ACI NSW Agency for Clinical Innovation

ICCMU Intensive Care Coordination & Monitoring Unit

IC Manual
best practice guidelines for intensive care

Physical Activity and Movement: A Guideline for Critically Ill Adults

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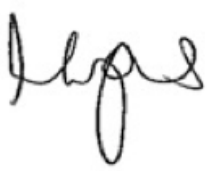
FOREWORD

Many survivors of a critical illness experience significant physical, psychological and cognitive deficits. Emerging research supports the inclusion of physical activity and movement programs into the care routines of Intensive Care Patients.

The purpose of this guideline is to provide intensive care clinicians with evidence and best practice recommendations to guide the development of local physical activity and movement (PAM) programs for critically ill adult ICU/HDU patients.

Developed under the auspices of the Intensive Care Best Practice Manual Project,
this guideline highlights the ability of the Agency for Clinical Innovation (ACI) to facilitate strong working relationships with clinicians as well other executive branches of the Ministry.

On behalf of the ACI, I would like to thank Susan Pearce, Chief Nursing and Midwifery Officer for providing state executive sponsorship for the project and funds for the Project Officer. I would also like to extend my appreciation to the LHD executives for facilitating the participation of LHD staff in developing these guidelines, which I commend to you the clinicians of NSW.



Dr Nigel Lyons

Chief Executive, Agency for Clinical Innovation

ABOUT THE ACI

The Agency for Clinical Innovation (ACI) works with clinicians, consumers and managers to design and promote better healthcare for NSW. It does this by:

- Service redesign and evaluation – applying redesign methodology to assist healthcare providers and consumers to review and improve the quality, effectiveness and efficiency of services.
- Specialist advice on healthcare innovation – advising on the development, evaluation and adoption of healthcare innovations from optimal use through to disinvestment.
- Initiatives including Guidelines and Models of Care – developing a range of evidence-based healthcare improvement initiatives to benefit the NSW health system.
- Implementation support – working with ACI Networks, consumers and healthcare providers to assist delivery of healthcare innovations into practice across metropolitan and rural NSW.
- Knowledge sharing – partnering with healthcare providers to support collaboration, learning capability and knowledge sharing on healthcare innovation and improvement.
- Continuous capability building – working with healthcare providers to build capability in redesign, project management and change management through the Centre for Healthcare Redesign.

ACI Clinical Networks, Taskforces and Institutes provide a unique forum for people to collaborate across clinical specialties and regional and service boundaries to develop successful healthcare innovations.

A priority for the ACI is identifying unwarranted variation in clinical practice and working in partnership with healthcare providers to develop mechanisms to improve clinical practice and patient care.

Table 1: Guideline development network members

NAME/POSITION	ROLE	ORGANISATION	HOSPITAL
Dr Angela Berry, RN, MHthSc, GradCert ICNurs, PhD CNC	Chair	Western Sydney	Westmead
Dr Doug Elliott, RN, PhD Professor of Nursing	Academic Advisor	University of Technology	
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Yoni Cross, CNS	Co-chair Evidence	Central Coast	Gosford
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All GDN members completed a 'declaration of interest' form based on NHMRC guidelines. The guideline development network members declared no conflicts of interest..

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1. EXECUTIVE SUMMARY

As survival rates following critical illness continue to improve [1] more information is becoming available about the significant physical, psychological and cognitive deficits experienced by many survivors during their recovery and subsequent hospital discharge. Some of these deficits can be attributed to muscle wasting as a result of critical illness, treatment and immobility while in the intensive care/high dependency unit (ICU/HDU). Studies have demonstrated that early physical activity and movement programs are feasible, safe and effective at reducing some of the adverse effects of surviving a critical illness [2, 3].

This guideline is based on three clinical health questions: How can critically ill adult patients in ICU/HDU be safely mobilised? What are the strategies for safely mobilising a patient within an adult ICU/HDU? What are the barriers to safe mobilisation of patients in an adult ICU/HDU?

This guideline offers 16 recommendations to guide the development of a physical activity and movement (PAM) program for critically ill adult ICU/HDU patients from the time of admission until discharge. It is recommended that when developing individual patient PAM programs local resources be taken into consideration to ensure successful implementation and maintenance of the program. Finally, it is important that clinicians evaluate the effectiveness of locally developed PAM programs to ensure that patients' recovery from their experience of critical illness has been optimised.

SECTION	RECOMMENDATION	GOR
1.	Early physical activity and movement is feasible and safe for critically ill patients and should be incorporated into usual practice [2-5].	Grade A
2.	All patients admitted to the ICU/HDU should be screened on a daily basis for inclusion in a PAM program. This assessment should be documented in the patient's medical record. Where feasible this screening should occur within 24 hours of admission [5, 6].	Grade C
3.	The program, based on the patient's current activity level, should be developed in consultation with a multidisciplinary team [6, 7].	Grade C
4.	A dedicated physical activity and movement program should be implemented to aid in the recovery of critically ill patients [8, 9].	Grade A
5.	In addition to the physical benefits, PAM should be implemented to support patients' psychosocial needs and reduce concerns such as anxiety, depression and sleep disorders/ disturbances that may impact the patient after discharge from the ICU/HDU [10].	Grade A
6.	The minimum human resources for safely ambulating the ventilated patient must be three staff members, one of whom is experienced and will act as team leader. The actual number of staff will be based on pre-mobility assessment. A Medical Officer with accreditation in advanced airway skills must be available on site [2, 3, 5, 7].	Grade C
7.	The equipment that may be required includes a portable ventilator and/or manual resuscitator bag, portable suction and oxygen, IV pole, monitoring equipment, a walking frame and a wheelchair to follow [2, 3, 5, 7].	Grade C
8.	The development of a dedicated multidisciplinary team is essential for the successful implementation and maintenance of a physical activity and movement plan [8].	Grade C

Table continues on page 2

Table continued from page 1

SECTION	RECOMMENDATION	GOR
Infection prevention		
9.	Clinicians are to undertake a risk assessment to identify the risk of contamination and mucosal or conjunctival splash injuries during PAM activities. PPE (including goggles/face shield/gloves and gown/apron) as per NSW 2007 Infection Control Policy are to be worn according to this risk assessment.	PD2007_036 Australian Guidelines for Prevention & Control of Infection in Healthcare.
10.	Clinicians must adhere to the Five Moments of Hand Hygiene.	PD2010_058
11.	To reduce the risk of microbial transmission, equipment utilised for each patient must be cleaned as per the NSW Infection Control Policy and ASA Standard 4187 prior to and following use [12, 13].	PD2007_036
Work, health and safety		
12.	Clinical staff undertaking patient physical activity and movement must undertake a risk assessment of the intended activity/ies to protect the health and safety of the patient and all staff involved.	Consensus
Governance		
13.	Education and training should be given to key stakeholders regarding the benefits/importance of physical activities and movement in the ICU/HDU patient.	Consensus
14.	Medical, nursing or physiotherapy ownership of a patient physical activity and movement plan should be determined [11].	Grade C
15.	Hospital executive support, in terms of management/budgetary maintenance of a patient physical activity and movement program, should be available.	Consensus
16.	Evaluation of a patient physical activity and movement program should occur following implementation, with regular audits for compliance conducted as a component of the ICU/HDU's routine quality improvement program.	Consensus

Glossary

ABHR	Alcohol-based hand rub
ACI	Agency for Clinical Innovation
ADL	Activity of daily living
AGREE Tool	The Appraisal of Guidelines for Research and Evaluation (AGREE) Instrument evaluates the process of practice guideline development and the quality of reporting.
AM	Ambulating monitoring
AROM	Active range of motion
Arrhythmia	An irregular heartbeat or abnormal rhythm
Barotrauma	Pulmonary barotrauma refers to alveolar rupture due to elevated transalveolar pressure
BMI	Body mass index
BSA	Body surface area
Critical illness polymyopathy	A syndrome of widespread muscle weakness which can develop in critically ill patients receiving intensive care.
Critical illness polyneuropathy	Defined as a predominantly motor axonal dysfunction in critically ill patients
CNC	Clinical Nurse Consultant
CPP	Cerebral perfusion pressure
DC	Data collector
Deconditioning	Muscle weakness that occurs in critically ill patients
DVT	Deep vein thrombosis
DF	Dorsiflexion
Dx	Diagnosis
Dyspnoea	Shortness of breath, breathlessness, laboured breathing to the point of discomfort or distress.
ETT	Endotracheal tube
FiO2	Fraction of inspired oxygen
GDN	Guideline development network
HDU	High dependency unit
HR	Heart rate
Hypoxaemia	Subnormal oxygenation of arterial blood
IABP	Intra aortic balloon pump
ICCMU	Intensive care coordination and monitoring unit
ICP	Intracranial pressure
ICU	Intensive care unit
IDC	Indwelling urinary catheter
IRR	Inter-rater reliability
MAP	Mean arterial pressure

MICU	Medical intensive care unit
MRO	Multi resistant organism
MV	Mechanical ventilation
NGT	Nasogastric tube
NHMRC	National Health and Medical Research Council
PAM	Physical activity and movement
PF	Plantar flexion
P/F Ratio	The P/F ratio is PaO2/FiO2 and is a means of describing the severity of pulmonary dysfunction of ventilated patients in ICU.
PPE	Personal protective equipment
ROM	Range of motion /movement is a term commonly used to refer to the movement of a joint from full flexion to full extension i.e. total amount of motion possible in a joint.
RR	Respiratory rate
RN	Registered Nurse
RROM	Resisted range of motion exercises
SBP	Systolic blood pressure
SOEOB	Sitting on the edge of the bed
SOOB	Sitting out of bed
SpO2	Peripheral oxygen saturations
Sx	Surgery
Tachypnoea	Rapid breathing
Taxonomy	The branch of science concerned with classification, especially of organisms; systematics.
Tracheostomy	A surgical procedure to create an opening through the neck into the trachea. A tracheostomy tube can be placed through this opening to create an airway and avenue to suction the patient's secretions.
VAP	Ventilator associated pneumonia
Vasopressor	A class of drugs that cause vasoconstriction as a means of elevating mean arterial pressure.

2. INTRODUCTION

Health question/s at focus of clinical practice

Mobilisation of critically ill patients, particularly those receiving mechanical ventilation, presents challenges to healthcare professionals. Current evidence suggests that lack of mobilisation poses a risk to patients [12]. Physical inactivity in critically ill patients may result in the development of neuromuscular weakness and delayed weaning from mechanical ventilation [7]. Critically ill patients often experience long-term sequelae including depression, anxiety and impaired mobility [6, 7, 13]. These complications can significantly impact the quality of life of both the survivor and their family [13]. To reduce the physical deficits and muscle weakness present as a consequence of a patient's treatment and bed rest with critical illness (14), recent attention has focused on early physical activity and movement while a patient is still in the ICU/HDU. Although further clinical trials are required to validate the benefits of physical rehabilitation programs (15, 16), there is sufficient evidence to demonstrate the feasibility and safety of physical activity and movement interventions. The aim of this guideline is to use current evidence to guide implementation of routine and systematic physical activity and movement interventions for patients in intensive care and high dependency units.

The guideline is based on three clinical health questions:

- How can critically ill adult patients in intensive care units (ICU) and high dependency units (HDU) be safely mobilised?
- What are the strategies for safely mobilising a patient within an adult ICU/HDU?
- What are the barriers to safe mobilisation of patients in an adult ICU/HDU?

Scope

This guideline is provided so that acute care facilities can develop local practices to support the development of a culture of early physical activity and movement for critically ill adults (individuals aged older than 14). For the purposes of this guideline mobilisation encompasses the full spectrum of physical activity from limb movement through to walking.

Target clinicians

The guideline concerns all members of the multi-disciplinary team including nurses, physiotherapists, doctors, occupational therapists, therapy assistants, wardspersons/orderlies and biomedical staff.

Consumer involvement

We were unable to recruit any consumers to participate in guideline development or review.

How the guideline was developed

Guideline development methods were based on earlier similar work[17] and revised to reflect updates from NHMRC[18] and the AGREE tool[19]. A guideline development network (GDN) was formed, involving practising intensive care nurses and physiotherapists from a range of ICUs throughout NSW. This network developed the guideline template that outlined the clinical question and specific areas to be addressed within the guideline. Following this, a systematic literature review was undertaken (for more details see below). A practice review was also conducted to determine a practice baseline. A technical report was developed from the systematic literature review and this document was used to inform discussions and recommendation development at the consensus meeting. NHMRC evidence statement forms were created and formed the evidence audit trail. Following the meeting the guideline document was written and circulated among group members. Consensus development and organisational consultation was undertaken over three stages:

1. Guideline group consensus - the guideline group reviewed the guideline and technical report. Agreement on recommendations was undertaken using an online survey platform (Survey Monkey) and a 1-9 Likert scale. Consensus was set as a median of ≥ 7.

2. External validation consensus – an additional clinician group was recruited from NSW and their agreement with the recommendation statements was sought using the processes outlined above. (See Appendix 1).
3. Organisational consultation was undertaken by distribution via Intensive Care Services Network.

The guideline was revised to reflect feedback received at each stage of the process.

Guideline group

The guideline development network (GDN) comprised senior nurses and physiotherapists working in NSW ICUs and HDUs and a nursing academic (See **Table 1)**. This group undertook the majority of development work for the guideline.

Evidence review

A systematic literature review was undertaken using the following clinical questions:

- How can critically ill adult patients in ICU/HDU be safely mobilised?
- What are the strategies for safely mobilising a patient within an adult ICU/HDU?
- What are the barriers to safe mobilisation of patients in an adult ICU/HDU?

The systematic literature review (see Appendix 1) considered studies that included patients in ICU/HDUs including those who were intubated and receiving mechanical ventilation. The interventions of interest were those designed to benefit critically ill patients in terms of physical activity and movement. The types of outcome measures considered were general and specific indicators of activities that promoted patients' ability with regards to specific activities and movement. Articles published from 2005 to 2013 in English and indexed in the following databases were searched: CINAHL, MEDLINE, Joanna Briggs Institute, Cochrane Library, EMBASE, DARE and Google. Key search terms used in the review were mobilisation, exercise, rehabilitation, mechanically ventilated, intensive care, critically ill and critical care. Full copies of articles considered to meet the inclusion criteria (on the basis of their title, abstract, and subject descriptors) were obtained for data synthesis. Articles identified through reference lists and bibliographic searches were also considered. Articles were excluded if the study sample consisted of healthy participants or the study was conducted in a setting other than a critical care environment. Articles were independently reviewed, using specific data extraction tools, by two reviewers who then formed a consensus on suitability for inclusion in the review. A third reviewer resolved discrepancies in reviewers' selections. NHMRC levels of evidence were used (see Appendix 3)

Level of evidence taxonomy

NHMRC procedures and taxonomy were used in the development of this guideline. Where research evidence could not be identified participants' expert opinions were used with agreement methods applied. **Table 2** below lists NHMRC grading of recommendation used in this guideline.

Table 2. NHMRC grading of recommendations [20]

GRADE OF RECOMMENDATION	DESCRIPTION
A	Body of evidence can be trusted to guide evidence
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendations but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution
Consensus	Consensus was set as a median of ≥ 7

Background

Immobility and bed rest of the critically ill patient is an ongoing problem that challenges the healthcare team. Critically ill patients may develop muscle weakness leading to impaired mobility as a result of high acuity, mechanical ventilation (MV), sedation and decreased level of consciousness. Specific physical complications of critical illness, recently labelled ICU-acquired weakness (ICU-AW)[21] including critical illness polymyopathy and critical illness polyneuropathy, contribute significantly to impaired mobility in ICU/HDU patients. The issue is heightened by extended periods of bed rest and inactivity [22, 23]. Impaired physical mobility and loss of muscular function from critical illness and periods of MV have ramifications for the patient, the patient's family and the healthcare system more broadly.

The impact on the patient may encompass functional decline and associated neuromuscular and musculoskeletal weakness, impaired coordination, prolonged hospital stay and delayed physical recovery after hospital discharge. The invasive treatment of MV can lead to a variety of other complications such as ventilator associated pneumonia, barotrauma and other ventilator induced injury, thromboses from circulatory issues and impaired skin integrity such as pressure injuries. Once the patient has left the ICU/HDU, ongoing complications can persist. These include a decline in activities of daily living and decreased independence, psychosocial concerns such as anxiety, depression and sleep disturbance [10, 24]. The impact to the healthcare system of the critically ill patient who is exposed to a prolonged ICU stay and MV include increased length of hospital stay and subsequent high cost of healthcare [22].

A growing body of evidence suggests that the implementation of early mobility practices by providing physical activity and movement guidelines and programs in the ICU/HDU can have long-term benefits for the patient and the healthcare system. Managing this group of patients to improve mobility needs a focus on increasing muscular strength; treating de-conditioning and maintaining muscular mass and function. The key to effecting change is to improve patient mobility through the implementation of dedicated physical activity and movement programs. This will require a collaborative approach from a multidisciplinary team based on established best practice. Physical training programs may include focusing on limb muscle training using passive and active range of movement and a progressive mobilisation plan. Research to date has shown this approach to be effective and economical [6, 7, 25].

Physical activity and movement (PAM) is a program to optimise functional outcome of the critically ill adult. It comprises a range of strategies that include patient assessment followed by a series of activities designed to optimise muscle strength and functional mobility. It can be summarised as a specific range of patient activities (**Table 3**).

A series of studies have demonstrated the feasibility and safety of mobilising ICU/HDU patients, including those who are mechanically ventilated via endotracheal tube or tracheostomy [3, 7, 23, 26]. **Table 4** notes a series of studies that examined the safety of mobility activities for patients in ICU/HDU, with changes in physiological parameters during exercise, monitored closely. A small proportion of actual adverse events were observed when compared to the overall number of activities. From a combined total of over 2,300 activity sessions, there was a less than 4% incidence of a clinically important change in cardio-respiratory parameters or an adverse safety event for a patient. It is important that staff members are aware of potential adverse events, to ensure that appropriate staffing levels, monitoring equipment and safety precautions are incorporated into the patient's PAM program.

Table 3: Types of physical activity and movement

ACTIVITY	DESCRIPTION	EXAMPLES	RESOURCES
Active range of motion exercises (AROM)	A range of movement where a patient can actively (without assistance) move a joint using the adjacent muscles.	• Shoulder abduction • elbow flexion • hip flexion • knee extension • ankle DF/PF	Staff as required
Resisted range of motion exercises (RROM)	Strength training by AROM against an opposing force.	• Exercises as AROM above.	Staff as required Therabands Free weights Manual resistance Ergometer
Bed exercises	A series of bed exercises to promote and preserve the patient's general bed mobility required to relieve pressure and to get up from the bed.	• Rolling • Bridging • Ankle pumps	Staff as required
Sitting on the edge of the bed (SOEOB)	The patient sits on the edge of the bed to build up trunk strength and control.	• Supported SOEOB. • Unsupported SOEOB.	Staff as required depending on the ability of the patient and the number of attachments/monitors.
Sit out of bed (SOOB)	Sitting the patient out of bed may be done in two ways; a) Passive such as sling/ hoist, Hovermat or Pat slide. b) Active assisted-standing transfer	• Sitting out in a chair • Sitting out in a water chair • Transfer to a commode	Staff as required depending on patient's stage of mobility and attachments. • Sling/hoist • Pat slide • Hover mat • Chair • Walking frame • Walk belt
Standing	Patient moves into a standing position. It can be done assisted or unassisted.	• Active at the bed side • Active assisted using tilt table	Staff as required depending on patient's stage of mobility and attachments. • Walking frame • Tilt table • Walk belt • Sling

Table continues on page 7

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ACTIVITY	DESCRIPTION	EXAMPLES	RESOURCES
Sit to stand	Patient is able to stand from a sitting position	• Active at bedside • Active assisted with standing lifter.	Staff as required depending on patient's stage of mobility and attachments.
Marching on the spot	If the patient cannot be mobilised for some reason then marching on the spot is done where the patient remains in the same place and performs marching for certain repetitions or duration.	Active at the bed side	• Chair • Standing lifter • Walking frame • Walk belt
Walking/ambulation	Patient walks with assistance or supervision.	Distance progression	Staff as required depending on patient's stage of mobility and attachments. • Portable O2 and suction equipment • Portable monitoring i.e. SpO2, • HR etc. • Portable/mobile ventilator or manual resuscitator bag • Walking frame or stick • Walk belt • Chair

Table 4: Potential adverse events versus actual adverse events

AUTHOR	POTENTIAL ADVERSE EVENTS	GOR
Bailey (3)	• A fall to knees • ET tube removal • SBP > 200mmHg • SBP < 90mmHg • SpO2 < 80%	During 1449 activities there were 14 adverse events: • 5 x fall to knees • 4 x SBP < 90 • 1 x SBP > 200 • 3 x SpO2< 80% • 1 x NGT removed
Burtin (4)	• Malignant arrhythmias • Symptoms of myocardial ischaemia • Respiratory distress/dyspnoea	No serious adverse events during 425 activities. • 8 x SpO2< 90% • 6 x SBP > 180mmHg • 2 x DBP > 20% decrease
Pohlman (2)	• MAP < 65 • HR < 40 or > 130 • RR < 5 or > 40 • SpO2 < 88% • Marked ventilator dysynchrony • Patient distress • New arrhythmia • Myocardial ischaemia • Loss of airway device integrity • Fall to knees • ETT removal	In 16% of sessions (82/498): • 31 x SpO2 > 5% decrease • 21 x HR 20% increase • 20 x ventilator asynchrony • 10 x patient agitation During the study there was 1 x arterial catheter, NGT and an expiratory ventilator limb tube temporarily removed.
Schweickert (5)	• A fall to knees • ET tube removal • SBP > 200mmHg • SBP < 90mmHg • SpO2 < 80%	No serious adverse events in 498 activities. • 1x SpO2<80% • 1x radial artery catheter removed • In 19 sessions the PAM was terminated early due to the patient becoming asynchronous with the ventilator.

Physical activity and movement practices

Staff from all ICU/HDUs in NSW were surveyed to establish a baseline of current patient physical activity and movement practices. Participants completed questions on unit demographics and current practices regarding mobilisation of mechanically ventilated and/or non-ventilated patients. If the usual practice was to mobilise patients, the questions were then designed to determine whether the unit had a formalised protocol in place, what equipment they used and whether there were any barriers to mobilising patients.

Once the survey was checked for clarity and relevance an email invitation to participate was sent to 56 potential participants including nursing and medical staff within NSW. From the initial email 14 participants responded to the survey. A second invitation to participate extended generally through ICUConnect (a mailing list coordinated by ICCMU) resulted in a further four participants who completed the online survey.

Of the 18 online participants, two ICU/HDUs mobilised patients within 72 hours of intubation. A total of six ICU/HDUs mobilised intubated patients after the first 72 hours and all 18 participants stated they mobilised non-ventilated patients. Only one ICU/HDU had a formalised protocol in use for walking a stable ventilated patient.

While the other participants didn't have formalised protocols in place within their units, they did respond that inclusion criteria for patients to commence mobilisation include: the patient must be conscious, have well managed pain and anxiety and be haemodynamically stable. Barriers reported included level of sedation, staffing levels and time constraints.

Figure 1: Image shows a ventilated patient walking with assistance from two clinicians.

3. RECOMMENDATIONS FOR PRACTICE

Assessment and clinical practice

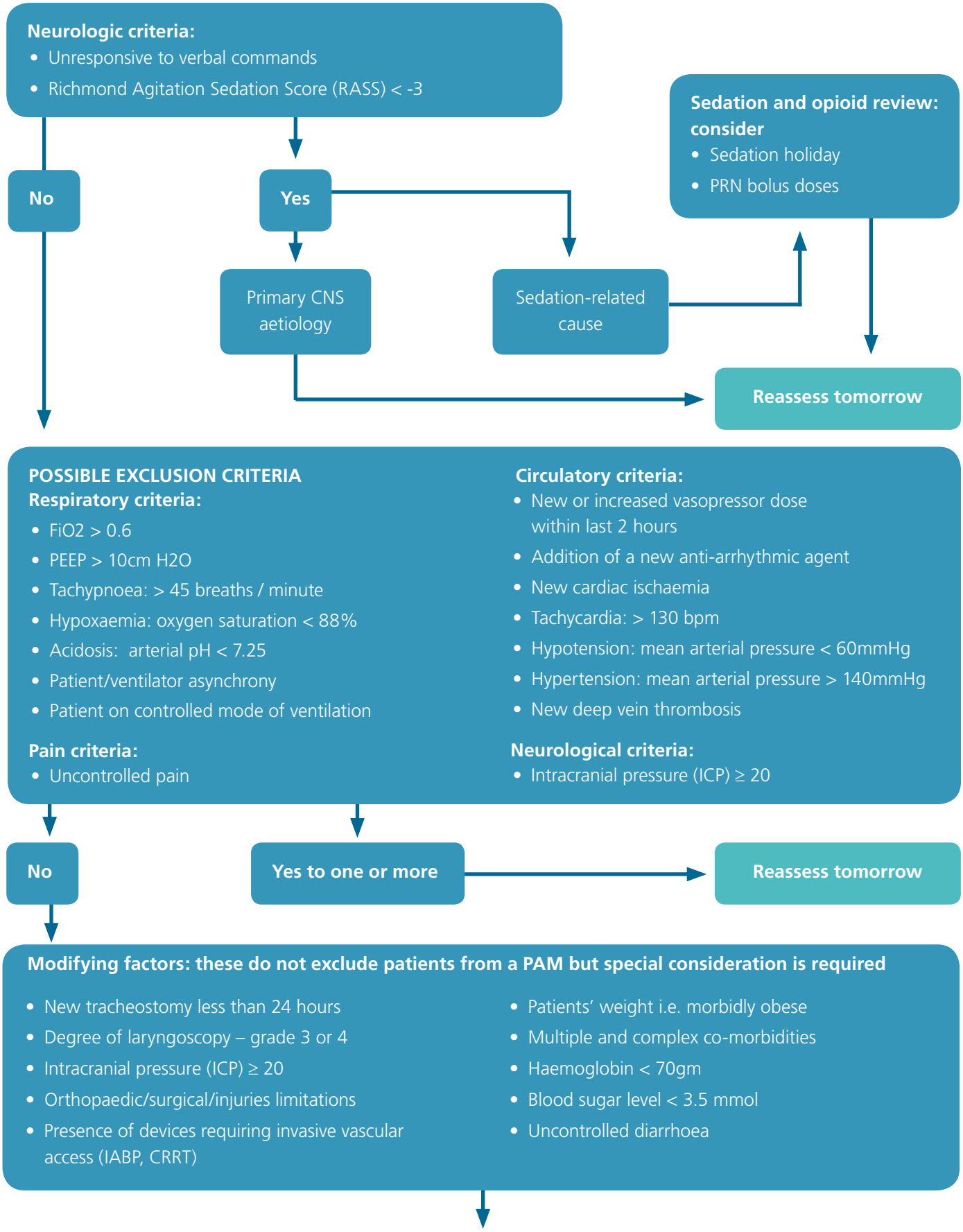
It is important that a PAM protocol identifies the healthcare worker in charge of initiating individual patient protocols. This may be the registered nurse or physiotherapist within the unit. Confusion as to the extent of a planned patient program and delayed initiation of the PAM protocol may occur if no clear guidelines exist for PAM protocol responsibility.

It has been shown that patients receive physical activity and movement interventions earlier when assessed as part of a protocol within a multidisciplinary team [8]. A rigorous screening process for inclusion in a PAM program should be performed by a designated staff member (Nurse/Physiotherapist) and based on individual assessment findings. See **Figure 2** for an example assessment tool.

Exclusion criteria for PAM may include some absolutes at the time of assessment; for example raised intracranial pressure, where the principal aim of treatment is to minimise stimulation of the patient. It is therefore important that assessment of the patient incorporates input from all members of the healthcare team.

SECTION	RECOMMENDATION	GOR
1.	Early physical activity and movement is feasible and safe for critically ill patients and should be incorporated into usual practice [2-5].	Grade A
2.	All patients admitted to the ICU/HDU should be screened on a daily basis for inclusion in a PAM program. This assessment should be documented in the patient's medical record. Where feasible this screening should occur within 24 hours of admission [5, 6].	Grade C
3.	The program, based on the patient's current activity level, should be developed in consultation with a multidisciplinary team [6, 7].	Grade C
4.	A dedicated physical activity and movement program should be implemented to aid in the recovery of critically ill patients [8, 9].	Grade A
5.	In addition to the physical benefits, PAM should be implemented to support patients' psychosocial needs and reduce concerns such as anxiety, depression and sleep disorders/ disturbances that may impact the patient after discharge from the ICU/HDU [10].	Grade A
6.	The minimum human resources for safely ambulating the ventilated patient must be three staff members, one of whom is experienced and will act as team leader. The actual number of staff will be based on pre-mobility assessment. A Medical Officer with accreditation in advanced airway skills must be available on site [2, 3, 5, 7].	Grade C
7.	The equipment that may be required includes a portable ventilator and/or manual resuscitator bag, portable suction and oxygen, IV pole, monitoring equipment, a walking frame and a wheelchair to follow [2, 3, 5, 7].	Grade C
8.	The development of a dedicated multidisciplinary team is essential for the successful implementation and maintenance of a physical activity and movement plan [8].	Grade C

Figure 2: Algorithm for PAM assessment



This is an example of an algorithm that should be adapted for local circumstances

Nurses reportedly refer to haemodynamic and respiratory variables as barriers to mobility, whereas physiotherapists refer to neurological function as the main barrier to mobility [11]. Strict criteria should be set to give confidence to the whole team that PAM will be well tolerated and is safe for their patient. Emphasis should also be placed on the continuum of activities possible for the patient. That is, there may be contraindications for the patient walking or standing but which allow for active or resisted exercises in bed.

If a patient is deemed suitable for PAM through the use of a screening tool, than each patient should be individually commenced at the level of activity considered suitable based on assessment. An example of assessment for treatment progression is provided in **Figure 3**. Patients are generally assessed as being more capable, when the assessment is performed by a Physiotherapist when compared to an assessment performed by a Nurse [11]. Therefore routine involvement of physiotherapists as part of a multidisciplinary team in directing physical activity and movement programs is essential to promote early mobilisation of critically ill patients [11]. An individual activity plan should be developed for each suitable patient in consultation with the multidisciplinary team and should include documentation of activities to be undertaken.

Figure 3: Treatment progressions for PAM

Stage 1: Active, resisted and bed exercises once patient awake and obeying commands

If able to do stage 1 and able to lift both arms >90 degrees (shoulder flexion) against gravity then progress to stage 2

Stage 2: Sit on the edge of the bed (SOEOB) supported or unsupported

- If able to do stage 2 but cannot do straight leg raise, try tilt table and/or SOOB passively
- If able to do stage 2 (SOEOB) unsupported and can perform straight leg raise then progress to stage 3

Stage 3: Stand transfer to SOOB

If able to stand, transfer wih minimal assistance. Progress to stage 4

Stage 4: Stand up and marching on the spot

If able to tolerate stage 4, progress to stage 5

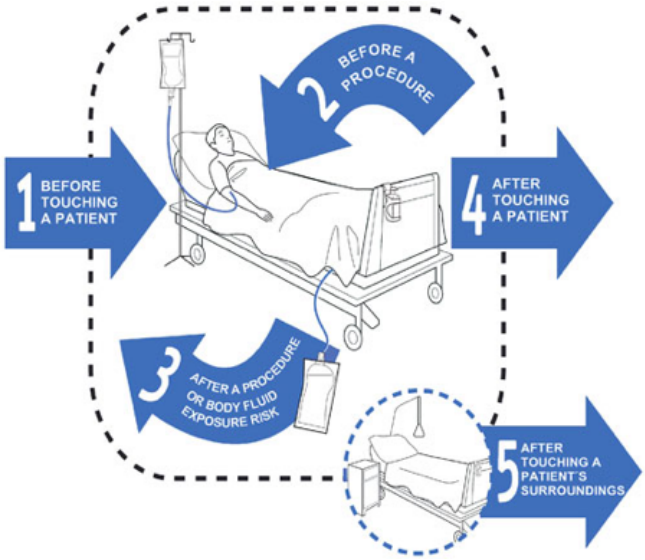
Stage 5: Ambulation with or without assistance

Infection prevention

SECTION	RECOMMENDATION	GOR
9.	Clinicians are to undertake a risk assessment to identify the risk of contamination and mucosal or conjunctival splash injuries during PAM activities. PPE (including goggles/face shield/gloves and gown/apron) as per NSW 2007 Infection Control Policy are to be worn according to this risk assessment.	PD2007_036 Australian Guidelines for Prevention & Control of Infection in Healthcare.
10.	Clinicians are to adhere to the Five Moments of Hand Hygiene.	PD2010_058
11.	To reduce the risk of microbial transmission, equipment utilised for each patient must be cleaned as per the NSW Infection Control Policy and ASA Standard 4187 prior to and following use (12, 13).	PD2007_036 AS 4187 2003

Hand hygiene

The NSW Health Hand Hygiene Policy (PD2010_058) states that all staff must perform hand hygiene as per the Five Moments for Hand Hygiene (http://www.hha.org.au/). Hand hygiene must occur before touching the patient; prior to a procedure; after a procedure or body fluid exposure risk; after touching a patient; after touching a patient's surroundings. Hand hygiene can be performed using appropriate soap solutions and water or alcohol-based hand rub (ABHR). Soap and water must be used when hands are visibly soiled.



NSW Ministry of Health policies

Prevention of infection is an important aspect of any clinical practice guideline. Users are directed to the following policy directives covering infection control. Local policy must also be consulted.

1. Infection Control Policy - http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_036.html
2. Infection Control Policy: Prevention & Management of Multi-Resistant Organisms (MRO) http://www0.health.nsw.gov.au/policies/pd/2007/PD2007_084.html
3. Hand Hygiene Policy http://www0.health.nsw.gov.au/policies/pd/2010/pdf/PD2010_058.pdf

Other relevant policies and standards

1. Australian Guidelines for the Prevention and Control of Infection in Health Care http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cd33_complete.pdf
2. Cleaning, disinfecting and sterilising reusable medical and surgical instruments and equipment, and maintenance of associated environments in healthcare facilities. ASA 4187:2003.

Cleaning of equipment

All equipment used during PAM is to be cleaned prior to and following use as per PD2007_036.

Workplace health and safety

SECTION	RECOMMENDATION	GOR
12.	Clinical staff undertaking patient activity and movement must undertake a risk assessment of the intended activity/ies to protect the health and safety of the patient and all staff involved.	Consensus

Risk assessment

Prevention of work injury is an important aspect of any clinical practice guideline. Users are directed to the following policy directives covering work health and safety. Local policy must also be consulted.

- NSW Work Health and Safety Act 2011 http://www.legislation.nsw.gov.au/maintop/view/inforce/act+10+2011+cd+0+N

The NSW Work Health and Safety Act 2011 states that organisations must eliminate the health and safety risks to workers where at all possible. When it is not possible to eliminate risks, the risk must be minimised as far as reasonably practicable. Organisations must provide appropriate PPE for use by staff. Staff have a responsibility to use that PPE according to policy.

The worker has an obligation under the NSW Work Health and Safety Act 2011 to;

i) • take all reasonable care for their own safety.

   • take care that their acts or omissions do not adversely affect the health and safety of other persons.

ii) comply with any reasonable instruction that they are given.

Governance

SECTION	RECOMMENDATION	GOR
13.	Education and training should be given to key stakeholders regarding the benefits/importance of physical activities and movement in the ICU/HDU patient.	Consensus
14.	Medical, nursing or physiotherapy ownership of a patient physical activity and movement plan should be determined (11).	Grade C
15.	Hospital executive support, in terms of management/budgetary maintenance of a patient physical activity and movement program should be available.	Consensus
16.	Evaluation of a patient physical activity and movement program should occur following implementation, with regular audits for compliance conducted as a component of the ICU/HDU's routine quality improvement program.	Consensus

While there is reported support for physical activity and movement programs to improve patient outcomes [9], nurses and physiotherapists need to identify potential local barriers associated with these interventions and develop strategies to achieve optimal patient outcomes.

4. IMPLEMENTATION OF PAM

PAM resources

The major factor in ensuring a successful PAM program is that it is tailored to the availability of local resources (both human and equipment) and the needs of the specific patient diagnostic group together with all associated patient medical devices.

The resources necessary for safe physical activity and movement can be divided into human and mechanical resources. Human resources include a trained multidisciplinary team, that may, depending on the patient's strength and the current activity, include some or all of the following healthcare workers: nurses, physiotherapists, medical staff, occupational therapists, therapy aides and wards-persons/orderlies. The roles adopted by these staff would include a dedicated staff member (nurse/medical officer/physiotherapist) to hold the airway; care must be taken with all other medical devices attached to the patient. In addition, a medical officer with accredited advance airway skills should be readily available. Biomedical personnel may also be required to adapt equipment to meet the demands of the intended patient activity. An example of this is the modification of ventilators and monitoring equipment to facilitate patient mobilisation.

Mechanical resources can be divided into simple and complex devices. Simple devices include those which promote strength training by resisted exercises, including squeeze balls, Therabands, weights, support frames, step and cycle ergometer. More complex devices range from mobile monitoring equipment, ventilators and other support equipment. **Table 5** summarises the recommended resources identified in the systematic literature review.

The minimum resources utilised in the study protocols were three to four staff members, a portable ventilator and manual resuscitator bag, monitoring equipment, a walking frame and either a wheelchair or static chair to follow behind in case the patient becomes fatigued. One study used a purpose-built frame that combined the mobile ventilator, intravenous lines and monitoring equipment, and an emergency seat [27].

Table 5: Summary of human and physical resources required for patient mobilisation

PERSONNEL	NUMBER
Nurse [2, 3, 5, 7]	1
Physiotherapist [2, 3, 5, 7]	2
Physiotherapy Assistant [3, 5, 7]	1
Occupational Therapist [2, 5, 7]	1
Doctor [2, 5]	1
EQUIPMENT	
Portable ventilator and manual resuscitator bag with medical gas supply and suction [2, 3, 5, 7]	Yes
Wheeled pole for IV lines [2, 5, 7]	Yes
Portable haemodynamic monitor [2, 3, 5, 7]	Yes
Portable pulse oximetry [2, 3, 5, 7]	Yes
Upright static chair [2, 3, 28, 29]	Yes
Walking frame [3, 7, 29]	Yes
Wheelchair to follow [3, 7, 29]	Yes

Education and training

Creating an ICU/HDU culture that embraces a PAM protocol is dependent on a rigorous and comprehensive educational program for all staff involved. As with implementation of most new models of care, success is more likely to occur and be maintained if a staff member supported by an enthusiastic team is identified to drive the change. This staff member could be a Nurse or Physiotherapist.

It is recommended that medical, nursing and allied health staff be educated in the PAM protocol for their ICU/HDU. Staff should be educated regarding all aspects of the protocol including:

- the benefits of PAM
- the types of PAM
- the equipment and staffing required for PAM
- the inclusion/exclusion of screening tools and processes, including who is responsible for the performance of screening
- the assessment and treatment progression, including utilisation of a Physiotherapist as part of the multidisciplinary team
- the potential for adverse events, particularly falls and the removal of medical devices
- the potential for barriers to mobilisation.
- The introduction of a specific patient mobility program can reportedly increase nursing compliance from 22% to 80% [30].

In summary, education programs to ensure successful implementation and maintenance of a PAM program must address all aspects of the protocol for early patient physical activity and movement and provide comprehensive training of the multi-disciplinary team. The team must perceive that the benefits of early mobilisation outweigh the risks of adverse events.

PAM implementation tools

There are a number of factors to consider prior to implementation of the PAM guideline. These include, but are not limited to, a determination of a need for a PAM program based on a comparison between current practice and the guideline recommendations; an understanding of the barriers to successful implementation and how these might be overcome; strategies to sustain a PAM program; and finally, a sound evaluation method to review the degree of success of the PAM program and its continued use.

In conjunction with this guideline there are a number of internet-based tools available from the ACI Vimeo channel) and other sites, to assist in the safe implementation of a PAM program.

Conclusion

Ultimately, the success of a PAM program will depend largely upon the timeliness of hospital executives to ensure sufficient resource funding and the willingness of the entire ICU/HDU clinical team to assess every patient, every day, for suitability in a physical activity and movement program.

www.aci.health.nsw.gov.au/networks/intensive-care

5. APPENDICES

Appendix 1 Guideline development history

1. April 2012 – GDN executive formed; guideline scope and systematic review formulated.
2. May 2012 – Team building; finalisation of guideline scope and CPG workplan; evidence-based practice education; team plan.
3. May-December 2012 – Systematic review work undertaken culminating in development of technical report.
4. February 2013 – Consensus development meeting – recommendation development.
5. Feb-May 2013 – Guideline writing.
6. May 2013 – Internal consensus – (see **Table 6**).
7. July 2013 – External validation panel (see **Table 8**), change to recommendations (see **Table 7**).
8. August 2013 – Organisation consultation via ICSN network.
   a. No feedback received.

Table 6 Consensus results

RECOMMENDATION NUMBER	CONSENSUS FINAL	1	2	3	4	5	6	7	8
		1	2	3	4	5		8	9
Internal consensus	Median	9	9	9	9	8.5	8	8	9
	IQR	8-9	8.25-9	8-9	8-9	8-9	7-9	7-9	9
External consensus	Median	8.5	9	9	9	8	6	7.5	8
	IQR	7-8.2	7-9	7-9	7-8.7	7-8.7	5-6	7-8.5	7-8.5

RECOMMENDATION NUMBER	CONSENSUS FINAL	9	10	11	12	13	14	15	
		10	11	12	13	14	15	16	
Internal consensus	Median	9	9	9	9	8	8.5	9	
	IQR	8-9	8.2-9	9	8.2-9	7.2-9	8-9	8-9	
External consensus	Median	9	9	9	8.5	7.5	8.5	8	
	IQR	7.2-9	7.5-9	7.7-9	7-9	5.7-7.7	7-9	7-8.7	

Table 7: Recommendation change log (post-external validation)

RECOMMENDATION NUMBER AT VALIDATION	RECOMMENDATION NUMBER IN FINAL GUIDELINE	FAILURE TO ACHIEVE CONSENSUS AT EVP
6	6-7	• The minimum resources to be utilised in the ambulation of the ventilated patient include three to four trained staff members, a portable ventilator, monitoring equipment, a walking frame and a wheelchair/static chair to follow. Action • Recommendation split into two revised statements based on feedback and group discussion
12	13	Original text • Education and training should be given to key stakeholders regarding the benefits/importance of activities and movement in the ICU/HDU patient. Action • Recommendation statement revised based on feedback and group discussion

Table 8 External validation clinician group

Rolls	Kaye	CPO ACI - ICCMU
Skylass	Katina	CNC ICU Concord Hospital
Shunker	Sharon-Ann	CNC ICU Liverpool
Breeding	Jeff	CNC ICU St Vincent's Hospital
Butcher	Rand	CNC ICU Tweed Hospital
Roy	Rita	Infection Control Professional
White	Elizabeth	Infection Control Professional
Thackray	Nigel	Physiotherapist, Campbelltown Hospital
Chung	Claire	Physiotherapist, Gosford Hospital
Reddy	Nazmeen	Physiotherapist, Royal Prince Alfred Hospital
Chaseling	Wendy	Physiotherapist, St George Hospital
Rose	Katrina	Physiotherapist, Westmead Hospital
Wright	Natalie	RN ICU Shoalhaven
Raper	Ray	Senior Staff Specialist RNSH

Appendix 2: Summary tables

FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Adler [31]	SR	• Search keywords, mobilisation, exercise and physical therapy, intensive care unit and critical illness. • Inclusion criteria: prospective randomised trials, prospective cohort studies, retrospective analyses and case series. 2000 to 2011	Mobilisation of the critically ill with emphasis on functional outcomes and safety.	15 papers (RCTs, cohort, quality improvement and case control studies)	Based on the limited evidence early physical therapy and mobilisation of the critically ill is achievable and safe.
Bailey [3]	Cohort	Respiratory ICU – 103 subjects	Early activity protocol with twice daily activity. Range from sit on edge of bed without back support; sit in chair, ambulate with or without assistance.	A majority of survivors (69%) were able to ambulate >100 feet at RICU discharge.	Early activity is feasible and safe in respiratory failure patients.
Burtin [4]	RCT	Medical and surgical ICU with 90 subjects divided into 2 groups	• Control group: Respiratory therapy and limb active or passive motion exercises. • Intervention group: Same as control group with additional use of bedside ergometer.	• At ICU discharge, functional status was not different between groups. • At hospital discharge: walking distance, quadriceps force and subjective wellbeing were significantly higher in the treatment group. • No adverse events were reported.	Early exercise in critically ill survivors enhances functional capacity and muscle force at time of hospital discharge.

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FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Chang [8]	Cohort	Adult ICU – 15 subjects	Investigate the effect of passive tilt table standing on short-term ventilation parameters and gas exchange in chronic critically ill population and to determine whether any changes are maintained after the intervention.	Standing in the tilted position for 5 minutes produced significant increases in tidal volume, minute volume and respiratory rate. Gas exchange was not enhanced post tilt table.	Short-term gains in ventilation can be achieved by use of a tilt table.
Clini [32]	Cohort	Adult respiratory ICU – 77 subjects	Structured program targeting limb and trunk control to facilitate transfer from bed to chair, standing and walking.	A large percentage of the patients who survived had recovered in all the basic activities of daily living (BADL) domains at respiratory ICU discharge.	Patients on long-term mechanical ventilation may benefit from a comprehensive rehabilitation program.
Deacon [33]	QA	Study website linked to other ICU websites. N = 35 subjects	Questionnaire following ICU discharge, to determine ex-ICU patients' experience of an ICU rehabilitation program.	Physiotherapy and occupational therapy identified as important.	There is a need to take a holistic approach to designing post ICU rehabilitation.
Garzon-Serrano [11]	Prospective observational study	Surgical ICU – 63 subjects	Mobilisation protocol developed by nurses, physical therapists, intensivists, respiratory therapists and surgeons.	Physical therapists achieved a significantly higher level of patient mobilisation than nurses. Different barriers to mobilisation were reported between the two groups.	Physical therapist involvement results in promotion of early mobilisation of critically ill patients.
Hildreth [30]	Cohort	Surgical adult ICU - 100 Subjects	Pre and post intervention comparison of mobilising patients from bed to chair.	There were no statistically significant differences between both group in terms of ICU or hospital LOS. There were no adverse events reported.	Surgical ICU patients can be safely mobilised.

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Table continued from page 23

FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Langhorne [34]	RCT	32 stroke patients randomised into 4 groups	Patients recruited within 24h of admission. Exclusions: Patients with severe pre-stroke disability, those fully recovered, or had severe co-morbidities. Intervention groups: 1. Standard care – immediate transfer to a stroke unit and mobilised 30-60 minutes/day. 2. Early mobility (EM) – standard care plus trial-based protocol, which aimed to get patients up to sit, stand and walk within 24hrs of the stroke and continue this at least 4 times per day. 3. Ambulatory monitoring – standard care plus a protocol-driven approach. 4. Combined protocol – this incorporated both EM and AM.	• The EM group was significantly more likely to mobilise very early and to achieve walking by day 5 without complications of immobility. • The AM group was significantly more likely to have pre-defined physiological complication events detected. • All these associations remained, but were less statistically significant, after correcting for unadjusted comparisons. • There were no significant safety concerns observed.	Larger trials are required to confirm benefits of these interventions.
Martin[35]	Cohort	Chronic ventilator-dependent rehabilitation unit – 49 subjects	Gradual, structured increase in rehabilitation sessions aimed at improving trunk control and maintenance of body posture to standing and ambulation including staircase.	Multidisciplinary team achieved significant improvement in patient rehabilitation from confined to bed with severe limb weakness to ability to stand and ambulate.	Multidisciplinary team approach to patient rehabilitation can improve both motor strength and functional status and is an important part in the care of chronically ventilated patients.

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Table continued from page 24

FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Masley [36]	QA	Three academic medical centres involving 18 physical	Semi-structured interviews of critical care physical therapists to determine knowledge associated with critical care physical therapy.	Process for decision-making in providing physical therapy to critical care patients was described.	Physical therapists in the acute care setting aimed to provide optimal care in the context of their work environment.
Morris [6]	Cohort	Medical ICU Block allocation of 3 blocks with 50 subjects/block	Multidisciplinary team mobility protocol comprising 4 levels of activity.	ICU and hospital LOS reduced in the intervention group	Early mobility therapy in respiratory ICU patients is feasible, safe and is associated with decreased ICU and hospital LOS. There is no increase in cost associated with a mobility program.
Morris [6]	Cohort	Adult medical ICU – 280 subjects	Multidisciplinary team driven 4 level protocol initiated within 48 hours of mechanical ventilation.	There was a significant difference between the usual care and protocol groups in both ICU and hospital LOS. There were no adverse events reported.	A planned early mobility regimen for critically ill ICU patients receiving mechanical ventilation is safe and can decrease ICU and hospital LOS.
Needham [7]	QA	MICU – 57 subjects	Multi-disciplinary team protocol with change to the ICU culture with regards to sedation, staffing and patient activity.	There was a higher level of functional mobility and a decrease in ICU and hospital LOS.	A structured and multifaceted QI process can reduce deep sedation and increase activities for mechanically ventilated patients.
NICE[37]	Guideline	Consensus derived clinical guideline for rehabilitation after critical illness.	Comprehensive list of recommendations. The responsibility for implementation and use remains with the clinicians.	No reported evaluation of the guideline identified in the literature.	The guideline should stimulate research, and the impact of the introduction of the recommendations, along with alternative approaches, should be thoroughly evaluated.

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Table continued from page 25

FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Pohlman et al [2]	RCT	Two tertiary adult ICUs – 49 subjects	Mobilisation protocol delivered by physical, occupational therapists and ICU nurses.	Patients achieved improved levels of mobilisation and required less assistance following discharge from ICU.	Mobilisation of MV patients is both feasible and safe.
Schweickert [5]	RCT	Medical adult ICU – 104 subjects Randomisation was based on functional independence.	• Control group: Daily interruption of sedation and therapy as determined by primary team. • 1ntervention group: physical and occupational therapy led early exercise and mobilisation during periods of sedation interruption.	At hospital discharge there was a 59% return to independent functional status in the intervention group compared to 35% in the control group.	A whole-body rehabilitation program is well tolerated and can achieve better functional outcomes at hospital discharge. The program can also achieve shorter durations of delirium and ventilator days compared to standard care.
Stockley [38]	Survey	Survey of 152 senior physiotherapists employed in general, neuro, trauma and cardiology ICUs.	Study of respondents' usual practice and aim of treatment in mechanically ventilated and sedated patients in terms of passive movement.	Majority stated that the aim of using passive movement (PM) was to maintain joint range of movement (ROM) in ventilated and sedated patients across all clinical areas.	There was agreement amongst the physiotherapists that PMs influence joint range and that this is at risk of being lost if PMs are not done. The author acknowledged that this opinion is not supported by evidence and that further research is required to investigate this view.
Thelandersson [39]	Cohort	Neuro ICU - 12 ICU pts vs. 12 healthy controls respect to intracranial, cerebrovascular and haemodynamic parameters.	A range of PROM exercises supervised by a physiotherapist.	In the patient group CPP, BP and HR did not significantly change during and after PROM exercise, but a significantly lower ICP (p 0.01) value was found after compared with during exercise.	In terms of intracranial, cerebrovascular and haemodynamic parameters, physiotherapist-supervised critically ill NICU patients can safely undertake PROM exercises,

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Table continued from page 30

FIRST AUTHOR	STUDY TYPE	Study design (N=subjects)	Intervention	RESULTS	CONCLUSIONS
Thomsen [29]	Cohort	Adult respiratory ICU – 104 subjects after transfer from general ICU to respiratory ICU.	• MV patients with respiratory failure. • Early activity protocol with criteria: follows commands and cooperative, FiO2 < 0.6, PEEP < 10, no inotrope support, no orthostasis. Mobilised from sit on edge of bed to ambulate.	The transfer of patients to the RICU, where activity was actively promoted resulted in a statistically and clinically significant increase in ambulation.	Controlled studies are needed to evaluate the effects of immobilisation on neuromuscular dysfunction associated with critical illness.

Appendix 3: NHMRC Levels of evidence

LEVEL	INTERVENTION	Diagnosis	Prognosis	AETIOLOGY	SCREENING
I	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies	A systematic review of Level II studies
II	A randomised controlled trial	A study of test accuracy with an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	A prospective cohort study	A prospective cohort study	A randomised controlled trial
III-1	A pseudo-randomised controlled trial (i.e. alternate allocation of some other method)	A study of test accuracy with an independent, blinded comparison with a valid reference standard, among consecutive patients with a defined clinical presentation	All or none	All or none	A pseudo-randomised controlled trial (i.e. alternate allocation of some other method)
III-2	• A comparative study with concurrent controls: • Non-randomised, experimental trial • Cohort study • Case-control study • Interrupted time series with a control group	A comparison with reference standard that does not meet the criteria required for Level II and III-1	Analysis of prognostic factors amongst untreated control patients in a randomised controlled trial	A retrospective cohort study	A comparative study with concurrent controls: • Non-randomised, • experimental trial • Cohort study • Case-control study
III-3	A comparative study without concurrent controls: • Historical control study • Two or more single arm study • Interrupted time series without a parallel control group				
IV	Case studies with either post-test or pre-test/post-test outcomes	Study of diagnostic yield (no reference standard)	Case series, or cohort study of patients at different stages of disease	A cross-sectional study	Case studies

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