

# Early Mobilization in the ICU - Literature List

## ICU-acquired weakness

### Review

- Jolley SE, Bunnell A, Hough CL.  
[Intensive Care Unit Acquired Weakness](#). Chest. 2016 Nov; 150(5):1129-1140.

### Guideline

- Fan E, Cheek F, Chlan L, Gosselink R, Hart N, Herridge MS, et al.  
[An official American Thoracic Society Clinical Practice guideline: the diagnosis of intensive care unit-acquired weakness in adults](#). American journal of respiratory and critical care medicine. 2014;190(12):1437-46.

## Early Mobilization

### Guidelines

- Hodgson CL, Stiller K, Needham DM, Tipping CJ, Harrold M, Baldwin CE, Bradley S, Berney S, Caruana LR, Elliott D, Green M, Haines K, Higgins AM, Kaukonen KM, Leditschke I, Nickels MR, Paratz J, Patman S, Skinner EH, Young PJ, Zanni JM, Denehy L, Webb SA.  
[Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults](#). Crit Care. 2014 Dec 4;18(6):658
- Bein T, Bischoff M, Brückner U, Gebhardt K, Henzler D, Hermes C, Lewandowski K, Max M, Nothacker M, Staudinger T, Tryba M, Weber-Carstens S, Wrigge H.  
[S2e guideline: positioning and early mobilisation in prophylaxis or therapy of pulmonary disorders: Revision 2015: S2e guideline of the German Society of Anaesthesiology and Intensive Care Medicine \(DGAI\)](#). Anaesthesist. 2015 Dec;64 Suppl 1:1-26.
- [Australian Clinical Guideline: Physical Activity and Movement: A Guideline for Critically Ill Adults](#), 2017.

## Barriers and ways to overcome them

### Studies

- Harrold ME, Salisbury LG, Webb SA, Allison GT; Australia and Scotland ICU Physiotherapy Collaboration.  
[Early mobilisation in intensive care units in Australia and Scotland: a prospective, observational cohort study examining mobilisation practises and barriers](#). Crit Care. 2015 Sep 14;19:336.
- Dubb R, Nydahl P, Hermes C, Schwabbauer N, Toonstra A, Parker AM, Kaltwasser A, Needham DM  
[Barriers and Strategies for Early Mobilization of Patients in Intensive Care Units](#). Crit Care. 2015 Sep 14;19:336.
- Engel HJ1, Needham DM, Morris PE, Gropper MA  
[ICU early mobilization: from recommendation to implementation at three medical centers](#). Crit Care Med. 2013 Sep;41(9 Suppl 1):S69-80..

## Mechanical Ventilation & Weaning

### Review

- Burns KE, Lellouche F, Nisenbaum R, Lessard MR, Friedrich JO.  
[Automated weaning and SBT systems versus non-automated weaning strategies for weaning time in invasively ventilated critically ill adults](#). Cochrane Database Syst Rev. 2014 Sep 9;(9):CD008638.

### Study

- Dres M, Dubé BP, Mayaux J, Delemazure J, Reuter D, Brochard L, Similowski T, Demoule A.  
[Coexistence and Impact of Limb Muscle and Diaphragm Weakness at Time of Liberation from Mechanical Ventilation in Medical Intensive Care Unit Patients](#). Am J Respir Crit Care Med. 2017 Jan 1;195(1):57-66.

## Sedation & Delirium

### Guidelines

- Barr J, Fraser GL, Puntillo K, Ely EW, Gélinas C, Dasta JF, Davidson JE, Devlin JW, Kress JP, Joffe AM, Coursin DB, Herr DL, Tung A, Robinson BR, Fontaine DK, Ramsay MA, Riker RR, Sessler CN, Pun B, Skrobik Y, Jaeschke R; American College of Critical Care Medicine.  
[Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit](#). Crit Care Med. 2013 Jan;41(1):263-306
- DAS-Taskforce 2015, Baron R, Binder A, Biniek R, Braune S, Buerkle H, Dall P, Demirakca S, Eckardt R, Eggers V, Eichler I, Fietze I, Freys S, Fründ A, Garten L, Gohrbandt B, Harth I, Hartl W, Heppner HJ, Horter J, Huth R, Janssens U, Jungk C, Kaeuper KM, Kessler P, Kleinschmidt S, Kochanek M, Kumpf M, Meiser A, Mueller A, Orth M, Putensen C, Roth B, Schaefer M, Schaefer R, Schellongowski P, Schindler M, Schmitt R, Scholz J, Schroeder S, Schwarzmann G, Spies C, Stingele R, Tonner P, Trieschmann U, Tryba M, Wappler F, Waydhas C, Weiss B, Weisshaar G.  
[Evidence and consensus based guideline for the management of delirium, analgesia, and sedation in intensive care medicine](#). Revision 2015 (DAS-Guideline 2015) - short version. Ger Med Sci. 2015 Nov 12;13:Doc19.

## Patient & financial Outcomes

### Studies

- Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, Spears L, Miller M, Franczyk M, Deprizio D, Schmidt GA, Bowman A, Barr R, McCallister KE, Hall JB, Kress JP.  
[Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial](#). Lancet. 2009 May 30;373(9678):1874-82
- Lord RK, Mayhew CR, Korupolu R, Manthey EC, Friedman MA, Palmer JB, Needham DM.  
[ICU early physical rehabilitation programs: financial modeling of cost savings](#). Critical Care Medicine 2013 Mar;41(3):717-24.

## Early Mobilization in the ICU - Literature List

### Abstracts

Writer	Subject	Publication	Page
Barr et. al.	Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit.	<i>Crit Care Med.</i> 2013 Jan;41(1):263-306	5
Bein T, et. al.	S2e guideline: positioning and early mobilisation in prophylaxis or therapy of pulmonary disorders: Revision 2015	<i>German Society of Anaesthesiology and Intensive Care Medicine (DGAI).</i> 2015.	6
Burns KE, Lellouche F, Nisenbaum R, Lessard MR, Friedrich JO	Automated weaning and SBT systems versus non-automated weaning strategies for weaning time in invasively ventilated critically ill adults.	<i>Cochrane Database Syst Rev.</i> 2014 Sep 9;(9):CD008638.	6
DAS Taskforce, et. al.	Evidence and consensus based guideline for the management of delirium, analgesia, and sedation in intensive care medicine. Revision 2015 (DAS-Guideline 2015) - short version.	<i>Ger Med Sci.</i> 2015 Nov 12;13:Doc19.	7
Dres M, et. al.	Coexistence and Impact of Limb Muscle and Diaphragm Weakness at Time of Liberation from Mechanical Ventilation in Medical Intensive Care Unit Patients	<i>Am J Respir Crit Care Med.</i> 2017 Jan 1;195(1):57-66	8
Dubb R, et. al.	Barriers and Strategies for Early Mobilization of Patients in Intensive Care Units	<i>Ann Am Thorac Soc.</i> 2016 May;13(5):724-30.	8
Engel HJ, et. al.	ICU early mobilization: from recommendation to implementation at three medical centers	<i>Crit Care Med.</i> 2013 Sep;41(9 Suppl 1):S69-80.	9
Fan, E. et. al., American Thoracic Society	An official American Thoracic Society Clinical Practice guideline: the diagnosis of intensive care unit-acquired weakness in adults.	<i>Am J Respir Crit Care Med.</i> 2014 Dec 15;190(12):1437-46.	9
Harrold ME, et. al.	Early mobilisation in intensive care units in Australia and Scotland: a prospective, observational cohort study examining mobilisation practises and barriers.	<i>Crit Care.</i> 2015 Sep 14; 19:336.	10
Hodgson CL, et.al.	Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults	<i>Crit Care.</i> 2014; 18(6): 658.	10

Jolley S, et. al.	ICU-Acquired Weakness	<i>Chest. 2016 Nov; 150(5):1129-1140.</i>	11
Lord RK, et. al.	ICU early physical rehabilitation programs: financial modeling of cost savings.	<i>Crit Care Med. 2013 Mar;41(3):717-24.</i>	12
NSW Agency for Clinical Innovation	Australian Clinical Guideline: Physical Activity and Movement: A Guideline for Critically Ill Adults	<i>Agency for clinical innovation, 2017.</i>	12
Schweickert WD, et. al.	Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial.	<i>Lancet. 2009 May 30;373(9678):1874-82.</i>	13

**Abbreviations:**

GUI – Guideline

REV – Review

STU – Study

GUI	Barr et. al.	<b>Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit.</b>	<i>Crit Care Med. 2013 Jan;41(1):263-306</i>
<p><b>Rationale and Objectives:</b> To revise the "Clinical Practice Guidelines for the Sustained Use of Sedatives and Analgesics in the Critically Ill Adult" published in Critical Care Medicine in 2002. The American College of Critical Care Medicine assembled a 20-person, multidisciplinary, multi-institutional task force with expertise in guideline development, pain, agitation and sedation, delirium management, and associated outcomes in adult critically ill patients. The task force, divided into four subcommittees, collaborated over 6 yr in person, via teleconferences, and via electronic communication. Subcommittees were responsible for developing relevant clinical questions, using the Grading of Recommendations Assessment, Development and Evaluation method (<a href="http://www.gradeworkinggroup.org">http://www.gradeworkinggroup.org</a>) to review, evaluate, and summarize the literature, and to develop clinical statements (descriptive) and recommendations (actionable). With the help of a professional librarian and Refworks database software, they developed a Web-based electronic database of over 19,000 references extracted from eight clinical search engines, related to pain and analgesia, agitation and sedation, delirium, and related clinical outcomes in adult ICU patients. The group also used psychometric analyses to evaluate and compare pain, agitation/sedation, and delirium assessment tools. All task force members were allowed to review the literature supporting each statement and recommendation and provided feedback to the subcommittees. Group consensus was achieved for all statements and recommendations using the nominal group technique and the modified Delphi method, with anonymous voting by all task force members using E-Survey (<a href="http://www.esurvey.com">http://www.esurvey.com</a>). All voting was completed in December 2010. Relevant studies published after this date and prior to publication of these guidelines were referenced in the text. The quality of evidence for each statement and recommendation was ranked as high (A), moderate (B), or low/very low (C). The strength of recommendations was ranked as strong (1) or weak (2), and either in favor of (+) or against (-) an intervention. A strong recommendation (either for or against) indicated that the intervention's desirable effects either clearly outweighed its undesirable effects (risks, burdens, and costs) or it did not. For all strong recommendations, the phrase "We recommend ..." is used throughout. A weak recommendation, either for or against an intervention, indicated that the trade-off between desirable and undesirable effects was less clear. For all weak recommendations, the phrase "We suggest ..." is used throughout. In the absence of sufficient evidence, or when group consensus could not be achieved, no recommendation (0) was made. Consensus based on expert opinion was not used as a substitute for a lack of evidence. A consistent method for addressing potential conflict of interest was followed if task force members were coauthors of related research. The development of this guideline was independent of any industry funding.</p>			
<p><b>Conclusion:</b> These guidelines provide a roadmap for developing integrated, evidence-based, and patient-centered protocols for preventing and treating pain, agitation, and delirium in critically ill patients..</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/23269131">https://www.ncbi.nlm.nih.gov/pubmed/23269131</a></p>			

GUI	Bein T, et. al.	<b>S2e guideline: positioning and early mobilisation in prophylaxis or therapy of pulmonary disorders : Revision 2015</b>	<i>German Society of Anaesthesiology and Intensive Care Medicine (DGAI). 2015.</i>
<p><b>Abstract:</b> The German Society of Anesthesiology and Intensive Care Medicine (DGAI) commissioned a revision of the S2 guidelines on "positioning therapy for prophylaxis or therapy of pulmonary function disorders" from 2008. Because of the increasing clinical and scientific relevance the guidelines were extended to include the issue of "early mobilization" and the following main topics are therefore included: use of positioning therapy and early mobilization for prophylaxis and therapy of pulmonary function disorders, undesired effects and complications of positioning therapy and early mobilization as well as practical aspects of the use of positioning therapy and early mobilization. These guidelines are the result of a systematic literature search and the subsequent critical evaluation of the evidence with scientific methods. The methodological approach for the process of development of the guidelines followed the requirements of evidence-based medicine, as defined as the standard by the Association of the Scientific Medical Societies in Germany. Recently published articles after 2005 were examined with respect to positioning therapy and the recently accepted aspect of early mobilization incorporates all literature published up to June 2014</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/26335630">https://www.ncbi.nlm.nih.gov/pubmed/26335630</a>  <b>PMC:</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4712230/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4712230/</a> (free full-text)</p>			

REV	Burns KE, Lellouche F, Nisenbaum R, Lessard MR, Friedrich JO	<b>Automated weaning and SBT systems versus non-automated weaning strategies for weaning time in invasively ventilated critically ill adults.</b>	<i>Cochrane Database Syst Rev. 2014 Sep 9;(9):CD008638.</i>
<p><b>Rationale and Objectives:</b> Automated systems use closed-loop control to enable ventilators to perform basic and advanced functions while supporting respiration. SmartCare™ is a unique automated weaning system that measures selected respiratory variables, adapts ventilator output to individual patient needs by operationalizing predetermined algorithms and automatically conducts spontaneous breathing trials (SBTs) when predetermined thresholds are met.</p> <p>The primary objective of this review was to compare weaning time (time from randomization to extubation as defined by study authors) between invasively ventilated critically ill adults weaned by automated weaning and SBT systems versus non-automated weaning strategies. As secondary objectives, we ascertained differences between effects of alternative weaning strategies on clinical outcomes (time to successful extubation, time to first SBT and first successful SBT, mortality, ventilator-associated pneumonia, total duration of ventilation, lengths of intensive care unit (ICU) and hospital stay, use of non-invasive ventilation (NIV), adverse events and clinician acceptance). The third objective of our review was to use subgroup analyses to explore variations in weaning time, length of ICU stay, mortality, ventilator-associated pneumonia, use of NIV and reintubation according to (1) the type of clinician primarily involved in implementing the automated weaning and SBT strategy, (2) the ICU (as a reflection of the population involved) and (3) the non-automated (control) weaning strategy utilized. We conducted a sensitivity analysis to evaluate variations in weaning time based on (4) the methodological quality (low or unclear versus high risk of bias) of the included studies.</p>			

**Conclusions:** Compared with non-automated weaning strategies, weaning with SmartCare™ significantly decreased weaning time, time to successful extubation, ICU stay and proportions of patients receiving ventilation for longer than seven days and 21 days. It also showed a favourable trend toward fewer patients receiving ventilation for longer than 14 days; however the estimated effect was imprecise. Summary estimates from our review suggest that these benefits may be achieved without increasing the risk of adverse events, especially reintubation; however, the quality of the evidence ranged from low to moderate, and evidence was derived from 10 small randomized controlled trials.

**PubMed:** <https://www.ncbi.nlm.nih.gov/pubmed/25203308>  
**Cochrane Library:** <http://cochranelibrary-wiley.com/doi/10.1002/14651858.CD008638.pub2/epdf> (free full-text)

GUI	DAS Taskforce, et. al.	<b>Evidence and consensus based guideline for the management of delirium, analgesia, and sedation in intensive care medicine. Revision 2015 (DAS-Guideline 2015) - short version.</b>	<i>Ger Med Sci. 2015 Nov 12;13:Doc19.</i>
<p>In 2010, under the guidance of the DGAI (German Society of Anaesthesiology and Intensive Care Medicine) and DIVI (German Interdisciplinary Association for Intensive Care and Emergency Medicine), twelve German medical societies published the "Evidence- and Consensus-based Guidelines on the Management of Analgesia, Sedation and Delirium in Intensive Care". Since then, several new studies and publications have considerably increased the body of evidence, including the new recommendations from the American College of Critical Care Medicine (ACCM) in conjunction with Society of Critical Care Medicine (SCCM) and American Society of Health-System Pharmacists (ASHP) from 2013. For this update, a major restructuring and extension of the guidelines were needed in order to cover new aspects of treatment, such as sleep and anxiety management. The literature was systematically searched and evaluated using the criteria of the Oxford Center of Evidence Based Medicine. The body of evidence used to formulate these recommendations was reviewed and approved by representatives of 17 national societies. Three grades of recommendation were used as follows: Grade "A" (strong recommendation), Grade "B" (recommendation) and Grade "O" (open recommendation). The result is a comprehensive, interdisciplinary, evidence and consensus-based set of level 3 guidelines. This publication was designed for all ICU professionals, and takes into account all critically ill patient populations. It represents a guide to symptom-oriented prevention, diagnosis, and treatment of delirium, anxiety, stress, and protocol-based analgesia, sedation, and sleep-management in intensive care medicine.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/26609286">https://www.ncbi.nlm.nih.gov/pubmed/26609286</a>  <b>PMC:</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4645746/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4645746/</a> (free full-text)</p>			

<b>STU</b>	<b>Dres M, et. al.</b>	<b>Coexistence and Impact of Limb Muscle and Diaphragm Weakness at Time of Liberation from Mechanical Ventilation in Medical Intensive Care Unit Patients</b>	<i>Am J Respir Crit Care Med. 2017 Jan 1;195(1):57-66</i>
<p><b>Rationale and Objectives:</b> Intensive care unit (ICU)- and mechanical ventilation (MV)-acquired limb muscle and diaphragm dysfunction may both be associated with longer length of stay and worse outcome. Whether they are two aspects of the same entity or have a different prevalence and prognostic impact remains unclear. The objective of this study was to quantify the prevalence and coexistence of these two forms of ICU-acquired weakness and their impact on outcome.</p>			
<p><b>Conclusion:</b> Diaphragm dysfunction is twice as frequent as limb muscle weakness and has a direct negative impact on weaning outcome. The two types of muscle weakness have only limited overlap.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/27310484">https://www.ncbi.nlm.nih.gov/pubmed/27310484</a> <b>AJRCCM:</b> <a href="https://www.atsjournals.org/doi/full/10.1164/rccm.201602-0367OC">https://www.atsjournals.org/doi/full/10.1164/rccm.201602-0367OC</a> (free full-text)</p>			

<b>STU</b>	<b>Dubb R, et. al.</b>	<b>Barriers and Strategies for Early Mobilization of Patients in Intensive Care Units</b>	<i>Ann Am Thorac Soc. 2016 May;13(5):724-30.</i>
<p>Early mobilization of patients in the intensive care unit (ICU) is safe, feasible, and beneficial. However, implementation of early mobility as part of routine clinical care can be challenging. The objective of this review is to identify barriers to early mobilization and discuss strategies to overcome such barriers. Based on a literature search, we synthesize data from 40 studies reporting 28 unique barriers to early mobility, of which 14 (50%) were patient-related, 5 (18%) structural, 5 (18%) ICU cultural, and 4 (14%) process-related barriers. These barriers varied across ICUs and within disciplines, depending on the ICU patient population, setting, attitude, and ICU culture. To overcome the identified barriers, over 70 strategies were reported and are synthesized in this review, including: implementation of safety guidelines; use of mobility protocols; interprofessional training, education, and rounds; and involvement of physician champions. Systematic efforts to change ICU culture to prioritize early mobilization using an interprofessional approach and multiple targeted strategies are important components of successfully implementing early mobility in clinical practice.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/27144796">https://www.ncbi.nlm.nih.gov/pubmed/27144796</a></p>			



STU	Engel HJ, et. al.	ICU early mobilization: from recommendation to implementation at three medical centers	<i>Crit Care Med. 2013 Sep;41(9 Suppl 1):S69-80.</i>
<p><b>Rationale and Objectives:</b> To compare and contrast the process used to implement an early mobility program in ICUs at three different medical centers and to assess their impact on clinical outcomes in critically ill patients.</p>			
<p><b>Conclusion:</b> Establishing an ICU early mobilization quality improvement program resulted in a reduced ICU and hospital length of stay at all three institutions and decreased rates of delirium and the need for sedation for the patients enrolled in the Johns Hopkins ICU early mobility program.</p> <p>Instituting a planned, structured ICU early mobility quality improvement project can result in improved outcomes and reduced costs for ICU patients across healthcare systems.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/23989097">https://www.ncbi.nlm.nih.gov/pubmed/23989097</a></p>			

GUI	Fan, E. et. al., American Thoracic Society	An official American Thoracic Society Clinical Practice guideline: the diagnosis of intensive care unit-acquired weakness in adults.	<i>Am J Respir Crit Care Med. 2014 Dec 15;190(12):1437-46.</i>
<p><b>Rationale and Objectives:</b> Profound muscle weakness during and after critical illness is termed intensive care unit-acquired weakness (ICUAW). Objective: To develop diagnostic recommendations for ICUAW.</p>			
<p><b>Main Results and Conclusions:</b> Severe sepsis, difficult ventilator liberation, and prolonged mechanical ventilation are associated with ICUAW. Physical rehabilitation improves outcomes in heterogeneous populations of ICU patients. Because it may not be feasible to provide universal physical rehabilitation, an alternative approach is to identify patients most likely to benefit. Patients with ICUAW may be such a group. Our review identified only one case series of patients with ICUAW who received physical therapy. When compared with a case series of patients with ICUAW who did not receive structured physical therapy, evidence suggested those who receive physical rehabilitation were more frequently discharged home rather than to a rehabilitative facility, although confidence intervals included no difference. Other interventions show promise, but fewer data proving patient benefit existed, thus precluding specific comment. Additionally, prior comorbidity was insufficiently defined to determine its influence on outcome, treatment response, or patient preferences for diagnostic efforts. We recommend controlled clinical trials in patients with ICUAW that compare physical rehabilitation with usual care and further research in understanding risk and patient preferences. Conclusions: Research that identifies treatments that benefit patients with ICUAW is necessary to determine whether the benefits of diagnostic testing for ICUAW outweigh its burdens.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/25496103">https://www.ncbi.nlm.nih.gov/pubmed/25496103</a>  <b>ATS Journals:</b> <a href="https://www.atsjournals.org/doi/full/10.1164/rccm.201411-2011ST">https://www.atsjournals.org/doi/full/10.1164/rccm.201411-2011ST</a> (free full-text)</p>			

STU	Harrold ME, et. al.	<b>Early mobilisation in intensive care units in Australia and Scotland: a prospective, observational cohort study examining mobilisation practises and barriers.</b>	<i>Crit Care. 2015 Sep 14; 19:336.</i>
<p><b>Rationale and Objectives:</b> Mobilisation of patients in the intensive care unit (ICU) is an area of growing research. Currently, there is little data on baseline mobilisation practises and the barriers to them for patients of all admission diagnoses. The objectives of the study were to (1) quantify and benchmark baseline levels of mobilisation in Australian and Scottish ICUs, (2) compare mobilisation practises between Australian and Scottish ICUs and (3) identify barriers to mobilisation in Australian and Scottish ICUs. We conducted a prospective, observational, cohort study with a 4-week inception period. Patients were censored for follow-up upon ICU discharge or after 28 days, whichever occurred first. Patients were included if they were &gt;18 years of age, admitted to an ICU and received mechanical ventilation in the ICU.</p>			
<p><b>Conclusion:</b> Ten tertiary ICUs in Australia and nine in Scotland participated in the study. The Australian cohort had a large proportion of patients admitted for cardiothoracic surgery (43.3%), whereas the Scottish cohort had none. Therefore, comparison analysis was done after exclusion of patients admitted for cardiothoracic surgery. In total, 60.2% of the 347 patients across 10 Australian ICUs and 40.1% of the 167 patients across 9 Scottish ICUs mobilised during their ICU stay (<math>p &lt; 0.001</math>). Patients in the Australian cohort were more likely to mobilise than patients in the Scottish cohort (hazard ratio 1.83, 95% confidence interval 1.38-2.42). However, the percentage of episodes of mobilisation where patients were receiving mechanical ventilation was higher in the Scottish cohort (41.1% vs 16.3%, <math>p &lt; 0.001</math>). Sedation was the most commonly reported barrier to mobilisation in both the Australian and Scottish cohorts. Physiological instability and the presence of an endotracheal tube were also frequently reported barriers. This is the first study to benchmark baseline practise of early mobilisation internationally, and it demonstrates variation in early mobilisation practises between Australia and Scotland.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/26370550">https://www.ncbi.nlm.nih.gov/pubmed/26370550</a>  <b>PMC:</b> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4570617">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4570617</a> (free full-text)</p>			

GUI	Hodgson CL, et.al.	<b>Expert consensus and recommendations on safety criteria for active mobilization of mechanically ventilated critically ill adults</b>	<i>Crit Care. 2014; 18(6): 658.</i>
<p><b>Rationale and Objectives:</b> The aim of this study was to develop consensus recommendations on safety parameters for mobilizing adult, mechanically ventilated, intensive care unit (ICU) patients. A systematic literature review was followed by a meeting of 23 multidisciplinary ICU experts to seek consensus regarding the safe mobilization of mechanically ventilated patients.</p>			
<p><b>Conclusion:</b> Safety considerations were summarized in four categories: respiratory, cardiovascular, neurological and other. Consensus was achieved on all criteria for safe mobilization, with the exception being levels of vasoactive agents. Intubation via an endotracheal tube was not a contraindication to early mobilization and a fraction of inspired oxygen less than 0.6 with a percutaneous oxygen saturation more than 90% and a respiratory rate less than 30 breaths/minute were considered safe criteria for in- and out-</p>			

of-bed mobilization if there were no other contraindications. At an international meeting, 94 multidisciplinary ICU clinicians concurred with the proposed recommendations. Consensus recommendations regarding safety criteria for mobilization of adult, mechanically ventilated patients in the ICU have the potential to guide ICU rehabilitation whilst minimizing the risk of adverse events.

**PubMed:** <https://www.ncbi.nlm.nih.gov/pubmed/25475522>  
**PMC:** <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4301888> (free full-text)

REV	Jolley S, et. al.	ICU-Acquired Weakness	<i>Chest. 2016 Nov; 150(5):1129-1140.</i>
<p><b>Abstract:</b> Survivorship after critical illness is an increasingly important health-care concern as ICU use continues to increase while ICU mortality is decreasing. Survivors of critical illness experience marked disability and impairments in physical and cognitive function that persist for years after their initial ICU stay. Newfound impairment is associated with increased health-care costs and use, reductions in health-related quality of life, and prolonged unemployment. Weakness, critical illness neuropathy and/or myopathy, and muscle atrophy are common in patients who are critically ill, with up to 80% of patients admitted to the ICU developing some form of neuromuscular dysfunction. ICU-acquired weakness (ICUAW) is associated with longer durations of mechanical ventilation and hospitalization, along with greater functional impairment for survivors. Although there is increasing recognition of ICUAW as a clinical entity, significant knowledge gaps exist concerning identifying patients at high risk for its development and understanding its role in long-term outcomes after critical illness. This review addresses the epidemiologic and pathophysiologic aspects of ICUAW; highlights the diagnostic challenges associated with its diagnosis in patients who are critically ill; and proposes, to our knowledge, a novel strategy for identifying ICUAW.</p>			
<p><b>Conclusion:</b> ICUAW is common in patients who are critically ill, often is underreported, and manifests in a spectrum of disease. Diagnostic limitations in our current testing modalities limit identification of weakness early in critical illness. Although illness severity, multiorgan failure, and immobilization are recognized as potential risk factors for ICUAW, the strength of these associations remains uncertain. Adjustment for baseline function may play an important role in understanding disease trajectories for ICUAW. To our knowledge, novel diagnostic methods, including single NCS and muscle ultrasound, may provide a minimally invasive means for early recognition of disease. Risk factor avoidance or modification and early activity may reduce the risk and severity of ICUAW. Studies are needed that explore interventions targeted toward patient participation and stage of disease rather than being applied uniformly across the spectrum.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/27063347">https://www.ncbi.nlm.nih.gov/pubmed/27063347</a></p>			

<b>STU</b>	<b>Lord RK, et. al.</b>	<b>ICU early physical rehabilitation programs: financial modeling of cost savings.</b>	<i>Crit Care Med. 2013 Mar;41(3):717-24.</i>
<p><b>Rationale and Objectives:</b> To evaluate the potential annual net cost savings of implementing an ICU early rehabilitation program.</p> <p>Using data from existing publications and actual experience with an early rehabilitation program in the Johns Hopkins Hospital Medical ICU, we developed a model of net financial savings/costs and presented results for ICUs with 200, 600, 900, and 2,000 annual admissions, accounting for both conservative- and best-case scenarios. Our example scenario provided a projected financial analysis of the Johns Hopkins Medical ICU early rehabilitation program, with 900 admissions per year, using actual reductions in length of stay achieved by this program.</p>			
<p><b>Conclusion:</b> Net cost savings generated in our example scenario, with 900 annual admissions and actual length of stay reductions of 22% and 19% for the ICU and floor, respectively, were \$817,836. Sensitivity analyses, which used conservative- and best-case scenarios for length of stay reductions and varied the per-day ICU and floor costs, across ICUs with 200-2,000 annual admissions, yielded financial projections ranging from -\$87,611 (net cost) to \$3,763,149 (net savings). Of the 24 scenarios included in these sensitivity analyses, 20 (83%) demonstrated net savings, with a relatively small net cost occurring in the remaining four scenarios, mostly when simultaneously combining the most conservative assumptions.</p> <p>A financial model, based on actual experience and published data, projects that investment in an ICU early rehabilitation program can generate net financial savings for U.S. hospitals. Even under the most conservative assumptions, the projected net cost of implementing such a program is modest relative to the substantial improvements in patient outcomes demonstrated by ICU early rehabilitation programs.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/23318489">https://www.ncbi.nlm.nih.gov/pubmed/23318489</a></p>			

<b>GUI</b>	<b>NSW Agency for Clinical Innovation</b>	<b>Australian Clinical Guideline: Physical Activity and Movement: A Guideline for Critically Ill Adults</b>	<i>Agency for clinical innovation, 2017.</i>
<p><b>Rationale and Objectives:</b> Many survivors of a critical illness experience significant physical, psychological and cognitive deficits. Emerging research supports the inclusion of physical activity and movement programs into the care routines of Intensive Care patients. The purpose of this guideline is to provide intensive care clinicians with evidence and best practice recommendations to guide the development of local physical activity and movement (PAM) programs for critically ill adult ICU patients.</p>			
<p><b>Conclusion:</b> As survival rates following critical illness continue to improve more information is becoming available about the significant physical, psychological and cognitive deficits experienced by many survivors during their recovery and subsequent hospital discharge. Some of these deficits can be attributed to muscle wasting as a result of critical illness, treatment and immobility while in the intensive care (ICU).</p>			

Studies have demonstrated that early physical activity and movement programs are feasible, safe and effective at reducing some of the adverse effects of surviving a critical illness. This guideline is based on three clinical health questions: How can critically ill adult patients in ICU be safely mobilised? What are the strategies for safely mobilising a patient within an adult ICU? What are the barriers to safe mobilisation of patients in an adult ICU? This guideline offers 16 recommendations to guide the development of a physical activity and movement (PAM) program for critically ill adult ICU patients from the time of admission until discharge. It is recommended that when developing individual patient PAM programs local resources be taken into consideration to ensure successful implementation and maintenance of the program. Finally, it is important that clinicians evaluate the effectiveness of locally developed PAM programs to ensure that patients' recovery from their experience of critical illness has been optimised.

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<b>STU</b>	<b>Schweickert WD, et. al.</b>	<b>Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial.</b>	<i>Lancet. 2009 May 30;373(9678):1874-82.</i>
<p><b>Rationale and Objectives:</b> Long-term complications of critical illness include intensive care unit (ICU)-acquired weakness and neuropsychiatric disease. Immobilisation secondary to sedation might potentiate these problems. We assessed the efficacy of combining daily interruption of sedation with physical and occupational therapy on functional outcomes in patients receiving mechanical ventilation in intensive care.</p>			
<p><b>Conclusion:</b> All 104 patients were included in the analysis. Return to independent functional status at hospital discharge occurred in 29 (59%) patients in the intervention group compared with 19 (35%) patients in the control group (p=0.02; odds ratio 2.7 [95% CI 1.2-6.1]). Patients in the intervention group had shorter duration of delirium (median 2.0 days, IQR 0.0-6.0 vs 4.0 days, 2.0-8.0; p=0.02), and more ventilator-free days (23.5 days, 7.4-25.6 vs 21.1 days, 0.0-23.8; p=0.05) during the 28-day follow-up period than did controls. There was one serious adverse event in 498 therapy sessions (desaturation less than 80%). Discontinuation of therapy as a result of patient instability occurred in 19 (4%) of all sessions, most commonly for perceived patient-ventilator asynchrony.</p> <p>A strategy for whole-body rehabilitation-consisting of interruption of sedation and physical and occupational therapy in the earliest days of critical illness-was safe and well tolerated, and resulted in better functional outcomes at hospital discharge, a shorter duration of delirium, and more ventilator-free days compared with standard care.</p>			
<p><b>PubMed:</b> <a href="https://www.ncbi.nlm.nih.gov/pubmed/19446324">https://www.ncbi.nlm.nih.gov/pubmed/19446324</a></p>			