort group, two exercise versus education and exercise studies) assessed functional ability using two different instruments. At six weeks, significant reductions in the modified Pulmonary Functional Status and Dyspnoea

Questionnaire, in the exercise group compared to the exercise and education group were found in participants aged over 80 years for the dyspnoea (p = 0.025) and fatigue with activities (p = 0.009) components (Norweg et al 2005b). At 12 weeks, there were significantly improved reductions in all components for the exercise and education group compared to the exercise group: dyspnoea with activities component (75 years: p=0.009; 80 years: p=0.003), fatigue with activities component (75 years: p=0.003; 80 years: p=0.001), change in activity involvement component (75 years: p=0.021; 80 years: p=0.002), total functional status score (75 years: p=0.01; 80 years: p=0.003) (Norweg et al 2005a). One study found no significant difference in the short term within the education group (Wedzicha et al 1998).

Cost

The cost of COPD was assessed in two studies (one education versus control study, one cohort group). Ries et al (1995) found no significant improvement in days spent in hospital throughout their six-year cohort study. In contrast, Worth and Dhein (2004) found a significant improvement in hospital admissions (p=0.05) and a significant reduction in both mild (exacerbations managed by patient) (p=0.03) and severe exacerbations (exacerbations managed by physician) (p=0.05) in favour of the education group after the intervention.

Others

Worth and Dhein (2004) assessed self control by evaluating the patient's monitoring of their symptoms and peak-flow monitoring. In both cases they found self control was significantly improved in the education group compared to a control group (monitoring of symptoms p=0.05; peak-flow monitoring p=0.02). They found no significant difference between the groups in self-management of medication.

In summary, there appears to be evidence to suggest that education has a positive impact on illness knowledge, disease-specific self-efficacy, disease-specific quality of life, health care utilisation (hospital admissions, number of mild exacerbations and number of severe exacerbations) and self-control in patients with COPD. There is some evidence that education does not impact on generic self-efficacy, coping strategies, generic quality of life, pulmonary function and exercise capacity. There is inconclusive evidence on the effect of education on psychosocial functioning and functional ability.

Comparisons of Results: Blackstock and Webster (2006) systematic review and the current review

In the Blackstock and Webster (2006) review 10 topics were covered by the included studies (n=4 studies) compared to 11 in this review (n=17 studies). The most common topics covered in both reviews were disease education and medication. In total, there were 8 topics common to both reviews (Table 3).

Both reviews found that didactic sessions were the most common mode of delivering education and that there were wide variations in the duration of the educational interventions in the included studies (ranging from 4 hours to 16 hours over 10 weeks).

Both reviews found a range of outcome measures were used to assess the efficacy of education. The only significant improvement found in the Blackstock and Webster (2006) was in the reduction of GP visits when compared to a control group. However, in this review of studies of mixed design, there appears to be evidence to suggest that education may have a positive impact on illness knowledge, self-efficacy, disease-specific quality of life, health care utilisation and self-control in patients with COPD. In agreement with Blackstock and Webster (2006) this review found that that education appears to have little or no effect on psychosocial functioning, pulmonary function and exercise capacity. In addition this review found that education has no effect on the coping strategies of patients with COPD.

Discussion

The efficacy of traditional education in COPD has been previously described in a systematic review including only randomised controlled trials (Blackstock and Webster 2006). Our review provides additional evidence for the role of education from trials of other designs. It also provides further information on key educational topics, the most common mode of delivery being used and also potentially useful outcome measures for assessing the efficacy of education.

There appears to be some agreement on the common educational topics for COPD between this review, Blackstock and Webster (2006), international guidelines, clinical practice and also the patients perspective; these topics include disease education, medication, dyspnoea and symptom management, exacerbation management, chest clearance, energy conservation and pacing, nutritional advice, anxiety and stress management, relaxation,

managing travel and benefits of exercise (British Thoracic Society (BTS) 2001; National Institute for Clinical Excellence 2004; American Thoracic Society/ European Respiratory Society (ATS/ERS) 2006; Blackstock and Webster 2006; Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2007; Wilson et al 2007; O'Neill et al 2008). Whether all of these topics need to be included in all programmes or whether they should be specific to each programme remains unclear. Welfare and Benefits was one of the key topics identified by patients with COPD that they wished to be informed about, however, it does not appear to be one of the most commonly covered topics (Wilson et al 2007). Where the correct skill mix is not available among a multidisciplinary team to deliver the range of topics it may be helpful to have an educational toolkit which would ensure that essential key topics are delivered to the patient.

There also appears to be consensus that education in COPD is best delivered in a group format. (Blackstock and Webster 2006; BTS 2001; GOLD 2007; Wilson et al 2007). Group-based education sessions are considered more economical and time efficient than individual sessions. This review additionally provides further support for the use of information booklets to reinforce educational sessions (BTS 2001; Wilson et al 2007).

Our review identifies that there is evidence that the provision of traditional disease-specific education in COPD is effective and therefore, it should be considered as a component of the overall management of patients with COPD. However, further research is required to ascertain the most effective model for delivering this education. It still remains to be determined which mode of delivery is most beneficial; for example, whether to incorporate education within pulmonary rehabilitation, introduce it as a regular aspect of the patients' annual review or incorporate it as a component of self-management programmes such as the Chronic Disease Self-Management Programme (Lorig 1996). The ATS/ERS statement on pulmonary rehabilitation (2006) supports the use of self-management education over didactic education. Self-management education in COPD, which incorporates both education and behavioural elements through the introduction of problem-solving skills and action plans, has been systematically reviewed (Blackstock and Webster 2006; Effing et al 2007). Blackstock and Webster (2006) (n=9) found self-management produced improvements in quality of life and health care utilization, although non- significant, while Effing et al (2007) (n=14) concluded that self-management education produced a significant reduction in hospital admissions and a significant improvement in quality of life and dyspnoea. Therefore, there is some rationale for supporting a model of education for patients with COPD which combines both traditional disease-specific education and self-management education.

Outcome measures used in research and clinical practice should relate to the aim and content of the intervention. The randomised controlled trials included in the review by Blackstock and Webster (2006) which examined the efficacy of educational intervention appear to have included a range of outcome measures not all of which are relevant to the proposed effects of education. In contrast, the studies of mixed design included in this review have more of a tendency to reflect the aim of education; for example, illness knowledge and self-efficacy. It seems likely that illness knowledge, disease-specific self-efficacy, disease-specific quality of life and health care utilization may be potentially useful outcomes to determine the effectiveness of education in COPD. It remains unclear which specific instrument is ideal to assess illness knowledge in COPD as the majority of the knowledge tests were developed by the authors for the purpose of that study. This review was also able to identify that generic instruments that assess self-efficacy and quality of life were not as sensitive to change as disease-specific instruments following education in COPD; the COPD self-efficacy scale (Wigal et al 1991) and the CRDQ (Guyatt et al 1987) were sensitive to change in self-efficacy and quality of life respectively. The best indicators to assess health care utilization were number of GP visits, hospital admissions, frequency of mild exacerbations and frequency of severe exacerbations.

There are a few factors which limit this review. A number of studies that are not in the English language were unable to be included in this review. The heterogeneity of outcomes used in the included studies made a meta-analysis of their results impossible. Also, the outcomes that appear to be relevant to education and that appear to be sensitive to change were not tested in controlled trials.

Conclusion

In conclusion, the results of this review support the role of education in the management of COPD. It also provides clinicians with information on key topics that should be included in their education programmes and also outcomes which may direct their delivery and evaluation of the benefits of their education programmes. Future research may be beneficial in developing an educational toolkit which

would facilitate the delivery of these key topics and also in a variety of settings, such as pulmonary rehabilitation or self management education.

Key points

- Education is important in the management of COPD provided key topics are included.
- Outcomes to assess the benefit of education in COPD should include illness knowledge, disease-specific self-efficacy, disease-specific quality of life and health care utilization.
- Further research is required to determine the optimal model for the delivery of education.

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Book reviews

Physiotherapy for Respiratory and Cardiac Problems: Adults and Paediatrics. (2008) Fourth Edition.

Jennifer A Pryor and S Ammani Prasad (Eds)
Price: £31.99

This comprehensive textbook on physiotherapy in respiratory and cardiac medicine has just been published in its fourth edition. The first edition was published in 1993 and the fact that, fifteen years later it is in its fourth edition is evidence of its success. The contributors are all well recognised experts in their respective fields and provide a truly international perspective. The book progresses in a logical manner commencing with chapters on examination of the cardiorespiratory systems of adults and children. The following chapters deal with physiotherapy techniques, indications for treatment and identifying specific patients' problems. Issues such as adherence, depression, and anxiety have considerable impact on the patient's presentation and response to treatment and need to be understood by the physiotherapist. These are sensitively dealt with in the chapter on psychological aspects of care. The management of patients in intensive care and the different modes of ventilatory support are comprehensively covered in chapters dedicated to both adults and children. The effects of surgery and details on different types of surgery are very well presented with accompanying diagrams. The topics of pulmonary rehabilitation, cardiac rehabilitation, thoracic organ transplantation, spinal cord injury, dysfunctional breathing and chronic respiratory diseases are presented in individual chapters. All chapters are supported by the highest level of evidence in the area. Each chapter is clearly divided into sections which makes it very user friendly and the information easily accessible. The text is well supported with illustrations and diagrams.

I was delighted to be asked to review this book. Over the past twelve years I have recommended previous editions to undergraduate students of physiotherapy for both academic study and preparation for clinical practice. I will continue to highly recommend this book for student and qualified physiotherapists and would suggest that it is an essential reference book for physiotherapy departments. The editors are to be congratulated on this latest achievement and the significant contribution they have made to the area.

Reviewed by Juliet Hussey (PhD, MSc, MA) Senior Lecturer and Head of School, Trinity College Dublin.

25 Years of Progress and Innovation in Intensive Care Medicine. (2007)

Kuhlen R, Moreno R, Ranieri M and Rhodes A (Eds)
Berlin, Medizinisch Wissenschaftliche Verlagsgescellschaft.
Price: £41.85

Published as part of the 25th anniversary celebrations of the European Society of Intensive Care Medicine, this book provides an excellent review of

developments within the field of intensive care. The explanations of the origins of some current practice remind us how far this branch of healthcare has moved in a relatively short time.

It is divided into eight sections of varying length. These include general intensive care medicine, acute respiratory insufficiency and mechanical ventilation, health services research and outcomes and ethics. Almost every area of intensive care from admission to follow-up and long-term outcomes is covered with a comprehensive evidence base. Many of the chapters are addressed from a medical perspective discussing management strategies and monitoring, but this provides the reader with a very good overview of the evidence and background to current strategies.

From the respiratory physiotherapists' point of view there are some excellent chapters on the principles of mechanical ventilation, quality of life issues following intensive care, long-term outcomes, brain trauma and the progression of COPD exacerbation management from invasive to non-invasive ventilation. There is a strong emphasis on the value of outreach services and ethical issues surrounding intensive care patients.

Although physiotherapy receives little mention within the chapter on nursing and allied health professionals in intensive care, there is a strong emphasis on the European Society's commitment to involving physiotherapists, if only we were greater in number and had a higher profile.

Specialists within intensive care may not find this book presents them with any new information, but I found the review of the historical background to some current practice very interesting. The book provides a very good source of references and information on a wide variety of topics and would be a very useful starting point for developing or refreshing knowledge.

Reviewed by Sian Goddard, Clinical Specialist Respiratory Physiotherapist, Royal Cornwall Hospital.

Journal of the Association of Chartered Physiotherapists in Respiratory Care

INSTRUCTIONS FOR AUTHORS

Submissions may take the form of review papers, research reports, audit reports, case studies, editorials, conference reports, equipment reports and reviews of books, CDs or DVDs. Student contributions are welcomed.

Please use double-spacing throughout, with a 4 cm margin on the left, with no headers and footers (other than page numbers), and without footnotes unless these are absolutely necessary, all pages must be numbered.

Articles should normally be no longer than 2000 words (editorials, case studies 1000 words and book reviews 250 words). They should be emailed to jm.bradley@ulster.ac.uk and b.oneill@ulster.ac.uk with the files named as follows

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Title of the article
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INTRODUCTION
The introduction should have a clear rationale and purpose/aim or state the question that the paper sets out to answer.

METHODS
This should outline the methodology used to complete the respiratory project or literature review. A summary of the statistical process should be provided, for research projects a statement of ethical approval should be included.

RESULTS
Results should include a detailed summary of your findings.

DISCUSSION
Interpretation of the results obtained in the study should be offered here. The findings must be considered in relation to previous work and in terms of whether the aim specified in the INTRODUCTION has been achieved. Suggestions should also be included for the improvement of the study. Furthermore recommendations for future research should be offered.

CONCLUSION
Your conclusions should be succinct and logically ordered. Identify gaps in present knowledge and suggest future initiatives.

KEY POINTS
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Please supply 3-5 key phrases that summarise the major themes of your article.
These will appear at the end of the article.

Headings
Please use headings and subheadings appropriately.

ABBREVIATIONS AND UNITS
Abbreviations should be defined at their first mention. SI units should always be used.
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TABLES AND ILLUSTRATIONS
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