Development of a tool to assess core cardiorespiratory physiotherapy skills: a Delphi study.

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Development of a Tool to Assess Core Cardiorespiratory Physiotherapy Skills: An e-Delphi Study.

ABSTRACT

Purpose: This study reports on the development of an outcome measure designed to evaluate pre-registration physiotherapy students' ability in performing core cardiorespiratory skills.

Method: A four round, e- Delphi study using an international panel of expert cardiorespiratory physiotherapists involved in pre-registration student education was undertaken. In round one participants identified what they look for in students competently performing core cardiorespiratory physiotherapy assessment and treatment skills. These items were refined in rounds two and three. Item content validity score (iCVI) of ≥0.8 at round four identified consensus. Scale content validity index (SCVI) was calculated. **Results:** Response rate for round one was 46% (6/13). Additional experts were invited to participate and response rates increased to 71% (round 2), 88% (round 3) and 100% (round 4). Of the 207 items across the seven skills identified in round one, 140 were presented in round four. Of these, consensus was achieved for 128 items, with 12 being excluded. The SCVI was 0.907. **Conclusion:** This e-Delphi study enabled the development of a draft outcome measure which aims to assess performance of seven cardiorespiratory physiotherapy skills. This tool will enable rigorous evaluation of different education methods to establish their effectiveness. However, it is first necessary to establish construct validity and assess inter and intra-rater reliability.

Words: 207

Keywords: outcome measures; education; Delphi technique; students.

INTRODUCTION

In their 'Perspectives' editorial, Jensen et al. (2016) discuss a 'bench-to-bedside' approach to education research for health professions. This framework indicates a need for: 1) basic research considering fundamental tools such as measurement, skills assessment, and evaluation; 2) applied research which shows the benefits of educational interventions; 3) translational research which can provide explanations about how learning is occurring, and 4) systems research focusing on the complex systems involved in education and health care (Jensen et al, 2016).

The need for robust evidence to support educational methods is supported by pressures experienced by higher education (HE) and the health service (Kings Fund 2018; Lacobucci, 2017; Mercer, 2015). Drivers to provide quality healthcare while reducing costs and addressing workforce issues are global (Deloitte, 2018) and they impact on clinical placement capacity, a critical element of physiotherapy student learning (World Confederation on Physical Therapy (WCPT), 2015). Due to these pressures, it is essential to demonstrate that learning methods are effective; to use optimal methods that enable students to be appropriately prepared for placement enabling them to gain the most from their critical clinical learning (Korpi, Peltokallio, and Piirainen, 2014).

A learning method being increasingly used is simulated learning, defined as:

> *An array of structured activities that represent actual or potential situations in education and practice. These activities allow participants to develop or enhance their knowledge, skills, and attitudes, or to analyse and respond to realistic situations in a simulated environment*. (Lopreiato, 2016, pp34)

Watson et al. (2012) and Blackstock et al. (2013) demonstrated that simulation can replace part of clinical time with no detriment to student development and, due to the work conducted by Wright, Moss, Watson, and Rue (2015), this is now an accepted part of entry level curricula in Australia (Chipchase, Blackstock, Patman, and Barnett-Harris, 2018). It is also used across the United Kingdom (UK), Canada, and the United States of America (USA) (Melling et al, 2018). Despite a wealth of published literature reporting positive student perceptions of this learning method, a recent systematic review (Roberts and Cooper, 2019) found only one pilot study reporting on the effect of high-fidelity simulation (HFS) on student skill performance. The pilot study suggested that HFS may be detrimental to student skill development (Phillips, Mackintosh, Bell, and Johnston, 2017). However, evidence has shown that HFS can increase student stress levels. If this was students' first exposure to HFS, and specifically simulated patients, high stress levels may have limited student learning and resulted in poorer skill performance (Judd et al, 2019; Sabus and Macauley, 2016).

To be able to effectively evaluate learning methods and their impact on students, it is essential to have valid and reliable outcome measures; lack of such measures is currently a fundamental limitation to research on learning methods in physiotherapy education. A systematic review of outcome measures for procedural skills in physiotherapy education found only six measures in existence (Sattelmayer, Hilfiker, and Baer, 2017). All six are focused on musculoskeletal skills, four have established content validity, and only one has reported on inter-rater reliability. Consequently, to undertake robust research evaluating learning methods used in cardiorespiratory physiotherapy teaching, valid and reliable outcome measures must first be developed.

This study therefore aimed to develop an outcome measure that enables the evaluation of core clinical skills competency in cardiorespiratory physiotherapy and to establish the content validity of the outcome measure developed.

METHOD

The Delphi expert consensus method, a systematic method to develop and measure consensus, which helps ensure content validity of an outcome measure, was employed (Humphrey-Murto et al, 2016). Typically, round one is used to develop the statements for subsequent rounds (up to four). Participants' views are analysed between-rounds and contribute to the next round's questionnaire, enabling the views, experience and knowledge of a wide range of experts to be utilised without undue influence from any dominant individuals (Humphrey-Murto, Vaipo, Gonsalves, and Wood, 2017; McPherson, Reese, and Wendler, 2018). Ethics approval was granted by the School of Health Sciences Research Review Group (ref: SHS/17/18).

Participants

Consensus from an international group of experts is recommended for establishing content, face and concurrent validity (Baker, Lovell, and Harris, 2006). The following definition of experts was used in this study:

- Involved in writing core cardiorespiratory physiotherapy textbooks *and/or*
- At least two recent publications (<10 years) relating to cardiorespiratory physiotherapy topics in peer-reviewed journals indexed in Medline or CINHAL *and*
- Involved in teaching pre-registration physiotherapy students as an academic or clinical educator *and preferably with*

- Wider activity such as certified cardiorespiratory specialist, involvement in specialist cardiorespiratory physiotherapy groups, national guideline development.

Experts were located by: (i) searching Medline and CINHAL for articles published in the last 10-years using the following terms: chest physical therapy, respiratory physical therapy, chest clearance techniques, and (ii) searching author lists from core cardiorespiratory textbooks. The online profiles of authors (experts) identified in this way were subsequently reviewed against the criteria identified above. A population of nineteen potential participants from Australia, Canada, New Zealand and the UK met the pre-defined criteria.

Due to a low response rate in round one, a further search for experts was undertaken prior to round two. This involved a search of staff databases for each university providing pre-registration physiotherapy education in Australia, Canada, New Zealand and the UK for participants that met the predefined criteria. This provided a further list of experts not found prior to round one as their publications did not meet the specific search terms used in Medline and CINHAL. However, identification of participants was limited in this search by accessibility of staff profiles on university websites.

<u>Round 1</u>

A demographic questionnaire was developed to gather data about participants' academic qualifications and years qualified/ specialised in cardiorespiratory physiotherapy/working with students. Participants were asked to identify the assessment and treatment techniques they considered core in cardiorespiratory

physiotherapy (Supplementary file 1). This also acted to indicate experts consent to participate.

Round one, developed by the lead author, asked participants to detail the various aspects of the skill they would expect to be demonstrated when they observed students performing core cardiorespiratory assessment and treatment techniques. The skills included were those identified by the initial respondents to the demographic questionnaire (n=13). To limit the length of the questionnaire and to encourage respondents to participate, only two assessment skills and three treatment skills were included. These were selected based on the number of respondents agreeing that the skill was core, on 'observability' of the skill and the need for minimal equipment beyond a stethoscope. Participants were asked to focus on all aspects of the skill (explanations, instructions and actual performance). This involved collection of qualitative data via open questions along with two closed questions detailing lists of areas of the thoracic cage which could be palpated and auscultated from which participants could select those they would expect to be used.

An online questionnaire was used (onlinesurvey.ac.uk) as this has been shown to increase completeness of responses since they can be set up to require a response before respondents progress to subsequent questions (Helms, Gardner, and McInnes, 2017).

An invitation email, including a link to the demographic questionnaire and information sheet detailing the purpose of the study and requirements of participants, was sent to 19 potential participants in February 2018. Participants were advised that completion of the demographic questionnaire would indicate consent to participate in the e-Delphi

study. Reminder emails were sent two weeks after the original invitation. Those who completed the demographic questionnaire were allocated a participant number to enable tracking of participants, targeting of reminder emails, and exclusion of non-responders from subsequent invitations. Once the demographic questionnaire was completed participants were sent their participant number and the link to the Round 1 questionnaire.

Analysis Round 1

Frequency of responses were calculated for closed questions using an Excel® spreadsheet. For the open questions, two researchers, the authors, independently reviewed qualitative data to identify codes, themes, sub-themes (Cresswell, 2016). These were agreed through discussion and each researcher then allocated data from all responses, as appropriate, before results were compared and agreed. Both authors have experience in qualitative data analysis. The lead author is a cardiorespiratory physiotherapist and the other an experienced qualitative researcher with a background in musculoskeletal physiotherapy. This ensured bias regarding content was avoided as reviewer two would be less likely to make inferences regarding content due to less developed understanding and expertise in this area.

Round 2

Round two clarified the various aspects of the skill required for competent skill performance. Initial analysis of data in round one involved grouping the various aspects of each skill identified by respondents so that similar features, for example, knowledge, skill performance, communication were grouped together. From this we identified four key categories: Professionalism, general patient care consideration, reasons for

undertaking the skill and skill performance (potential explanation components, instructions, steps involved in performing the technique, hand positions and potential modifications). There were multiple items in each of these categories. Questions relating to core professional and patient care items used five point Likert scales (strongly agree, agree, neutral, disagree, strongly disagree) to gain agreement levels with the option of providing additional clarification. Further questions required participants to identify all aspects of the skills they would look for from a list of items developed from round one. Free-text options were also provided for clarification of responses. Sixteen new experts were identified from university websites (already detailed). An invitation to participate, the same information sheet used prior to round one and link to the same demographic questionnaire were sent to the potential additional sixteen participants (R2+) identified between rounds 1 and 2. Those who completed the demographic questionnaire at this point (n=8), along with those who had completed the demographic questionnaire prior to round 1 (R1)(n =13) received the link to round 2. Consequently, the questionnaire was sent to 21 potential participants.

Analysis Round 2

Percentage agreement (strongly agree/agree) was calculated for Likert scale questions using Excel®; items that achieved ≥80% agreement were progressed to round three. Those with <80% agreement were rejected. Frequencies for items relating to reasons for undertaking the skills and performance of each skill were calculated for items identified by participants from the pre-determined list. Items identified by >40% of respondents progressed to round three and those <40% were rejected. The same reviewers independently analysed free-text comments to determine whether additional

items identified added to current data or whether existing items should be modified in line with the additional information provided. These were then discussed and agreed.

Round 3

The same Likert scale agreement (strongly agree – strongly disagree) was used for items that were modified from round two data analysis and progressed into round three. For items that were unmodified from round two, participants were asked whether they were essential/nice to have/not required, to enable identification of items required for meeting expectations, i.e. competence, and items that could be used to define those 'exceeding expectations'. This round was sent to 16 participants comprised of: (i) the ten participants recruited at round one who responded in round two, and (ii) six participants from round two (the five who completed round two plus one who was unable to respond at that time but indicted they wished to be involved in future rounds).

Round 3 Analysis

For Likert questions percentage agreement was calculated by combining strongly agree and agree. Items with ≥80% agreement progressed to round four. Item content validity index (iCVI) was calculated for other items and in line with recommendations an iCVI ≥ 0.78 were accepted as giving consensus (Polit and Beck, 2006). Items with an iCVI ≥ 0.78 from 'essential' progressed to round four as components for 'meeting expectations', that is that they are core items. Items that could identify performance that 'exceeds expectations' were included in round four where an iCVI ≥ 0.78 resulted from combining 'essential' and 'nice to have'. Items not achieving an iCVI of 0.78 from this combination were excluded. Calculation of iCVI at this point was used to enable identification of items to go forward to round 4 or be rejected.

Round 4

For each technique, items identified in round three as necessary for 'meeting expectations' were included. These were followed by items to identify performance 'exceeding expectations'. Levels of agreement were established for each item using a four point Likert scale (strongly agree, agree, somewhat agree, disagree) (Polit and Beck, 2006). For items considered to identify performance that was 'exceeding expectations' where participants responded 'somewhat agree' or 'disagree' they had the option of identifying whether the item should be included as a 'meeting expectations', that is core, requirement. This avoided any potentially important items being erroneously excluded.

Only 10 respondents are required to calculate iCVI (Polit and Beck, 2006). To allow for non-respondents 12 round three participants were invited to complete round four. To ensure equal representation, where there were more than four respondents per country, an independent research assistant randomly selected four participant numbers from a list (see table 1). Round four was sent out in November 2018 and closed mid-December 2018.

Round 4 Analysis.

The iCVI was calculated for every item. Core items achieving an iCVI of ≥0.8 were included in the outcome measure. For items identified as indicating performance 'exceeds expectations', an iCVI of ≥0.8 had to be achieved either from agreement or for a combination of those who agreed and those who 'somewhat agree/disagreed' but thought it should be included as 'meeting expectations'. Scale content validity index

(SCVI) was calculated to assess the degree to which all items belong together in the outcome measure (Polit and Beck, 2006).

Piloting of questionnaires

All questionnaires were piloted by four local cardiorespiratory physiotherapists for readability prior to being distributed and minor changes were made in response to feedback.

RESULTS

Of the original 19 participants invited to participate, 13 completed the demographic questionnaire and were subsequently sent the link to round one. Of these 13 only six completed round one giving a response rate for round one of 46% (6/13). Of the 16 additional participants invited after round one, eight consented to participate by completing the demographic questionnaire, with a response rate of 71% (15/21) for round two. Original participants who had not replied to rounds one or two, and those who had not responded to the demographic questionnaire at round two were excluded, resulting in a potential sample size of 16 for round three, with a response rate of 88% (14/16). The response rate for round four was 100% (12/12). Respondents in all four rounds represented Australia, Canada and the UK. Demographic data, by round, is provided in table two. All respondents were involved in teaching cardiorespiratory skills to students and all met the publication requirements.

Table 2: Demographic Data by Round

Round One results

Three hundred and seventy two pieces of information relating to how techniques should be undertaken were identified from the six respondents. Two core categories were identified within the data: 1) reasons for undertaking techniques, including explanations of the technique and its aims, and 2) elements of skill performance. Both reviewers identified 207 specific items across the seven techniques that would progress to round 2 (shown in Fig 1) and a further 11 generic aspects relating to two additional categories, professionalism and general patient care were also progressed.

Fig 1: Insert here

Round Two and Three Results

Seven items of professionalism and general patient care achieved 80-100% agreement (table 3) in round two and could be removed until round four as further clarification was not required.

Table 3: insert here

Round Four Results

In round four, 140 items were presented to the experts; 83 as potential core, 'meeting expectations', items with a further 57 'exceeding expectations' items. Table 4 shows the number of items included for each technique in round one, round 4 and at the conclusion of round four. Four "meeting expectations" items and nine "exceeding expectations" items failed to reach the iCVI of 0.8 at the end of round four (table 5) and were excluded from the draft outcome measure (Supplementary file 2). In summary, only one palpation point was agreed upon (lateral bases) and two auscultation points (lateral and posterior bases) although six further auscultation points were agreed for

'exceeding expectations' (anterior apices/mid and base, lateral mid zone, posterior apice). Communication items related to feeling for movement of the chest wall, listening to how the lungs sound and how the techniques would be performed/what was required of the patient. For the treatment techniques, communication items related to what the technique aimed to do and what was required of the patient, while skill items addressed how techniques would be taught, hand positions and other relevant skill items. The scale CVI (SCVI) was 0.907.

Table 4: Insert here

Table 5: insert here

DISCUSSION

This study gained consensus from a group of international cardiorespiratory physiotherapy experts about the items they would expect a student to undertake to demonstrate competent performance of core cardiorespiratory techniques. There was agreement that the final outcome measure should include 127 items spread across the seven skills which included 79 core items (professionalism items were integrated in these) and 48 'exceeds expectation' items.

The first step in defining competence in a defensible and transparent way, as advocated by Searle (2000), is to determine exactly what competence looks like. A review of core respiratory techniques in journal articles and online resources shows a variety of descriptions of the techniques and lack of clarity of exactly how students should perform the techniques (Fink 2007; Lewis, Williams and Olds 2012). This limits the

ability to objectively measure competence in skill performance, a critical element if educational research is to be able to investigate the benefits of educational interventions.

As a method of establishing how well experts agree on a specific issue, a Delphi study is appropriate for identifying the core elements required for competent skill performance (Humphrey-Murto et al, 2016). Although there are no specific guidelines relating to conducting a Delphi study, and no standard approach to data analysis, general guidelines indicate the methods used in this study were appropriate (McPherson, Reese, and Wendler, 2018).

The inclusion of professionalism items: consent, back care, ensuring patient comfort/status and dignity are supported by a previous Delphi study, which aimed to identify key professional behaviours that should be included in physiotherapy observed structured clinical examinations (Blackstock et al, 2013). Blackstock et al. (2013) used a panel of 10 examiners, local to the institution of the authors, involved in assessing their students agreed on communication elements: explaining techniques in lay terms; appropriate commands in relation to type and timing; using voice effectively and using appropriate language and tone. These elements also gained consensus in this study. However, respondents in this e-Delphi study were more explicit regarding specific instructions and explanations that should be incorporated, resulting in an outcome measure that is arguably more objective and transparent, as recommended by Searle (2000). The current study also included key elements that constitute skill performance in relation to teaching elements of the ACBT, as well as motor performance elements of percussion and vibrations, which to our knowledge no previous tool has done.

This study is further strengthened by involvement of an international panel representing countries where cardiorespiratory physiotherapy is supported by special interest groups (Cardiorespiratory Division, Canadian Physiotherapy Association; Association of Chartered Physiotherapists in Respiratory Care, UK) and in Australia by specialist status (Australian College of Physiotherapists). Clear criteria were used in defining 'expert status' as suggested by Jorm (2015), since previous reports on the Delphi method have identified lack of clarity of 'expert status' as a weakness of the method (Baker, Lovell, and Harris, 2006). Use of expert judgement is always open to subjectivity and bias, although it has also been suggested that use of experts in the Delphi technique ensures content and concurrent validity (Baker, Lovell, and Harris, 2006; Bruce, Langley, and Tjale, 2008). Content validity is further supported by only including items with iCVI of > 0.8, with many items achieving and iCVI of 1 or 0.917, and involving international panel members. Additionally, the Delphi technique is recognised as an accurate and reliable way of consulting experts and achieving group consensus (Humphrey-Murto, Vaipo, Gonsalves, and Wood, 2017).

The use of experts may, however, have influenced the items that achieved agreement. It has been suggested that experienced practitioners develop and refine their own set of rules and criteria for safe, effective practice: They critique protocols and general rules governing practice, interpreting boundaries of practice according to circumstances (Smith, Higgs, and Ellis, 2010). This may have led to more selectivity in items determined as important; for example, only auscultation of the lateral and posterior bases was agreed for competent practice. A key requirement for panel membership however was involvement in student learning, either as a clinician or university educator, and the wording of the questionnaires clearly stated that the study aimed to

376 establish the key items required for students to demonstrate basic competence of
377 techniques. Consequently, the items included should reflect the appropriate skills for
378 entry level practice. It may be useful to subsequently survey physiotherapists more
379 widely about what elements they would require for these techniques so that less expert
380 views can be collated.
381
382 Limitations
383 Of the initial sample originally consenting to participate (n=13) only 46% completed
384 round one. This is despite using a personalised approach and providing extensive
385 information about the purpose of the study (Helms, Gardner, and McInnes, 2017).
386 Some of the initial respondents did not have a vested interest in this area of research as
387 indicated by the three participants who declined to participate due to no longer working
388 in a suitable area of practice (Helms, Gardner, and McInnes, 2017). In round two 10 of
389 the original 13 respondents participated suggesting a further reason for the low response
390 rate may have been the nature of round one, which required approximately 30-minutes
391 to complete. The improved response rate in subsequent rounds, where only level of
392 agreement was required (with the option of adding additional comments), and
393 consequently completion was quicker, may support this. Self-selection to participate
394 may have introduced responder bias to the results, although it is recognised practice to
395 invite people to participate in Delphi studies after defining participant characteristics
396 and for participation to be voluntary (Hsu & Sandford 2007). It is not possible to
397 identify the degree of bias present in our results as information regarding non-
398 responders' knowledge and views was not available for analysis. However, since 10/13
399 of those initially asked to participate responded in round two the degree to which the

three non-respondents would have influenced many of the results is questionable due to the high levels

Inviting additional participants to join the study at round two may be seen as a strength since the additional participants all had a clear role in providing cardiorespiratory education within a higher education context as well as being published authors and therefore had a clear vested interest in addition be being 'experts'. This additional recruitment resulted in a response rate of 71% and this was maintained through subsequent rounds (Helms, Gardner, and McInnes, 2017). This panel size and response rate reflects other Delphi studies and can be considered acceptable (Forbes, Mandrusiak, Smith, and Russell, 2018; Jones et al, 2017). Enabling respondents to provide additional qualitative information at this stage of study, in addition to level of agreement, ensured new participants could contribute fully to the content of the outcome measure.

Data was collected from only English speaking countries and therefore it cannot be assumed that the practices that are used across the world are reflected in this study. This is a limitation if the subsequent outcome measure were to be used more widely across the world. Further work would be required to investigate the skills taught more widely and also what clinicians expected of students.

CONCLUSION

This e-Delphi study has enabled the development of a draft outcome measure which aims to assess skill performance of seven cardiorespiratory physiotherapy techniques; two respiratory assessment skills along with five treatment techniques. This has been possible through gathering consensus from a range of expert cardiorespiratory physiotherapists across three countries. Development of such a tool will enable rigorous evaluation of different education methods to establish their effectiveness and help ensure students gain the best education possible while in the university setting. Before the outcome measure can be used in research or practice however it will be necessary to establish construct validity and to assess inter and intra-rater reliability.

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Conflict of Interests: There are no conflicts of interests.

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Table 1: Participant Flow

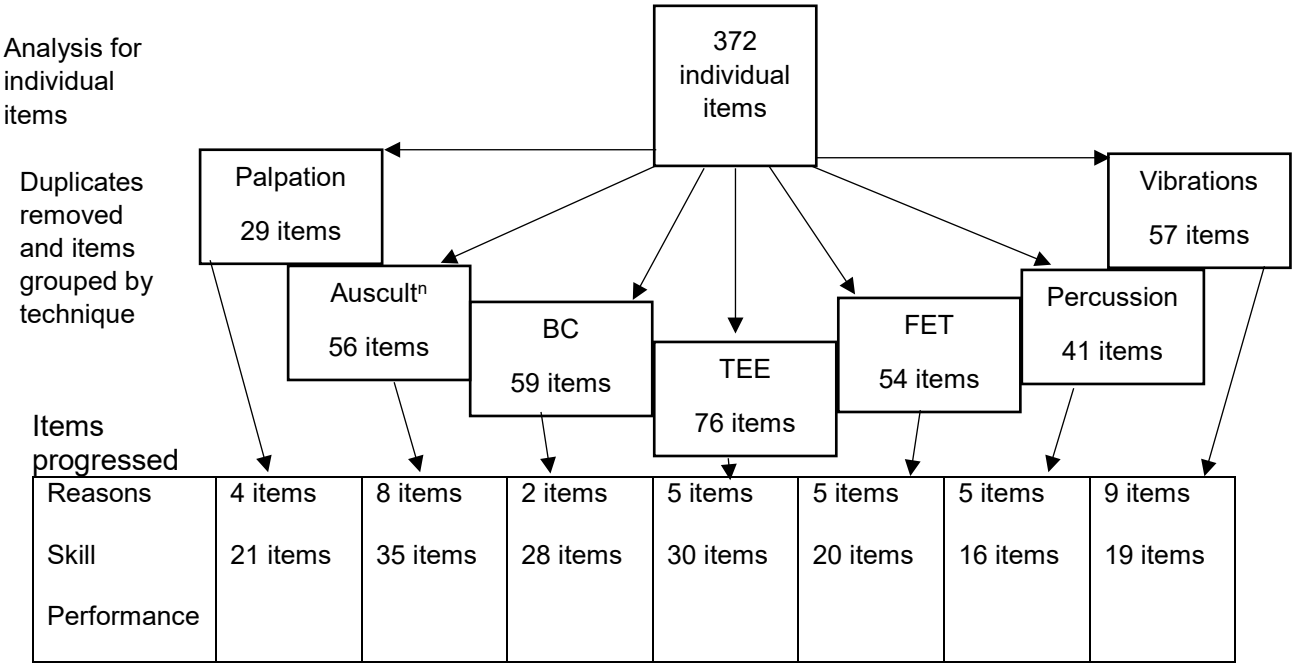
Round	Sample	Responses	Excluded
Demographic	Participant Flow n=19	13/19	n = 6 3 no response 3 declined
Round 1	n = 13 (R1)	6/13	none
Pre-round 2	New participants N = 16 (R2+)	8/16 returned demographics	n = 8 no response
Round 2	n = 21 13 R1 8 R2+	15/21 10/13 R1 5/8 R2+	 3 R1 no response 2 R2+ no response*
Round 3	n = 16 10 R1 6 R2+	14/16 9/10 R1 5/6 R2+	 1 R1 no response 1 R2+ no response
Round 4	n = 12 9 R1 3 R2+	12/12	

R1 = participants recruited for round 1

R2+ = participants recruited between round 1 and 2

*the remaining participant indicated they did not have time to reply to round 2 but would like to be included at round 3.

Fig 1: Round 1 results summary



Auscultⁿ = Auscultation: BC = breathing control: TEE = thoracic expansion exercises: FET = forced expiratory technique

1 Table 2: Demographic Data by Round

		Round 1	Round 2	Round 3	Round 4
Participants		6/13 (46%)	15/21 (71%)	14/16 (88%)	12/12 (100%)
Country: Australia		3/3(100%)	6/12 (50%)	7/8 (88%)	5/5 (100%)
Canada		2/3 (67%)	3/5 (60%)	3/3 (100%)	3/3 (100%)
New Zealand		0/1 (0%)	0/1 (0%)	-	-
UK		2/6 (33%)	5/11 (45%)	4/5 (80%)	4/4 (100%)
Years Qualified		26.67 +/-7.20	26.17 +/- 7.36	25.75 +/- 7.45	26.17 +/- 7.09
Mean(SD), range		13-32	13-36	13-36	13-36
Year in clinical practice		25.33 +/-6.65	21.4 +/- 9.39	22.43 +/- 8.82	23.5 +/- 7.82
Mean(SD), range		13-32	5-35	5-35	11-35
Year in academia		12.6 +/-10.11	12.25 +/- 9.35	11.5 +/- 9.28	11.58 +/- 9.69
Mean(SD), range		3-28	1-28	1-28	1-28
Years Specialized in CR		23.4 +/-7.92	20.42 +/- 9.07	21.71 +/-8.14	22.30 +/- 8.64
Mean(SD), range		10-30	5-32	10-32	10-32
Year working with students Mean(SD), range		23.83 +/- 6.37 13-32	20.23 +/- 9.86 4-34	20.12 +/- 10.22 4-34	20.67 +/-10.68 4-34
Role with students	Lecturer	3	10	9	8
	Clinical Educator	2	1	1	1

	Combined lectured/clinical educator	1	3	3	3
	Other	0	1 coordinator student program	1 coordinator student program	0
Highest Academic Qualification			9 PhD 2 Ed D 4 Masters	9 PhD 1 Ed D 4 Masters	7 PhD 1 Ed D 4 Masters

Clinical educator= clinician supervising students in clinical practice.

SD = standard deviation

PhD = Doctor of Philosophy

EdD = Doctor of Education

Table 3: Round 2 - Professionalism and General Patient Care

Items	Level of agreement
1. Consent should be gained before each technique	93% BC and Vibrations 100% all others
2. Ensure own back care	100%
3. Position self to avoid invading patients personal space	80%
4. Avoid using jargon	100%
5. Student should overtly ask the patient how they are during each technique	93%
6. Patients should be reminded before each technique to advise the	
student if they experience dizziness,	87%
thoracic/chest pain,	93%
increased breathlessness	93%
distress of any type	93%
7. Students should consider the optimal position for the patient for each technique	100%

BC = breathing control

Table 4: Comparison of number of items included at round 1, round 4 and agreed in round 4.

	Palp[n]	Ausc[n]	BC	TEE	FET	Perc[n]	Vib[n]	Total
Round 1	25	43	30	35	25	21	28	207
Round 4	16	28	21	9	12	9	13	140
(EE)	(5)	(12)	(8)	(10)	(8)	(4)	(10)	(57)
Retained after R4	9	15	12	9	12	9	13	127
(EE)	(3)	(10)	(5)	(9)	(8)	(3)	(10)	(48)

EE = Exceeds Expectation; R4 = round 4; Palp[n] = palpation; Ausc[n] = auscultation; BC = breathing control; TEE = thoracic expansion exercises; FET = forced expiratory technique; Perc[n] = percussion' Vib[n] = vibrations.

Table 5: Round 4 Excluded Items

Item	iCVI
Palpation: Explains feeling for symmetry of movement	0.667
Palpation: Palpates anterior apices	0.583
Palpation: Palpates posterior bases	0.5
Palpation: Overtly asks the patient about their status	0.75
Auscultation: I would expect the student to clean their stethoscope in the presence of the patient	0.633
Auscultation: Explains auscultation determines if there are any problems that physiotherapy can aid	0.633
Auscultation position: posterior mid zones	0.75
BC: hand placed on the patients abdomen below sternum but above umbilicus	0.75
BC: Encourages patient to allow abdominal wall to move forward with each breath	0.633
BC: encourages patient not to worry about the rate or depth of breathing	0.633
BC: stands close to the patient	0.75
TEE: uses sniffs at maximal inspiratory hold as appropriate if relevant for patients presentation	0.633
Percussion: technique applied for between 30 secs – 2 mins	0.667

Key: BC= breathing control; TEE= thoracic expansion exercises

Supplementary File 1

Demographic Questionnaire – Assessment and treatment techniques considered core

<table>
<tr><td>Assessment skills</td><td>No in agreement</td><td>Treatment skills</td><td>No in Agreement</td></tr>
<tr><td>Palpation</td><td>13</td><td>Vibrations</td><td>12</td></tr>
<tr><td>Observation</td><td>13</td><td>Shaking</td><td>10</td></tr>
<tr><td>Auscultation</td><td>13</td><td>Percussion</td><td>10</td></tr>
<tr><td>Respiratory rate</td><td>12</td><td>ACBT</td><td>13</td></tr>
<tr><td>Pulse oximetry</td><td>12</td><td>Autogenic drainage</td><td>3</td></tr>
<tr><td>Percussion note</td><td>9</td><td>Positive expiratory pressure</td><td>9</td></tr>
<tr><td colspan="2" rowspan="4">Other – defined:
Chest XRay interpretation x 3
Bloods
Pulmonary function tests x 2
Thoracic active and passive range of movement
Ventilatory muscle strength
Aerobic capacity/exercise tolerance x 3
Dyspnoea x 3
Arterial blood gas analysis x 2
Deep venous thrombosis assessment
Heart rate x 3
Blood pressure x 4
Chest expansion
Cough and sputum</td><td>Flutter</td><td>9</td></tr>
<tr><td>Incentive spirometry</td><td>9</td></tr>
<tr><td>Positioning</td><td>13</td></tr>
<tr><td colspan="2">Other – defined:
Mobilisation x 5
Manually assisted cough
Cough/supported cough x 2
Inspiratory muscle training x 2
Exercise x 4
Thoracic mobility work
Relaxation x 2
Soft tissue techniques
Pursed lip breathing
Suction x 2
Deep venous thrombosis exercises
Metered dose inhaler technique
Oxygen therapy
Nebulisers
Postural drainage
Intermittent positive pressure breathing</td></tr>
<tr><td colspan="4"></td></tr>
</table>

Supplemental Data 2: Round 4 Results

1: Palpation Statements	iCVI
1.1 Explains feeling for movement/ expansion of chest wall	1
1.2 Explains feeling for symmetry of movement	0.633
1.3 Consent gained	1
1.4 Patient is optimally positioned	1
1.5 Explains they will place their hands on different areas of the patients thoracic cage	0.917
1.6 Advises the patient they should breath normally and with big breaths when requested	1
1.7 Advises patient to let the student know if they experience pain/light headedness of dizziness/ discomfort	0.917
1.8 Palpates lateral bases	0.833
1.9 Positions self for back care	0.917
1.10 Avoids using jargon or clarifies jargon	0.833
1.11 Overtly asks the patient about their status ie if they are OK	0.75
1.1EE Explains palpation to help identify where there may be problems in the patients lungs that physio may help with	0.833
1.2EE Explain they will palpate through inspiration and expiration	0.833
1.3EE Advise the patient they will palpate for several breaths	1
1.4EE Palpate anterior apices	0.633
1.5EE Palpate posterior bases	0.633

2: Auscultation Statements	iCVI
2.1 explains listening to the sounds that the airways and lungs make when you breath	0.917
2.2 Gains consent for auscultation	1
2.3 Stethoscope applied directly on skin	0.917
2.4 Advises the patient to breath in and out through an open mouth	0.917
2.5 Appropriately positions or repositions patient for auscultation	0.917
2.6 Advises patient to let the student know if they experience pain/light headedness of dizziness/discomfort	0.917
2.7 Patient reminded about depth of breath if necessary	0.917
2.8 Patient dignity/comfort considered using towels/draping	0.917
2.9 Auscultates lateral bases	0.833
2.10 Auscultates posterior mid zone	0.75
2.11 Auscultates posterior base	1
2.12 Listens throughout the respiratory cycle at each auscultation point	1
2.13 Overtly asks the patient about their status ie if they are OK	0.833
2.14 positions self to ensure back care	0.917
2.15 positions self with consideration of patients personal space throughout intervention	0.917
2.16 Avoids using jargon or clarifies jargon	0.833
2.1EE I would expect the student to clean their stethoscope in the presence of the patient	0.633
2.2EE Explains auscultation gives insight into how breathing/lungs sound and compare to normal	0.833
2.3EE Explains auscultation determines if there are any problems that physio can help	0.633
2.4EE Explicit conversation of how therapist is to navigate/manage breast tissue	0.833
2.5EE Patient asked to take normal, comfortable breaths then for deep breaths	1
2.6EE Right to left, left to right technique used to compare sides	1
2.7EE Auscultates anterior apices	1
2.8EE Auscultates anterior mid zones	0.917
2.9EE Auscultates anterior right base	0.917
2.10EE Auscultates lateral mid zone	0.917
2.11EE Auscultates posterior apice	0.917
2.12EE Explains what was heard and what it means for treatment to patient	0.917

3: Breathing Control Statements	iCVI
3.1 Explains BC aims to help relax the patient, focus attention on quiet breathing, rib cage movement and relaxed airflow	1
3.2 Advises patient to let the student know if they experience pain/light headedness of dizziness/discomfort	1
3.3 Ensures the patient is in a comfortable, supported position	1
3.4 Consent to place hand on patients abdomen	0.917
3.5 hand placed on patients abdomen, below the sternum but above the umbilicus	0.833
3.6 Patient encouraged to breath in a manner that is comfortable for them	1
3.7 Performs active listening during the technique	0.917
3.8 Uses a soft tone to encourage maximal relaxation and control	1
3.9 Instructions succinct and kept to a minimum	1
3.10 Positions self to ensure back care	0.917
3.11 Positions self with consideration of the patients personal space	0.917
3.12 Avoids using jargon or clarifies jargon	0.917
3.13 Overtly asks the patient about their status ie if they are OK	0.833
3.1EE Encourages patient to focus efforts to breath gently/quietly, relax in lower chest	1
3.2EE Encourages patient to allow their abdominal wall to move forward with each breath	0.633
3.3EE Encourages patient to relax their shoulders on expiration	0.833
3.4EE Encourages patient to minimize effort and upper chest/accessory muscle activity	1
3.5EE Encourages patient not to worry about rate or depth of breathing	0.633
3.6EE Encourages patient to focus attention on breathing and where movement is occurring	0.833
3.7EE Stands close to patient	0.75
3.8EE If patient struggles with BC considers other hand positions eg hand on sternum + abdomen or hand on upper trapezius	0.833

4: Thoracic Expansion Exercises Statements	iCVI
4.1 Explains TEE used to prevent or treat reduced lung volume	1
4.2 patient positioned/repositioned appropriately to their needs	1
4.3 Consent gained to place hands on thoracic wall	1
4.4 Patient asked to focus on increasing depth of the breath in ie maximal breath	1
4.5 Explains inspiration should be slow and comfortable rather than short and sharp	0.917
4.6 Reminds patient to let the student know if they experience pain/light headedness of dizziness/discomfort	1
4.7 Positions self to ensure back care	0.917
4.8 Avoids jargon or clarifies jargon	0.833
4.9 Overtly asks the patient about their status ie if they are OK	0.833
4.1EE Explains TEE are used to prevent lung complications post-surgery (when appropriate)	0.833
4.2EE Explains TEE are used to move secretions (when appropriate)	0.917
4.3EE Encourages patient to try to keep shoulders and neck relaxed	1
4.4EE Performs sets of 3-4 breaths	1
4.5EE Appropriately positions hands with palms on lateral chest wall between ribs 6-10	0.833
4.6EE Provides proprioceptive input from hands on chest to provide feedback	0.917
4.7EE Provides encouragement/feedback on depth of breath (aiming for TLC)	1
4.8EE Provides encouragement/feedback on speed/flow (not fast gulping air but slow controlled basal expansion)	0.833
4.9EE Uses sustained maximal holds/inspiratory hold as appropriate	1
4.10EE Uses sniffs at maximal inspiratory hold as appropriate	0.633

5: Forced Expiratory Technique Statements	iCVI
5.1 Explains FET is a forced expiratory effort designed to increase airflow within the airways and help move secretions to the mouth	0.917
5.2 Instructs the patient to force air out through an open mouth	1
5.3 Reminds patient to let the student know if they experience pain/light headedness of dizziness/discomfort	0.833
5.4 Consent gained to try technique	1
5.5 Provides verbal explanation and demonstration	1
5.6 Provides feedback/guidance about volume of inspiration	0.917
5.7 Provides feedback about the force and duration of expiratory phase	0.917
5.8 Feedback, as required, about keeping mouth and glottis open	1
5.9 Avoids using jargon or clarifies jargon	0.917
5.10 Positions self with consideration of patients person space	0.917
5.11 Positions self to ensure back care	0.917
5.12 overtly asks the patient about their status ie if they are OK	0.833
5.1EE Explains will move secretions from further out than a cough	0.917
5.2EE Explains 3 different volumes of breath may be used, small/medium/large	0.833
5.3EE If relevant explains FET can be less painful than a cough	1
5.4EE Explains the approach of low to mid to large volume hugs depending on when secretions heard on expiration	1
5.5EE Ensures slow, relaxed inspiration to desired lung volume	0.917
5.6EE requires patient to keep back of throat open	0.917
5.7EE Emphasises patient needs to use a short sharp huff out	0.833
5.8EE Explains like fogging up a mirror	0.917

6: Percussion Statements	iCVI
6.1 Explains it is rhythmical clapping of the chest wall applied by a cupped hand through towel	0.917
6.2 Consent to perform technique	0.917
6.3 Reminds patient to let the student know if they experience pain/light headedness of dizziness/discomfort	0.917
6.4 Positions/repositions appropriate to their needs for sputum drainage	0.917
6.5 Appropriate layer of towel/padding over chest area to be percussed	0.833
6.6 Hand cupped to generate hollow sound	0.917
6.7 Positions self to ensure back care	0.917
6.8 Positions self with consideration of patients personal space	0.833
6.9 Overtly asks the patient about their status ie if they are OK	0.917
6.1EE Explains the rhythmical force wave may assist the movement of secretions towards the mouth where it can be expectorated	0.833
6.2EE Ensures relaxed write but firm hand	0.833
6.3EE Uses rhythmical rate	0.833
6.4EE Technique applied for between 30sec-2mins	0.75

7: Vibration Statements	iCVI
7.1 Explains vibrations move secretions to larger airways and make it easier to cough up	1
7.2 Consent to perform technique	1
7.3 Reminds patient to let the student know if they experience pain/light headedness of dizziness/discomfort	1
7.4 Explains they will place their hands on patients ribs over the secretions	0.917
7.5 Advises patient they will perform small oscillations on expiration while also gently compressing chest wall with their hands	1
7.6 Applies compression to chest wall	1
7.7 Applies vibration on expiration	1
7.8 Ensures bed height low enough to allow use of body weight not arms	1
7.9 Optimises wrist position and ability to maintain technique for required duration	0.917
7.10 Avoids using jargon or clarifies jargon	0.917
7.11 Positions self to ensure back care	1
7.12 Positions self with consideration of patients personal space	0.917
7.13 Overtly asks the patient about their status ie if they are OK	0.917
7.1EE Explains vibration will help dislodge and mobilize secretions	1
7.2EE Explains vibration moves secretions to larger airways and makes it easier to expectorate	1
7.3EE Advise the vibrations may cause the patient to cough	1
7.4EE Should give warning that vibrations will be applied	1
7.5EE Applies even pressure through both hands	1
7.6EE Uses small, high frequency oscillations	1
7.7EE Ensures hands on skin and not skin rubbing	1
7.8EE Applies adequate expiratory overpressure intensity to increase expiratory flow	0.833
7.9 EE Ensures pressure is applied at the start of expiration	0.833
7.10EE Ensures close observation and modification of technique for fatigue and discomfort of joints	1

EE = Exceeds expectations