2016

Minimum standards of clinical practice for physiotherapists working in critical care settings in Australia and New Zealand: A modified Delphi technique

Elizabeth Skinner

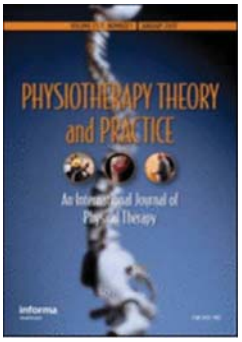
Peter Thomas

Julia C. Reeve

Shane Patman
University of Notre Dame Australia, shane.patman@nd.edu.au

This article was originally published as:
Skinner, E., Thomas, P., Reeve, J. C., & Patman, S. (2016). Minimum standards of clinical practice for physiotherapists working in critical care settings in Australia and New Zealand: A modified Delphi technique. *Physiotherapy Theory and Practice: an international journal of physical therapy, 32* (6), 468-482.
http://doi.org/10.3109/09593985.2016.1145311
Original article available here:
http://www.tandfonline.com/doi/full/10.3109/09593985.2016.1145311

This is an Accepted Manuscript of an article published in Physiotherapy Theory and Practice: an international journal of physical therapy on June 03, 2016 available online: http://www.tandfonline.com/doi/full/10.3109/09593985.2016.1145311



Minimum standards of clinical practice for physiotherapists working in critical care settings in Australia and New Zealand: a modified Delphi technique.

Journal:	*Physiotherapy Theory and Practice*
Manuscript ID	UPTP-2015-0072.R2
Manuscript Type:	Research Report
Keywords:	Delphi technique, Critical Care, Physiotherapy, Professional Competence, Education

Minimum standards of clinical practice for physiotherapists working in critical care settings in Australia and New Zealand: A modified Delphi technique

Authors:

Elizabeth H Skinner[1] BPhysio (Hons), PhD; Peter Thomas[2] BPhty (Hons), PhD, FACP; Julie C Reeve[3] Grad Dip Phys, MSc, PhD; Shane Patman[4] B.AppSc(Physio), PhD

Affiliations:

[1]Western Health, 176 Furlong Road Sunshine, Melbourne, Victoria 3020, Australia

[2]Royal Brisbane and Women's Hospital, Physiotherapy, Melbourne, Victoria 3011 Australia

[3]AUT University, School of Rehabilitation and Occupation Studies, Private Bag 92006 Auckland 1142 New Zealand

[4]University of Notre Dame Australia, Physiotherapy, Fremantle, Victoria Australia

Corresponding Author:

Elizabeth H Skinner, BPhysio (Hons), PhD
elizabeth.skinner@wh.org.au

ABSTRACT

Objective: Achieving competency in critical care in entry-level physiotherapy courses across Australia and New Zealand is not essential, and accredited training for qualified physiotherapists working in critical care units is lacking. As a result, practice standards and training may vary. The objective was to establish consensus-based minimum clinical practice standards for physiotherapists working in critical care settings in Australia and New Zealand. **Design:** A modified Delphi technique, which consisted of three rounds of questionnaires, was used to obtain consensus on items. **Setting:** Australian and New Zealand critical care settings. **Participants:** A panel (n=61) was invited from a pool of eligible physiotherapists throughout Australia and New Zealand (n=93). Eligibility criteria were defined *a-priori* on the basis of possession of expertise and experience in the practice and teaching of critical care physiotherapy clinical skills. **Main Outcome Measure:** Questionnaires were disseminated electronically (either via email, or SurveyMonkey®). Items were designated by participants as being 'Essential/Unsure/Not Essential'. Consensus for inclusion was achieved when items were ranked 'Essential' by more than 70% of participants. **Results:** Fifty physiotherapists consented and participated in the initial Delphi round, of whom forty-five (90%) completed all rounds. Consensus was reached on 199 (89%) items. The panel agreed that 132 (58%) items were 'Essential' items for inclusion in the final framework. **Conclusions:** This is the first study to develop a consensus framework of minimum standards of practice for physiotherapists working in critical care. The clinical utility of this framework now requires assessment.

Key words: Delphi technique; Critical Care; Physiotherapy; Professional Competence; Education

INTRODUCTION

In Australia and New Zealand, competency of practice in critical care settings is not a requirement of entry-level physiotherapy courses despite Level 1 evidence demonstrating the benefit of physiotherapy intervention in reducing length of stay, ventilation duration and improving physical function, quality of life and muscle strength (Kayambu, Boots, and Paratz, 2013). Respiratory physiotherapy techniques including hyperinflation, positioning, have also been reported to resolve atelectasis, improve oxygenation and chest radiograph findings in ventilated patients (Ntoumenopoulos, Presneill, McElholum, and Cade, 2002; Patman, Jenkins, and Stiller, 2000; Stiller et al, 1990; Stiller et al, 1996). For physiotherapists to deliver evidence-based care (Kayambu, Boots, and Paratz, 2013; Stiller, 2013) within this environment, postgraduate education and acquisition of knowledge and specific diagnostic and task related skills are therefore required (Berney, Haines, and Denehy, 2012). However, nationally accredited postgraduate courses or training pathways do not exist for critical care physiotherapy and education and training programs are determined and delivered by individual workplaces. To provide 7-day a week services, which is currently the case in 66% of Australian ICUs (Chaboyer, Gass, and Foster, 2004), physiotherapy staff are often required to contribute to critical care rosters regardless of their primary area of clinical practice (e.g. orthopaedics).

Staff are often required to complete tailored, in-house/local critical care orientation programs which include theory, clinical skills training and supervised clinical practice (Reeve, 2003). These programs are commonly delivered and assessed by senior physiotherapy staff, thus the process is often subjective and informal (Gough and Doherty, 2007; Reeve, 2003) with variability in the content, requirements and duration of the education provided (Reeve, 2003). Practice may also vary, and may be subject to local practitioner's bias, or hospital's historical practice, and may therefore lack broad evidence-based or expert practitioner support. This lack of

consistency in professional standards, practice, and dedicated training poses a substantial threat to the role of physiotherapists. The experience of the multidisciplinary team and patient outcomes in ICU may be vastly different whether the treating therapist is a new-graduate staff member who has not worked in the ICU previously, compared to a cardiorespiratory specialist physiotherapist with over twenty years clinical experience in ICU. Calls for a competency framework that is endorsed by experienced physiotherapy clinicians working in the critical care environment have been made in order to clarify the role of the physiotherapist in ICU and ensure safe and effective evidence-based physiotherapy practices (Berney, Haines, and Denehy, 2012; Bersten and Soni, 2009; Gosselink et al, 2008; Hanekom et al, 2011a).

Publishing a set of bi-national standards will allow clarification of the minimum level of knowledge and practice expected of those practitioners working in critical care. Developing this framework may enhance the consistency of the physiotherapy role within critical care settings and may provide a foundation with which to further develop the role of the physiotherapist within critical care. Through a professional commitment to these standards, the provision of consistent, high quality, evidence-based physiotherapy services in critical care should add value to the healthcare team, and ultimately assist in improving patient outcomes. An agreed set of minimum standards aims to provide a foundation to underpin the provision of consistent education and training in critical care physiotherapy across Australia and New Zealand. Accordingly, the aim of this project was to establish a framework for minimum standards of clinical practice for physiotherapists working in Australian and New Zealand critical care settings.

METHOD

Ethics

The Human Research Ethics Committees of The University of Notre Dame Australia (study number 013013F) and the Auckland University of Technology (study number 13/38) approved

the study. All participants gave implied informed consent by completion of the survey. The trial registration number is ACTRN12613000753752.

Design

A modified Delphi technique (Reid, 1988) was used to obtain a consensus on the minimum professional practice standards for critical care physiotherapy in Australia and New Zealand. The Delphi technique allows a large number of individuals across diverse locations to participate in free discussion of views in an anonymous manner and the combination of many opinions into a collective response prevents domination of the process by one or a few participants (Reid, 1988).

Participants, Therapists, Centers and Eligibility Procedure

Potential participants were selected to reflect experienced physiotherapy stakeholders whom it was envisaged would have a potential interest in the outcomes of the project (Boulkedid et al, 2011). It was estimated that the potential panel size required to enable expert consensus while remaining practically achievable would be between 30 to 50 participants (Hasson, Keeney, and McKenna, 2000). The group involvement and dynamics to achieve consensus rather than group size as a method to achieve statistical power is considered an essential part of the Delphi technique (Keeney, Hasson, and McKenna, 2006; Okoli and Pawlowski, 2004). Additional participants were invited to participate to account for attrition to ensure completion of all three Delphi rounds by between 30-50 participants.

The Delphi panel aimed to select expert physiotherapists with advanced skills in the clinical practice, training requirements or conduct of research in critical care settings; either as a specialist physiotherapist in critical care (as awarded by the Australian College of Physiotherapy), experienced critical care physiotherapy clinician, or a physiotherapy academic in cardiorespiratory physiotherapy education. Potential participants were identified via the following sources by the author group: professional networks; publicly available sources (such as

the internet or white pages); and contacting all hospitals with critical care units (n=154) and all universities offering entry-level physiotherapy degrees (n=22) in Australia and New Zealand by telephone.

A snowball recruitment strategy also utilized where identified potential participants were asked to forward to the researchers the contact details of anyone else in their center that might be eligible to participate, based on a general criterion of experienced ICU physiotherapists. Specific eligibility criteria were not communicated. Each potential participant was emailed a screening questionaire on April 19th, 2013 which was comprised of ten short questions aiming to establish their eligibility and willingness to participate (Appendix 1). Participants who wished to remain anonymous were unable to be included in this study as respondents had to be able to recieve personalized feedback to enable them to compare their own response to those of other respondents. This is an essential part of the Delphi technique to enable consensus to be reached (Hsu and Sandford, 2007). All participants were reassured of confidentiality of their individual responses within the collated feedback distributed to all participants.

To be eligible for the Delphi panel, participants' required a minimum of five years clinical experience. In addition, academic and clinician panel members were required to have: 1) at least three years full-time equivalent ICU experience with recency of practice (past two years) and at least two years in a senior role with responsibility for training staff in ICU; or 2) authorship on five or more published manuscripts in the area of ICU. Specialist physiotherapists were eligible if they had at least three years ICU experience with recent practice over the last two years.

Questionnaire Development, Response Levels and Pilot

The authors developed the initial questionnaire (Hsu and Sandford, 2007). It was designed to be as expansive as possible across the physiotherapy role in critical care, using existing empirical resources known to the authors, including critical care competency lists from several healthcare

organizations in several states (e.g. Intensive Care Physiotherapy Clinical Capability Framework (Queensland Health Cardiorespiratory Physiotherapy Network (2010)) and existing course materials from critical care teaching courses and cardiorespiratory and critical care medicine teaching texts (Bersten and Soni, 2009; Pryor and Prasad, 2008). Existing landmark reviews of physiotherapy practice and the role of physiotherapy in critical care were also searched (Berney et al, 2011; Gosselink et al, 2008; Hanekom et al, 2011b; Stiller, 2000). The author group also generated additional items based on their experience (the author group possessed 50 years of critical care experience between them).

The questionnaire emphasized that the objective was to determine the minimum standard of clinical practice that should be expected from physiotherapists to enable them to work independently and safely with patients in Australian and New Zealand critical care settings. The first round questionnaire outlined a proposed framework of minimum standards developed by the authors, which included specific areas of practice, skills and knowledge required by physiotherapists working in the critical care. This first round questionnaire comprised 217 items grouped into 19 'themes' to reflect aspects of common clinical conditions found in critical care and physiotherapy assessment and treatment in critical care.

Participants were asked to grade each item based on its relevance in regards to achieving a minimum standard of independent clinical physiotherapy practice. Items were to be ranked as Essential, Not Essential or Unsure. Open comment fields were available in each item in all rounds and participants were invited to submit additional items in Rounds 1 and 2.

Prior to the formal Delphi process the first round questionnaire was piloted by three of the investigators, and three additional physiotherapists not included within the Delphi panel in order to assess clarity of questions, review content and face validity, and determine time commitments to complete the questionnaire. Minor changes were made which included adding items and

alteration of question wording, but no substantial alterations were made to the structure or content of the questionnaire.

Procedure

Three rounds of questionnaires were administered to the final panel (June 28th 2013, September 30th 2013 and January 9th 2014), with each round allowed up to eight weeks to complete (Duffield, 1993). Questionnaires were disseminated electronically either via email, or SurveyMonkey® (Palo Alto CA, USA). The participant information sheet was included in the invitation email. Participants were asked to complete questionnaires individually. Electronic reminders to submit were issued to non-responders. Between each round, each participant was sent a personalized report containing quantitative group results, qualitative feedback and the participant's own responses for comparison purposes (Appendix 2).

Items where consensus had been achieved were removed from each subsequent questionnaire round (Linstone and Turoff, 1975; Skulmoski, Hartman, and Krahn, 2007). Items where consensus was not reached were refined by the authors (if required) and included in the subsequent round. Consensus for inclusion or exclusion on an item was determined to have been achieved *a priori* when agreement as the item being 'Essential' was documented by greater than 70% of respondents, or conversely where 'Not Essential' was documented by greater than 70% of respondents. Items were excluded from subsequent rounds when less than 30% of respondents documented them as 'Essential' items. Any items which were not rated by respondents were ranked as 'Unsure'.

In order to ensure that results were not biased by proportions of 'unsure' responses, by modelling the percentage consensus in the event that 'Unsure' and missed item responses were added either to the 'Not Essential' percentage where most respondents (e.g. 72% had ranked the item as 'Essential') or to the 'Essential' percentage where most respondents (e.g. 26% had ranked the

item as 'Not Essential'). For example, if an item was scored 'Essential' by 72% of participants, but 6% of participants scored it as 'Unsure', the consensus rate would be less than 70% if the 6% of participants ranking the item as 'Unsure' changed their response to 'Not Essential'; consensus was deemed to not have been achieved and the item retained for the next round. The inverse process was applied for items scoring less than 30% of 'Not Essential' responses, once Unsure/missing responses were taken into account.

Additional item suggestions from Rounds 1 and 2 were cross-referenced against existing survey items, and were only submitted in following rounds where they did not duplicate an already administered item. Additional items suggested in Round 1 were included in Round 2, and additional items suggested in Round 2 were included in Round 3. As Round 3 aimed to finalize consensus, additional items were not sought in Round 3.

Data Analysis

Demographic data was collected in the eligibility screening survey and the Round 1 Delphi questionnaire. Data analysis was primarily descriptive and open comments were collated and grouped narratively. Data entry and descriptive analysis was performed using Microsoft Excel™ (Version 14.0.7116.5000, Microsoft Corporation, Redmond WA, USA). Data are presented as *n* (%) unless otherwise specified.

RESULTS

Panel Selection

One hundred and thirty-five potential participants completed the screening questionnaire, 93 of whom met *a priori* defined eligibility criteria as outlined in the Methods. In order to select a representative sample that could be feasibly managed by the project team and would ensure completion of all three Delphi rounds by the target sample size of at least 30 – 50 participants, a panel of 61 members was selected. The 61-member panel was selected by a single investigator

(ES) from the 93 eligible participants to optimize representation of the critical care physiotherapy population on the basis of the following criteria: 1) role (equivalent proportions of respondents to the screening survey of 30% academics, 60% clinicians and 10% specialist physiotherapists (as defined by the Australian College of Physiotherapists)); 2) geographical location (e.g. representation from each country, state and territory); 3) diversity in practice settings (e.g. representation of different ICU level; public/private; regional/metropolitan centers); and 4) experience levels (e.g. mix of very experienced and less experienced staff).

A panel of 61 members (49 clinicians, eight academics, and four specialists) were invited to participate in the Delphi rounds (Table 1). Fifty participants accepted the invitation and completed the first Delphi round, with 46 participants (92%) completing two rounds, and 45 participants (90%) completing all rounds (Figure 1).

Reporting on Consensus

Figure 2 shows the flow of items through the rounds of the Delphi process. The first round comprised 217 items. Nine additional items (incorporating two revised Round 1 items) were administered in Round 2, along with 72 retained items from Round 1 where consensus wasn't reached. Forty retained items where consensus hadn't been reached were administered in Round 3 and no new additional items were administered in this round.

Consensus regarding inclusion in or exclusion from the framework was reached on 199 (89%) items. The panel agreed that 132 (58%) items were 'Essential' and these items comprise the framework of consensus minimum clinical practice standards for physiotherapists working in Australian and New Zealand critical care settings (Table 2). Items excluded by consensus and at which round these items were excluded are presented in Table 3.

Consensus was unable to be reached on 25 items (11%). Table 4 shows the items where consensus was unable to be reached and includes the percentage of respondents who voted these items as being 'Essential'.

Comments

A key theme that emerged from collation and summation of the comments was the relevance of some of the included items to all critical care settings. For example, clinical conditions including burns and spinal cord injury management, or the use of equipment such as the intra-aortic balloon pump, intracranial pressure monitoring, and extracorporeal membrane oxygenation, included comments that suggested these may only be required for specialist centers, and thus were potentially unnecessary to include within a minimum standards framework. Some participants suggested such items should be reflected in a 'center-specific minimum standards framework' or considered generally as desirable but not essential, while some participants felt the items may represent advanced practice items.

DISCUSSION

The aim of this project was to enable experienced physiotherapy clinicians and academics engaged in critical care environments throughout Australia and New Zealand to determine minimum standards of clinical practice for physiotherapy in critical care settings. Standards of education and practice for physiotherapists working in critical care may vary (Hayes et al, 2011; Reeve, 2003), and this framework of consensus-driven minimum standards of practice is important for defining future training programs. While some practice-based competency standards have been published by other disciplines in the critical care environment (Critical Care Networks National Nurse Leads, 2012), and minimum standards relating to organizational practices in critical care settings have been published (College of Intensive Care Medicine of Australia and New Zealand, 2011), this study is the first step in determining peer reviewed

minimum standards of clinical practice for physiotherapists working in critical care in Australia and New Zealand.

Overall, the response rate throughout the three rounds of this study was excellent. In order to achieve the response rate, several strategies were used which included personalized administration, an offer of the results of the Delphi process, setting and maintaining a deadline for responses, and reminders to non-responders (Edwards et al, 2009). Given the initial response rate to participate (n = 50, 82%) and the subsequent limited attrition rate throughout the rounds of those who consent to participate with the Delphi (n = 5, 10%), it is likely that the respondents thought the study was valuable and that the results reflect the opinions of experienced critical care physiotherapist clinicians, academics and specialists. Additionally, the use of a modified Delphi technique, which requires continuous input, refinement and ultimate endorsement of the items within the framework by a panel of experts, confers a further level of validity on the development of the framework.

It should be noted that the critical care minimum standards agreed in this study have been specifically designed to relate to content knowledge; skills and techniques required by physiotherapists in critical care settings and should be seen as distinct, albeit intrinsically linked, to overarching professional standards and codes of conduct (Physiotherapy Board of Australia, 2014; Physiotherapy Board of New Zealand and Physiotherapy New Zealand, 2011). Such codes of conduct guide physiotherapy practitioners in their professional conduct but do not provide specific guidelines for day-to-day care. A large proportion of the framework comprised understanding pathophysiology, clinical signs and symptoms relevant to physiotherapy, likely medical management, and the implications for physiotherapy for a range of conditions. This included the provision of physiotherapy techniques, which encompassed respiratory, neurological and musculoskeletal management and rehabilitation. Moreover, items included in the framework

were not cross-referenced against the evidence base for physiotherapists working in critical care settings or physiotherapy modalities delivered in these settings and this is a potential area for future investigation.

Although the findings from this Delphi have been generated from physiotherapists across Australian and New Zealand, they should have relevance to practice in other countries. Further research should include comparison and/or collaborations with physiotherapists beyond Australia and New Zealand to allow comparison of regional practice requirements and determination of the wider utility of these competency standards. However, consultation with other critical care professional groups may assist in further refinement and validation of the results in order to ensure the relevance and acceptability of these to the wider multidisciplinary team in delivering a patient-centered model of care. Internationally, there is some evidence to suggest that the role of the physiotherapist within the critical care setting is not clearly defined and may overlap with roles provided by different healthcare professions (Chaboyer, Gass, and Foster, 2004; Jones, 2001; Norrenberg and Vincent, 2000). The development of this document gives some clearer definition to the role occupied by physiotherapy in the critical care environment, as perceived by experienced physiotherapists and educators. There are several key benefits likely to result from clearer definition of the role of the physiotherapist in the critical care setting, specifically: 1) more focused and consistent education pathways; 2) better consistency in practice; and 3) strengthened integration and role within the critical care team. Improvements in these areas may lead to a higher quality of care provided by physiotherapists in critical care and subsequently improve patient health outcomes (Gallesio, Ceraso, and Palizas, 2006). As formalized pathways in intensive care medicine and critical care nursing have evolved, the credibility of these specialties has concomitantly grown within the healthcare setting; it is envisaged that physiotherapists working in this setting and the physiotherapy profession could benefit from

similar pathways (Besso et al, 2006; Gill et al, 2014; Judson and Fisher, 2006, Lipman and Lichtman, 1997).

It is suggested that there are five key domains to competence in health care practice, specifically: 1) professional ethical practice; 2) approaches to care/care delivery and the integration of knowledge; 3) organization and management of care; 4) personal and professional development; and 5) interpersonal relationships (O'Connor et al, 2009). For the competent delivery of care it is suggested that knowledge and skill acquisition are underpinned by three levels of competency being: 1) Technical; 2) Situational; and 3) Advanced. Technical competency is the performance of the skill. Situational competency is the ability to clinically reason around the implementation around technical competence. Advanced competency can be seen as that which does not relate to the performance of the skill or clinical reasoning but might instead include tacit knowledge and behaviours from experiential learning. The framework in this study pertains primarily to technical and some aspects of situational competency, although it is acknowledged that the framework does not define the steps necessary against which the application of an intervention might be assessed. For example, the item 'manual hyperinflation' did not include assessment of appropriateness of the intervention, disconnection from the ventilator, choice of circuit, or delivery of the breaths. It was beyond the scope of this project to define such steps; moreover the use of a modified Delphi technique to define these steps would be impractical. It could be perceieved that a limitation of the framework may be that it focuses on technical competence rather than situational competence. However, it can be argued that as this is the first step in the development of hierarchy of competence it is an appropriate initial 'tool' from which to develop further resources. It is anticipated that the framework will also have a role in the supervision and performance appraisal of staff working within critical care, through its application as a guide for training requirements for staff working in critical care enviroment. The framework now needs to

be tested within the environment for which it was intended to ascertain its utility and what further development needs to occur; for example, as an audit tool. Universities and other education providers may also want to consider whether the framework can be utilized to guide curriculae for entry-level and/or post-graduate courses.

Critical care case-mix varies between individual centers, and this questionnaire has enabled the identification of skills and knowledge considered by the panel to be 'Essential' despite the situation that some of these items arise only sporadically within some units. During the Delphi rounds, common statements within item open feedback related to whether certain items were 'center-specific' minimum standards rather than minimum standards applicable to all critical care units in Australia and New Zealand. The authors believe that the difficulty with the concept of 'center-specific' standards is that they are likely to result in similar challenges already faced by the profession (i.e. that of variable and inconsistent practice and training). The results of this Delphi study provide direction on the areas of knowledge or practice, considered by expert critical care physiotherapists to be required generically, even if exposure may be infrequent in particular settings. For example, knowledge and skills in the management of patients with a new (or old) spinal cord injury who have respiratory failure was deemed by consensus to be required as a minimum standard. These patients may present to any hospital, or critical care setting, even where the settings are not designated specialist spinal injury centers. Specific situations such as these could be considered 'red flags' (Ross and Boissonnault, 2010), where it is necessary that all staff receive basic education and training in the principles of management in these patients, in order that appropriate physiotherapy management can be delivered in a timely fashion to optimize patient outcomes, prevent sequelae such as intubation and tracheostomy, and reduce costs (Berney, Stockton, Berlowitz, and Denehy, 2002). The focus on minimum standards required generally across all critical care units may have resulted in the rejection of items

considered too 'center-specific' by respondents. Additionally, areas of practice that are developed after further education and experience or advanced and extended scope of practice may also have been rejected. For example, in the United Kingdom, physiotherapists have been trained to undertake extended scope roles including performing bronchoscopy (Barber, Martin, and O'Donnell, 2004). However, respondents in this Delphi were not asked to comment on their reasons for marking items 'Not Essential' and future investigation of advanced/extended scope practice standards could also be considered.

There were several limitations with this study. The first round consisted of 217 items and it is possible that this may have resulted in response fatigue (Egleston, Miller, and Meropol, 2011) and affected respondents' willingness to comment openly on items. Simplifying response options (Essential/Unsure/Not Essential) attempted to mitigate this burden. It is also possible that there were items relevant to practice that were not included in the Delphi process, and while participants had opportunity to highlight areas they considered should be included, this may have also been affected by the length of the questionnaire. A further limitation when using a Delphi technique is that there is no agreement on the level required for consensus; indeed various studies using this method have used differing levels of consensus, seemingly arbitrarily. The method of agreement adopted for this study (i.e. a pre-defined proportion of experts who rated the indicator as essential had to be greater than a pre-defined threshold) (Boulkedid et al, 2011), and given the diversity of the panel, the authors agreed, on a pragmatic basis, that the level for inclusion in the 'Essential' category was to be acceptance by over 70% of participants. Had the consensus level been set at 75%, only a further 12 (5%) items would have been excluded from the framework. Ultimately, only 25 items remained where consensus was unable to be reached. Of these 25 items, only four of the items scored 60% or more which leads to the belief that the threshold adequately discriminated those items believed by participants to be 'Essential'. External

consultation and validation of the framework with other critical care leadership team stakeholders, such as ICU directors, medical consultants and nurse unit managers would be valuable to reflect the interests of other stakeholders in refining the role of the physiotherapist in the multidisciplinary critical care team.

It is debatable whether the use of a modified Delphi technique is the most appropriate technique to define the minimum standard of clinical practice for physiotherapists working in Australian and New Zealand critical care settings, and it is anticipated that future empirical studies will further refine the concepts explored and identified here. Such studies should include assessing the feasibility and acceptability of the framework within clinical education and practice, defining the requisite steps to achieving each of the individual items, testing the best educational methods to achieve each of the items, and evaluating the impact of the framework on practice and healthcare environments and outcomes (Kirkpatrick and Kirkpatrick, 2009). It should be recognized that a substantial investment of time and resources would be required to develop and refine this work.

CONCLUSIONS

This study aimed to develop a framework for minimum standards of practice for physiotherapists working in the critical care environment. The utility of this framework now requires further assessment.

ACKNOWLEDGEMENTS

The individuals who piloted the initial Delphi questionnaire; the Delphi panel participants for their time and contribution; Associate Professor Terry Haines' input into study design.

Declarations of Interest

The authors report no declarations of interest.

REFERENCES

Barber PV, Martin J, O'Donnell PN 2004 The development of the first nurse-led bronchoscopy post in the United Kingdom. Respiratory Medicine 98: 504-508

Berney S, Bragge P, Granger C, Opdam H, Denehy L 2011 The acute respiratory management of cervical spinal cord injury in the first 6 weeks after injury: a systematic review. Spinal Cord 49: 17-29

Berney S, Haines K, Denehy L 2012 Physiotherapy in critical care in Australia. Cardiopulmonary Physical Therapy Journal 23: 19-25

Berney S, Stockton KA, Berlowitz D, Denehy L 2002 Can early extubation and intensive physiotherapy decrease length of stay of acute quadriplegic patients in intensive care? A retrospective case control study. Physiotherapy Research International 7: 14-22

Bersten A, Soni N 2009 Oh's Intensive Care Manual. Philadelphia, Butterworth Heinemann: Elsevier

Besso J, Bhagwanjee S, Takezawa J, Prayag S, Moreno R 2006 A global view of education and training in critical care medicine. Critical Care Clinics 22: 539-546

Boulkedid R, Abdoul H, Loustau M, Sibony O, Alberti C 2011 Using and reporting the Delphi method for selecting healthcare quality indicators: a systematic review. Plos One 6: e20476-e20476

Chaboyer W, Gass E, Foster M 2004 Patterns of chest physiotherapy in Australian intensive care units. Journal of Critical Care 19: 145-151

College of Intensive Care Medicine of Australia and New Zealand 2011 Minimum Standards for Intensive Care Units

Critical Care Networks National Nurse Leads 2012 National Standards for Critical Care Nurse Education, United Kingdom

Duffield C 1993 The Delphi technique: A comparison of results obtained using two expert panels. International Journal of Nursing Studies 30: 227-237

Edwards PJ, Roberts I, Clarke MJ, DiGuiseppi C, Wentz R, Kwan I, Cooper R, Felix LM, Pratap S 2009 Methods to increase response to postal and electronic questionnaires. Cochrane Database of Systematic Reviews 3: MR000008

Egleston BL, Miller SM, Meropol NJ 2011 The impact of misclassification due to survey response fatigue on estimation and identifiability of treatment effects. Statistics in Medicine 30: 3560-3572

Gallesio AO, Ceraso D, Palizas F 2006 Improving quality in the intensive care unit setting. Critical Care Clinics 22: 547-571

Gill FJ, Leslie GD, Grech C, Boldy D, Latour JM 2014 Developing and testing the Standard of Practice and Evaluation of Critical-Care-Nursing Tool (SPECT) for Critical Care Nursing Practice. Journal of Continuing Education in Nursing 45: 312-320

Gosselink R, Bott J, Johnson M, Dean E, Nava S, Norrenberg M, Schonhofer B, Stiller K, van de Leur H,Vincent JL 2008 Physiotherapy for adult patients with critical illness: Recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients. Intensive Care Medicine 34: 1188-1199

Gough S,d Doherty J 2007 Emergency on-call duty preparation and education for newly qualified physiotherapists: A national survey. Physiotherapy 93: 37-44

Hanekom S, Berney S, Morrow B, Ntoumenopoulos G, Paratz J, Patman S, Louw Q 2011a The validation of a clinical algorithm for the prevention and management of pulmonary dysfunction in intubated adults--A synthesis of evidence and expert opinion. Journal of Evaluation in Clinical Practice 17: 801-810

Hanekom S, Gosselink R, Dean E, van Aswegen H, Roos R, Ambrosino N, Louw Q 2011b The development of a clinical management algorithm for early physical activity and mobilization of critically ill patients: Synthesis of evidence and expert opinion and its translation into practice. Clinical Rehabilitation 25: 771-787

Hasson F, Keeney S, McKenna H 2000 Research guidelines for the Delphi survey technique. Journal of Advanced Nursing 32: 1008-1015

Hayes K, Seller D, Webb M, Hodgson CL, Holland AE 2011 Ventilator hyperinflation: A survey of current physiotherapy practice in Australia and New Zealand. New Zealand Journal of Physiotherapy 39: 124-130

Hsu C, Sandford B 2007 The Delphi technique: Making Sense of consensus. Practical Assessment, Research and Evaluation 12: 10

Jones AY 2001 Intensive care physiotherapy -- Medical staff perceptions. Hong Kong Physiotherapy Journal 19: 9-16

Judson JA, Fisher MM 2006 Intensive care in Australia and New Zealand. Critical Care Clinics 22: 407-423

Kayambu G, Boots R, Paratz J 2013 Physical therapy for the critically ill in the ICU: A systematic review and meta-analysis. Critical Care Medicine 41: 1543-1554

Keeney S, Hasson F, McKenna H 2006 Consulting the oracle: Ten lessons from using the Delphi technique in nursing research. Journal of Advanced Nursing 53: 205-212

Kirkpatrick J, Kirkpatrick W 2009 Kirkpatrick Then and Now: A Strong Foundation for the Future. St. Louis, MO, Kirkpatrick Partners

Linstone HA, Turoff M 1975 The Delphi Method. Reading, MA, Addison-Wesley

Lipman J, Lichtman AR 1997 Critical care in Africa. North to south and the future with special reference to southern Africa. Critical Care Clinics 13: 255-265

Norrenberg M, Vincent JL 2000 A profile of European intensive care unit physiotherapists. European Society of Intensive Care Medicine. Intensive Care Medicine 26: 988-994

Ntoumenopoulos G, Presneill JJ, McElholum M, Cade JF 2002 Chest physiotherapy for the prevention of ventilator-associated pneumonia. Intensive Care Medicine 28: 850-856

O'Connor T, Fealy GM, Kelly M, Mc Guinness AM, Timmins F 2009 An evaluation of a collaborative approach to the assessment of competence among nursing students of three universities in Ireland. Nurse Education Today 29: 493-499

Okoli C, Pawlowski SD 2004 The Delphi method as a research tool: An example, design considerations and applications. Information and Management 42: 15-29

Patman S, Jenkins S, Stiller K 2000 Manual hyperinflation--effects on respiratory parameters. Physiotherapy Research International 5: 157-171

Physiotherapy Board of Australia 2014 Code of Conduct For Registered Health Practitioners. http://www.physiotherapyboard.gov.au/Codes-Guidelines/Code-of-conduct.aspx

Physiotherapy Board of New Zealand and Physiotherapy New Zealand 2011 Aotearoa New Zealand Physiotherapy Code of Ethics and Professional Conduct with Commentary

Pryor JA, Prasad AS 2008 Physiotherapy for Respiratory and Cardiac Problems. London, Churchill Livingstone

Queensland Health Cardiorespiratory Physiotherapy Network 2010 Intensive Care Physiotherapy Clinical Capability Framework

Reeve JC 2003 A survey of physiotherapy on-call and emergency duty services in New Zealand. New Zealand Journal of Physiotherapy 31: 75-83

Reid NG 1988 The Delphi technique, its contribution to the evaluation of professional practice. In: Ellis R (Ed.) Professional Competence and Quality Assurance in the Caring Professions, pp 230-262. London, Chapman & Hall

Ross MD, Boissonnault WG 2010 Red flags: To Screen or not to screen? Journal of Orthopaedic and Sports Physical Therapy 40: 682-684

Skulmoski GJ, Hartman FT, Krahn J 2007 The Delphi method for graduate research. Journal of Information Technology Education 6: 1-21

Stiller K 2000 Physiotherapy in intensive care: Towards an evidence-based practice. Chest 118: 1801-1813

Stiller K 2013 Physiotherapy in intensive care: An updated systematic review. Chest 144: 825-847

Stiller K, Geake T, Taylor J, Grant R, Hall B 1990 Acute lobar atelectasis. A comparison of two chest physiotherapy regimens. Chest 98: 1336-1340

Stiller K, Jenkins S, Grant R, Geake T, Taylor J, Hall B 1996 Acute lobar atelectasis: A comparison of five physiotherapy regimens. Physiotherapy Theory and Practice 12: 197-209

Table 1. Participant characteristics

	Units	Invited (n=61)[a]	Completed Round 1[b] (n=50)	Completed Round 2[b] (n=46)	Completed Round 3[b] (n=45)
Country					
New Zealand	n (%)	7 (11)	5 (10)	4 (9)	4 (9)
Australia		54 (89)	45 (90)	42 (91)	41 (91)
- ACT		1 (2)	1 (2)	1 (2)	1 (2)
- NSW		17 (28)	12 (24)	11 (24)	10 (22)
- NT		1 (2)	1 (2)	1 (2)	1 (2)
- QLD		11 (18)	9 (18)	8 (17)	8 (18)
- SA		5 (8)	5 (10)	4 (9)	4 (9)
- TAS		2 (3)	1 (2)	1 (2)	1 (2)
- VIC		11 (18)	10 (20)	10 (22)	10 (22)
- WA		6 (10)	6 (12)	6 (13)	6 (13)
Clinical experience (*yrs)*	Median (IQR)	14 (10 - 25)	14 (9 - 25)	14 (10 - 25)	14 (10 - 25)
	Mean (SD)	17.4 (9.1)	16.7 (9.1)	17.0 (9.2)	17.0 (9.2)
	Range	6 - 40	6 - 40	6 - 40	6 - 40
ICU clinical experience (*yrs)*	Median (IQR)	10 (6 -15)	10 (6 -15)	10 (6 - 15)	10 (6 - 15)
	Mean (SD)	11.6 (7.1)	11.5 (7.3)	11.7 (7.2)	11.7 (7.3)
	Range	3 - 35	3 - 35	3 - 35	3 - 35
ICU experience in senior role (*yrs)*	Median (IQR)	7 (5 -12)	7 (5 - 12)	7 (5 - 12)	7 (5 - 12)
	Mean (SD)	9.7 (7.0)	9.5 (7.3)	9.5 (7.2)	9.6 (7.3)
	Range	2 - 35	2 - 35	2 - 35	2 - 35
ICU manuscript publications	Median (IQR)	0 (0 - 2)	0 (0 - 2)	0 (0 - 2)	0 (0 - 2)
	Mean (SD)	3.1 (8.1)	2.8 (7.7)	2.7 (7.8)	2.8 (7.9)
	Range	0 - 48	0 - 48	0 - 48	0 - 48
Non-hospital respondent	n (%)	10 (16)	7 (14)	7 (15)	7 (16)
ICU level		N/A			
- Level 1			0 (0)	0 (0)	0 (0)
- Level 2			9 (18)	7 (15)	6 (13)
- Level 3			34 (68)	32 (70)	32 (71)
Highest qualification level					
- Entry-level degree	n (%)	N/A	28 (56)	N/A	N/A
- Masters (Course work)			8 (16)		
- Masters (Research)			0 (0)		
- PhD			12 (24)		
- Other			2 (4)		
Titled physiotherapist	n (%)	N/A	7 (14)	N/A	N/A
Specialist physiotherapist			3 (6)		

[a]Demographic data presented in this column was collected from the eligibility screening survey; [b]Demographic data in these columns was collected from the Round 1 Delphi questionnaire. N/A = not administered.

Table 2. Proposed framework of minimum clinical practice standards for physiotherapists working in Australian and New Zealand critical care settings.

	Round 1	Round 2	Round 3
A physiotherapist is aware or has knowledge of:			
Key literature that guides evidence-based physiotherapy practice in critical care settings (1 item)			
Key literature that guides evidence-based physiotherapy practice in critical care settings	70[a]	83	-
The actions and implications for physiotherapy of the following medications (7 items)			
Vasopressors/inotropes (e.g. dobutamine, milrinone, adrenaline, dopamine, noradrenaline)	96	-	-
Anti-hypertensives (e.g. beta-blockers, hydrallazine)	94	-	-
Anti-arrhythmics (e.g. amiodarone, digoxin)	92	-	-
Sedation and neuromuscular paralysing agents	96	-	-
Bronchodilators	100	-	-
Mucolytics	79	-	-
Analgesia*	100	-	-
Methods for advanced haemodynamic monitoring, can interpret the measurements and understands the implications for physiotherapy of: (1 item)			
Implanted or external pacemakers, and determine the presence of pacing on ECG	72[a]	80	-
A physiotherapist can understand:			
Equipment (including recognition of equipment), can use/safely apply or handle equipment, understands the implications for physiotherapy of: (10 items)			
Oxygen therapy devices	100	-	-
Endotracheal tubes and tracheostomy	98	-	-
Central venous catheters	98	-	-
Arterial lines	98	-	-
Intercostal catheters	98	-	-
Wound drains	98	-	-
Indwelling urinary catheters	98	-	-
Vascath/haemodialysis/continuous veno-venous haemodiafiltration	77	-	-
Nasogastric tubes	96	-	-
Intracranial pressure (ICP) monitors and extra-ventricular drains (EVD)	71[a]	74	-
The key principles of providing the following differing modes of mechanical/assisted ventilation including: (8 items)			
CPAP	100	-	-
PEEP/EPAP	100	-	-
PS/IPAP	98	-	-
SIMV (Volume)/(Pressure)	98	-	-

Assist-control	67	76	-
Pressure-regulated Volume Control (PRVC)	58	72	-
BiLevel	77	-	-
Weaning Protocols	81	-	-
Pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including: (31 items)			
Respiratory failure (Type I and II)	100	-	-
Community acquired/nosocomial/hospital-acquired pneumonia (including VAP)	100	-	-
Pleural effusion	94	-	-
Obstructive respiratory disease (e.g. asthma, COPD)	100	-	-
Restrictive respiratory disease (e.g. pulmonary fibrosis, kyphoscoliosis)	100	-	-
Suppurative lung disease (e.g. cystic fibrosis, bronchiectasis)	98	-	-
Acute lung injury/acute respiratory distress syndrome (ARDS)	96	-	-
Acute coronary syndrome (e.g. angina, STEMI, NSTEMI)	91	-	-
Shock (cardiogenic)	83	-	-
Heart failure	96	-	-
Post-cardiac surgery	87	-	-
Post-thoracic surgery	87	-	-
Post-abdominal surgery	96	-	-
Post-surgery other (e.g. orthopaedic, vascular)	94	-	-
Renal failure (acute and chronic)	85	-	-
Pancreatitis	64	70[a]	73
Immunocompromise	77	-	-
Metabolic/electrolyte disturbances	51	63	73
Systemic inflammatory response syndrome (SIRS)	72[a]	89	-
Shock (septic)	94	-	-
Multi-organ failure/MODS	91	-	-
ICU-acquired weakness (ICU-AW)	94	-	-
Guillain-Barre Syndrome	87	-	-
Thromboembolic disease (e.g. deep vein thrombosis, pulmonary embolus)	94	-	-
Fat embolism	64	74	-
Thrombotic Cerebrovascular accident	91	-	-
Intracerebral haemorrhage/Subarachnoid haemorrhage	87	-	-
Traumatic Brain Injury	77	-	-

Chest Trauma	83	-	-
Multi-trauma	68	80	-
Spinal cord injury	62	67	76
A physiotherapist can accurately/independently (*assess and*) interpret:			
Readings from clinical monitoring including: (8 items)			
Body temperature	100	-	-
Heart rate	100	-	-
Blood pressure (systolic, diastolic and mean arterial blood pressure)	100	-	-
Central venous pressure	75	-	-
Basic ECGs (i.e. Sinus Rhythm/Tachycardia/Bradycardia, Atrial fibrillation, Atrial flutter, Ventricular Tachycardia, Ventricular Fibrillation, asystole, PVCs)	92	-	-
SpO_2 / Pulse oximetry	100	-	-
End tidal carbon dioxide	58	72	-
Fluid intake and output	79	-	-
Findings from laboratory investigations including:			
Haemoglobin	100	-	-
Platelets, APTT (Activated Partial Thromboplastin Time), INR (International Normalized Ratio)	88	-	-
Troponin	85	-	-
White cell count (WCC)	94	-	-
Renal function tests (e.g. urea, creatinine)	54	59	73
Blood glucose levels	77	-	-
Sputum cultures	75	-	-
Respiratory function tests (e.g. FEV_1, FVC etc)	92	-	-
Findings from imaging investigations (excluding the imaging report) including:			
Chest radiographs (CXR)	92	-	-
Results from neurological equipment/examinations and functional tests including:			
Intra-cranial pressure (ICP) monitors (intra-parenchymal, intra-ventricular) and cerebral perfusion pressure (CPP)	71[a]	74	-
Extra-ventricular drain (EVD)	65	70[a]	73
An ability to interpret a Glasgow Coma Score (GCS)	98	-	-
An ability to interpret an assessment of sedation levels (e.g. Ramsey Sedation Scale, Richmond Agitation-Sedation Scale)	58	70[a]	78
An ability to perform a neurological examination of motor and sensory functions (e.g. light touch, pain, ASIA score)	85	-	-
Indices from blood gas measurement including:			

pH	96	-	-
$PaCO_2$	98	-	-
PaO_2, SpO_2, SaO_2	98	-	-
PaO_2/FiO_2 ratio	77	-	-
HCO_3	85	-	-
Base excess	71	83	-
(assess and interpret) Mechanical ventilation settings / measurements including:			
Respiratory rate	100	-	-
Tidal volume	100	-	-
Breath types (spontaneous, mandatory, assisted)	100	-	-
The level of FiO_2	100	-	-
The level of PEEP	100	-	-
The level of PS	100	-	-
Peak inspiratory pressure	98	-	-
A physiotherapist can:			
Perform and accurately interpret the results of common respiratory examinations including:			
Observation of respiratory rate	100	-	-
Patterns of breathing	98	-	-
Palpate the chest wall	92	-	-
Auscultation	98	-	-
Assess:			
The effectiveness/quality of a patient's cough (on or off mechanical ventilation)	98	-	-
Perform:			
Respiratory function tests (e.g. for measurement of FEV_1, FVC, PEF)	58	72	-
Provide the following techniques, including an understanding of indications, contraindications, evidence for the technique and progressions			
Oxygen therapy including initiation and titration of oxygen therapy	87	-	-
Humidification	89	-	-
ACBT [Breathing control, thoracic expansion and FET]	98	-	-
Manual airway clearance techniques – percussion, vibration, chest shaking	89	-	-
Positive pressure devices for airway clearance (e.g. AstraPEP, PariPEP, TheraPEP or oscillating expiratory pressure devices like Acapella, Flutter)	74[a]	80	-
Pursed lip breathing*	-	74	-
Inspiratory hold/sustained maximal inspiration*	93		

Supported coughing	98		
Directed coughing/instructing the patient to cough effectively	98		
Assisted coughing – chest wall	85		
Assisted coughing – subcostal thrusts for spinal cord injuries	61	72	
Cough stimulation – tracheal rub	74[a]	70[a]	71
Cough stimulation – oropharyngeal catheter stimulation	89	-	-
Manual hyperinflation (MHI)	74[a]	83	-
Nasopharyngeal airway suctioning including insertion of NP airway	87	-	-
Oropharyngeal airway suctioning including insertion of OP airway	85	-	-
Suction via a tracheal tube (Endotracheal tube, tracheostomy, minitracheostomy)	96	-	-
Patient positioning for respiratory care – including use of side lie, sitting upright, postural drainage (modified or head down tilt)	100	-	-
Patient positioning for prevention of pressure ulcers, management of tone, maintenance of musculoskeletal function	98	-	-
Mobilisation of non-ventilated patient (e.g. sitting on edge of bed, stand, hoist or slide transfer to chair, march on spot, walk, use of gait aids)	100	-	-
Mobilisation of ventilated patient (e.g. sitting on edge of bed, stand, hoist or slide transfer to chair, march on spot, walk, use of gait aids)	80	-	-
Bed exercises (e.g. passive – active – resisted range of motion exercises)	98	-	-
Complete musculoskeletal and/or functional assessments including:			
Manual Muscle testing (e.g. MRC scale)	96	-	-
Range of motion	98	-	-
Ability to assess tone (e.g. utilising a Modified Ashworth Scale) and reflexes	79	-	-
Deep vein thrombosis screening (i.e. colour, temperature, touch, swelling, Homan's test)	81	-	-
Peripheral oedema	89	-	-
Objective measures of physical function [e.g. the Physical Function ICU Test (PFIT), Timed Up and Go Test (TUG), 6MWT, De-Morton Mobility Index (DEMMI)]	57	72	-
Appropriately request/coordinate the following:			
Titration of analgesia to achieve physiotherapy goals	91	-	-
Appropriately:			
Be aware of sedation and implications for physiotherapy treatment*	-	98	-
Be aware of inotropes and implications for physiotherapy treatment*	-	100	-
Liaise with medical/nursing staff to increase/decrease sedation to achieve physiotherapy goals*	-	96	-
Liaise with medical/nursing staff to increase/decrease inotropes to achieve physiotherapy goals*	-	70[a]	71

*Item introduced in Round 2. [a]Essential rankings did not exceed 70% when unsure and missing responses taken into account.

Table 3. Items excluded by consensus (% essential ratings)

Items excluded	Round 1	Round 2	Round 3
A physiotherapist can understand equipment (including recognition), can use/safely apply or handle equipment, understands the implications for physiotherapy of:			
ECMO	26[a]	22	-
Sengstaken-Blakemore/Minnesota tubes	22[a]	15	-
A physiotherapist can accurately interpret readings from clinical monitoring including:			
Advanced ECGs (i.e. conduction block, 12-lead ECG)	0	-	-
Nutritional status including feed administration, volume and type	32	22	-
A physiotherapist can accurately interpret findings from laboratory investigations including:			
Haematocrit	22[a]	-	-
Albumin	30	26	-
Procalcitonin	12	-	-
Liver function tests (e.g. ALT, LDH, Bilirubin)	28[a]	17	-
A physiotherapist is aware of the actions and implications for physiotherapy of the following medications:			
Prostacyclin	30	20	-
A physiotherapist can independently interpret findings from imaging investigations (excluding the imaging report) including:			
CT – Brain imaging	8	-	-
CT – Chest imaging	10	-	-
CT – Spine imaging	4	-	-
MRI – Brain	2	-	-
MRI – Chest	0	-	-
MRI – Spine	2	-	-
Ultrasound – Chest	0	-	-
A physiotherapist can interpret the results from neurological equipment/examinations and functional tests including:			
Electroencephalograms (EEG)	4	-	-
An ability to **perform** an assessment of sedation levels	10	-	-
An ability to **perform** an assessment of cranial nerve function	12	-	-
Ability to **perform** a delirium assessment (e.g. the CAM-ICU)	4	-	-
A physiotherapist understands the key principles of providing the following modes of mechanical/assisted ventilation including:			
Airway Pressure Release Ventilation (APRV)	38	41	24

High frequency oscillatory ventilation (HFOV)	16[a]	20	-
A physiotherapist can assess and interpret mechanical ventilation settings/measurements including:			
Static and/or dynamic lung compliance measures	34	26	-
Upper and lower inflection points of P-V curves	14	-	-
Maximum inspiratory pressure (MIP) measurements	16	-	-
Maximum expiratory pressure (MEP) measurements	12	-	-
A physiotherapist can:			
Measure peak cough flow on or off mechanical ventilation	14	-	-
Perform a spontaneous breathing trial	12	-	-
Interpret the rapid shallow breathing index (RSBI)	12	-	-
Perform a swallow assessment	4	-	-
Assess and interpret ventilator waveforms*	-	35	20
A physiotherapist can interpret indices from blood gas measurement including:			
A-a gradient	26[a]	24	-
P50	8	-	-
Oxygen content (CaO_2)	8	-	-
Anion gap	2	-	-
Lactate	32	33	22
A physiotherapist has knowledge of methods for advanced haemodynamic monitoring, can interpret the measurements and understands the implications of these for physiotherapists:			
Pulmonary arterial catheter measurements (e.g. CO, CI, SVRI, PAP, etc)	32	22	-
PiCCO measurements (e.g. CO, CI, SVV, SVRI etc)	16[a]	11	-
A physiotherapist can complete musculoskeletal and/or functional assessments including:			
Dynamometry	40	24	-
Bioimpedance testing of body composition	2	-	-
Objective measures of quality of life (e.g. Short Form 36, EQ-5D, AQoL)	28[a]	17	-
A physiotherapist understands pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including:			
Organ transplantation	40	41	18
A physiotherapist can provide the following techniques, including an understanding of indications, contraindications, evidence for the technique and progressions:			
Glottal stacking (frog breathing)	6	-	-
Feldenkreis	0	-	-
Other breathing techniques (please state)	14	-	-

Autogenic drainage	18	-	-
Butyeko breathing*	-	2	-
NIV / BiPAP - for Type I or Type II respiratory failure, initiation and titration of e.g. COPD exacerbation with hypercapnia	24[a]	24[a]	24
Intermittent positive pressure breathing (IPPB, The Bird)	26[a]	24	-
Inexsufflator (Cough Assist)	28[a]	24	-
Recruitment manoeuvres	6	-	-
Bronchial lavage (i.e. up to 120 mls in one treatment session administered by bronchoscopy for sputum/organism retrieval for diagnostic purposes)	6	-	-
Performing bronchoscopy independently	0	-	-
Assisting bronchoscopy via delivery of secretion mobilisation techniques (e.g. vibrations, assisted coughing) during the procedure	36	24	-
Inspiratory muscle training	22[a]	17	-
Splinting and/or casting for the upper and lower limbs	28[a]	24	-
Braces	38	41	20
Electrical stimulation (e.g. for isolated muscle activation to prevent muscle wasting, such as neuromuscular/functional electrical stimulation)	18	-	-
Additional rehabilitation techniques (e.g. hydrotherapy, Wii)	18	-	-
A physiotherapist can:			
Intubate a patient	0	-	-
Extubate a patient	8	-	-
Lead the co-ordination of weaning protocols	8	-	-
Lead the co-ordination of cuff deflation trials	10	-	-
Lead the co-ordination of speaking valve trials	6	-	-
Determine the appropriateness of tracheostomy decannulation	42	37	27
Decannulate a tracheostomy	4	-	-
Tracheostomy exchange	2	-	-

*Item introduced in Round 2. [a]Essential rankings did not remain less than 30% when unsure and missing responses taken into account.

Table 4. Items in which consensus was not reached throughout all rounds (Essential ranking %)

Items	Round 1	Round 2	Round 3
A physiotherapist can understand equipment (including recognition), can use/safely apply or handle equipment, understands the implications for physiotherapy of:			
Intra-aortic balloon pump	56	65	69
A physiotherapist can accurately interpret findings from laboratory investigations including:			
Creatinine kinase (CK)	52	57	58
Neutrophil counts	38	39	36
C-reactive protein (CRP)	50	57	49
A physiotherapist is aware of the actions and implications for physiotherapy of the following medications:			
Calcium channel blockers	56	54	49
Nitric oxide	56	57	58
A physiotherapist can independently interpret findings from imaging investigations (excluding the imaging report) including:			
Skeletal X-rays	69	67	56
A physiotherapist can interpret the results from neurological equipment/examinations and functional tests including:			
An ability to **perform** a Glasgow Coma Score (GCS)	42	39	36
An ability to **interpret** an assessment of cranial nerve function	58	59	58
Ability to **interpret** a delirium assessment (e.g. the CAM-ICU)	44	48	40
A physiotherapist can:			
Perform a cuff volume and/or pressure test on an endotracheal tube (or tracheostomy)	48	57	67
A physiotherapist can interpret indices from blood gas measurement including:			
Venous blood gas interpretation (including SvO_2)	27*	30*	38
A physiotherapist can complete musculoskeletal and/or functional assessments including:			
Objective measures of cardiopulmonary exercise tolerance (e.g. 6-minute walk test; incremental shuttle walk test)	55	63	64
A physiotherapist understands pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including:			
Hepatitis	45	41	42
Brain death and organ procurement	51	61	60
Burns (cutaneous/inhalational)	34	41	40

A physiotherapist can provide the following techniques, including an understanding of indications, contraindications, evidence for the technique and progressions:			
Periodic/intermittent CPAP (non-invasive via mask) including initiation and titration of	37	41	36
NIV / BiPAP - intermittent, short term applications during physiotherapy to assist secretion mobilisation techniques or lung recruitment including initiation and titration of	48	63	58
NIV / BiPAP - for use during exercise or mobilisation including initiation and titration of	39	43	42
Ventilator hyperinflation (VHI) via an endotracheal tube or tracheostomy	50	57	51
Instillation of normal saline into the endotracheal tube (i.e < 20 mls in one treatment session aimed at increasing sputum yield by diluting and loosening thick secretions)	57	59	64
Patient prone positioning in severe respiratory failure / acute lung injury	50	50	40
Collars	57	61	47
Treadmill, cycle ergometry (e.g. Motomed) or stationary bike	43	35	36
A physiotherapist can:			
Determine the appropriateness of a patient for extubation	37	33	33

*When modelled with 'Unsures', % exceeded 30%

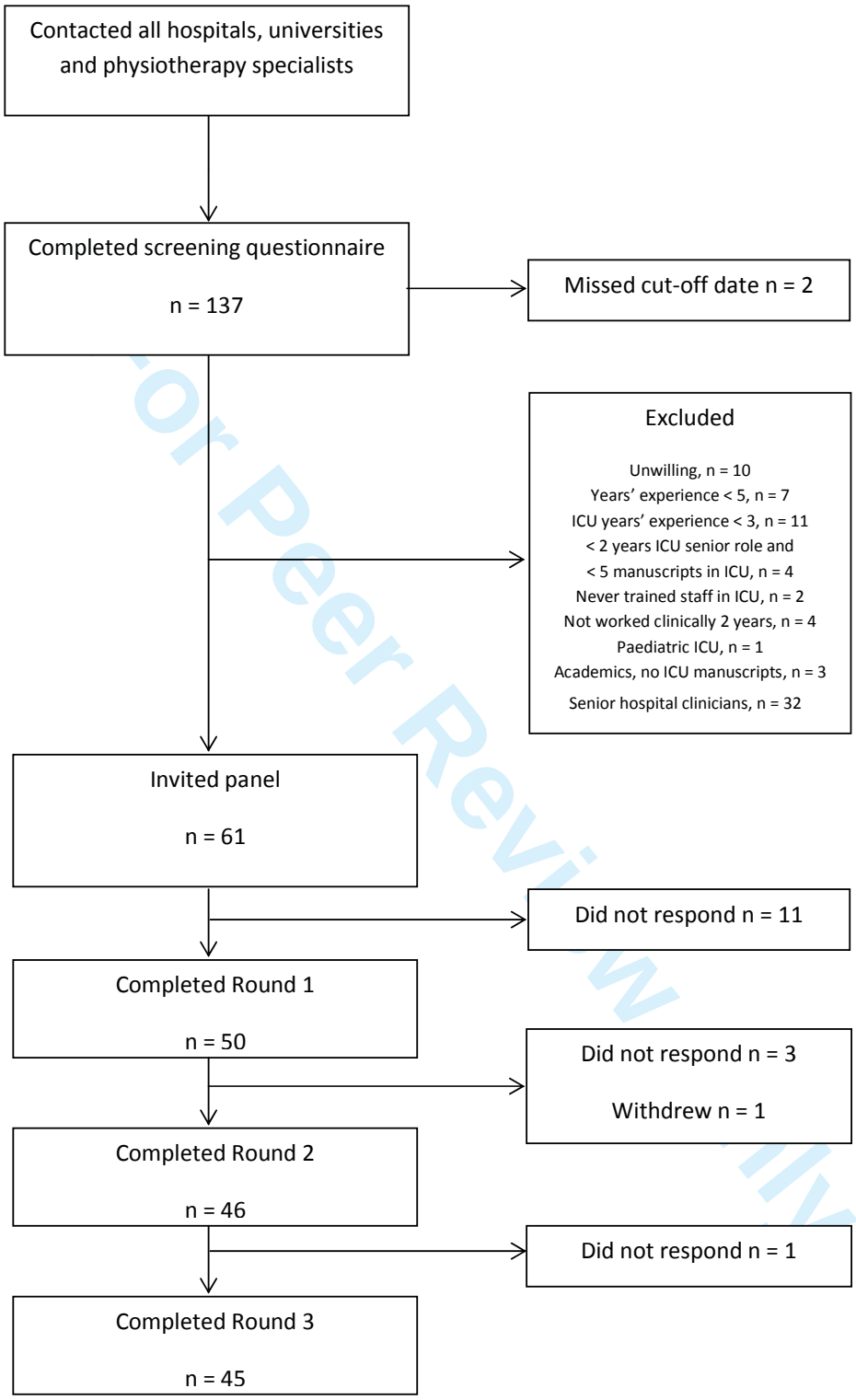


Figure 1. Panel selection and completion rates.

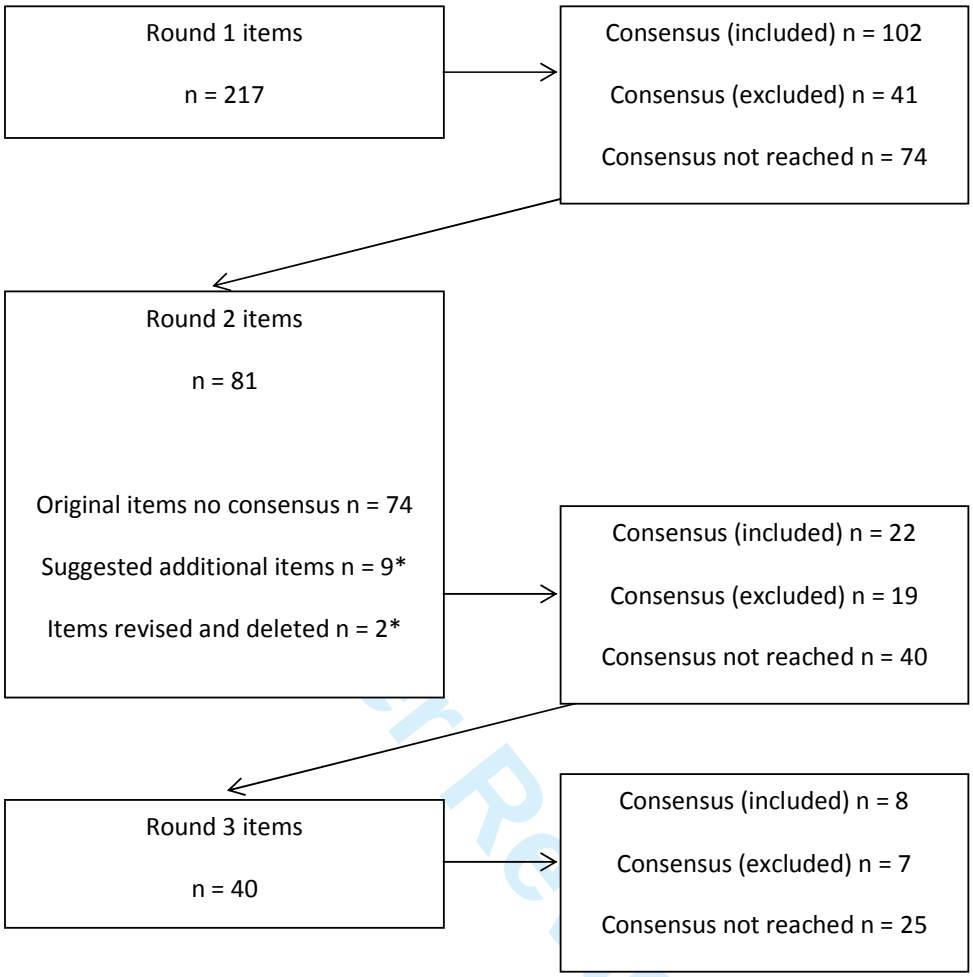


Figure 2. Flow of items through the Delphi rounds.

*Two items from Round 1 survey were split into four items (considered new suggested additional items, included in Round 2) and the original two items were deleted from Round 2. Therefore the total number of items in Round 2 was 81 (74 original items, plus nine additional new items, less two deleted items).

Appendix 1. This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Eligibility for Physiotherapy ICU Delphi Panel

You have been identified as potentially meeting our eligibility criteria. Answering the following six short questions will allow us to establish your eligibility. Fulfilling the eligibility criteria does not necessarily mean you will be invited to take part.

If you have any questions, please don't hesitate to contact the Survey Administrator, [redacted] at [redacted]

1. What is your full name and email address?
   Free-text response field

2. How many years of clinical experience have you worked as a physiotherapist (full-time equivalent)?
   Free-text response field

3. How many years of experience do you have working clinically in ICU (full-time equivalent)?
   Free-text response field

4. How many years of experience do you have working in a senior role in ICU (full-time equivalent)?
   Free-text response field

5. Do you/have you train(ed) qualified physiotherapists in ICU?
   Yes/No

6. Have you continued clinical practice in ICU in the past two years?
   Yes/No

7. How many published manuscripts do you have in the area of cardiorespiratory physiotherapy (including co-author)?
   Free-text response field
8. How many published manuscripts do you have in the area of ICU (including co-author)?
   Free-text response field

9. How many free-paper presentations do you have in the area of ICU (including co- author):
   Free-text response field

10. Would you be willing to participate?
    Yes/No

Thank you! We anticipate approaching potential participants within four weeks of this survey.

Appendix 2. Sample item feedback from a personalized report containing quantitative group results, qualitative feedback and the participant's own response.

Question 2a. As a minimum standard a physiotherapist can understand equipment (including recognition of equipment), can use/safely apply or handle equipment, understands the implications for physiotherapy of: Intra-aortic balloon pump (IABP)

The group responses for this item from the first round are outlined below (Number, %).

ESSENTIAL for a minimum standard of independent practice	27 (56%)
NOT essential for a minimum standard of independent practice	13 (27%)
Unsure	8 (17%)

Your response for this item was: ESSENTIAL for a minimum standard of independent practice

The number of respondents who made comments about this item was: 9 (19%)

The following is a summary of the comments.

Comment	*N*
Not Essential, due to infrequent use / exposure	1
Unsure or Not Essential. Specific to some but not all ICU sites, therefore only essential for those units and not a generic requirement	5
Unsure. Need to be able to understand terminology and implications for physiotherapists - but not necessarily use or handle them	2
No, rely on other staff for guidance e.g. nursing staff	1

After considering the above results, please rescore your response for this item. It may be the same response as in round 1, or you may decide to alter your response after considering the group response and comments. **Please go to the relevant item within SurveyMonkey and rescore your response.**