

# ICU

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# Early Mobilisation: Movements, Barriers and Complications



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## Introduction

Early mobilisation is recommended as part of a multi-component, nonpharmacological strategy to improve physical, mental and

Early mobilisation includes several progressive kinds of movements. Many barriers and safety concerns must be addressed to allow a smooth and effective introduction of this procedure in the ICU daily practice.

cognitive outcomes of critically ill adults. Physical rehabilitation minimises muscle weakness and impaired physical functioning, reduces cognitive impairment and optimises nocturnal sleep (Devlin et al. 2018). Early mobilisation (EM) in the ICU includes passive and active movement and training. This multifaceted intervention involves a wide range of activities, from in-bed to out-of-bed exercises, as shown in **Table 1** (Clarissa et al. 2019; Nydahl et al. 2023; Watanabe et al. 2022). EM also refers to any other type of active exercise modality started while the participant is in the ICU, like activities of daily living (ADLs): self-care tasks such as eating, bathing, dressing and toileting (Doiron et al. 2018). Some studies exclude from this definition interventions such as turning in bed, change of positions, particularly when done to prevent pressure sores, or use of neuromuscular electrical stimulation or robotics (Nydahl et al. 2023), whereas other studies include them (Doiron et al. 2018). At present, EM lacks a specific definition and encompasses a range of heterogeneous interventions that have been used alone or in combination (Hodgson et al. 2013).

The combination of critical illness and prolonged immobility results in substantial muscle wasting during the ICU stay. That's one reason why EM should start as soon as feasible after admission to the ICU. Evidence suggests that starting rehabilitation within 72 hours from admission may lead to improvements in both physical and cognitive function, minimising the sequelae of prolonged physical immobilisation during mechanical ventilation, such as muscle atrophy, weakness, and paresis, thereby enhancing future autonomy and quality of life (Doiron et al. 2018; Matsuoka

et al. 2023). Furthermore, EM is a holistic activity with physical, cognitive, and psychosocial dimensions, including coordinated movements, increased proprioception, gravity effects, sympathetic activation of neurotransmitters, improved cerebral perfusion, cognitive activation and participation, and interaction with the

IN-BED EXERCISES	OUT-OF-BED EXERCISES
Active-assisted exercises: Exercises performed by the participant with manual assistance of another person	Sitting on the edge of the bed
Active range-of-motion exercises: Exercises moving a joint(s) through its range of motion that are performed independently by the participant	Standing
Cyclo-ergometer: A stationary cycle where work intensity can be adjusted by varying pedal resistance and cycling rate	Active/passive transfer training into a chair or commode
Bed mobility activities: Activities including rolling, bridging and transfer to upright sitting	Pre-gait exercises: Improving postural stability, static and dynamic balance and marching on the spot
	Walking or similar

**Table 1: In-bed and out-of-bed exercises**

environment and healthcare providers (Lai et al. 2017). These aspects may contribute to improving a patient’s orientation and overall well-being, possibly facilitating their return to functional independence (Patel et al. 2023; Zhang et al. 2019).

The most common protocol was created by Morris et al. (2008) and is divided into four levels:

1. Level I: Passive extremities movements for unconscious patients.
2. Level II: Active extremities movements and interaction with the physical therapist for conscious patients who can respond to simple commands in a sitting position on the bed.
3. Level III: Like level II but sitting on the edge of the bed for patient’s biceps strength of >3/5 on the Medical Research Council Scale (Medical Research Council 1976).
4. Level IV: Like level II, but with the patient actively moving from the bed to a chair beside the bed for patient’s quadriceps strength of >3/5.

The highest level of mobilisation is kept for as long as possible before a step-down to lower levels of activity, should the patient become fatigued, as measured by the ICU Mobility Scale (Hodgson et al. 2014; Lai et al. 2017).

EM should be applied in short and frequent sessions (Eggmann et al. 2022). Morris suggests twice daily, five days a week and, if possible, involving caregivers (Lai et al. 2017; Morris et al. 2008).

The sessions are individually tailored to achieve the highest possible level of mobilisation that is deemed to be safe for the patient at the initiation of daily therapy. EM should be integrated into a patient-centred approach (Zhang et al. 2019).

Implementing an EM programme requires a multidisciplinary team and approach: a critical care nurse, nursing assistant, respiratory therapist, physical therapist, and even family (Lai et al. 2017). EM can be delivered either as a standalone intervention or as part of a broader care approach, such as the ABCDEF bundle, which addresses analgesia, sedation, delirium, mobilisation, and family integration (Frade-Mera et al. 2022; Nydahl et al. 2023).

### Barriers to Implementation of Early Mobilisation

Implementation of EM in the ICU can be difficult due to several factors. Barriers correlated with EM could be divided into four groups: patient-related, structural, cultural and process-related barriers (Alaparathi et al. 2020).

#### Patient-related barriers

These include haemodynamic instability, pain, deep sedation, agitation and delirium, patient denial, lack of motivation, and lack of intensive care unit equipment and devices. Interventions must be tailored to patient conditions such as level of arousal, haemodynamic stability and tolerance. Fontela et al. (2018) reported in their multicentre Brazilian survey that the most common barriers in the application of EM were weakness, haemodynamic instability and sedation. Nurse’s opinions about factors limiting EM were analysed in two surveys. In the cross-sectional multicentre survey of Zhang et al. (2022), instability of patients (94.9%), mechanical ventilation (84.6%) and unconsciousness (82.8%) were perceived as the main barriers. In a survey by Babazadeh et al. (2021), deep sedation (88.9%), mobilisation of obese patients (82.2%), mobilisation of agitated patients (65%) and pain induced by mobilisation of mechanically ventilated patients (57.9%) were perceived as significant barriers. Physiotherapists identified haemodynamic instability, raised intracranial pressure, low platelet count and mental instability as barriers (Tadyanemhanduet al. 2022). Barriers to EM were more frequent in the first seven days after admission (Watanabe et al. 2021); haemodynamic instability was the most common barrier on day 1 and day 2, while a reduced level of consciousness was most common on day 3 to 5 (Watanabe et al. 2021). Safety criteria for EM have been proposed in **Table 2**.

#### Structural barriers

These include limited staff, lack of guidelines, lack of equipment and lack of protocols. ICU staff reported that there is insufficient equipment and staff (87.9%), lack of appropriate training (83.6%) and lack of time for mobilising patients (Zhang et al. 2019; Babazadeh et al. 2021; Akhtar et al. 2021). Work experience is an important aspect for the perception of the barriers: health

	Yang et al. 2021	Alaparathi et al. 2020
RASS	-2/+2	-2/+2
Heart rate	40-130 b/min	40-130 b/min
MAP	65/110 mmHg	60/110 mmHg
SBP	90/200 mmHg	90/180 mmHg
FiO2-PEEP	≤ 0,6 - ≤ 10 cmH2O	<0,6 - <10 cmH2O
SpO2-respiratory rate	≥88% - 5-40 b/min	>88% - >5 b/min
PaO2/FiO2	≥200	-
Temperature	No fever	<38,5

**Table 2. Safety criteria for starting an early mobilisation session**  
RASS=Richmond Agitation Sedation Scale; MAP Mean Arterial Pressure; SBP Systolic Blood Pressure; FiO2: inspiratory oxygen fraction; PEEP: positive end-expiratory pressure; PaO2: arterial oxygen pressure; SpO2: pulse-oximetry

professionals with years of experience in hospitalised patients have a better approach to early mobilisation (Tadyanemhandu et al. 2022; Goodson et al. 2020). The lack of guidelines is remedied by the use of their own experience (Goodson et al. 2020). On the other hand, the introduction of guidelines and protocols alone is not sufficient to promote EM (Anekwe et al. 2020; Akhtar et al. 2021).

#### Cultural barriers

These include lack of knowledge and awareness about benefits and feasibility of EM (Anekwe et al. 2020; Akhtar et al. 2021). Nurses and physicians that did not receive education and training on EM have inadequate knowledge about it and a low level of intention to apply EM, considering EM too risky and unnecessary (Zhang et al. 2022; Anekwe et al. 2020; Tadyanemhandu et al. 2022).

#### Process-related barriers

These include a lack of daily coordination and planning and risks for mobility providers. Patient safety and medical disputes are

something nurses are concerned about (Zhang et al. 2022). Poor coordination in the multidisciplinary group can cause problems in planning daily treatments without goal-sharing (Anekwe et al. 2020; Tadyanemhanduet al. 2022; Akhtar et al. 2021).

All these barriers must be addressed and solved to allow the adoption of EM with the right protocol and the right “dose” for all suitable patients.

### Adverse Events During Early Mobilisation

Traditionally, EM was avoided for lack of awareness of its beneficial effects and for the possible adverse events which may occur to frail ICU patients. In recent years, some studies have evaluated the incidence and type of adverse events during EM. Doiron et al. (2018) published a review focused on the safety profile of EM. Overall, the analysed studies included 690 adult patients and a wide range of interventions ranging from in-bed mobility to ambulation. Among the four included studies in the review, only two reported adverse events in the intervention group that were deemed to be related to EM: one asymptomatic bradycardia, one episode of severe oxygen desaturation and one episode of catheter dislodgement. Furthermore, only 19 sessions had to be ceased due to patient instability. (Doiron et al. 2018).

In a systematic review and meta-analysis, Takaoka et al. (2020) investigated the impact of in-bed leg cycle ergometry in the ICU. They collected data from 12 RCTs and two nonrandomised studies published between 2014 and 2019. Only five adverse events were reported out of 3117 sessions (0.16%). Six of the evaluated studies reported 18 session terminations during 1829 (0.98%) cycling sessions due to complications. However, the authors underlined the heterogeneity in the definitions of adverse events and in the criteria adopted for suspending a session.

In a meta-analysis on EM in mechanically ventilated patients (Klem et al. 2021), which included 17 studies and 1805 patients, only two life-threatening adverse events were identified: a case of bradycardia and one of hypoxia. A total of 79 adverse events were reported during 5675 sessions (1.4 %) and, among them, 35 of these events caused the interruption of the sessions.

Two studies evaluated EM safety in patients undergoing continuous renal replacement therapy (CRRT) or during extracorporeal life support (ECLS). Wang and colleagues (2014) published a prospective study, collecting data from 33 patients admitted to two Australian ICUs. The primary outcome of this study was to investigate the safety of mobilisation in patients who underwent CRRT via femoral vascular access. The authors included, as adverse events, the following: catheter dislodgement, clotting or disruption of filter and lines, bleeding or haematoma, clinical suspicion of thrombosis and arrhythmias. They tested three levels of mobilisation: in-bed passive mobilisation, sitting on the edge of the bed and walking. Each planned activity lasted 20 minutes. No adverse events occurred during mobilisation or after it. One of the participants also had a Swan-Ganz catheter in place, but neither arrhythmias nor other relevant clinical sequelae were reported. During mobilisation, no CRRT machine alarms rang. The authors also tested the hypothesis that mobilisation might reduce circuit and filter clotting. Data collected from the femoral venous access subgroup indicate that passive hip flexion and position changes might have increased filter life (Wang et al. 2014).

Most of the patients requiring ECLS are still treated with cautious strategies that include deep sedation and invasive mechanical ventilation since immobilisation and reduced range of passive movements may minimise complications. In 2023, Cucchi and

co-authors performed a systematic review in order to provide evidence-based recommendations on early mobilisation in awake patients undergoing ECLS (Cucchi et al. 2023). They summarised data from 29 observational studies and one RCT, including 1157 patients who received physiotherapy while undergoing veno-venous or veno-arterial extracorporeal support. They investigated the incidence of adverse events caused by mobilisation while on ECLS, such as circuit kinking or cannula dislocation, bleeding, haemodynamic instability, respiratory failure or need for tracheal intubation, neurological deterioration or infections. Patients supported with non-invasive ventilation (NIV) and with femoral cannulation were more likely to develop mechanical and haemorrhagic complications (respectively 4.2% and 4.4%). Infective and cardiovascular complications were mostly reported in patients undergoing veno-arterial ECLS (11.3 and 9.5%). Neurological sequelae were rare and mostly affected patients supported with NIV who could walk (7.8%). They concluded that EM, and even ambulation, can be safely performed regardless of the cannulation site (Cucchi et al. 2023).

### Conclusion

Despite the potential benefits of EM, barriers to its implementation have been reported. Further research is needed to standardise practices and determine optimal initiation timing and extent of mobilisation, including considerations on duration, intensity, and frequency in order to maximise its effectiveness and minimise adverse events.

### Conflict of Interest

None.

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