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Role Of Nurses In Early Mobility Interventions In Intensive Care Unit (ICU)

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Abstract

Objectives: *To investigate processes for delivering early mobility interventions in adult intensive care unit patients used in research and quality improvement studies and the role of nurses in early mobility interventions.*

Methods: *A systematic review was conducted. Electronic databases PubMED, CINAHL, PEDro, and Cochrane were searched for studies published from 2000 to June 2017 that implemented an early mobil- ity intervention in adult intensive care units. Included studies involved progression to ambulation as a component of the intervention, included the role of the nurse in preparing for or delivering the interven- tion, and reported at least one patient or organisational outcome measure. The System Engineering Initiative for Patient Safety (SEIPS) model, a framework for understa [1] nding structure, processes, and healthcare outcomes, was used to evaluate studies.*

Results: *25 studies were included in the final review. Studies consisted of randomised control trials, prospective, retrospective, or mixed designs. A range of processes to support the delivery of early mobil- ity were found. These processes include forming interdisciplinary teams, increasing mobility staff, mobil- ity protocols, interdisciplinary education, champions, communication, and feedback.*

Conclusion: *Variation exists in the process of delivering early mobility in the intensive care unit. In par- ticular, further rigorous studies are needed to better understand the role of nurses in implementing early mobility to maintain a patient's functional status.*

Introduction

Intensive care unit (ICU) induced functional limitations are a prevalent and persistent problem for survivors of critical illness (Ehlenbach et al., 2015; Iwashyna et al., 2010; van der Schaaf et al., 2009). Early mobility is a safe intervention to decrease the negative effects of bedrest and preserve ICU and hospital func- tional outcomes (Morris et al., 2008; Schweickert et al., 2009).

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Early mobility programmes typically consist of exercises that begin in bed and progress to the end goal of ambulation, beginning as soon as patients demonstrate sufficient physiologic stability. To date, six systematic reviews have found overall positive benefits of early mobility delivered in the ICU. These reviews have assessed patient mortality and functional status (Tipping et al., 2017); func- tional outcomes and patient safety with early mobilisation (Adler and Malone, 2012; Li et al., 2013); types and measurement of mobility interventions in older critically ill adults (Casey, 2013); outcomes of different types of mobility interventions in mechani- cally ventilated adults (Choi et al., 2008) and, physical therapy interventions in the ICU (Kayambu et al., 2013). In addition, guide- lines describe recommendations for use of physical therapy in adult ICU patients (Gosselink et al., 2008) and provide algorithms for nurses and therapists to execute early mobility interventions (Hanekom et al., 2011).

Despite empirical evidence on the benefits of early mobility, patients are not routinely receiving these interventions during in their ICU stay. Only 45% of United States ICUs acknowledge imple- menting early mobility practices (Bakhru et al., 2015) and point prevalence studies in Australia, New Zealand (Berney et al., 2013), Germany (Nydahl et al., 2014) and Switzerland (Sibilla et al., 2017)show variations in practice with few to one-third of ICU patients (18–33%) being mobilised out of bed. Increasingly, modifiable barriers to early mobility are being identified and there is a recognition that multiple barriers often co-exist (Bakhru et al., 2015; Barber et al., 2015; Dubb et al., 2016; Honiden and Connors, 2015; Hoyer et al., 2015).

A systems approach is useful in understanding broader, contex- tual factors of a process, such as barriers and actionable opportuni- ties for improvement. The Institute of Medicine's report, ''To Err is Human: Building a Safer Health System," notably described the need for systems-based approaches in healthcare to improve qual- ity and safety (Kohn et al., 2000). One example of a systems approach is the Systems Engineering Initiative for Patient Safety (SEIPS) model, which is one of the most commonly used models to analyse and redesign work systems in healthcare (Carayon et al., 2014). The SEIPS model is based on Donabedian's healthcare quality model of using structure and process measures as a means to inform outcomes (Donabedian, 1978). The SIEPS model depicts how specific work system structures (person, tasks, technology and tools, environment and organisation) interact to impact pro- cesses and outcomes and also emphasises the role of feedback from processes and outcomes to inform work system re-design (Carayon et al., 2006). This model is particularly useful in providing a framework for identifying relevant elements within the health- care work system that can be adapted to improve processes and outcomes.

In order to better understand early mobility and quality improvement research and the gap between existing evidence and current practice, this systematic review aims to organise and summarise existing evidence on early mobility interventions from a systems perspective, using the SEIPS model. While published lit- erature on early mobility in the ICU is growing, there is a signifi- cant gap in describing the role of the nurse in early mobility interventions. Because nurses are the largest providers of direct care in the ICU, it is vital to address this gap in the science (Bureau of Labor Statistics, 2015). For this reason, the scope of this review will focus on the role of the nurse within processes for delivering early mobility interventions in the ICU.

Methods

A review protocol was developed in advance of the literature search to guide study inclusion and analysis.

Search strategy

A comprehensive search of PubMED, CINAHL, PEDro, and the Cochrane Database from 2000 to June 2017 was conducted. The following medical subject headings (MeSH) and

keywords were used: mobility OR early mobility OR progressive mobility OR ambulation OR early ambulation OR exercise OR exercise therapy AND critical care OR intensive care OR ICU. Limits were set to adults, publication dates January 1, 2000 to June 1, 2017, and Eng- lish language. The search strategy was designed in collaboration with a professional librarian. Additional studies were identified Data extraction though reference and citation review.

Study selection and inclusion criteria

Articles included in this review met the following inclusion criteria: provided a description of a mobility programme initiated within the first seven days of ICU admission and included ambulation while in the ICU. Ambulation was defined to include walking in place, assisted ambulation, or independent ambulation. Studies were included if one or more patient or programme outcomes was reported. Studies were excluded when the intervention started after transferring out of ICU or did not describe the role of the nurse in preparing for or implementing the intervention. Case studies were excluded. Two reviewers independently conducted initial screening for eligibility based on the title and abstract. Full text was then evaluated to determine final eligibility. Differences in screening between reviewers were discussed until consensus was reached.

Data extraction

Each study was reviewed and these elements were extracted: a description of work system elements related to the intervention (person, tasks, technology and tools, environment, and organisation), intervention processes, and patient and/or organisational outcomes (see Table 1).

Results

Twenty-five studies meet the inclusion criteria (see Table 1, Fig. 1). The SEIPS model was used to organise a synthesis of the findings. Fig. 2 provides a summary of findings in relation to the SEIPS model.

Work system: people

People are central in the work system component of the SEIPS model and this component represents the individual(s) performin

Table 1
Summary of included literature (n = 25).

Author, year country	ICU work system structure			Early mobility processes		Outcomes
	Personnel; Tasks	Tools & Technology	Organisation	Activity Intervention	Duration, Progression, Progression	
Azuh et al. (2016) United States	PT, OT, RN, mobility assistant; Patient education		Mobility assistant position created, patient mobility level displayed weekly	ROM, bed mobility, sitting EOB, transfer OOB, ambulation	Daily, progressed by mobility team	Highest level of activity, ICU LOS, hospital LOS, pressure ulcer rate
Bailey et al. (2007) United States	RN, unit-PT, aide, RT	Early mobility protocol	Education focused on teamwork and culture change	Sit EOB, transfer to chair, ambulation	Twice daily Progressed using safety guidelines Goal ambulation > 100 feet before ICU discharge	Time from admission to activity, frequency and type of activity events, distance ambulated
Balas et al. (2014) United States	RN and PT	Mobility safety screen and protocol, mobility EHR documentation, pocket cards and unit posters	Multimodal education, engaged unit leaders, implemented with sedation and delirium bundle, discussed at daily rounds, opt-out order, used implementation framework	Sit EOB, stand at bedside and transfer to chair, ambulation	Once daily	Mobilised out of bed during ICU stay
Dafoe et al. (2015) Australia	RN, physiotherapist	Mobility plan in EHR	Multimodal education, discussed at daily rounds, mobility champions	Sitting EOB, transfer OOB, ambulation	At least once daily	Mobilisation frequency, highest level, barriers
Dammeyer et al. (2013) United States	PT, RN; RN coordinated ambulation preparation	Automatic PT consult	Interdisciplinary team used champions, defined roles, emphasized communication and coordination with PT and RN and discussion during rounds, shared safety data with staff	Ambulation	Standard patient criteria for initiating and terminating a PT session Progression individualized	PT consults, activity events, ventilator LOS, ICU LOS, discharge disposition
Davis et al. (2013) United States	PT, OT, RN, RT; RN prepared patients for mobility Therapists provided activity and patient education	PT protocol		ROM, bed mobility, sitting EOB, transfer OOB, ambulation	Progressed using activity protocol	Number of therapy sessions attempted and completed, RAND 36-Item Short Form Health Survey (SF-36), Barthel Index score, hospital discharge location, adverse events
Dickinson et al. (2013) United States	RN, PT	Mobility protocol, automatic PT consult, family education sheets	Principles established for culture change, multimodal education, leadership encouragement	Turning, ROM, positioning, dangling, resistance exercises, bicycling, OOB with sling, standing, transfer to chair, ambulation	Activity three times per day Ability to progress evaluated each shift using protocol	Mobility level, frequency of each mobility activity, RN compliance with mobility protocol
Drolet et al. (2013) United States	RN, PT, OT, aide	Order sets and protocol, developed ambulation	Quality improvement framework, multidisciplinary education	Ambulation	Progressed using activity protocol	Ambulation frequency documented by nurse

Table 1 (continued)

Author, year country	ICU work system structure			Early mobility processes		Outcomes
	Personnel; Tasks	Tools & Technology	Organisation	Activity Intervention	Duration, Frequency, Progression	
		status report, custom walker				
Fraser et al. (2015) United States	Dedicated PT, RT, aide; Mobility team completed patient screening, intervention, family education	Mobility algorithm	Interdisciplinary planning committee	ROM, bed mobility, sitting EOB, transfer OOB, ambulation	One daily during weekday	Barthel index, ventilator days, ICU LOS, hospital LOS, discharge location, number of mobility sessions, highest level of mobility
Garzon-Serrano et al. (2011) United States	RN, PT	Interdisciplinary team developed mobility categories and protocol	Interdisciplinary mobility committee	Bed mobility, EOB activities, transfer to chair, ambulation	Progressed by RN or PT using independent mobilisation assessment Developed a standardised level of mobility tool	Level of mobilisation assessed and achieved using standardised scale, barriers to further mobilisation, nursing acuity score, vent days, adverse events
Hassan et al. (2017) Australia	RN; Physiotherapist provided training and competency assessment	Mobilisation handbook, posters	Knowledge translation model to engage key stakeholders, education, positive reinforcement	EOB, transfer to chair, ambulation	Progressed using handbook	Frequency of nurse-initiated active patient mobilisations
Hildreth et al. (2010) United States	RN	Computerized mobility orders, nurse protocol		Out of bed activity	Not specified other than had to be OOB at least once	Frequency of mobility orders,% mobilised
Hodgson et al. (2016) Australia, New Zealand	Physiotherapist, aide, and RN	Mobility algorithm		Active physical exercises intended to maximize physical activity at the highest functional level the patient could achieve	Goal 1 h/day in 1–2 sessions highest level of activity possible for that patient progressed using a mobility algorithm	ICU mobility scale, strength, ventilation duration, ICU and hospital LOS, and total inpatient (acute and rehabilitation) stay as well as 6-month post-ICU discharge, quality of life, ADLs, and anxiety and depression
Klein et al. (2015) United States	RN, technician added to support mobility, lift team available	Mobility protocol placed on room clipboard, additional chairs purchased	Team reviewed protocol with RN twice daily, leadership support	Progressive mobility protocol	Daily upon admit	Highest mobility achieved, psychological profile, ICU and hospital LOS, discharge disposition, demographics, comorbidities, hospital-acquired conditions
Mah et al. (2013) United States	RN, RT PT and PT aide added for study; PT coordinated activity daily with RN	Activity protocol	Mobility discussed at daily rounds	ROM, OOB to chair, sit at EOB, stand at EOB, transfer to chair, ambulation	Activity planned 2–3 times per day Progressed using an activity protocol	Comparison of Functional Independence Measure (FIM) at ICU admission, discharge, and hospital discharge; number of days to PT referral
McWilliams et al. (2015) United Kingdom	Physiotherapy-initiated with RN involvement in maintaining plan	Individualized plan and goals written down in patient room	Quality improvement framework, interdisciplinary education, developed critical care rehabilitation team	Bed mobility, EOB activities, transfer to chair, ambulation	Individually tailored per PT	Manchester Mobility Score, ICU and post-ICU LOS, ventilator days, in-hospital mortality
Morris et al. (2016) United States	Dedicated mobility team consisting of PT, RN, aide			ROM, bed mobility, EOB activities, transfer to chair, ambulation and progressive resistance exercises	Three times daily, 7 days per week Progressed using activity protocol	Hospital LOS, ventilator LOS, ICU LOS, Short Physical Performance Battery score, SF-36, Functional Performance Inventory score, Mini-Mental State Exam, handgrip strength
Morris et al. (2008) United States	Dedicated mobility team consisting of PT, RN, aide	Automatic PT consult, mobility protocol		Passive ROM, turning, active resistance, sitting, transfers, ambulation	Daily, 7 days per week Progressed using activity protocol	Proportion of patients at hospital discharge who received ICU PT, days OOB, ICU and hospital LOS
Needham et al. (2010) United States	PT, OT, aide; RN managed pain and sedation per protocols	Changed default activity level, OT and PT consultation guidelines	Multidisciplinary QI project, meetings to engage direct care providers and leadership, shared patient stories and videos to increase buy-in	Supine to sit, sitting EOB, transfer OOB, transfer from sit to stand, ambulation	Progressed using safety guidelines	Number of treatments per patient, number of treatments per day, number of therapy consults, functional mobility
Schaller et al. (2016)	PT, RN, facilitator made sure mobility goal	Mobility algorithm, mobility goal	Mobility goal discussed during daily rounds, closed loop communication across	ROM, sitting, standing, ambulation	Daily, progressed using mobility algorithm	ICU activity score, ICU LOS, Functional Independence Measure (FIM) at hospital

Table 1 (continued)

Author, year country	ICU work system structure			Early mobility processes		Outcomes
	Personnel; Tasks	Tools & Technology	Organisation	Activity Intervention	Duration, Frequency, Progression	
Austria, Germany, United States	discussed in handoff	posted at bedside, lift equipment purchased	shifts			discharge
Sigler et al. (2016) United States	RN, PT, OT, RT; PT and OT consulted for out of bed activities	Mobility protocol, protocol posted in each patient room	Implemented with sedation and delirium bundle, nurse education	Bed mobility, EOB activities, transfer to chair, ambulation	Attempt to progress activity every 8 h	Ambulation distance, ICU LOS, adverse events
Thomsen et al. (2008) United States	RN, unit-PT, aide, RT	Mobility protocol	Developed culture by having ICU RN shadow patient post-ICU, interdisciplinary team, hospital leadership support, shared data	Sit EOB, transfer to chair, ambulation	Twice daily Progressed using safety guidelines	Ambulation occurrence and distance, severity of illness, ventilator LOS, discharge disposition
Titsworth et al. (2012) United States	RN, PT, OT	Mobility protocol, implementation toolkit (education, checklists), MD order to opt-out	Interdisciplinary mobility task force	Positioning in bed, sitting EOB, standing, chair, ambulation	Activity planned 3 times per day for 30–60 min, ambulation goal of 20–150 ft. Ability to progress evaluated each shift using protocol	Mean I-MOVE mobility score, LOS, pressure ulcers, hospital-acquired conditions
Wahab et al. (2016) United States	PT, OT; ICU clinicians reviewed patients daily with PT and OT		Weekly interdisciplinary team meetings to discuss implementation	Positioning in bed, sitting EOB, standing, chair, ambulation	Rehab therapist advanced activity	Rehabilitation treatments, ICU and hospital LOS, hospital mortality, discharge disposition
Winkelman et al. (2012) United States	RN	Research staff delivered intervention		Bed exercise, sit in chair, ambulation	20 min of exercise daily for 2–7 days Progressed using an activity protocol	Time to first exercise, type and frequency of activity, MRC, Katz Activities of Daily Living Scale, patient report of pain and fatigue, IL-6 and IL-10 pre/post exercise on days 1–3, 7 and 14

Note: PT = physical therapy, OT = occupational therapy, ROM = range of motion, EOB = edge of bed, OOB = out of bed, LOS = length of stay, EHR = electronic health record.

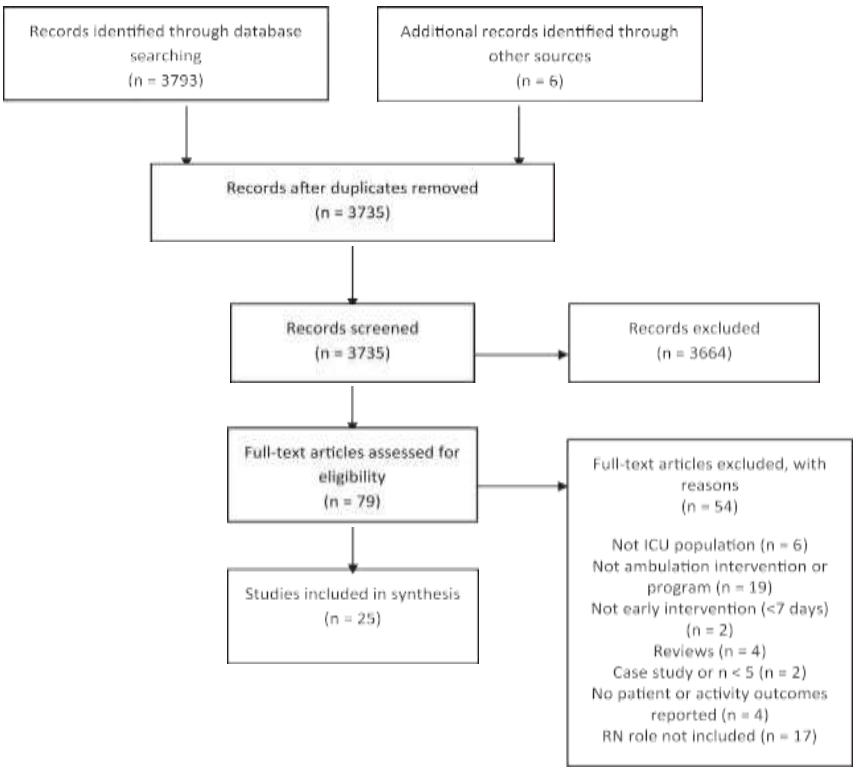

Fig. 1. Article selection process.

The work. Nurses and physical therapists (PTs) or physiotherapists are the most frequently identified providers of mobility and multiple clinical models for early mobility interventions have been researched. Four studies implemented nurse-led mobility programmes (Dammeyer et al., 2013; Dickinson et al., 2013; Drolet et al., 2013; Hildreth et al., 2010). Each of these programmes used clinical guidelines to support nurses in initiating and pro- gressing patient mobility across diverse patient acuity levels from non-intubated patients (Hildreth et al., 2010) to complex intubated patients with neurologic injuries (Klein et al., 2015). The remaining studies implemented interdisciplinary mobility teams. Several studies added staff members to support early mobility. Additional staff roles included a facilitator (Schaller et al., 2016) and aide (Azuh et al., 2016; Klein et al., 2015; Mah et al., 2013; Morris et al., 2016, 2008).

Work system: tasks
Tasks may represent job responsibilities and related concepts, such as workload, time pressure and skills required to complete tasks. Role clarity is an important consideration as multiple disci- plines are likely involved in mobility interventions. The primary role of the nurse within the interdisciplinary mobility team was described as managing pain and sedation (Balas et al., 2014; Needham et al., 2010) or for patient preparation and coordination (Dammeyer et al., 2013; Davis et al., 2013; Mah et al., 2013; Wahab et al., 2016).

Work system:
organisation the work. Nurses and physical therapists (PTs) or physiotherapists are the most frequently identified providers of mobility and multi- The organisation element describes the culture and structure of ple clinical models for early mobility interventions have been the organisation. Two studies implemented unit champions to fos- researched. Four studies implemented nurse-led mobility ter a culture of mobility (Dafoe et al., 2015; Dammeyer et al.,

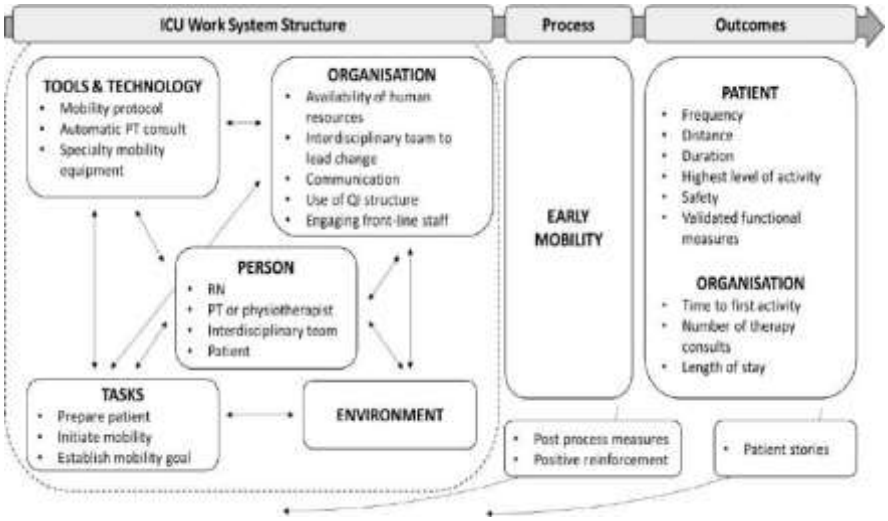

Fig. 2. Summary of early mobility literature using the SEIPS model.

2013). Prior to implementation, eight studies described establish- ing an interdisciplinary team to develop and implement early mobility (Dammeyer et al., 2013; Fraser et al., 2015; Garzon- Serrano et al., 2011; McWilliams et al., 2015; Needham et al.,
2010; Thomsen et al., 2008; Titsworth et al., 2012; Wahab et al., 2016). These teams were used to develop and implement mobility protocols, review ongoing data and champion the process. Several studies also highlighted the importance of communication between nurses and physical therapists so that an activity plan was clear (Dammeyer et al., 2013; Mah et al., 2013; Schaller et al., 2016; Wahab et al., 2016).

The structure for implementing an early mobility programme was commonly specified in quality improvement publications (see Table 1). The Standards for Quality Improvement Reporting Excellence (SQUIRE) guideline recommends reporting the use of theories or frameworks, context in which the work was done, and the approach used to assess impact of the intervention in qual- ity improvement publications (Ogrinc et al., 2015). The explicit use of a quality improvement framework or methodology was reported in six of these studies (Balas et al., 2014; Drolet et al., 2013; Hassan et al., 2017; McWilliams et al., 2015; Needham et al., 2010; Titsworth et al., 2012). Context was also commonly discussed. For example, one site had a hospital-based lift team that was avail- able to assist unit nurses and physical therapists with mobility (Klein et al., 2015), others specified the amount of educational ses- sions held and number of staff that required education (Balas et al., 2014; Needham et al., 2010) or methods to engage staff, such as creating a slogan for the mobility programme (Titsworth et al., 2012).

Work system: technology and tools

Healthcare systems use a variety of technologies and tools, such as electronic health records and medical devices. Usability of these tools is one critical concept within this element of the SEIPS model. Eleven studies described an implementing an early mobility proto- col or algorithm (see Table 1) and seven studies described using electronic documentation (Balas et al., 2014), mobility plans (Dafoe et al., 2015), or orders in the electronic health record to sup- port use of the protocol (Dammeyer et al., 2013; Dickinson et al., 2013; Drolet et al., 2013; Hildreth et al., 2010; Morris et al., 2008). Some studies used low-technology tools as reminders or communication tools, such as unit posters (Balas et al., 2014; Hassan et al., 2017) or a written plan at the patient's bedside (McWilliams et al., 2015; Schaller et al., 2016; Sigler et al., 2016). Few studies defined medical devices to support the process of mobility. Drolet et al. (2013) described the purchase of a custom walker to promote mobility with patients requiring mechanical ventilation and Klein et al. (2015) included that the purchase of more patient chairs was a component of their early mobility pro- gramme implementation.

Work system: environment

Environment focuses on the physical space in which care is pro- vided. While physical space varies between ICU units, this element of the work system was not described in any of the included articles.

Early mobility processes

Early mobility programmes typically consist of a range of activ- ities that began in bed and progressed to ambulation. Ambulation interventions were commonly reported by either frequency of times ambulated (Bailey et al., 2007; Dafoe et al., 2015; Dammeyer et al., 2013; Dickinson et al., 2013; Drolet et al., 2013;
Fraser et al., 2015; Hassan et al., 2017; Needham et al., 2010; Wahab et al., 2016; Winkelman et al., 2012) or whether it occurred during the ICU stay (Balas et al., 2014; Garzon-Serrano et al., 2011; Klein et al., 2015; Thomsen et al., 2008). Reported frequency of ambulation varied from once daily to three times daily. Variation in the definition of daily was also noted with some interdisci- plinary models. Two studies specified that the intervention occurred seven days per week (Morris et al., 2008; Moss et al., 2016), other studies described mobility team availability during weekdays (Dammeyer et al., 2013; Fraser et al., 2015; McWilliams et al., 2015), and many studies did not specify avail- ability of weekend PT coverage.

Early mobility feedback

The SEIPS model includes feedback arrows from process and outcomes back to the work system and several studies included feedback mechanisms to ICU clinicians. Programme feedback included displaying patient mobility levels weekly in the unit (Azuh et al., 2016) sharing safety data (Dammeyer et al., 2013). Routinely recognising nursing staff with the most frequent patient mobilisation is another method to provide feedback and positive

reinforcement (Hassan et al., 2017). One study described sharing patient feedback using specific patient stories and videos (Needham et al., 2010). Other studies sought feedback from clini- cians about barriers to mobility before or during implementation. Dafoe et al. (2015) identified communication as one barrier to early mobility and then focused interventions on interdisciplinary com- munication to support early mobility.

Discussion

Findings from this systematic review, evaluating literature around early mobilisation mapped to the SEIPS model, showed that the majority of studies found that early mobility in the ICU is effec- tive in improving ICU and hospital and functional outcomes using varied healthcare provider models, physical therapists, nurses and nurse/therapist teams, to deliver the intervention. There is a signif- icant need for future study of interdisciplinary models and how physical therapists and nurses work together to support functional outcomes. Overall, these interdisciplinary models were successful in increasing activity levels in the ICU and implementation factors, such as forming interdisciplinary teams and focusing on communi- cation were important characteristics of these mobility pro- grammes. However, less is known at the systems level how nurses and physical therapists work together to maintain func- tional outcomes for the unit, specifically it is not known how nurses make decisions about providing a mobility standard of care and then identify high-risk patients that require physical therapy interventions.

The role of the nurse during mobility in these models was not clearly described. It is not known in some settings if mobility occurs when PT is not present, such as more than one time daily and on evenings, nights and weekends. While the role of the nurse is clearer in preparing patients for mobility, such as managing pain and sedation, it is not known how nurses prioritise mobility within a routinely busy shift. In addition, there are multiple patient con- siderations related to the process of mobility care, such as patient stability and patient availability that influence how tasks are pri- oritised. Better understanding about job responsibilities between providers is needed, as lack of role clarity between nurses and physical therapists results in patients receiving variable levels of activity (Garzon-Serrano et al., 2011). Additional research is needed to learn how nurses make decisions about initiating mobil- ity and increasing the dose of activity with increasingly complex populations.

Early mobility is one intervention within a complex ICU envi- ronment. Many studies reported results from quality improvement work and included contextual factors related to implementing an early mobility programme. Twenty-eight unique barriers to early mobility have been identified (Dubb et al., 2016). Reporting con- textual factors can help other ICUs overcome local barriers in implementing and sustaining early mobility programmes. There is a need for studies that use a systems-approach to contribute important information about early mobility interventions within the context of the ICU. A systems approach, with comprehensive, evidence-based implementation strategies, may help to identify that multiple interventions are needed. For example, one ICU reported an early mobility education intervention did improve nurses' knowledge about the benefits of mobility, but chart review of mobility occurrences did not demonstrate a change in behaviour (Messer et al., 2015); demonstrating that knowledge alone did not change practice, which is well documented in the literature (Grimshaw et al., 2001).

Overall, there is inconsistent measurement for the type, fre- quency and duration of early mobility interventions. Leading researchers in ICU functional outcomes have recently published recommendations for the standardised use of valid functional assessment tools, such as the ICU Mobility Scale (Hodgson et al., 2014) and four-minute gait speed measure (Chan et al., 2016) to measure mobility. Standardised assessments and intervention descriptors are needed for clinicians and patients to understand beneficial dose of mobility, improve communication about amount of mobility that has occurred, and track progress over time.

Finally, feedback loops are an important element in the SEIPS model, yet methods to provide feedback to those performing early mobility interventions were not routinely

discussed. ICU nurses traditionally focus care on acute needs in a highly technical environment. These acute needs, such as maintaining airway, breathing and circulation, provide immediate feedback. The outcome of early mobility interventions, such as a patient being able to walk inde- pendently at hospital discharge, is not currently visible to the ICU nurse. Even more immediate feedback loops, such as a culture of mobility on the unit that supports peer feedback about mobility occurrences is not consistent, as ambulation is one of the most fre- quently missed types of nursing care (Kalisch and Xie, 2014). Future work should focus on identifying relevant feedback loops to sustain mobility practice and provide nurses with information that reinforces the importance of early mobility as a critical patient intervention.

Conclusion

This systematic review on early mobility studies demonstrates a high variability in the frequency,

Type , dose of activity, and a vari- ety of processes to support early mobility interventions in the ICU. The SEIPS model is a useful framework for understanding the com- plexity of early mobility interventions and identifying opportuni- ties for future investigation. Systems-based research is needed to gain further understanding of the complex interactions between patients, health care providers, and the context of the ICU in which mobility occurs. For nursing in particular, the role in initiating early mobility is not well-defined. Additional studies are needed to better understand how nurses identify patients that can be mobilised, coordinate mobility within an interdisciplinary team, and determine effectiveness of the mobility dose to maintain a patient's functional status. This work is vital to understanding how early mobility can be consistently implemented into ICU culture and nursing practice.

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Ethics statement

Ethics approval was not required for the systematic review of literature.

Conflict of interest

The authors declare no conflict of interest.

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