

Minimum standards of clinical practice for physiotherapists working in critical care settings in United Kingdom: A modified Delphi technique

Paul Twose^{1,2}, Una Jones² and Gareth Cornell³

Abstract

Introduction: Across the United Kingdom, physiotherapy for critical care patients is provided 24 h a day, 7 days per week. There is a national drive to standardise the knowledge and skills of physiotherapists which will support training and reduce variability in clinical practice.

Methods: A modified Delphi technique using a questionnaire was used. The questionnaire, originally containing 214 items, was completed over three rounds. Items with no consensus were included in later rounds along with any additional items suggested.

Results: In all, 114 physiotherapists from across the United Kingdom participated in the first round, with 102 and 92 completing rounds 2 and 3, respectively. In total, 224 items were included: 107 were deemed essential as a minimum standard of clinical practice; 83 were not essential and consensus was not reached for 34 items.

Analysis/Conclusion: This study identified 107 items of knowledge and skills that are essential as a minimum standard for clinical practice by physiotherapists working in United Kingdom critical care units.

Keywords

Critical care, on-call, physiotherapy, minimum standards

Introduction

The National Guidelines for the Provision of Intensive Care Services¹ identify physiotherapy as one of the principle and most consistent therapy services for Critical Care. Traditionally, the aim of physiotherapy was to maintain bronchial hygiene for people who are intubated,² and while this remains a key area, the focus is now towards early rehabilitation and on physical recovery.^{3,4}

In most hospitals across the United Kingdom (UK), physiotherapy for critical care patients is provided 24 h a day, 7 days per week¹ and is achieved through the provision of out-of-hours or on-call services and weekend working. A recent on-call position statement⁵ recognised that to achieve this cover, the service often relies on non-respiratory specialists of varying clinical grade and experience.^{5–7} Frequently, staff will not have worked within critical care since qualification, and increasingly staff may have not gained any entry-level experiences within critical care. As a result, the quality of the service provided to the patient may become dependent on the skills of the treating physiotherapist and thus clinical

assessment, interventions and management may vary significantly in quality or effectiveness.⁸

To overcome the challenges of non-respiratory specialists working in critical care to provide 24-h cover, physiotherapists are required to complete in-house/local critical care orientation programs with varying content. Such training may include theory, clinical skills training, and supervised clinical practices although the exact content has not been researched or analysed. Any such programs are commonly delivered and assessed by senior physiotherapy staff; thus, the process is often subjective and informal with variability in the content, requirements, and duration of the education provided.^{5,8}

Based on the above, there is a national^{5,9} and international^{8,10} drive to standardise the expected

¹Physiotherapy Department, Cardiff and Vale UHB, Cardiff, UK

²School of Healthcare Studies, Cardiff University, Cardiff, UK

³Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK

Corresponding author:

Paul Twose, University Hospital of Wales, Cardiff and Vale UHB, Heath Park, Cardiff, UK.

Email: TwosePW@cardiff.ac.uk

knowledge and skills of physiotherapists assessing and treating patients within the critical care environment. Skinner et al.⁸ used a modified Delphi approach to investigate the minimum standards of clinical practice for physiotherapists working in critical care settings in Australia and New Zealand. The study involved a panel of 50 senior or specialist critical care physiotherapists and appropriate academic staff completing three rounds of questionnaires exploring the knowledge and skills required. 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. Consensus was reached on 199 (89%) items. The panel agreed that 132 (58%) items were 'Essential' items for inclusion in the final framework. Following its completion, the authors aimed to explore the utility of the framework and how it may be used within clinical education and practice to standardise patient assessment and care, and reduce the current variations. However, this further exploration of the framework is not yet available or published.

More recently, van Aswegen and colleagues¹⁰ explored the minimum standards for physiotherapy in South African ICUs. The study adopted a different approach to that of Skinner et al.,⁸ and completed three focus group sessions with 25 purposively sampled experienced clinicians (average 10.8 years critical care experience). Rather than determining essential and non-essential characteristics, the results focused around key themes of practice with the aim of answering the fundamental question: 'What is the minimum standard of clinical practice needed by physiotherapists to ensure safe and independent practice in South African ICUs'. Three themes were identified: (1) Integrated Medical Knowledge, which included sub-themes of anatomy and physiology, presenting conditions, ICU environment, pathophysiology; (2) Multi-disciplinary teamwork, including communication, documentation, ethics, and culture sensitivity; and (3) Physiotherapy practice, which included clinical reasoning, handling skills, and patient care. Despite the variation in methodology to the Australasian study,⁸ the conclusions are similar. Both the South African and Australasian studies recognise the need to develop consensus agreement and national standards, and determine their role within clinical practice.

Due to anecdotal international differences in entry-level training (e.g. entry-level curriculum, length of training), clinical experience, and potential physiotherapy roles (e.g. clinical responsibility, job descriptions and roles), it is not possible to generalise international findings within UK practice.

Furthermore, changing demands on oncall services,⁵ reductions in workforce capacity,⁵ variability in staff entry-level and postgraduate experiences,⁹ and perceptions of variability in clinical practice mean

that it is necessary to explore the minimum standard of clinical practice for physiotherapists in critical care units across the UK. These minimum standards can then be used to inform entry-level and postgraduate training, support on-call services and standardise the delivery of physiotherapy to critical care patients.

Method

Ethics

Ethical approval was provided by Cardiff University School of Healthcare Science Research Ethics Committee. An information sheet was provided to potential participants and informed consent was assumed by completion of the questionnaires in each round.

Design

A modified Delphi technique was used to obtain a consensus on the minimum standards of physiotherapy clinical practice in critical care units in the UK. The Delphi technique was chosen as it allowed participants from across the UK to participate and could be completed using online surveys making it more accessible.¹¹⁻¹⁴ Additionally, the Delphi technique allows formation of consensus or the exploration of a field beyond existing knowledge.¹¹⁻¹⁴ It can be tailored to the particular requirements of the research question, ranging from open and exploratory questioning to standardised confirmatory approaches.¹⁵ The standard Delphi technique was modified to allow question refinement, addition of new items and ultimate endorsement of the items by the panel of experts.

Participants

Potential participants were recruited via advertisement of the study using existing networks such as the Association of Chartered Physiotherapists in Respiratory Care, UK Physiotherapy Respiratory Leaders Network, Intensive Care Society Nurse and Allied Health Professionals, Critical Care Nurse Lead Network, and the All Wales Physiotherapy Critical Care Network. Posts were also provided via social media and Interactive Chartered Society of Physiotherapy.

A predetermined sample size was not chosen, to allow as many physiotherapists to be involved as possible. The inclusion criteria were (1) experienced critical care physiotherapists with at least 5 years postgraduate experience of which at least 3 years have been in a senior role within critical care and (2) involved in supervision or teaching of physiotherapy staff working oncall or completing emergency duty. Additionally, academic physiotherapy staff involved in the provision of entry-level cardio-respiratory physiotherapy were

recruited. An eligibility questionnaire was utilised to allow these data to be collected.

An essential component of the Delphi approach was provision of personalised reports to enable participants to compare their answers with the consensus opinions.¹³ As a result, those participants that wished to remain anonymous or did not provide sufficient personal and contact details were excluded from the study.¹⁶

Questionnaire development

The questionnaire used within this study was based on the one piloted and used by Skinner et al.⁸ The Australasian questionnaire⁸ was designed and intended to be as expansive as possible across the physiotherapy role in critical care, and utilised existing empirical resources, available critical care competency lists, and existing entry-level course materials. Prior to utilisation in this UK study, minor modifications were made to ensure relevance with the UK. The minor alterations consisted solely of alterations of language (e.g. intercostal catheter altered to intercostal drain). The amendments were discussed and approved by Skinner and colleagues.⁸ No formal piloting was completed because of its previous usage.

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 UK critical care settings. This minimum standard must be for all staff no matter of individual's primary specialist area (e.g. respiratory or non-respiratory specialist) and pre-existing critical care experience, or the specialism of the critical care unit.

For each questionnaire item, participants were asked to either answer as 'essential for clinical practice', 'not essential for clinical practice', or 'unsure'. The questionnaire also allowed for comments and in rounds 1 and 2 participants were invited to submit potential additional items that they deemed essential for clinical practice but not previously included.

Procedure

Three rounds of questionnaires were administered to participants who were given up to 4 weeks to complete¹³ each phase. Questionnaires were disseminated electronically via Bristol Online Surveys (Bristol University, UK). The participant information sheet was included in the invitation email. Electronic reminders to submit were issued to non-responders and set time periods (2 weeks and 3 weeks), alongside regular prompting via social media.

At the end of each round, each participant was sent a personalized report containing quantitative group results, qualitative feedback, and the participant's own responses for comparison purposes.

Analysis

Demographic data were collected in round 1 only. All data analysis was descriptive and open comments were themed for purposes of the personalised report. All data were exported from Bristol Online Survey (Bristol University, UK) and data analysed using Microsoft ExcelTM.

Items were determined as essential or not essential based on consensus option of >70% (essential or not essential accordingly). The 70% threshold was chosen to correlate with previous research,⁸ allowing later comparison of findings. Additionally, items were excluded from future rounds when less than 30% of respondents felt the item was essential for clinical practice.

To ensure that final consensus was not biased by 'unsure' responses, consensus was calculated using three potential denominators. For example, consensus of 70% was required when considering (1) total number responses (e.g. the total number of participants completing the survey) including missing answers; (2) total number of responses excluding missing answers; and (3) total number of definitive essential and not essential responses (excludes 'unsure' responses). To be included as essential or not essential, 70% consensus was required for all three calculations.

Comments received throughout each round were themed based on response. For all items the comments were themed by one investigator and checked for accuracy by at least one of the other investigators.

Results

The eligibility questionnaire was completed by 197 physiotherapists, with 142 being invited to participate in round 1. Of these, 114 completed round 1 (80%) with 92 participants completing all three rounds (65%) (see Figure 1). Participants (n = 114) represented all UK nations (England (96), Wales (8), Scotland (7), Northern Ireland (1) and Jersey (1)), and had an average of 16.6 years postgraduate experience, of which 15.0 years was in a senior critical care role. All participants (except the ten England and one Wales based academics) were working in a Physiotherapy Team Lead role or above, with 54.9% having postgraduate training at Masters level or above.

Round 1 consisted of 214 items of which 91 were deemed as essential. Based on responses, an additional eight questions were added to round 2, during which a further 11 items were deemed as essential. One additional item was added to round 3, and five items were determined as essential. Across all three rounds, 107 items reached consensus to be classified as essential, 73 not essential and consensus agreements was not reached in 33 (see Figure 2).

All items reaching consensus to be essential, not essential, and no consensus are detailed in

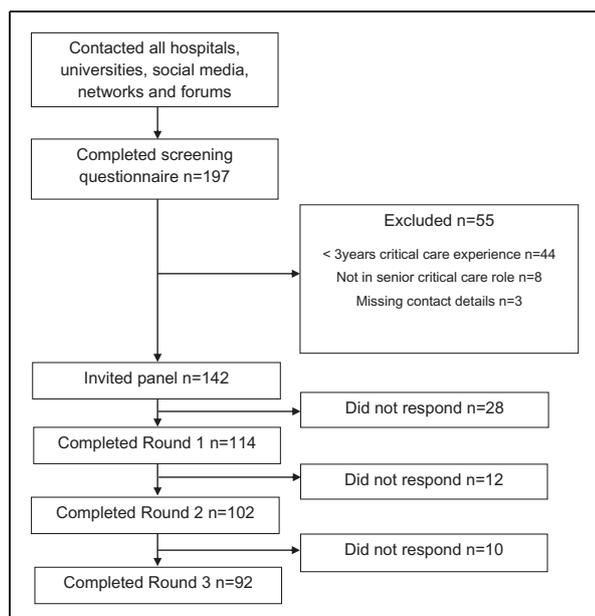


Figure 1. Participant involvement.

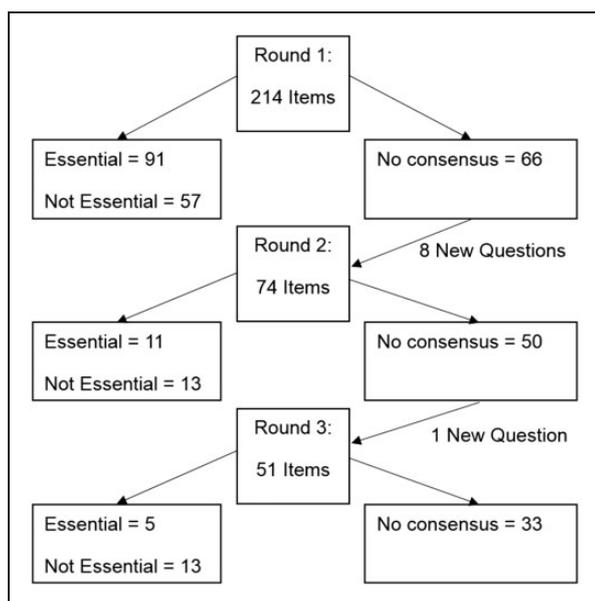


Figure 2. Inclusion and exclusion of items.

Tables 1 to 3, 4 to 6, and 7 to 9, respectively. Items have been categorised to assessment, conditions, or treatment.

No consensus

During the three rounds 2976 comments were made by the participants regarding the items in the questionnaire. Of these, 1720 comments were made in round 1; 762 in round 2; and 494 in round 3. The comments were themed with the five most commonly occurring shown in Table 10.

Discussion

The aim of this study was to explore the minimum standard of clinical practice for physiotherapists in critical care units across the UK. The rationale for the study was based on changing demands on oncall services, reductions in workforce capacity, variability in staff entry-level and postgraduate experiences and perceptions of variability in clinical practice.

In this three-round Delphi study of highly experienced critical care physiotherapists, 107 items of knowledge and skill have been deemed essential as a minimum standard of clinical practice in critical care in the UK. Furthermore, 73 such items have been determined as not essential for clinical practice. The challenge now is to consider how this clarification of requirements needs to be integrated into entry-level and postgraduate training, and within competency standards for on-call working.

The study had significant interest within the UK with a far higher than anticipated response to advertisement. In total, 142 physiotherapists were deemed eligible for inclusion and invited to participate with 114 completing round 1, of which 80.7% completed all three rounds. Whilst lower than the retention rate in the Australasian equivalent (90%), it is still above that accepted for Delphi-based studies.¹⁷

The high response and retention rate were likely a result of targeted advertisement, use of personalised reports and regular electronic emails, as well as social media prompting. Similarly, the response rate may reflect the significant interest in the research topic and its current importance within supporting and standardising on-call working.^{5,8,10} Across the UK, on-call services are being placed under increasing pressure and regularly require non-respiratory specialist physiotherapists to contribute to rotas.⁵ Standardising the role of the physiotherapist in critical care will help to support training, education, and competencies to support these staff, and to also ensure the ongoing delivery of high-quality assessment and treatment to the service user.

The participants had significant critical care experience (15 years in a senior role) and were all involved in the delivery of on-call teaching within their local organisation. This degree of experience is above that observed in similar studies^{8,10} and further enhances the validity of the results recorded.

In comparison to the findings of the Australasian Delphi,⁸ the UK study had fewer items considered to be essential (107 vs 132) with similar numbers of non-essential items (73 vs 67 for UK and Australasia respectively).

A number of these items may be considered generic physiotherapy skills rather than specific to critical care, with some being deemed essential whilst others not or with no consensus. Within clinical monitoring, interpretation of temperature, heart rate, and blood

Table 1. Assessment items determined as essential (consensus >70% 'essential').

Assessment	Round		
	1	2	3
As a minimum standard a physiotherapist can understand equipment (including recognition of equipment), use/safely apply or handle equipment, understand the implications for physiotherapy of:			
Oxygen therapy devices	99		
Endotracheal tubes and tracheostomy	98		
Central venous catheters	75		
Arterial lines	91		
Intercostal catheters	95		
Wound drains	81		
Indwelling urinary catheter	88		
Vascath/haemodialysis catheter/continuous veno-venous haemofiltration	76		
Nasogastric tubes	89		
As a minimum standard a physiotherapist can accurately interpret readings from clinical monitoring including:			
Body temperature	97		
Heart rate (HR)	100		
Blood pressure	100		
Basic ECGs	71 ^a	79	
SpO ₂ /pulse oximetry	100		
End tidal carbon dioxide	66	72 ^a	76
Fluid intake and output	90		
As a minimum standard a physiotherapist can accurately interpret findings from laboratory investigations including:			
Haemoglobin (Hb)	93		
Platelets, APTT, INR	88		
Troponin	68	65	70
White cell count	89		
C-reactive Protein	65	65	72
Blood glucose levels	68 ^a	79	
As a minimum standard a physiotherapist is aware of the actions and implications for physiotherapy of the following medications:			
Vasopressors/inotropes	100		
Basic electrolytes	^b	66	75
Anti-hypertensives	81		
Anti-arrhythmia	84		
Sedation and neuromuscular paralysing agents	99		
Bronchodilators	96		
Mucolytics	86		
As a minimum standard a physiotherapist can independently interpret findings from imaging investigations (excluding the imaging report) including:			
Chest radiographs	92		
As a minimum standard a physiotherapist can interpret the results from neurological equipment/examinations and functional tests including:			
An ability to interpret a Glasgow Coma Score	91		

(continued)

Table 1. Continued.

Assessment	Round		
	1	2	3
As a minimum standard 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	99		
Auscultation	99		
As a minimum standard a physiotherapist understands the key principles of providing the following differing modes of mechanical/assisted ventilation including:			
CPAP	98		
PEEP/EPAP	98		
PS/IPAP	98		
SIMV (volume)/(pressure)	90		
BiLevel	85		
As a minimum standard a physiotherapist can assess and interpret mechanical ventilation settings/measurements including:			
Respiratory rate	99		
Tidal volume	98		
Breath types (spontaneous, mandatory, assisted)	98		
The levels of FiO ₂	99		
The levels of PEEP	97		
The levels of PS	95		
Peak inspiratory pressure	85		
Inspiration: Expiration ratio	^b	69	70
As a minimum standard a physiotherapist can:			
Assess the effectiveness/quality of a patient's cough	98		
Record and interpret observations from physical clinical examination	^b	100	
As a minimum standard a physiotherapist can interpret indices from blood-gas measurement including:			
pH	98		
PaCO ₂	99		
PaO ₂ , SpO ₂ , SaO ₂	100		
HCO ₃	94		
Base excess	85		
A physiotherapist can complete musculoskeletal and/or functional assessments including:			
Manual muscle testing	85		
Range of motion	95		
Deep-vein thrombosis screening	73		
Peripheral oedema	81		

^aItem not reaching consensus when using all possible denominators.

^bItem added during subsequent rounds.

APTT: Activated Partial Thromboplastin Time; CPAP: Continuous Positive Airway Pressure; FiO₂: Fraction of inspired Oxygen; INR: International Normalised Ratio; IPAP: Inspiratory Positive Airway Pressure; PaCO₂: Partial Pressure of arterial Carbon Dioxide; PaO₂: Partial Pressure of arterial Oxygen; PEEP: Positive End Expiratory Pressure; PS: Pressure Support; SIMV: Synchronised Intermittent Mandatory Ventilation; SaO₂: Arterial Oxygen Saturation; SPO₂: Peripheral Capillary Oxygen Saturation.

Table 2. Condition items determined as essential (consensus >70% 'essential').

Conditions	Round		
	1	2	3
As a minimum standard a physiotherapist understands pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including:			
Respiratory failure Types I and II	100		
Community acquired/nosocomial/hospital-acquired pneumonia	97		
Pleural effusion	96		
Obstructive respiratory disease	100		
Restrictive respiratory disease	96		
Suppurative lung diseases	96		
Acute lung injury/acute respiratory distress syndrome	98		
Acute coronary syndrome	89		
Shock (cardiogenic)	73		
Heart failure	86		
Post-abdominal surgery	88		
Renal failure: acute and chronic	69 ^a	80	
Immunocompromise	79		
Systemic inflammatory response syndrome	64	75	
Shock (septic)	87		
Multi-organ failure	83		
ICU-acquired weakness (ICU-AW)	81		
Guillain-Barre Syndrome	60	74	
Thromboembolic disease	88		
Intracerebral haemorrhage/Subarachnoid haemorrhage	81		
Traumatic brain injury	76		
Chest trauma	76		
Spinal cord injury	72		
Neuromuscular disease	^b	80	

^aItem added during subsequent rounds.

^bItem not reaching consensus when using all possible denominators.

pressure were determined as essential whereas advanced echocardiograms (ECGs) and nutritional status were not-essential. Similarly, in interpretation of laboratory investigations haemoglobin, platelets, and white cell count were determined as essential, yet haematocrit and neutrophil count were non-essential, see Tables 1 and 5. The authors suggest this reflects current clinical practice, with basic cardiovascular monitoring and interpretation of blood results being used to guide physiotherapy assessment and treatment, whereas more detailed understanding would not be required in an on-call scenario. These findings were common across both the UK and Australasian studies.⁸ Of particular interest in relation to generic skills was the UK finding that completion of objective measures of physical function was not essential, which the Australasian study determined essential.⁸ The reason for this difference is unclear, although is likely a reflection of the role of the physiotherapist in an on-call/emergency duty scenario within the UK, where physical function would not be deemed a priority.

Equally as concerning is the finding from the UK study that skills taught at entry level, i.e. performing and interpreting respiratory function tests, was deemed non-essential; however, these skills were both seen as essential in the Australasian study.⁸ Reasons for this are unclear and would require further investigation.

This Delphi study, like that completed in Australia and New Zealand,⁸ focussed purely on skill and knowledge requirements, and did not consider non-technical components. van Aswegen and colleagues¹⁰ identified the following requirements for minimum practice in South Africa: (1) Integrated Medical Knowledge; (2) Multi-disciplinary teamwork; and (3) Physiotherapy practice. It is likely that the skill and knowledge items recorded in the UK are like those that would be encapsulated in integrated medical knowledge and physiotherapy practice, but not multi-disciplinary team working. Therefore, if multi-disciplinary team working were added, the number of items required for essential practice could be higher than the 107 recorded, with additional focus tasks

Table 3. Treatment items determined as essential (consensus >70% 'essential').

Treatment	Round		
	1	2	3
As a minimum standard a physiotherapist can 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	93		
Humidification	95		
Active cycle of breathing technique (ACBT)	98		
Manual airway clearance techniques – percussion, vibration, chest shaking	98		
Intermittent positive pressure breathing	74		
Mechanical insufflation-exsufflation (MI-E)	85		
Supported coughing	94		
Directed coughing/instructing the patient to cough effectively	96		
Assisted coughing – chest wall	71		
Cough stimulation – oropharyngeal catheter stimulation	71		
Manual hyperinflation via an endotracheal tube or tracheostomy	76		
Nasopharyngeal airway suctioning, including insertion of NP airway	89		
Oropharyngeal airway suctioning, including insertion of OP airway	88		
Suction via a tracheal tube (ETT, tracheostomy, mini-tracheostomy)	98		
Instillation of normal saline into the endotracheal tube	62	73	
Patient positioning for respiratory care – including use of side lie, sitting upright, postural drainage (modified or head down tilt)	99		
Patient positioning for prevention of pressure ulcers, management of tone, maintenance of musculoskeletal function	89		
Mobilisation of non-ventilated patient	98		
Mobilisation of ventilated patient	66	82	
Bed exercises	96		
Nasal high flow	^b	76	
As a minimum standard a physiotherapist can appropriately request/coordinate the following:			
Titration of sedation to achieve physiotherapy goals	63	75	
Titration of analgesia to achieve physiotherapy goals	89		

^bItem added during subsequent rounds.

ETT: Endotracheal Tube.

such as communication, team discussion, and documentation needing to be considered.

As identified by Skinner et al.,⁸ each critical care unit has different caseloads, patient specialities, and complexity. Additionally, some centres deliver tertiary services such as major trauma, neurosurgery, and extracorporeal membrane oxygenation (ECMO). As a result, the knowledge and skills that the physiotherapist requires to work independently on critical care will vary. Throughout this Delphi project it was emphasised that items should only be considered a minimum standard if required to work on general critical care units. Therefore, it was assumed that items such as knowledge of ECMO would not be essential (e.g. not needed for most of UK critical care units). However, by the comments received in each round, this was still challenging. The theme of 'Trust or University Health Board Specific' occurred over 500 times during the three rounds emphasising that some still felt that items may need to be included if present at

that critical care unit. However, most of these comments occurred when respondent replied 'unsure' to whether it was essential or not and therefore is unlikely to have influenced the final consensus result.

As with similar previous Delphi studies, there were a number of limitations to this study. Primarily, the length of each questionnaire may have resulted in response fatigue.¹⁸ It was noted that fewer comments were received for later questions and there may have been a tendency to select answers more rapidly with less prior thought. To avoid this, participants were able to complete the survey over 4 weeks, with the option to regularly save progress. However, the authors are aware of intermittent technical issues that resulted in some answers not being completed.

In accordance with Skinner et al.,⁸ three methods for consensus agreement were completed. This was to reduce the potential impact of 'unsure' responses or non-completion of questions. The result was that

Table 4. Assessment items determined as not essential (consensus >70% 'not essential').

Assessment	Round		
	1	2	3
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	28	26 ^a	14
Extra-corporeal membrane oxygenation	13 ^a	10	
Sengstaken-Blakemore/Minnesota tubes	23 ^a	9	
Intracranial pressure (ICP) monitors and extra-ventricular drains	49	47	23
As a minimum standard a physiotherapist can accurately interpret readings from clinical monitoring including:			
Advanced ECG's	0		
Nutritional status including feed administration, volume and type	33	22	
As a minimum standard a physiotherapist can accurately interpret findings from laboratory investigations including:			
Haematocrit	13		
Creatinine Kinase (CK)	31	17	
Neutrophil count	36	25	
Albumin	29 ^a	29 ^a	26
Procalcitonin	3		
Liver function tests	17		
As a minimum standard a physiotherapist is aware of the actions and implications for physiotherapy of the following medications:			
Calcium channel blockers, cerebral diuretics, hypertonic saline	48	30	12
Nitric oxide	27 ^a	17	
Prostacyclin	13		
As a minimum standard a physiotherapist can independently interpret findings from imaging investigations (excluding the imaging report) including:			
Skeletal X-rays	35	28 ^a	20
CT – Brain	2		
CT – Chest	5		
CT – Spine	3		
MRI – Brain	1		
MRI – Spine	3		
MRI – Chest	2		
Ultrasound – Chest	1		
As a minimum standard a physiotherapist can interpret the results from neurological equipment/examinations and functional tests including:			
Electroencephalograms (EEG)	3		
An ability to perform a Glasgow Coma Score (GCS)	27 ^a	24 ^a	12
An ability to perform an assessment of sedation levels	15		
An ability to interpret an assessment of cranial nerve function	23	7	
An ability to perform an assessment of cranial nerve function	4		
Ability to perform a delirium assessment	12		
As a minimum standard a physiotherapist understands the key principles of providing the following differing modes of mechanical/assisted ventilation including:			
High Frequency Oscillatory Ventilation	24 ^a	19	
As a minimum standard a physiotherapist can assess and interpret mechanical ventilation settings/measurements including:			
Static and/or dynamic lung compliance measurements	12		
Upper and lower inflection points of P-V curves	4		

(continued)

Table 4. Continued.

Assessment	Round		
	1	2	3
Maximum inspiratory pressure (MIP) measurements	15		
Maximum expiratory pressure (MEP) measurements	10		
As a minimum standard a physiotherapist can:			
Perform respiratory function tests (e.g. for measurements of FEV ₁ , FVC, PEF)	20		
Perform and interpret percussion note	^b	20	
Measure peak cough flow on or off mechanical ventilation	24		
Measure peak inspiratory flow rate: Peak Expiratory Flow	^b	^b	16
Perform a spontaneous breathing trial	13		
Interpret the rapid shallow breathing index	12		
Perform a swallow assessment	1		
As a minimum standard a physiotherapist can interpret indices from blood gas measurement including:			
PaO ₂ /FiO ₂ ratio	46	33	29
A-a gradient	6		
P50	1		
Oxygen content (CaO ₂)	12		
Anion gap	1		
Venous blood gas interpretation (including SvO ₂)	31	25	
As a minimum standard a physiotherapist has knowledge of methods for advanced haemodynamic monitoring, can interpret the measurements and understands the implication of these for physiotherapists:			
Pulmonary arterial catheter measurements	19 ^a	14	
PiCCO measurements	13		
A physiotherapist can complete musculoskeletal and/or functional assessments including:			
Dynamometry	18		
Bioimpedance testing of body composition	1		
Objective measures of physical function	38	35	21
Perform and Interpret Chelsea Critical Care Physical Assessment Tool	^b	26 ^a	21
Objective measures of cardiopulmonary exercise tolerance	24		
Objective measures of quality of life	15		

^aItem not reaching consensus when using all possible denominators.

^bItem added during subsequent rounds.

ECG: ElectroCardioGram; FEV₁: Forced Expiratory Volume in 1 second; FiO₂: Fraction of Inspired Oxygen; FVC: Forced Vital Capacity; PaO₂: Partial Pressure of arterial Oxygen; PEF: Peak Expiratory Flow; SvO₂: Venous Oxygen Saturation.

Table 5. Condition items determined as not essential (consensus >70% 'not essential').

Conditions	Round		
	1	2	3
As a minimum standard a physiotherapist understands pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including:			
Pancreatitis	50	58	54
Hepatitis	24		
Organ transplantation	32	25	
Burns	28	20	

Table 6. Treatment items determined as not essential (consensus >70% 'not essential').

Treatment	Round		
	1	2	3
As a minimum standard 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	15 ^a	28	16
Autogenic drainage	21		
NIV/BiPAP - for use during exercise or mobilisation including initiation and titration of	36	29 ^a	23
Cough stimulation - tracheal rub	10		
Recruitment manoeuvres e.g. staircase manoeuvres	10		
Bronchial Lavage	1		
Performing bronchoscopy independently	0		
Assisting bronchoscopy via delivery of secretion mobilisation techniques during the procedure	16		
Patient prone positioning in severe respiratory failure/acute lung injury	35	39	28
Inspiratory muscle training	13		
Splinting and/or casting for the upper limbs and lower limbs	6		
Collars	12		
Braces	9		
Electrical stimulation (e.g. for isolated muscle activation to prevent muscle wasting, such as neuromuscular/functional electrical stimulation)	0		
Treadmill, cycle ergometry or stationary bike	13		
Additional rehabilitation techniques (e.g. hydrotherapy, Wii)	7		
As a minimum standard a physiotherapist can:			
Intubate a patient	2		
Extubate a patient	1		
Lead the co-ordination of weaning protocols	14		
Lead the co-ordination of cuff deflation trials	14		
Lead the co-ordination of speaking valve trials	15		
Determine the appropriateness of a patient for tracheostomy decannulation	28 ^a	41	33
Decannulate a tracheostomy	4		
Tracheostomy exchange	2		

^aItem not reaching consensus when using all possible denominators.

NIV: Non-Invasive Ventilation.

Table 7. Assessment items not reaching any consensus.

Assessment	Round		
	1	2	3
As a minimum standard a physiotherapist is aware:			
Of key literature that guides evidence-based physiotherapy practice in critical care settings	54	60	61
As a minimum standard a physiotherapist can accurately interpret readings from clinical monitoring including:			
Central venous pressure (CVP)	59	61	68
As a minimum standard a physiotherapist can accurately interpret findings from laboratory investigations including:			
Renal function tests e.g. urea and creatinine	56	61	68
Sputum cultures	62	66	65

(continued)

Table 7. Continued.

Assessment	Round		
	1	2	3
As a minimum standard a physiotherapist can interpret the results from neurological equipment/examinations and functional tests including:			
Intra-cranial pressure (ICP) monitors (intra-parenchymal and intra-ventricular) and cerebral perfusion pressure (CPP)	50	49	33
An ability to interpret an assessment of sedation levels (e.g. Ramsey Sedation Scale, Riker, Richmond-Agitation Sedation Scale)	64	61	51
An ability to perform a neurological examination of motor and sensory functions (e.g. light touch, pain) e.g. ASIA score	47	42	34
As a minimum standard a physiotherapist understands the key principles of providing the following differing modes of mechanical/assisted ventilation including:			
Assist-control (AC)	70 ^a	60	57
Airway pressure release ventilation (APRV)	40	41	28 ^a
Weaning protocols	56	60	58
As a minimum standard a physiotherapist can:			
Interpret respiratory function tests (e.g. for measurements of FEV ₁ , FVC, PEF)	55	50	51
Perform a cuff volume and/or pressure test on an endotracheal tube or tracheostomy	42	44	37
As a minimum standard a physiotherapist can interpret indices from blood gas measurement including:			
Lactate	52	49	38
As a minimum standard a physiotherapist has knowledge of methods for advanced haemodynamic monitoring, can interpret the measurements and understands the implication of these for physiotherapists:			
Implanted or external pacemakers and determine presence of pacing on ECG	48	58	50
A physiotherapist can complete musculoskeletal and/or functional assessments including:			
Ability to assess tone (e.g. utilising a Modified Ashworth Scale) and reflexes	63	61	51

^aItem not reaching consensus when using all possible denominators.

FEV₁: Forced Expiratory Volume in 1 second; FVC: Forced Vital Capacity; PEF: Peak Expiratory Flow.

Table 8. Condition items not reaching any consensus.

Conditions	Round		
	1	2	3
As a minimum standard a physiotherapist understands pathophysiology and presenting features, likely medical management and implications for physiotherapy for a range of conditions including:			
Post-cardiac surgery	50	55	47
Post-thoracic surgery	50	60	50
Pancreatitis	50	58	54
Metabolic/electrolyte disturbances	46	50	45
Fat embolism	43	42	34
Brain death and organ procurement	47	37	32
Multi-trauma	65 ^a	68	68
Sleep-disordered breathing (e.g. Obstructive Sleep apnoea, hypoventilation)	^b	61	62

^aitem not reaching consensus when using all possible denominators.

^bitem added during subsequent rounds.

Table 9. Treatment items not reaching any consensus.

Treatment	Round		
	1	2	3
As a minimum standard a physiotherapist can provide the following techniques, including an understanding of indication, contraindications, evidence for technique and progressions:			
Positive pressure devices for airway clearance (e.g. AstraPEP, PariPEP, TheraPEP, or oscillating expiratory pressure devices like Acapella, Flutter)	65	59	58
Periodic/intermittent CPAP (non-invasive via mask) including initiation and titration of	58	59	59
NIV/BiPAP – for Type I or Type II respiratory failure, initiation and titration of e.g. COPD exacerbation with hypercapnia	63	64	65
NIV/BiPAP – intermittent, short term applications during physiotherapy to assist secretion mobilisation techniques or lung recruitment including initiation and titration of	53	52	48
Assisted coughing - subcostal thrusts for spinal cord injuries	43	49	39
Ventilator hyperinflation (VHI) via an endotracheal tube or tracheostomy	46	44	35
As a minimum standard a physiotherapist can appropriately request/coordinate the following			
Titration of inotropes to achieve physiotherapy goals	38	42	41
As a minimum standard a physiotherapist can			
Determine the appropriateness of a patient for extubation	43	44	40
Determine the appropriateness of a patient for tracheostomy decannulation	28 ^a	41	33

^aItem not reaching consensus when using all possible denominators.

COPD: Chronic Obstructive Pulmonary Disease; CPAP: Continuous Positive Airway Pressure; NIV: Non Invasive Ventilation.

Table 10. Five highest ranked themes across all three rounds.

Overall Rank	Theme	Round 1	Round 2	Round 3	Total
1	Specific to Unit, Hospital, Trust or University Health Board	161 (1)	210 (1)	142 (1)	513
2	Basic or general understanding/awareness/interpretation required	87 (2)	119 (2)	76 (2)	282
3	As part of or in liaison with multi-disciplinary team	30 (3=)	50 (3)	29 (3)	89
4	Not essential for on-call working/staff	2 (-)	15 (15)	20 (4)	37
5=	Able to be completed/performed by other MDT members	30 (3=)	6 (-)	0 (-)	36
5=	Advanced skill	16 (5)	8 (-)	12 (5)	36

() Individual rank for each round; - Unranked in round; = joint rank for each round.

some items neared essential or non-essential consensus but due to different calculations were unable to be included and therefore were classified as not reaching consensus. Additionally, the decision to use 70% as the cut-off criteria was based on the previous Delphi.⁸ As commented by previous authors, changing this threshold will have resulted in more or less items being considered as essential and non-essential, respectively.

Much consideration is now required as to how these results can be used to standardise both physiotherapy education (entry-level and postgraduate) and clinical practice, and how the results may be used to reduce variation in practice especially during 'on-call' working. There is a need to determine who is

responsible for delivering the training and education required to ensure physiotherapists have the necessary knowledge and skills to practice autonomously. The results of the study need to be discussed with both higher education establishments (delivering entry-level physiotherapy degree programmes) and National Health Service (NHS) organisations. Additionally, the results of the Delphi will be disseminated to the study participants with a plan for further discussion of findings and onward studies.

It is aimed that this project will allow organisations to standardise training and competencies, to reduce both single-site variations (e.g. service being delivered in a single critical care) and across-site variations. One proposed method would be to develop a model of

competency framework similar to the critical care nursing framework (Critical Care Network Nurse Leads).¹⁹ By using such a framework, it may also be possible to generate a tiered system (e.g. foundation; specialist; advanced) to further recognise the role of the physiotherapist within critical care. Through this process, it may be possible to improve the quality of the service provided to the patient by reducing the impact of the variances in physiotherapy practice and standardise clinical assessment, interventions, and management.

Conclusions

This study identified 107 items of knowledge and skills that are essential as a minimum standard for clinical practice by physiotherapists working in UK critical care units.

The findings of this study require dissemination, which may support training programmes in both higher education and the health service, to reduce variability in clinical practice.

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