REHABILITATION OF PATIENTS MANAGED IN ICU

RECOMMENDATIONS

Safety to mobilize / exercise:  
Post your comments on the website

Recommendation 1

• All critically ill patients nursed in ICU should be screened closely before active mobilization. The decision must be based on hemodynamic; respiratory and neurological criteria as well as therapist judgment. Patients need to be monitored closely during mobilization and FiO2 can be temporarily adjusted if patient desaturates during an activity.

Weak recommendation: Patients mobilized in ICU based on specific criteria remained hemodynamically stable (Stiller et al 2004; Bailey et al 2006) and few adverse effects were documented (14 of 1,449) (Bailey et al 2006). This included falls to the knees without injury, variations in systolic blood pressure, oxygen desaturation and a nasal-small bowel feeding tube removal. None of these adverse events resulted increased LOS or additional cost. The effects of these outcomes on functional outcomes are not yet clear.

Low quality evidence: Two observational studies (Stiller et al 2004; Bailey et al 2006) evaluated the safety of actively mobilizing intubated patients based on specific criteria. There was insufficient cause to upgrade the evidence form these two observational studies (estimate and precision of effect can not be calculated).

Effectiveness of mobilization/ exercise

Recommendation 2

• An individually designed mobility plan might be developed for each critically ill patient admitted to the unit in consultation with the interdisciplinary team.

Weak recommendation: The implementation of a specific mobility plan for all patients in ICU did not adversely effect hemodynamic stability or resulted in an increase in adverse effects (Bailey et al 2007). However, the cost benefit of implementation has not been established.

Low quality evidence: One observational study (Bailey et al 2007) with insufficient cause to upgrade the quality of the evidence (estimate and precision of effect can not be calculated).
Effectiveness of mobilization/ exercise

**Recommendation 3**
- A specific exercise program that targets the upper extremity and trunk focusing both on endurance and strengthening might be implemented for patients that have been intubated for longer than 14 days. The daily exercise session should include at least 30 minutes 5/week and incorporate MBS rating to ensure a specific intensity.

**Weak recommendation** the implementation of a targeted exercise program in patients intubated for longer than 14 days have not affected mortality or LOS (Nava et al 1998) but has improved functional capacity (Nava et al 1998); functional independence (Martin et al 2005; Chiang et al 2006) and muscle strength (Martin et al 2005; Porta et al 2005; Chiang et al 2006). Because these studies were performed in a respiratory rehabilitation setting (step down facility) it is not clear whether the increase burden on therapy services in a critical environment is economically justified.

**Low quality evidence**: Three RCT’s (Nava et al 1998; Porta et al 2005; Chiang et al 2006) downgraded due to study limitations (moderate risk of bias) and indirectness (refer to table 3).

Effectiveness mobilization in unresponsive patients

**Expert opinion**
- Patients in ICU that are not medically stable enough to be actively mobilized, must be turned two hourly and all joints should be moved through full range of motion once daily.

**Expert opinion** of a variety of experts (nurses; therapists and intensivists) (Topp et al 2002; Thomas et al 2006; Krishnagopalan et al 2002; Morris 2007; Winkelman 2007; Nava 2002)

Inspiratory Muscle Training

- IMT is not currently regarded as standard care in the management of critically ill patients and questions have been raised as to the physiological basis of this intervention. There is a lack and poor quality evidence to make any recommendations with regards to the implementation of an IMT program at this time. In the one RCT identified there was no effect on re intubation rate or TOV between the intervention group or the control group. The study was not powered to detect a change; patients were lost to follow up; no blinding was applied and data was not analyzed on an intention to treat basis. Good quality studies are urgently required in this area.
Review question one:
Is it safe (any harmful outcomes) and effective (improve function; functional capacity; LOS; TOV; muscle strength) to mobilize/exercise intubated and ventilated adult patients in ICU?

Background
• The shift of focus from mortality as primary outcome for patients from ICU care to the HRQoL emphasize the importance of mobilization of patients suffering from a critical illness. This issue is increasingly being addressed in the literature (Morris 2007; Jones et al 2003).
• The physiologic effects of immobility have been well described (Timmerman 2007; Cirio et al 2003; Nava 2000; de Jonge et al 2007; Winkelman et al 2007; Topp et al 2002). It is therefor proposed by the majority of interdiciplinary teammembers involved in patient management in ICU that early rehabilitation may be beneficial to this patient population (Timmerman 2007; Morris et al 2007; Clini et al 2005; Greenleaf et al 1997).

Following a systematic review of the literature; critical appraisal of identified studies; the following conclusions were reached:

SEARCH RESULTS

Experimental studies
• Eight studies were identified and included in this review

• Three of the studies addressed the issue of safety by defining criteria for identifying eligible patients and effective monitoring during the mobilization/exercising of critically ill patients (Stiller et al 2004; Vitacca et al 2006; Bailey et al 2007).
• This included two observational studies (Stiller et al 2004 and Bailey et al 2007) and one crossover design with patients acting as their own controls (Vitacca et al 2006).

• Five experimental studies assessed the effectiveness of exercise in a variety of patients that have been intubated for longer than 14 days. This included four RCT's (Nava et al 1998; Zanotti et al 2002; Porta et al 2005; Chiang et al 2006) and one observational study with retrospective group analysis (Martin et al 2005)
• The outcomes investigated included functional capacity; function ability; muscle strength, mortality and LOS (refer to table 1).

Expert opinion
• There seems to be interdisciplinary consensus amongst team members involved in the management of patients in ICU as to the importance of mobilization and optimal positioning. This includes intensivists (Morris 2007; Morris et al 2007; Nava et al 2000; Nava et al 2002) registered nurse practitioners (Winkelman et al 2007; Vollman et al 2004; Timmerman et al 2007; Krishnagopalan et al 2002); and physiotherapists (Thomas et al 2006; Johansson et al 2005)
• Mobility should not be regarded as an adjunct to therapy but as a primary intervention for each patient managed in ICU (Morris 2007; Winkelman 2007; Johansson et al 2005).
• An individual goal orientated mobility plan should be developed for each patient on admission to ICU (Nava 2000; Nava 2002; Thomas 2002; Vollman 2004).
• Optimal patient positioning should be prescribed for each patient to reach specific outcomes (Thomas et al 2006; Krishnagopalan et al 2002)

SUMMARY OF CURRENT EVIDENCE:
Safety criteria have been defined in terms of cardiovascular-, respiratory- and neurological- stability and reserve. However clinical judgment of the physiotherapist remains to be important in the exercise prescription (Bailey et al 2007; Stillier et al 2004; Vittaca et al 2006).

Based on the eight experimental studies included in this review three groups of patients were identified:

GROUP 1: patients that do not fulfill criteria for active mobilization (Stillier et al 2004; Bailey 2007);  
GROUP 2: patients that are medically stable based on defined criteria (Stillier et al 2004; Bailey 2007);  
GROUP 3: patients that have been intubated for longer than 14 days (Nava et al 1998; Zanotti et al 2002; Martin et al 2005; Porta et al 2005; Chiang et al 2006)

GROUP 1: Patients that do not fulfill criteria (hemodynamic; respiratory and neurological stability) for active mobilization
No experimental studies into the effectiveness of mobilization in this group of patients were identified. This is a summary of current expert opinion of interventions which, based on clinical observations, have not resulted in harm.

- Two hourly change of position supine – quarter turn (Topp et al 2002; Thomas et al 2006; Krishnagopalan et al 2002)  
- Nurse in 30-45 degrees head up position (supine) (Dodek 2004)  
- Passive movement of upper and lower extremities once daily through full range of motion (Morris 2007; Winkelman 2007; Nava 2002)

GROUP 2: Patients that are medically stable based on defined criteria
- Identification and monitoring of patients that will benefit from mobilization is based on clinical judgment and set criteria (Stillier et al 2004; Baily et al 2007).  
- In acutely ill patients, start actively mobilizing the patient as soon as the patient is medically stable based on strict criteria and continuous monitoring (Stillier et al 2004; Baily et al 2007)  
- Early activity including moving from lying to sitting on the edge of the bed, sitting to standing, a standing transfer from the edge of the bed to a chair, or walking is safe (based on clinical observations) for acute ill patients (Stillier et al 2004; Baily et al 2007)  
- Temporary increasing of FiO2 is recommended when there is decrease in saturation levels >4 (Stillier et al 2004; Baily et al 2007)  
- In patients that cannot be mobilized out of bed - include arm exercises (both strengthening and endurance) into a mobility regime. No harm has been reported and could potentially facilitate weaning (Porta et al 2005; Vittaca et al 2006)

GROUP 3: Patients that have been intubated for longer than 14 days
- In patients that have been intubated for more than 14 days and is medically stable mobility is not enough and specific daily strengthening exercise training sessions should be included (Nava et al 1998; Chiang et al 2006; Martin et al 2005; Vittaca et al 2006; Zanotti et al 2002)  
- In difficult to wean patients the arm exercises should be performed during periods of pressure support ventilation (Vittaca et al 2006).  
- These exercise sessions could incorporate whole body rehabilitation - including trunk stability and strengthening of Pectoralis Mayor (Chiang et al 2006; Martin et al 2005).  
- Include both strengthening and endurance exercise of upper extremity (Porta et al 2005; Vittaca et al 2006; Zanotti et al 2002)  
- Daily exercise session of at least 30 minutes 5X per week (Chiang et al 2006; Martin et al 2005)
- Exercise intensity based on 11 on Borg Rating of Perceived Exertion Scales (RPE) for first week and progress to 13 by week 6 (Chiang et al 2006; Martin et al 2005)

**Table 1: Summary of current evidence**

<table>
<thead>
<tr>
<th>Studies</th>
<th>Internal validity (Pedro Score)</th>
<th>Sample size</th>
<th>Population</th>
<th>Intervention and comparison</th>
<th>Study design</th>
<th>Outcome measured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STUDIES EVALUATING SAFETY</strong></td>
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<tr>
<td>Stiller et al 2004</td>
<td>4</td>
<td>31</td>
<td>Acutely ill intubated patients with varying diagnoses admitted to an ICU</td>
<td>Investigated the safety of mobilizing on specific hemodynamic and pulmonary criteria</td>
<td>Prospective cohort observational</td>
<td>Heart rate; BP; SATS</td>
</tr>
<tr>
<td>Vitacca et al 2006</td>
<td>7</td>
<td>8</td>
<td>Tracheostomised, difficult to wean COPD patients who had been mechanically ventilated for at least 15 days</td>
<td>Comparing the physiological effects of arm exercise (strength and endurance) while on MV support to when the patient is on a trachea collar</td>
<td>Crossover with patients as own controls</td>
<td>Hemodynamic variables; dyspnea; ABG's</td>
</tr>
<tr>
<td>Bailey et al 2007</td>
<td>4</td>
<td>103</td>
<td>Patients with varying diagnosis, in acute respiratory failure and have been intubated for longer than 4 days</td>
<td>Activity directed therapist supervised exercise program twice daily with goal to ambulate 100 metres before discharge</td>
<td>Prospective cohort observational study</td>
<td>Hemodynamics and adverse effects during program</td>
</tr>
<tr>
<td><strong>STUDIES EVALUATING EFFECTIVENESS</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Nava et al 1998</td>
<td>5</td>
<td>80</td>
<td>Acute respiratory failure in a sample of stable COPD patients following admission to ICU</td>
<td>Four step twice daily intensive targeted exercise program (cycling; treadmill and strengthening exercises <strong>Compared to</strong> basic ambulation)</td>
<td>RCT</td>
<td>LOS; 6MWT; mortality</td>
</tr>
<tr>
<td>Zanotti et al 2002</td>
<td>4</td>
<td>24</td>
<td>Stable COPD population following ICU admission for acute respiratory failure.</td>
<td>Active limb movement (ALM) 30 minutes daily for 4 weeks per day <strong>Compared to</strong> ALM plus electrical stimulation.</td>
<td>RCT</td>
<td>Muscle strength based on Oxford</td>
</tr>
<tr>
<td>Martin et al 2005</td>
<td>3</td>
<td>49</td>
<td>A variety of patients that have been intubated for longer than 14 days and had failed two previous attempts of extubation</td>
<td>Intensive targeted rehab program of 60 min daily. Retrospectively identified factors that contributed to prolonged intubation</td>
<td>Observational / Experimental retrospectively</td>
<td>Developed muscle scale and FIM</td>
</tr>
<tr>
<td>Porta et al 2005</td>
<td>5</td>
<td>66</td>
<td>Patients with varying diagnosis ventilated longer than 48 hours</td>
<td>Specific targeted arm exercises (both aerobic and strengthening general strengthening) <strong>Compared to</strong> only general strengthening</td>
<td>RCT</td>
<td>Maximum endurance test; MIP; Borg scale</td>
</tr>
<tr>
<td>Chiang et al 2006</td>
<td>5</td>
<td>32</td>
<td>Patients with varying diagnosis ventilated for longer than 14 days</td>
<td>Therapist supervised training sessions 5 days a week <strong>Compared to</strong> verbal encouragement to mobilize.</td>
<td>RCT</td>
<td>Respiratory muscle strength; peripheral muscle strength (handheld dynomometre) Functional status (FIM; BI)</td>
</tr>
</tbody>
</table>
SUMMARY OF THE QUALITY OF THE EVIDENCE

Safety of mobilizing / exercising acutely ill patients:
Two observational studies were considered in determining the quality of the evidence for safely mobilizing acutely ill patients. Both studies evaluated the effect of identifying and mobilizing acutely ill patients in a general ICU based on set criteria. None of these studies included a control group.

One observational study (Stiller et al 2004) reported three clinical significant events that needed intervention from 69 activity events of 31 patients (9.6% of patients or 4.3% of total activity events). All three cases included a fall in saturation levels, which were effectively managed by a temporary increase in FiO2. It did not result in any further management or the discontinuation of the mobilization event.

Bailey et al (2007) reported adverse effects in 9/103 (8.7%) patients. These adverse events occurred infrequently in 14 (0.97% of all events) of the 1,449 recorded activity events and included falls to the knees without injury (n=5), systolic blood pressure fall below 90 mm Hg (n=4), oxygen desaturation below 80% (n=3), nasal-small bowel feeding tube removal (n=1), and an increase in systolic blood pressure above 200 mm Hg (n=1). The oxygen desaturation was immediately corrected with a temporary increase in FiO2. The four hypotensive episodes were orthostatic and were corrected by having the patient lie down. None of these adverse events resulted in extubation, complications that required additional therapy, additional cost, or longer length of hospital stays.

There is not sufficient cause to upgrade this evidence because there were no control groups to compare and determine the relative risk of developing an adverse effect.

Table 2 Factors considered in determining the quality of the evidence for the safety of including arm exercises.

<table>
<thead>
<tr>
<th>Experimental Studies</th>
<th>Risk of bias</th>
<th>Directness of evidence</th>
<th>Heterogeneity</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study design</td>
<td>Washout period</td>
<td>Sample selected</td>
<td>Intervention investigated</td>
</tr>
<tr>
<td>Vittaca et al 2006</td>
<td>Appropriate</td>
<td>Insufficient</td>
<td>Insufficient</td>
<td>Yes</td>
</tr>
</tbody>
</table>

One cross over design study (without randomization) with patients acting as their own controls were considered in determining the quality of evidence to include arm exercises (both strengthening and endurance) in difficult to wean patients. The quality of the evidence was downgraded to very low because of the moderate risk of bias, indirectness (the sample was specifically COPD patients) and imprecision of the sample and data (refer to table 2).

Effectiveness of mobilizing / exercising acutely ill patients

Four RCT’s were considered in determining the quality of the evidence for including an exercise program into the management of patients that have been ventilated for longer than 14 days. The evidence was downgraded to low because of the high risk of bias due to study limitations across all the studies; and the indirectness of the evidence (specifically using COPD population in two studies) (refer to table 3).
Table 3 Factors considered in determining the quality of the evidence for studies evaluating effectiveness

<table>
<thead>
<tr>
<th>Experimental Studies</th>
<th>Risk of bias</th>
<th>Directness of evidence</th>
<th>Heterogeneity</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concealed allocation</td>
<td>Lost to follow up</td>
<td>ITT</td>
<td>Intervention investigated</td>
</tr>
<tr>
<td>Nava et al 1998</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Zanotti et al 2002</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Porta et al 2005</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Chiang et al 2006</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Review Question 2: Does the inclusion of IMT facilitate weaning in chronic intubated and ventilated patients?

BACKGROUND
- The physiologic rationale for IMT is not sound as there are numerous factors influencing successful weaning from mechanical ventilation (Jubran 2006; de Jonge et al 2004)
- It is unsure whether decreased inspiratory muscle strength is the cause of prolonged ventilation or the outcome (Chang et al 2005).

Following a systematic review of the literature; critical appraisal of identified studies; the following conclusions were reached:

SEARCH RESULTS
- Four experimental studies were identified:
  - Three studies were case series (Chang et al 2005; Martin et al 2002; Sprague et al 2003) scoring between 3-4/11 on the Pedro scale.
  - One RCT (Caruso et al 2005) scored 4/11 on the PEDRO scale. Data was not analyzed on an intention to treat basis; patients were lost to follow up and the study was underpowered to detect a difference in the outcome.

SUMMARY OF EVIDENCE
- Caruso et al (2005) conducted a small study (25 subjects) and reported a trend towards a lower reintubation rate and weaning duration. However the inspiratory strength in this group tended to decrease during mechanical ventilation suggesting a lack of beneficial effect on the IMT.
- The seventeen patients included in the three case series (Chang et al 2005; Martin et al 2002; Sprague et al 2003) all reported promising gains into weaning time; successful extubation and inspiratory pressure but all advise the importance of controlled trials.

QUALITY OF THE EVIDENCE
- One RCT downgraded to very low quality evidence due to study limitations (high risk of bias) and imprecision of sample and data.
- Three case series are regarded as very low quality evidence