Early mobility and family partnerships in the Intensive Care Unit: A scoping review of reviews

Abstract

Background: Critical illness significantly impacts the well-being of patients and families. Previous studies show that family members are willing to participate in patient care. Involving families in early mobility interventions may contribute to improved recovery and positive outcomes for patients and families.

Aim: In this scoping review we investigated early mobility interventions for critically ill patients evaluated in randomised controlled trials and the extent to which family engagement in those interventions are reported in the literature.

Study Design: In this scoping review of reviews, EMBASE; CINAHL; PubMed; and Cochrane Central databases were searched in October 2019 and updated in February 2022. Systematic reviews were included and assessed using A MeaSurement Tool to Assess Systematic Reviews (AMSTAR) 2. Data were synthesised using a narrative approach. PRISMA-ScR guidelines were adhered to for reporting.

Results Thirty-three reviews were included which described a range of early mobility interventions for critically ill patients; none explicitly mentioned family engagement. Almost half of the reviews were of low or critically low quality. Insufficient detail of early mobility interventions prompted information to be extracted from the primary studies.

Conclusion There are a range of early mobility interventions for critically ill patients but few involved families**.** Given the positive outcomes of family participation, and family willingness to participate in care, there is a need to explore the feasibility and acceptability of family participation in early mobility interventions.

Relevance to Clinical Practice Family engagement in early mobility interventions for critically ill patients should be encouraged and supported. How to best support family members and clinicians in enacting family involvement in early mobility requires further investigation.

KEYWORDS

Critical Care, Family partnership, Intensive care, Mobility, Scoping Review

1 Introduction

Critical illness has a significant impact on the clinical and psychological well-being of patients and family members.[1-3] Improvements in the clinical management of critically ill patients have led to improved survivorship; however, more than 50% of critical illness survivors exhibit intensive care unit acquired weakness (ICU-AW) at discharge, and half will have a cognitive, mental or physical problem at one year. It is increasingly recognised that early mobility (also referred to as exercise, physical therapy, early ambulation, early rehabilitation, progressive mobilisation) plays a significant role in preventing ICU-AW and may contribute to improved physical recovery.[3-6]

Despite the importance of early mobility, data obtained from observational studies suggest that globally physical activity levels in ICU remain low[7-10] with a number of barriers to early mobility identified.[11] Over the last decade, professional organisations have developed clinical practice guidelines to help promote and guide early mobility practice in critical illness and overcome commonly identified barriers.[12] A team approach to early mobility has been identified as one such strategy to help promote early mobility in critical illness;[12, 13] however, the concept of the 'team' at present is restricted to health professionals.

The embeddedness of families in a Patient and Family Centred Care (PFCC) approach is strongly established in intensive care, where the capacity of the care recipient may limit active participation.[14] PFCC focuses on the individual patient and recognises the importance of family inclusion in achieving a holistic approach to care.[15, 16] Family inclusion in PFCC is important because evidence suggests that family involvement improves quality of care.[14] Given that functional recovery and the ability to independently resume activities of daily living is of high importance to patients and their families,[17, 18] engagement of families in early mobility during and following recovery from critical illness may be an important strategy to improve outcomes for both patients and their family members. This scoping review investigates early mobility interventions for critically ill patients and the extent to which family engagement in those interventions are reported in the literature.

2 Background

Family members have demonstrated a willingness to partner with health professionals in the ICU and participate in patient care provided they are furnished with the necessary knowledge and skills.[19,20] This type of engagement can have a positive impact on outcomes for patients and their family members.[21-25] Patients demonstrate improved experience, medical goal achievement and mental health outcomes with family engagement.[21] For families who can experience substantial physical, economical and psychological burdens[1, 26] during and following the episode of critical illness[1, 26] engagement can reduce family members' incidence of anxiety, depression, and other psychological symptoms long-term.[27]

Engaging with families to promote and encourage early mobility during recovery in ICU and throughout hospitalisation could be a potential strategy to increase adherence to early mobility and have a positive impact on patient outcomes. The literature supports interventions such as the

ABCDEF bundle which includes early mobility and family engagement and aims to improve recovery from critical illness. [28-30] Implementation of the bundle has been shown to promote early mobility in critical care [30] and may improve functional outcomes and health related quality of life. [28] Even with research that supports these types of interventions, family engagement in early mobility in critical care remains poorly defined within the literature [31] [32, 33] despite evidence advocating for increased patient and family centred care [24, 25, 33, 34] and is an important gap in this area of research.

3 THE REVIEW

3.1 Aim

In this scoping review we investigated early mobility interventions for critically ill patients evaluated in randomised controlled trials and the extent to which family engagement in those interventions are reported in the literature. The following research questions guided the review:

1. What early mobility interventions are reported for critically ill patients?

2. Is family involvement in early mobility interventions for critically ill patients reported in the literature?

4 METHODS

4.1 Design

A scoping review was the preferred approach to address the research questions, as it allows systematic exploration of the evidence and reveals gaps in the literature, ultimately identifying research priorities for early mobility and family engagement in ICU.[35] For pragmatic reasons we restricted our focus to systematic reviews and the RCTs therein, an accepted approach in scoping reviews.[33] We specifically selected RCTs as they provide the strongest level of evidence for interventions, are the most widely accepted standard for evaluating interventions and the most likely to be implemented into clinical practice.[34] Arksey and O'Malley's[36] methodological framework was followed, which consists of five steps: (i) identifying the research question; (ii) identifying relevant studies; (iii) selecting studies; (iv) charting the data; and (v) collating, summarising and reporting results. The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist[37] was adhered to for reporting.

4.2 Search methods

Relevant studies were identified using a search strategy developed by the research team and experienced health librarians. The bibliographic databases: Excerpta Medica Database (EMBASE); Cumulative Index of Nursing and Allied Health Literature (CINAHL); PubMed; and Cochrane Central were searched for English language systematic reviews in October 2019 and updated in February 2022. Thesaurus/medical subject headings (MeSH) using key terms and Boolean operators (OR, AND) were used to expand and narrow the search. Systematic reviews (with and without meta-analysis), integrative reviews, and scoping reviews published in English between 1995 and 2022 that included randomised controlled trials (RCTs) of early mobility interventions in the intensive care setting were included. The year 1995 was chosen as the search starting point because the association between immobility and ICU-AW as a deleterious consequence for critically ill patients was recognised in the literature in early 2000s. Selecting the 1995 timepoint allowed time to capture all relevant studies. Backward citation searching of the reference lists of included articles was undertaken. Keywords used for the search strategy are outlined in Table 1. A complete search strategy is provided in Supplementary File S1.

Table 1. Keyword search strategy

Concept	Keywords	Databases
Critical care	ICU* OR Intensive Care Units* OR Critical Care* OR Critical Illness* OR Critical Care Patient* OR Mechanical Ventilation*	CINAHL, PubMed, Embase, Cochrane Central
Early mobilisation	Exercise* OR Physical Therapy* OR Early Ambulation*	
	Limiters included review only, English language, adults, publication year	

4.3 Search outcome

All search results were exported to Endnote (X9.3.3, Clarivate), and uploaded to the online screening and selection tool, Rayyan.[38] A standardised form with inclusion and exclusion criteria was used to guide the selection of studies. The inclusion/exclusion criteria were based on the PCC (Population, Concept, Context) format [39] (Table 2). To minimise errors and ensure high interrater agreement two reviewers (CC and JP) independently screened titles and abstracts using the inclusion/exclusion criteria. Papers deemed 'relevant' had full texts downloaded and were independently assessed by the same reviewers against inclusion/exclusion criteria. Round table discussion after full-text screening occurred to resolve queries, which were moderated by AM and/or GT. This was an iterative process until a consensus was reached.

Table 2 Inclusion and exclusion criteria using PCC

PCC	Inclusion Criteria	Exclusion Criteria
Population	Reviews that included RCTs of critically ill patients ≥18 years of age who were admitted to ICU for management of their critical illness	Reviews with elective surgical patients with a relative short ICU stay (may not be generalisable to longer-stay patients)
Concept	Reviews that included RCTs where the interventions promoted early mobility for critically ill patients in the ICU Reviews that included RCTs where the interventions that promoted early mobility	Reviews where the focus was on inspiratory muscle training, neuromuscular stimulation, or patients on ECMO (interventions may preclude family involvement)

	for critically ill patients in the ICU and included family members Reviews that included RCTs published after 1995	
Context	Reviews that included RCTs relating to critically ill patients and early mobility commenced in the ICU	

4.4 Quality appraisal

There are concerns that Arksey and O'Malley's framework does not provide an assessment of the quality of the literature[40] which is necessary for robust dissemination of results,[41] Thus, this review incorporates an appraisal of the methodological quality of each review using A MeaSurement Tool to Assess Systematic Reviews (AMSTAR) 2.[42] Reviews were independently appraised by JC and SM with AM providing arbitration to resolve disagreements until a consensus was reached. AMSTAR 2 provides an overall rating based on weaknesses in critical domains. Domain items are allocated a 'yes' or 'no' or a 'partial' rating if the review met some but not all AMSTAR 2 criteria.[42] Percentage agreement between the two reviewers for the AMSTAR 2 items was 75%.

Quality of intervention reporting was assessed using the Template for Intervention Description and Replication (TIDieR) checklist,[43] a 12-item checklist is a tool designed to improve the reporting of interventions in RCTs by prompting authors to describe interventions in enough detail to allow their replication. Checklist items include a brief name, why, what (materials), what (procedure), who provided, how, where, when and how much, tailoring, modifications, how well (planned), and how well (actual). The systematic approach of this checklist is intended to facilitate standardisation of interventions in clinical practice.

4.5 Data extraction

Data extraction was performed by two researchers independently (JC, SM). A data charting spreadsheet was developed in Microsoft Excel by the research team (AM, GT, and JC) using pre-determined headings which included: (i) author/s and year of publication, (ii) aim/s, (iii) sample/setting (iv) RCTs, and (v) intervention descriptions. When intervention descriptions in a systematic review were not comprehensive, details were sourced from the original published RCT. Any inconsistencies in the data extracted were resolved by discussion between reviewers until consensus was reached.

4.6 Data Synthesis

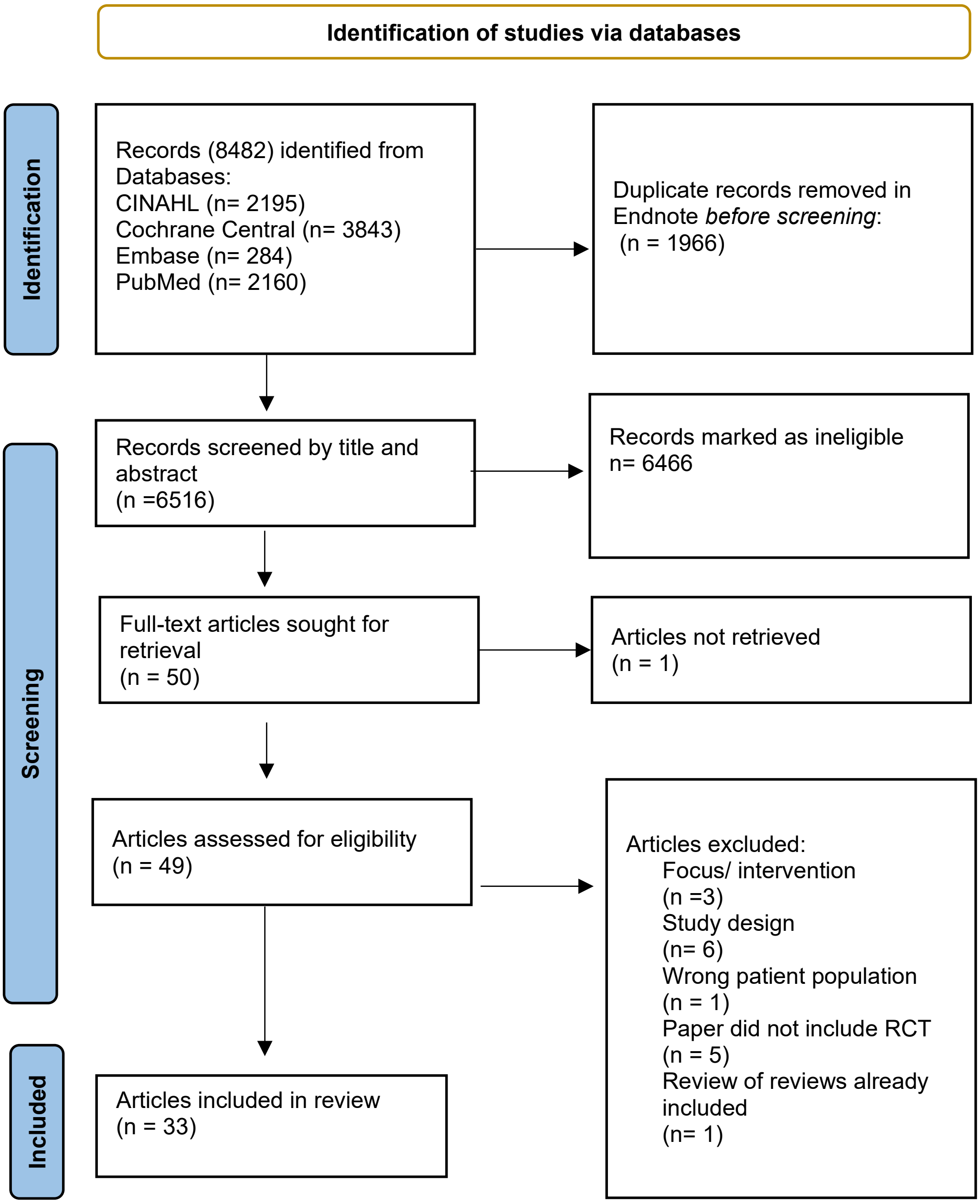
Due to the methodological heterogeneity of the included papers our evidence is presented in a narrative format with tables and figures. Synthesis of the data was undertaken to map and summarise the types of early mobility interventions used and the context in which they were conducted, including any evidence of family involvement.[44] This process highlighted the available evidence of early mobility interventions in ICU, family member engagement across the literature and identified potential gaps in the research.

5 RESULTS

5.1 Study selection

A total of 8482 articles were identified (Figure 1). Duplicates were removed in Endnote and the remaining 6516 papers were screened with 6466 excluded. Fifty full-text reviews were assessed for eligibility and 33 were included. No further reviews were identified through backward citation searching. Characteristics of excluded reviews is provided in Supplementary File S2.

Figure 1: PRISMA 2020 flow diagram of study selection and inclusion



5.2 Characteristics of selected studies

Reviews included 11 systematic reviews with meta-analyses; 13 systematic reviews without meta-analyses; two scoping reviews; three integrative reviews; one review of the literature; and three studies that did not explicitly state their methodology but followed the format of a systematic review.[45-47] Included reviews were published between 2008 and 2021 with summary data for review characteristics provided in Table 3. There was overall consistency in patient populations, which included critically ill adult medical and surgical patients with varied diagnoses. Reviews predominantly focused on interventions initiated after 48-72 hours of ICU admission and/or with patients with prolonged mechanical ventilation. Reviews included 37 RCTs, 33 of which were included in more than one systematic review. The total number of patients included in the RCTs ranged from 50 to 2202. Substantial heterogeneity was observed in patient characteristics, intervention types, initiation times, frequency and outcome measures. Interventions were not consistently or well described in all systematic reviews requiring this information to be sourced from the original RCTs. Supplementary File S3 provides a citation matrix identifying RCTs included in systematic reviews.

Interventions delivered in the ICU were described in general terms such as early mobilisation, passive mobilisation, rehabilitation programs, active exercises, cardiopulmonary endurance program although some provide more specific descriptions of activities such as range of motion exercises, in bed mobility (turning, bridging), sitting in bed, sitting out of bed, sit to stand, balance training, standing, transfers, resistance training, ambulation, and cycle ergometry. Family involvement in early mobility interventions was not explicitly discussed in any review; however, in one review,[48] the researchers noted that one RCT included in their review had limitations because caregivers did not adequately complete compliance records, suggesting that there was some family involvement.[49]

Table 3 Review characteristics

Author/s year	Aim	Sample/ Setting	RCT	Intervention description	AMSTAR 2 confidence rating
Adler and Malone 2012	Early mobilisation and functional outcomes and patient safety	N=226 General ICU	3 [50-52]	Functional mobility, supine to sit, SOEB, standing, transfers, ambulation, marching, ROM/ strength exercises, upper and lower extremity exercises	Critically low
Arias-Fernandez et al. 2018	Rehabilitation and early mobilisation for critically ill and effects of interventions	N=564 General ICU	8 [50, 52-58]	Cycling, active mobilisation, SOEB, transfers, walking, passive progressive exercises, active-assisted to active, sit to stand, walking, passive transfer to a chair	Moderate
Azevedo and Gomes 2015	Effects of early mobilisation in functional rehab of ICU patients	N=489 General ICU	5 [50, 52, 54, 55, 59]	Early mobilisation protocol, rehabilitation program, cycle ergometry	Critically low
Calvo-Ayala et al. 2013	Identify effective interventions that improve long-term physical function in ICU patients	N=171 General ICU	2 [50, 52]	Cycling, early exercise, and mobilisation during periods of sedation interruption	High
Casey 2013	Study of activity in older ICU patients with a focus on activity	N=420 General ICU	5 [50-52, 59, 60]	PROM, AROM, sitting balance, early ambulation, treadmill, rolling, standing, transfers, arm & leg exercises with weights, active resistance training, ergometry	Critically low

	measurement and technology				
Castro-Avila et al. 2015	Determine the effect of early rehabilitation on functional status in ICU/HDU patients	N=445 General ICU	5 [50, 52, 55, 60, 61]	PROM, AROM, cycling, SOEB, transfer bed to chair, marching on the spot, walking, tilt table, active resistance training.	Moderate
Choi et al. 2008	Review mobility outcomes in prolonged mechanically ventilated patients	N=178 respiratory SICU and HDU	3 [51, 60, 62]	Physical therapy + supported arm training on arm ergometer, upper and lower limb exercise, bedside functional training, PROM, early ambulation, lower limb training on a treadmill	Critically low
Conceicao et al. 2017	Safety criteria most often used to start mobilisation in ICU	N=314 General /respiratory ICUs	5 [52-54, 60, 63]	SOEB, passive chair transfer, passive, active-assisted and active mobilisation, transfer, standing, walking, stretching, resistance training, balance	High
Deng et al. 2020	Compare non-pharmacological interventions in preventing delirium in ICU patients	Sample size not reported General ICUs	2 [52, 59]	Exercise program, multi-component studies	Critically low
De Queiroz et al. 2018	Evaluate description of mobilisation protocols in ventilated ICU patients	N=1744 General ICU	15 [49, 50, 52, 54-57, 60, 64-68]	Transfer training, progressive resistance training, highest level ICU mobility scale, sitting, cyclometer, active exercise, stair climbing, actively training lower limbs	Critically low
Ding et al. 2019	Evaluate effects of early	N=1081	8 [50, 52, 55, 56, 58, 59, 63, 69]	Not reported. Focus related to time mobilisation initiated	Low

	mobilization times on mechanically ventilated patients	General ICU			
Doiron et al. 2018	Does early mobilisation improve the ability to perform ADL	N=454 General ICU	3[52, 57, 65]	Mobilisation or active exercise	High
Dunn et al. 2017	To determine effects of mobilisation interventions in prolonged mechanically ventilated patients	N=187 General ICU	3 [49, 51, 64]	Upper and lower strengthening exercises, ROM, use of weights, chair transfer, SOOB, standing, ambulating, cycling, stretching exercises upper limb and chest, resisted arm activities with weights	Critically low
Engels et al. 2013	Review early mobilization in polytrauma ICU patients	N=104 Trauma ICU	1[52]	Not clearly described	Critically low
Geense et al. 2019	Effectiveness of nonpharmacologic interventions to prevent/mitigate adverse long-term outcomes among ICU survivors	N=1212 General ICU	8 [49, 55-58, 65, 67, 69]	Intensive physical rehabilitation therapy, PROM, physical therapy, progressive resistance training, Active functional activities (walking, standing, sitting), ROM, muscle strengthening, exercise, functional activity training	Moderate

Kayambu et al. 2013	Review of evidence for exercise in critically ill patients	N=379 General ICU	5 [50-52, 60, 62]	Positioning, stretching, ROM, resistive exercises, ergometry, walking, mobilisation activities, aerobic training	Moderate
Klem et al. 2021	Compare early mobilisation with standard care in mechanically ventilated adult ICU patients	N=1519 General ICU	13 [50, 52, 54, 56, 58, 63, 65, 67, 69-73]	Early mobilisation, cycle ergometry, active exercise with resistance bands	Moderate
Laurent et al. 2015	Qualitative approach early exercise in ICUs	N=745 General ICU	9 [49-52, 59, 60, 62, 64, 74]	Standardised upper and lower limb mobilisation, cycle ergometry, passive, active, resistance, SOEB, SOOB, active strengthening exercises, sitting, standing, balance, walking, PROM, stair climbing	High
Li et al. 2013	Effectiveness & safety of mobilisation to improve physical function and hospital outcomes patients ventilated> 24 hrs	N=451 General ICU	9 [49-52, 60, 62, 64, 74]	Passive mobilisation, walking, cycle/ stair training, supported arm exercise training, general physiotherapy, ROM, transfers, standing, limb exercises, functional activity training, stretching, muscle strengthening exercises, PROM, AROM, bed to chair mobilisation	High
Newman et al. 2018	Safety and effectiveness of physiotherapy in neuro/trauma ICU patients	N=325 General ICU	5 [53, 56, 69, 74, 75]	Early mobilisation	Critically low

Nydahl et al. 2017	Synthesise safety data mobilisation in ICU	N=361 General ICU	4 [52, 57, 58, 61]	ROM, sitting in bed, sit to stand, transfer to chair, pre gait, walking, ADL training	Moderate
Pinheiro and Christofoletti 2011	Outcomes of motor physical therapy in ICU patients	N=114 General, respiratory ICU	4 [50-52, 62]	Cycle ergometry, strengthening of limbs, functional activities, walking	Low
Reid et al. 2018	Determine the extent of ICU physical rehabilitation interventions and how reported and measured	N=1582 General and neurological /neurosurgical ICU	19 [49, 50, 52, 54-58, 60, 61, 63-66, 68, 69, 74-76]	Upper and lower PROM, passive slide transfer, SOOB, tilt table, passive robotic stepping, assist transfer, SOEB, assist bed to chair transfer, cycling, balance training,	Critically low
Sosnowski et al. 2015	Appraise the impact of early rehabilitation practices on functional outcomes and quality of life	N=221 General ICU	3 [50, 52, 64]	Cardiopulmonary endurance program, muscle strengthening, and stretching exercises, early exercise and mobilisation, cycling exercises	Critically low
Stiller 2012	Examine evidence of the effectiveness of physiotherapy in mechanically ventilated ICU patients	N=242 General ICU	3[50, 52, 74]	ROM, functional tasks, sit/stand/walk, cycling, SOOB	Critically low
Taito et al. 2018	Does rehabilitation impact clinically	N=50 General ICU	1 [57]	PROM, AROM, SOOB, transfers, ambulation, and other mobilisation techniques	High

	relevant outcomes on patients with sepsis?				
Takaoka et al. 2020	Understand the effect of ICU leg cycle ergometry on clinical and patient outcomes	N=853 General ICU	12 [50, 54, 57, 60, 72, 73, 76-81]	In bed cycle ergometry, passive limb stretching, active resistive exercise, transfer sitting to chair, balance training, walking, ROM	High
Thomas 2011	Describe the effects of physical rehabilitation started on ICU admission compared to delayed rehabilitation	N=434 General ICU	2 [52, 59]	ROM, sitting, active transfers to a chair, pre-gait activities in standing and ambulation; ADL practice	Critically low
Thomas 2009	Examine evidence of rehabilitation of the patient with critical illness	N=119 General ICU	2 [51, 60]	Passive /active bed exercises, walk retraining, cycling, treadmill, upper lower limb ROM progressing to resistance, functional training- rolling in bed, transfers, sit to stand, walk	Critically low
Tipping et al. 2016	Determine the effect of active mobilisation and rehabilitation in ICU	N=1454 General and trauma ICUs	12 [52, 54-59, 61, 63, 65, 68, 69]	Exercise therapy, systematic mobilisation protocol, AROM, PROM, SOOB, transfers, ambulation, therapy progression by strength and sitting ability	High
Trethewey et al. 2019	Interventions for management and prevention	N=762 General ICU/ HDU	7 [50, 52, 55-57, 65, 68]	Phased rehabilitation program, cycling, exercise, PROM, physical therapy, progressive resistance training	High

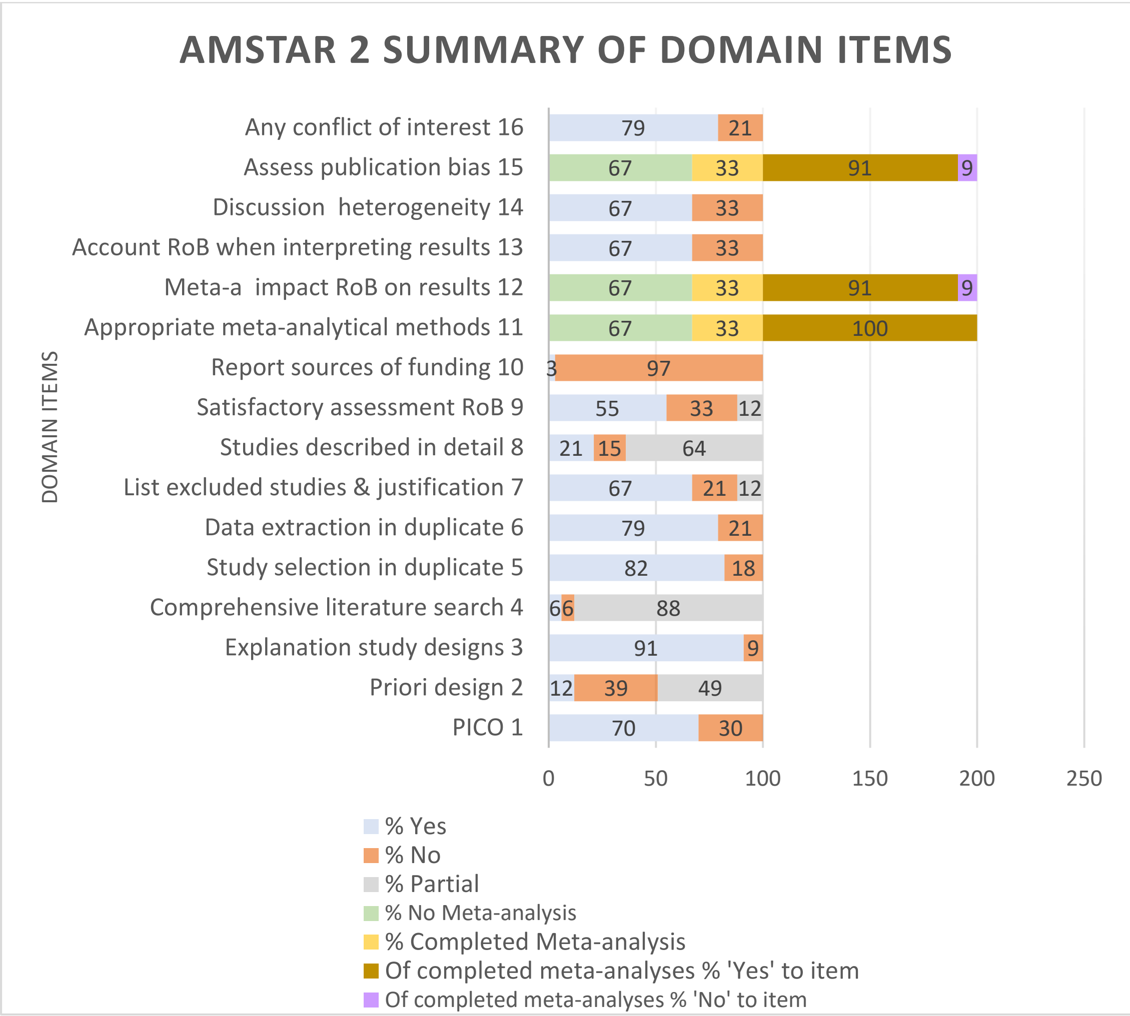
	of sarcopenia in critically ill patients				
Worraphan et al. 2020	Compare effectiveness and rank physical therapy interventions on mechanical ventilation duration and weaning times	N=582 General ICU	10 [49, 50, 52, 56, 63, 64, 69, 74, 79, 82]	Cycling, PROM, AROM, transfers, bed mobility, sitting up, ADLs, sit to stand, gait training, early mobilisation, stretching, arm resistance, sandbag on abdomen, active functional activities, passive cycle	Moderate
Zhang et al. 2019	Assess evidence regarding effects of early mobilisation in ICU	N=2202 General ICU	22[50, 52, 54-58, 60, 61, 63, 65, 69, 72-74, 76, 78, 80-84]	Cycling, passive tilting, enhanced rehabilitation, resistance training, early mobilisation, intensive mobilisation, passive exercises, goal-directed mobilisation, chair sitting, more active functional rehabilitation	High

Legend: ADL activities of daily living, AROM active range motion, HDU high dependency unit, ICU intensive care unit, PROM passive range motion, ROM range of motion, SICU surgical intensive care unit, SOEB sitting on edge bed, SOOB sitting out of bed

5.3 Critical appraisal of systematic reviews

After applying AMSTAR 2 an overall confidence rating of high was reported for ten reviews (30%),[6, 85-93] moderate for seven reviews (21%),[94-99] low for two reviews (6%),[100, 101] and critically low for 14 reviews (43%) (See Supplementary File S4).[45-48, 102-111] The extent to which the included reviews met the domains is reflected in Figure 2.

Figure 2: Summary of AMSTAR 2 domain items



5.4 Early mobility interventions

A synthesis of interventions reported in the primary RCTs (Table 4) highlighted a broad range of early mobility interventions. Active (n= 24, 65%) and passive (n= 25, 68%) range of motion were the most common. Interventions such as sit to stand (n= 13, 35%) and cycling (n=13, 35%) and in-bed mobility (n= 7, 19%) were less common. Only two RCTs involved family members or caregivers[74,51] and both studies focused on patients with prolonged mechanical ventilation (Table 4). Both studies included exercise interventions including range of motion, sitting, standing, and walking. For example, Chen et al. [49] trained caregivers to assist patients with intensive physical therapy techniques including breathing control, strengthening exercises, active transfer to chair, and functional training such as sitting in a chair, standing or walking. In Chiang et al.'s [51] study, family members were also instructed in diaphragmatic breathing techniques in preparation for a home program.

5.4.1 Intervention reporting

Of the interventions described in the 37 RCTs there was substantial variability in the TIDieR scores which ranged from 3-12 (median, 8; IQR, 2.5). Three areas of the TIDieR checklist which were addressed in less than one-third of studies included item 10 'modifications' (n= 3, 8% completion) which reflects changing circumstances and learning about the intervention, and item11 (n= 9, 24% completion), and item 12 (n= 13, 35% completion) which related to intervention fidelity (Supplementary file S5).

Table 4: Synthesis of results RCT interventions

RCT ↓	PROM	AROM	In bed mobility turning/ bridging	Sitting on edge of bed/ out of bed	Sit to stand	Transfers	Ambulate	Cycling	Vertica-lisation	Intervention initiation	Duration intervention	TIDIER out of 12	Included family members
Amundadottir et al 2019	✓	✓		✓	✓	✓	✓		✓	48 h after inclusion	20 mins twice daily	12	✗
Bianchi et al 2018								✓		MV> 24- 48 h and at least ≥ 1 week ICU stay	1 x 20 min/d until day 7 of MV	10	✗
Brummel 2014	✓	✓		✓	✓	✓	✓			within 24 h study enrollment	20 min sessions twice daily	8	✗
Burtin et al 2009	✓	✓					✓	✓		MV > 7 days	20 min, 5 d/w	8	✗
Chang et al 2011				✓						MV > 72 h	30-120 min (as tolerated) 6 days	6	✗
Chen et al 2011	✓	✓		✓	✓	✓	✓			MV > 14 d	5 days per week x 6 weeks	8	✓
Chen et al 2012				✓				✓		MV > 21 d	30-40 min, 4-6 sessions/w	5	✗
Chiang et al 2006	✓	✓	✓		✓	✓	✓			MV > 14 d	5 sessions per week x 6 weeks	5	✓
Collings and Cusack 2015				✓		✓				MV > 4 d	10 mins daily	6	✗
Coutinho et al 2016	✓	✓						✓		MV 24- 48 h	30-45 min/ d	5	✗
Dantas et al 2012	✓	✓		✓		✓	✓	✓		not described	twice daily 7 d/w	3	✗
Denehy et al 2013		✓			✓	✓				day 5 post admission	2 x 15 min/d	9	✗
Dong et al 2014	✓	✓		✓	✓					MV > 48 h and < 72 h	twice daily adjusted to condition	6	✗
Eggman et al 2018	✓	✓	✓	✓	✓	✓	✓	✓		within 48 h of ICU admission	3 times daily weekdays	12	✗
Fossat et al 2018				✓			✓			within < 72 h ICU admission	daily 15 min of cycling 5 d/w	10	✗
Franca et al 2017								✓		not clearly described	daily 20 min	4	✗
Frazzitta 2016	✓								✓	> day 7	15 sessions	11	✗
Hickman et al 2018		✓		✓				✓		within 72 h post admission	2 x 30 min/d for up to 7 days	8	✗
Hodgson et al 2016		✓	✓	✓	✓		✓			on day of enrollment	1 hour daily	12	✗

RCT ↓	PROM	AROM	In bed mobility turning/ bridging	Sitting on edge of bed/ out of bed	Sit to stand	Transfers	Ambulate	Cycling	Vertica-lisation	Intervention initiation	Duration intervention	TIDIER out of 12	Included family members
Kayambu et al 2015	✓	✓		✓		✓	✓			within 48 hours of sepsis diagnosis	1-2, 30 min sessions/d	8	×
Kho et al 2019								✓		within 3 days post admission	1x 30 min/ d	10	×
Kim et al 2014	✓	✓								< day 7 ICU	for 4 weeks	9	×
Machado et al 2017	✓	✓						✓		median start day 3 ICU	1 x 20 min/d 5 days/w	9	×
Maffei et al 2017	✓	✓		✓	✓		✓			during sedated and intubated phase	2 sessions daily	9	×
McWilliams et al 2018										MV $\geq$ 5 d and initiation after randomisation	30-45 min/d during weekday	8	×
Morris 2008	✓		✓	✓		✓	✓			initiated within 48 h MV	not accessed	8	×
Morris et al 2016	✓					✓				within 48 h intubation	20-60 min daily	8	×
Moss et al 2016	✓	✓				✓				within 1 d post randomisation	once daily	7	×
Nava 1998	✓	✓		✓			✓	✓		within first 24 h post admission	different levels	9	×
Porta et al 2005	✓	✓					✓			96 h post wean MV	45 + 20 mins d, total 15 sessions	8	×
Rocca et al 2016	✓	✓	✓					✓		from admission to ICU	30 min 5 d/w	9	×
Sarfati et al 2018							✓			MV > 3 d, initiation post randomisation	2 h/ daily sitting, 1 h/daily tilting	8	×
Schaller 2016	✓	✓		✓	✓	✓	✓			no later than 1 d after enrollment	not clearly described	7	×
Schweickert et al 2009	✓	✓	✓	✓	✓	✓	✓	✓		MV < 72 h	once daily	9	×
Wright et al 2018		✓		✓	✓		✓			MV at least 48 h	90 mins on weekdays	8	×
Yang et al 2010	✓	✓		✓		✓	✓			requiring MV > 14 d	30 mins daily 5 times/w	4	×
Yosef-Brauner et al 2015	✓	✓	✓	✓	✓	✓	✓			MV $\geq$ 4 d	twice daily	7	×

* AROM active range of motion, d day, h hours, MV mechanical ventilation, min minutes, PROM passive range of motion, w week,

6 DISCUSSION

The aim of this scoping review was to describe the extent to which early mobility interventions for critically ill patients in ICU settings include family involvement. We identified 33 systematic reviews (which included a total of 37 RCTs) undertaken in critically ill adult medical and surgical patients with varied diagnoses. There were significant variations in early mobility interventions used and interventions in the systematic reviews lacked sufficient detail prompting additional information to be obtained from the included RCTs. None of the included systematic reviews explicitly mentioned family engagement in early mobility interventions; however, this was reported in two RCTs included in 13 of the 33 systematic reviews. The TIDieR checklist revealed weaknesses in reporting tailoring, modifications and fidelity of RCTs, although it should be noted that several RCTs (n=14, 38%) were published before the inception of the TIDieR checklist.

Researchers are increasingly suggesting that early mobility,[112 113] including activities such as range of motion, turning, positioning the patient, and/ or mobilisation/ walking/transfers,[31] should be undertaken with family participation, where appropriate. In this scoping review two RCTs [49, 51] that included family members in early mobility interventions were identified. In Chiang et al. [51] patients and their family member were instructed in diaphragmatic breathing exercises in a respiratory care centre (post intensive care unit) in preparation for a home program which began with three 10-minute sessions per day and progressed as tolerated. Chen et al.[49] described early mobility interventions which included diaphragmatic breathing control, strengthening exercises for upper and lower extremities, active transfer to a chair and maintenance of a sitting position for 20 minutes per day, and functional activity training such as sitting in a chair, standing, and walking. For the first six weeks a physical therapist provided intense training directly to the patient. Following this period, family members were then trained to assist patients with the same techniques for an additional six weeks. A therapist supervised and assisted the intervention exercises once a week during this time of family involvement. Although the two RCTs [49, 51] provided a description of the early mobility interventions involving family members they did not provide any further information to describe how they included them or what the strategy for family participation involved. Chiang et al. [51] and Chen et al. [49] studies were the only to discuss family participation despite similar interventions being described in many of the other included reviews.

Family engagement in ICU is universally advocated,[114, 115] however there is limited research describing structured interventions that promote family engagement during critical illness.[116] Kydonaki et al. [117] identified that a cultural shift from families as recipients of care to a more active role in care required an investment in relationship building by clinicians and family members to recognise patient and family members qualities and values. Researchers have successfully trialled interventions in the ICU that enhance family engagement and have the potential to optimise care for ICU patients. This work has occurred in the context of family participation in medical rounds,[118] nutrition care,[20] delirium screening[119] , and physical care of the patient.[120]

Specific to early mobility interventions, a systematic review by van Delft et al [31] observed positive attitudes to physiotherapy related tasks with up to 97% of family members willing to participate in early mobility interventions. Up to 90% of patients and family members were favourable to family participation in passive exercises. More active interventions such as mobilisation out of bed and ambulation were received less positively with up to 77% of family members agreeing to participate. It is worthwhile noting however that the intervention studies in this review did not include any RCTs and focused on family member perceptions rather than actual family member participation in early mobility interventions. Rukstele and Gagnon[32] describes the process of incorporating the family into an ICU early progressive mobility protocol as part of an initiative to implement a more PFCC approach. The aim was to encourage families to play a role – passive or active- that would result in an increase in mobility sessions in the surgical ICU. After an invitation for families to engage with healthcare professionals a welcome pack provided information about the ICU and elicited information about patient preferences. Education about the complications of immobility and demonstrations of the mobility interventions were provided with nurses determining the level of involvement desired by families. Engaging with families in early mobilisation interventions showed an increase in mobility compliance over 6 months. Initial compliance with early mobility was as low as 66%; however, activity sessions increased to 94% following the initiative to involve family. This perhaps highlights the vital role family members play in giving meaning to the patient's recovery and in promoting positive outcomes.

In the ICU, the benefits of family engagement include improved well-being, reduced post-traumatic stress and depression and increased satisfaction.[114] The process of practical engagement helps families make sense of what is happening and gives meaning to their new and changing role.[121] Early mobility interventions are a practical way to engage and families can redirect stress and anxiety into a purposeful activity like early mobility. Clinicians and researchers are more aware than ever of the challenges ahead for families of ICU survivors who are essential but hidden care partners.[122] Families need information and skills to manage the patient's care needs and their own health needs after ICU,[123] and engaging families in early mobility interventions could help to achieve recovery goals throughout the recovery trajectory.

Conceptually family engagement in ICU is a unique continuum and as such there is no specific time to introduce the practice. The two RCTs in this scoping review that described family involvement[49, 51] included patients who had prolonged mechanical ventilation of 14 days or more and who were alert and cooperative. One study, [51] recruited participants from a respiratory care centre which was post-intensive care. Clinicians should use a personalised patient and family centred approach when establishing family member preferences for when to participate.[114] Such an approach should include an assessment of the appropriateness related to the patient preferences and condition, family competence and readiness, and safety considerations.[31] Ding et al [100] found that initiation of mobility interventions within 48-72 hours of mechanical ventilation may be the optimal timing for improving clinical outcomes. Considering the unique continuum of family engagement in critical care, family members may not feel comfortable or able to engage this early in the ICU admission. What is important, however, is to continually assess family member readiness for early mobility intervention engagement as this will change throughout the course of the ICU admission.

Despite the benefits and call for increased family engagement, 'how to engage' family members in the ICU is not well established. [114] This may require a shift in culture [26, 124-126] where we include family members as part of the team offering them a role they are comfortable with. Not all family members may want to participate in early mobility interventions but for those who do, engagement may give them a sense of purpose and meaning and may contribute to more positive outcomes for both families and patients. Successful strategies include engagement of families early in the ICU admission process [32] and providing appropriate education and support. [114, 117] Additionally, prioritising the development and maintenance of team cohesion with support, education and training in family engagement is required.[114] There remains huge potential to promote family engagement in early mobility interventions across the ICU continuum.

Limitations

Our review had several limitations. Our findings were constrained by only including reviews that used a systematic approach. For pragmatic reasons we restricted our focus to systematic reviews and the RCTs therein, an accepted approach in scoping reviews.[33] We specifically selected RCTs as they provide the strongest level of evidence for interventions, are the most widely accepted standard for evaluating interventions and the most likely to be implemented into clinical practice.[34] Although we consider that the search strategy was comprehensive, it is possible that research using other study designs which described family engagement in early mobility interventions may have been overlooked and further, that other study designs may contribute additional information such as feasibility and acceptability not reported in the RCTs. Nevertheless, we are confident that we have identified an important gap in this area of research, highlighting the need for rigorous evaluation of the effectiveness of family engagement in early mobility interventions. Strengths of our review include conducting screening, data extraction and quality assessments with two independent researchers. Further, we conducted quality appraisal using a validated instrument (AMSTAR 2), strengthening this scoping review.

Recommendations and implications for further research

This review has implications for clinical practice, education and research. Family members often are willing to participate in care, [19,31] and their involvement can influence quality of care.[14, 23, 127] Thus, for clinical practice, partnering with families in early mobility interventions seems an obvious choice and provides opportunities for family education and knowledge about the patient condition and motivates patients and families to move towards a meaningful recovery.[32] However, adopting family engagement in early mobility interventions remains challenging and requires a change in practice culture.[26, 125, 128, 129] Thus, clinical practice leaders must understand what healthcare professionals need to support this approach to care. Additionally, involving family members in the research process may uncover important considerations for family members, to ensure interventions are acceptable for them (e.g., how, and when family members want to engage in early mobility interventions).

For research, although more recent publications [70, 72] have improved adherence to the TIDieR checklist, overall, this review highlights the importance of intervention reporting. Future researchers who test early mobility interventions need to report modifications to their interventions along with intervention fidelity. Modifications can show learning [43] about the intervention, which informs other researchers how to prevent the repetition of errors when attempting to replicate the intervention.[43] Intervention fidelity helps to explain findings, reduce errors in interpreting outcomes and inform intervention modifications needed in the future.[43] Future research should be directed to the development and evaluation of interventions which promote family engagement in early mobility interventions. Attention to concepts of feasibility, acceptability and intervention fidelity will be important alongside future evaluation of intervention effectiveness. The vast range of early mobility interventions, diverse study populations, timing, and types of outcome assessments can result in substantial heterogeneity and should also be taken into consideration when planning future research.

CONCLUSION

The limited evidence of family engagement in early mobility interventions in this scoping review suggests that families are not widely incorporated into early mobility activities undertaken in the context of clinical trials despite families' willingness for this task and the potential for improved patient and family outcomes. It is unclear whether this reflects clinical practice and highlights an area for future research. The results also show that the quality of intervention reporting could be improved, thus, careful planning and implementation of future research is required to advance the field.

What is known about the topic

- Critical illness has a significant effect on the clinical and psychological well-being of patients and family members
- Improvements in clinical management of ICU patients have led to improved survivorship but > 50% of ICU survivors exhibit Intensive Care Unit Acquired Weakness (ICU-AW)
- Early mobilisation plays a significant role in preventing ICU-AW

What this paper adds

- Summarises current knowledge in relation to early mobility interventions in critical care
- Highlights variations in how mobility interventions are assessed and reported
- Demonstrates the absence of family inclusion in early mobility interventions
- Highlights the need to include family members in mobility interventions for critically ill patients, as they are willing to participate, and it may improve outcomes
- Highlights that many reviews to date are of low or critically low quality and more robust research is needed to understand early mobility interventions for critically ill patients and how best to capacitate family members to be involved

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