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Early Mobilization of Patients in Intensive Care: Organization, Communication and Safety Factors that Influence Translation into Clinical Practice

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Abstract

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Background

Early mobilization in the intensive care unit (ICU) is currently a hot topic, with more than 15 randomized controlled trials (RCTs) in the past ten years including several high impact publications [1]. However, the largest studies of early mobilization have enrolled 300 patients, and the results of phase II randomized trials, pilot studies and observational studies have been used to encourage practice change [2–5]. There are currently several international practice guidelines available, and early mobilization has consistently been reported as safe and feasible in the ICU setting [6]. There is no doubt that this early intervention in ICU shows exciting potential. The reported benefits of early mobilization, include reduced ICU-acquired weakness, improved functional recovery within hospital, improved walking distance at hospital discharge and reduced hospital length of stay [1]. However, medical research has repeatedly demonstrated that the results of pilot studies and phase II studies may not result in improved patient-centered outcomes when tested in a larger trial [7, 8]. More importantly, it has been difficult to test this complex intervention, with several randomized trials delivering significantly less early mobilization than specified in the study protocol [2, 9] and observational studies reporting very low rates of early mobilization during the ICU stay [10, 11].

This chapter summarizes the considerations for patient safety during early mobilization; including the physiological assessment of the patient, the consideration of invasive lines and monitoring, the management of sedation, strategies to educate and manage the multidisciplinary team and environmental factors. Importantly, we will consider the long-term effect of early mobilization on patient outcome and the future directions for this important area of work for ICU clinicians.

Safety of Early Mobilization in the ICU: Short-Term Consequences

Early mobilization is a complex intervention that requires careful patient assessment and management, as well as interdisciplinary team cooperation and training [12]. Patient safety is one of the most commonly reported barriers to delivering early mobilization, including respiratory, cardiovascular and neurological stability and the integrity of invasive lines. In a recent systematic review and meta-analysis of patient safety during early mobilization, 48 studies were identified that reported data on safety during early mobilization, including falls, removal of endotracheal tubes (ETT), removal or dysfunction of intravascular catheters, removal of catheters or tubes, cardiac arrest, hemodynamic changes and oxygen desaturation [13]. Five studies were not included as their data were reported in other included publications. The 43 included studies had different descriptions of safety events and, in most, the criteria for ceasing early mobilization were the same

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criteria used to define a safety event. The most frequently reported safety events were oxygen desaturation and hemodynamic changes, each reported in 33 (69%) of the eligible studies and removal or dysfunction of intravascular catheters reported in 31 (65%) of the eligible studies. Several studies did not report on important safety events, including falls (n = 21, 43%), ETT removal (n = 17, 35%) and cardiac arrest (n = 15, 31%).

Of the 43 included studies, 23 (53%) reported consequences of potential safety events [13]. There were 308 potential safety events from 13,974 mobilization sessions, for an incidence of 2% potential safety events during mobilization. Of these, consequences of the safety event were reported for 78 occasions (0.6%) including 49 debridement or suturing of wounds and 11 tube removals with 4 of these requiring replacement. With regards to adverse events including a high heart rate, low blood pressure or oxygen desaturation, the pooled incidence for each was less than 2 per 1,000 episodes of mobilization. Safety events that resulted in additional care requirements or consequences were very rare.

There have been several publications that recommend criteria for the safe mobilization of patients receiving mechanically ventilated. The first was published approximately 15 years ago, and later adopted as a recommendation by the European Respiratory Society and the European Society of Critical Care Medicine [12, 14]. At this time, the evidence was considered level C and D (observational studies and expert opinions). In particular, these authors recommended identification of patient characteristics that enable treatment to be prescribed and modified on an individual basis, with standardized pathways for clinical decision making. The flow diagram detailing patient assessment prior to early mobilization is a useful tool in clinical practice, and may be used to assist with staff training.

More recently, an international multidisciplinary expert consensus group developed recommendations for consideration prior to mobilization of patients in the ICU during mechanical ventilation [15]. The panel consisted of 23 clinical or research experts from four countries, including 17 physiotherapists, five intensivists and one nurse. Following a modified Delphi process, the group developed a traffic light system for each of the identified safety criteria to determine the risk/benefit of performing early mobilization. Green indicated that there was a low risk of an adverse event, and the benefit outweighed the potential safety consequences of early mobilization. Yellow indicated a potential risk or consequence of adverse event during early mobilization, such that precautions and contraindications should be discussed with the interdisciplinary team prior to mobilization. Red indicated a significant potential risk of an adverse event, where early mobilization should not occur unless it was authorized by the medical team responsible for the overall patient management in ICU.

Importantly, a 'red' sign was not a contraindication to early mobilization, but rather a clear message that the risks may outweigh the benefits in this instance (Fig. 1) [15]. The safety criteria were divided into the categories of respiratory, cardiovascular, neurological and other considerations (e.g., securing intravascular lines). Consensus was achieved on all criteria for safe mobilization with the exception of levels of vasoactive agents, where the panel agreed that more evidence was required to guide the recommendations. At an international meeting, 94 multidisciplinary ICU clinicians concurred with the proposed expert recommendations prior to publication.

The safety criteria developed by the group were intended to be used whenever mobilization was being considered, which might be up to several times per day for an individual patient. In considering the decision to mobilize a patient, the criteria should be assessed based on the status of the patient at the time of planned mobilization, but changes in condition, and direction of trends, in the preceding hours should also be taken into account [15]. The potential consequences of an adverse event in an individual patient should also be considered as part of the overall clinical reasoning process. This group noted that further research was required to validate the traffic light system in centers of clinical expertise and in centers without clinical expertise in early mobilization. They also noted that practice may change and progress in the future, so that areas that were considered a significant potential risk (red) may change to yellow with further investigation, or *vice versa*.

Barriers and Facilitators to Mobilization Reported in Quantitative Studies

Many observational and randomized controlled trials over the past decade have demonstrated that ICU clinicians are reluctant to mobilize mechanically ventilated patients, despite the scarcity of reported adverse events and the potential benefits [11, 16, 17]. The barriers and facilitators to early mobilization can be divided into patient factors, ICU team factors and organizational factors (Table 1). A recent systematic review identified barriers to delivering the Awakening, Breathing Coordination, Delirium and Early mobility/exercise (ABCDE) bundle to minimize adverse outcomes and improve patient care for ICU patients [18]. This study reported 107 barriers, categorized into four classes: patient-related (patient instability); clinician-related (lack of knowledge and staff safety concerns); protocol-related (unclear protocol criteria); and ICU contextual barriers (interdisciplinary team coordination).

Several large, multicenter observational studies have reported barriers to mobilization across regions. For example,

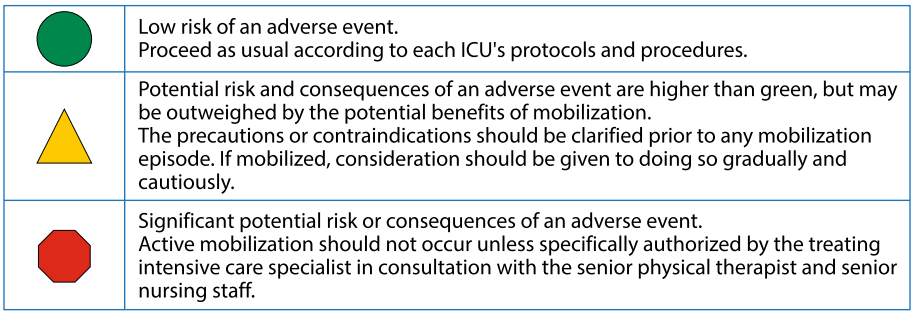

Fig. 1 Expert consensus color coding definitions for safe early mobilization of mechanically ventilated patients [15]

a prospective, observational study of mobilization practice in mechanically ventilated patients enrolled 192 patients from 12 ICUs in Australia and New Zealand [11]. The data were collected from 1,288 physiotherapy–patient interactions and no early mobilization occurred in 1,079 (84%) of these episodes during mechanical ventilation. A total of 122 (63.5%) patients did not receive early active mobilization and the main reported barrier to mobilization was sedation, with nearly half of the cohort too sedated for active mobilization on the first two days in the ICU. The study suggests that unit culture, rather than patient-related factors, may be the main barrier to early mobilization in these ICUs. The use of vasopressors was common (n = 127, 66%), however there was no evidence to suggest the appropriate level of vasopressor support to enable safe mobilization. Similarly, a point prevalence study completed across 38 ICUs in Australia and New Zealand showed that no patients mobilized or sat out of bed during mechanical ventilation [16].

Table 1 Barriers and facilitators to mobilization

Barriers	Facilitators
Patient Factors	
Physiological instability (hemodynamic, respiratory, neurological)	Manage patient physiological instability
Sedation	Management of sedation & delirium
Low Glasgow Coma Scale	Sleep
Delirium/agitation	Delirium screening/management
Psychological state	Analgesia prior to mobilization
Pain	Patient goals
Medical procedures/orders	Family engagement and education
Patient refusal/anxiety	
Intensive Care Team Factors	
Poor culture	Develop a positive team culture
Lack of communication	Ward rounds, multidisciplinary team meetings
Lack of leadership	Designated leaders
Disengaged team members	Team planning and communication
Inexperienced staff	Education and up-skilling staff
Lack of planning and coordination	Screening of appropriate patients
Unclear expectations	Flexible and cooperative team members
Risk for mobility providers	Utilization of safety criteria for mobilizing mechanically ventilated patients
Femoral lines	Anticipated benefits
Early ward transfers	
Anticipated risks	
Organizational Factors	
Lack of funding	Business case for additional staff to outline the economic benefits for the organization
Time constraints	Appropriate equipment & resources
Lack of equipment and resources	Dedicated staffing
Lack of staffing or availability	Mobility guidelines/protocol
Busy caseloads	Training on appropriate equipment

Harrold and colleagues compared early mobilization between Australian and Scottish ICUs [10]. This study found that 60.2% (209/347) patients were mobilized in the Australian cohort and 40.1% (68/167) patients were mobilized in the Scottish cohort during the ICU stay. Mobilization in the presence of an ETT was rare in both cohorts (3.4% Scotland and 2.2% in Australia). Physiological instability and the presence of an ETT were frequently reported barriers; however sedation was the most commonly reported barrier to mobilization in both the Australian and Scottish cohorts.

Randomized trials have also had difficulty delivering the planned dose of early mobilization in the intervention group. The TEAM pilot study found that early, goal-directed mobility was feasible, safe and resulted in increased duration and level of active exercise [19]. Fifty patients were randomized and the intervention group received a median duration of 20 min/day early goal-directed mobilization, despite the 30–60 min pre-specified goal of the intervention. Although the intervention group did not meet the targeted duration of early mobilization, the proportion of patients that walked in the ICU was almost doubled in the intervention group. Two of the largest randomized trials of early mobilization have also reported difficulties delivering intensive dosage of active mobilization. One study was only able to deliver the intervention on 57% of study days [9], whilst the other was able to complete physical therapy on 55% and progressive resistance exercise on 36% of study days [2]. Sedation management, in particular, limited the number of early mobilization interventions, which may have contributed to the findings that ICU-based physical rehabilitation did

not appear to improve physical outcomes at 6 months compared to standard physical rehabilitation.

To address the concern with unit culture and interdisciplinary goals and communication, a multicenter international randomized trial in five university hospitals in Austria, Germany and the USA was performed where the mobilization goal was defined during daily morning ward rounds and facilitated by interdisciplinary closed-loop communication [4]. The mobilization goal was achieved in 89% of study days in the intervention group. Early goal-directed mobilization improved patient mobilization throughout ICU admission, shortened patient length of stay in both the surgical ICU and hospital, and improved patients' functional mobility at hospital discharge (51% of patients in the intervention group vs 28% of patients in the control group). The current evidence suggests that early mobilization is safe and feasible and may improve functional recovery at hospital discharge; however ICUs are still very conservative in mobilizing mechanically ventilated patients, with some potentially avoidable barriers. Interdisciplinary communication and a clinical lead or champion may reduce barriers to early mobilization [20–22].

Themes that Identify Barriers and Facilitators to Early Mobilization

There have been several studies that have used qualitative methods to establish themes associated with barriers and facilitators to early mobilization in ICU. Barber and colleagues used three discipline-specific focus groups to establish barriers and facilitators to early mobilization amongst 25 ICU staff, including separate focus groups for doctors, nurses and physiotherapists [21]. Three key themes emerged to both barriers and facilitators across all groups. The barriers included: first, culture which included the use of sedation and the reluctance to mobilize patients with an ETT; second, communication which included contacting the appropriate physiotherapist to mobilize a patient, and doctors writing it as a care plan for the day without it being operationalized; and third, a lack of resources, which included staff, training and equipment to safely conduct mobilization in the ICU. The facilitators to early mobilization in the ICU included: organizational change, such as a dedicated mobility team; leadership including a champion who would assist with multidisciplinary team planning, team meetings and daily goal setting; and resources to provide adequate staff, training and equipment for mobilization in this complex area.

Using the theory of planned behavior, Holdsworth and colleagues elicited attitudinal, normative and control beliefs toward early mobilization of mechanically ventilated patients [23]. A nine-item elicitation questionnaire was administered electronically to a convenience sample of 22 staff in the ICU. Respondents wrote the most text about barriers to mobilization, including that it was time consuming, posed a safety risk to patients with line dislodgement or disconnection and unstable patient physiology and that there was a negative workplace culture.

Perhaps the most comprehensive publication in this area is a recent systematic review of quantitative and qualitative studies that identified and evaluated factors influencing physical activity in the ICU setting (and post-ICU setting) [20]. Eighty-nine papers were included with five major themes and 28 sub-themes including: first, patient physical and psychological capability to perform physical activity, including delirium, sedation, motivation, weakness and anxiety; second, safety influences, including physiological stability and invasive lines; third, culture and team influences, including leadership, communication, expertise and administrative buy-in; fourth, motivation and beliefs regarding risks versus benefits; and lastly environmental influences including funding, staffing and equipment. Many of the barriers and enablers to physical activity were consistent across both qualitative and quantitative studies and geographical regions, and they supported themes established from previous research in this area. Barriers and facilitators to physical activity were multidimensional and may be altered by raising general awareness about post-intensive care syndrome and the potential risks versus potential benefits of early mobilization in the ICU.

Drivers of Clinical Decision Making That Are Modifiable

It is possible that several of the drivers of clinical decision making with regards to early mobilization of mechanically ventilated patients are modifiable [20]. In a large prospective cohort study across 12 ICUs, the main reported barrier to early mobilization was sedation [11]. Only one of 12 ICUs in this study routinely used a sedation protocol, including sedation minimization or daily sedation interruption. Implementing a sedation protocol into routine ICU care across regions may facilitate early mobilization by allowing ICU patients to wake and participate in physical activity. These results were also identified in an international study of early mobilization practices in Australia and Scotland [10].

In another observational study, Leditschke and colleagues reported on 327 patient days audited for early mobilization or barriers to early mobilization [22]. Early mobilization did not occur on 151 (46%) of these days and the reasons for inability to deliver early mobilization was potentially avoidable in almost half of these. Potentially avoidable barriers to mobilization included femoral vascular catheters, timing of procedures, sedation management, agitation and early transfer to the hospital ward. Active identification of barriers to early mobilization and strategies to avoid these issues should be included as part of an early mobilization plan.

Early Mobilization and Long-term Consequences

The importance of completing long-term follow-up of patient outcomes after ICU has become well recognized and is now prioritized in research [24, 25]. It is recommended that studies follow up patients for a least six months after ICU admission [26]. Mortality is a commonly reported outcome in critical care research. Due to the complexities of critical care and the interventions provided to patients, it is possible that early mobilization and rehabilitation may have long-term adverse effects on our patients [1]. An updated meta-analysis of controlled and randomized trials of early mobilization and rehabilitation in ICU showed no significant difference in mortality at six months between the intervention and control groups (OR −0.01, 95% CI −0.07–0.05, p = 0.74, seven studies, n = 265) (Fig. 2).

Whilst mortality is an important outcome to assess after critical illness, it is long-term physical, psychological and cognitive function that patients and their family members rate as important outcomes post-critical illness [27]. To this end, there are a large number of outcome measures available to assess the key domains after ICU discharge, including physical, cognitive and psychological function [28]. In studies of early mobilization and rehabilitation it is common that different outcome measures are used to assess the same domains across different studies [1, 20]. This makes combining the results in a meta-analysis difficult and makes it challenging to compare the results across studies.

A recent meta-analysis assessed six-month outcomes from randomized and controlled clinical trials of early mobilization and rehabilitation. It reported that there was no significant difference in timed-up-and-go test and the 36 Item Short Form Survey (SF-36) results [1]. It did, however, show significantly higher SF-36 results favoring the intervention group in the role physical and role emotional domains for high-dose rehabilitation compared to low-dose rehabilitation and significantly more days alive and out of hospital favoring the intervention group (mean difference 9.63, 95% CI 1.68–17.57, p = 0.02, five studies, n = 509). There were consistent concerns regarding the high rates of loss to follow up across the studies, making outcomes like the SF-36 and timed-up-and-go difficult to interpret as they do not

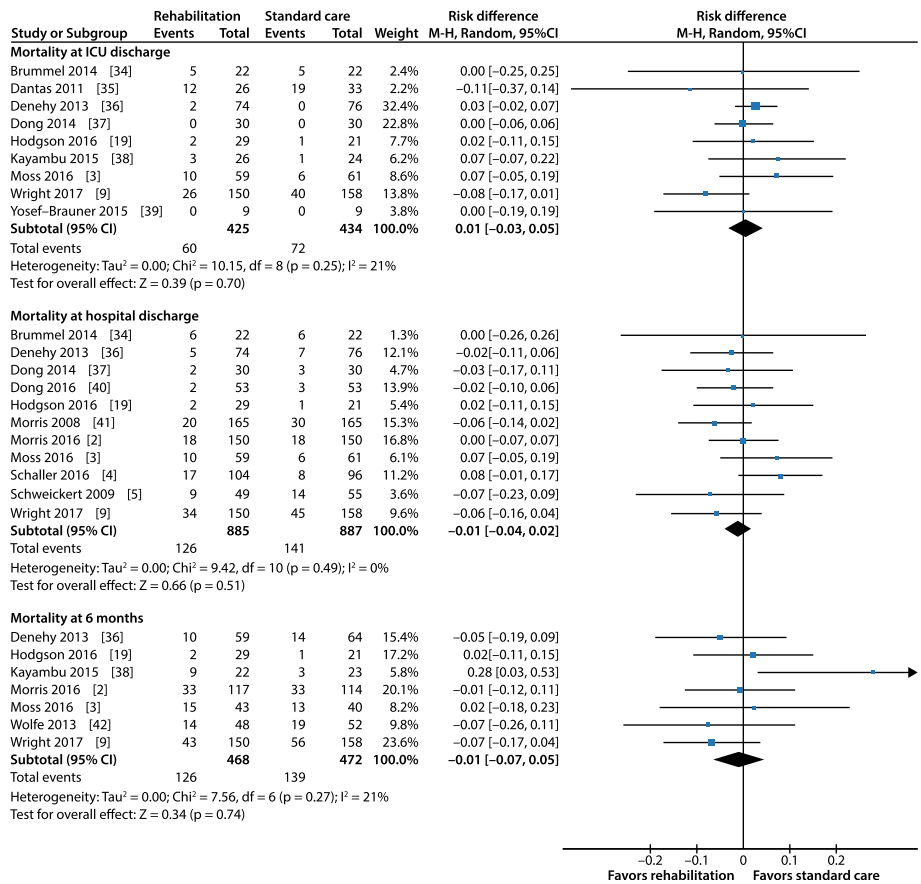

Fig. 2 Forest plot of mortality in ICU, in hospital and at six months comparing early mobilization with standard care in randomized controlled trials

account for death [1, 29]. There is currently no consistent message regarding the long-term effects of early mobilization in the ICU on physical function or quality of life [30, 31].

Do We 1Have Consensus on Long-term Outcomes for ICU Survivors?

A two-stage, international Delphi process determined that the following domains are important to assess post-ICU discharge in patients with acute respiratory failure: physical function, cognition, mental health, satisfaction with life and personal enjoyment, survival, pulmonary function, pain and muscle or nerve function [32]. The Delphi process evaluated which outcome measures should be used to assess domains identified as important. Consensus could not be reached on all domains, however the minimal acceptable outcomes to report based on this study are survival, EuroQol-5D (EQ-5D; assessing satisfaction with life and personal enjoyment), hospital anxiety and depression scale and impact of event scale revised (assessing mental health).

Perhaps we can learn some lessons from other acute areas of medicine. A dose-response analysis of early mobilization, completed on the AVERT Study stoke patient data, helps to unravel uncertainties in the dosage, timing and frequency of early mobilization interventions following stroke onset [33]. In the primary analysis, the results demonstrated that very early mobilization in stroke patients resulted in decreased odds of a favorable outcome [7]. The secondary analysis, however, showed a 13% improvement in odds of a favorable outcome with each episode of out-of-bed activity per day, keeping time to mobilization and daily amount constant. Conversely increasing the amount of time doing out-of-bed activity reduced the odds of a favorable outcome. Patients who started mobilizing earlier post-onset of stroke also had more favorable outcomes. The beneficial effect of regular short periods of out-of-bed activity was consistent across most of the analysis. These results may guide further research in the critical care population with regards to the prescription of early mobilization. To date, studies of early mobilization in the ICU have delivered variations in dose, timing and progression of the rehabilitation intervention [1]. This variability has made it challenging to compare the study results and to determine the most appropriate dosage and timing of early mobilization in the ICU.

Conclusion

Currently there is a divide between ICU clinicians who wish to implement early mobilization based on current evidence and clinicians who believe that early mobilization is an intervention that should be tested in a large patient-centered trial to determine long term outcomes (including functional recovery). Despite the publication of safety recommendations and clinical practice guidelines [6, 14, 15], the implementation of early mobilization remains a challenge in the ICU, with limited information on safe levels of vasoactive support, ongoing evidence of over-sedation of mechanically ventilated patients and poor staff resources limiting the ability to deliver early mobilization. Based on current evidence, early mobilization is safe during mechanical ventilation, but the conservative management of ICU patients translates into a culture of bed rest. Some of the drivers of clinical decisions may be modifiable, with better adherence to sedation and mobilization protocols, clinical leadership and increased staff resources and training. However, given our experience in other areas of medicine including stroke and traumatic brain injury, early mobilization should be tested in a patient-centered trial with evaluation of long-term outcomes prior to implementation.

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Prof Carol Hodgson is lead investigator of a multicenter Phase III study of early activity and mobilisation in intensive care. Claire Tipping is on the management committee of the same Phase III study. There are no other competing interests.

Disclaimer
The following references are cited in Figure 2: [34–42].

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