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Journal of the Association of Chartered Physiotherapists in Respiratory Care

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Editorial

Editorial

Amy Bendall, Owen Gustafson

Journal of the Association of Chartered Physiotherapists in Respiratory Care

We are delighted to bring you Volume 56, Issue 1 for the *Journal of the Association of Chartered Physiotherapists in Respiratory Care*.

You may have noticed that this issue looks different to our previous publications, and this is because it is the first time we have used the Scholastica platform for production. We are really pleased with the new-look Journal, and we hope that you agree – we'd love to hear what you think of it too!

You may have read in a recent newsletter that we have moved to also using the Scholastica platform to improve the peer review process for both authors and reviewers. In time, we are also looking forward to being able to use this platform to provide key metrics on the Journal's performance such as time sent to peer review, article acceptance and publication. In addition, the Journal is now accepting submissions throughout the year, and we will continue to publish two issues of the Journal each year in Spring and Autumn. We also have more exciting plans to come over the next twelve months including applying for the Journal to become a member of COPE (Committee on Publishing Ethics) and piloting an editorial internship. Please do keep an eye out in future newsletters – we look forward to sharing details with you soon.

This issue opens with an article by Jones et al. that reports on a feasibility study investigating the use of a thigh-worn accelerometer to measure physical activity in patients recovering from critical illness. A study by Balls et al. reports on the use of ventilator hyperinflation in paediatric critical care in the UK and Ireland. There is also a qualitative study exploring physiotherapists experiences in delivering care remotely to adults with Cystic Fibrosis in the UK during the pandemic and a further study by Che et al. that considers what is the minimal clinically important difference in the one-minute sit to stand test during remote interventions.

There are also two articles from the ACPRC board with Allaina Eden leading on a review synthesis from the surgery scoping reviews and a scoping review on simulation-based education within respiratory physiotherapy training led by Stephanie Mansell. The issue also includes an article by King et al. which considers physiotherapy led research in critical care from across different roles and perspectives and a further article by Willigen et al. which depicts the challenges of defining 'safe staffing' for physiotherapists in critical care.

In the New Year, there will be also some changes to the Journal Editor team with Amy Bendall finishing her term on the committee and Liz King joining as co-editor working alongside Owen. We wish Liz all the very best in her new role and the committee looks forward to welcoming her on board.

Please remember that we also provide members with support through the research champion (research@acprc.org.uk), and as editors, we are very happy to discuss any potential article ideas with you too – please do get in touch: Journal@acrpc.org.uk

Amy Bendall and Owen Gustafson

Jones L, Swingwood E, Shannon H. A feasibility study investigating the use of a thigh-worn accelerometer to measure physical activity in patients recovering from critical illness. *ACPRC Journal*.:3-8. doi:10.56792/RIHA6466

Critical care

A feasibility study investigating the use of a thigh-worn accelerometer to measure physical activity in patients recovering from critical illness

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Keywords: critical care, activity, measurement

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Journal of the Association of Chartered Physiotherapists in Respiratory Care

Background

Rehabilitation of patients recovering from critical illness has been a focus of clinical research, however heterogeneity exists in the measurement of physical recovery. Wearable technology offers a simple, unobtrusive method of continuous activity monitoring. However, studies have reported issues with placement of wrist and ankle devices in critically ill patients.

Aim

To evaluate the feasibility of a thigh-worn accelerometer to measure the physical activity of patients recovering from critical illness.

Methods

A prospective observational feasibility study was conducted within a 33-bedded critical care unit over nine weeks. Thigh-worn activPAL^{TM} accelerometers were applied to patients for the duration of their critical care admission.

Results

A total of 12 participants were recruited. Median (IQR) device wear time was 268.35 (299.15) hours or 99.58% of their critical care admission. A priori feasibility success criteria of three days of wear time for more than ten hours were achieved in every participant. Device removal primarily occurred for recharging.

Conclusion

The practical application of a thigh-worn accelerometer may be feasible in this population for the duration of admission. As this was a small, single centre study additional research is necessary to further inform and determine the feasibility of this device.

INTRODUCTION

The consequences of critical illness are multifaceted, and can include significant physical deconditioning, acquired weakness and reduced functional capacity.[1] Physical activity is advocated for survivors of critical illness, initiated early in their critical care stay,[2] although currently there is little agreement regarding the optimum frequency and type of interventions.[3] Outcome measures largely focus on specific functional milestones that are not necessarily representative of the patient's consistent level of function.[4] As an alternative, measurements of overall physical activity beyond rehabilitation sessions, could facilitate a more accurate representation of a patient's recovery trajectory[5] and provide more meaningful data in order to tailor rehabilitation interventions.[6]

Wearable technology provides a simple, unobtrusive and objective approach to continuous activity monitoring.[7] Wearable devices for activity monitoring take many forms, measuring different variables to capture both physiological and activity data.[8] They provide continuous data regarding activity, without any additional effort from the patient or staff. Wearable device application during critical illness poses unique challenges with various aspects of feasibility discussed in the literature such as wear time, comfort, adverse events and ease of data interpretation.[4,9,10] Wrist and ankle devices are common, however these may not be appropriate for patients during critical illness who are administered medications and invasively monitored using their limbs. Limb oedema, line insertions and dressings

have been identified as complications associated with use in this population.[4,9,10] An alternative is a thigh-worn device, which has been examined within inpatient populations but not within critical care.[11] These devices can distinguish between lying/sitting and standing postures, which is of significance in the investigation of sedentary behaviours and low-level rehabilitation.[12] These devices provide objective activity data capturing acceleration and thigh position information, generating a near continuous picture of patient position and activity unable to be measured using subjective methods.

Investigation of feasible activity measurement tools in this population could provide valuable information for researchers and clinicians, and is currently lacking.[7] To date, studies have only captured data over relatively short periods of time. Consequently, it is unclear if wearable devices are a feasible data collection tool throughout critical care admission. This should be examined due to the unique challenges posed in this environment. Although arm and ankle devices have been studied to some extent within critical care,[4,9,10,13] no study has examined the feasibility of a thigh-worn device as an alternative.

AIM

This study aimed to investigate the feasibility of using a thigh worn accelerometer to measure physical activity levels of patients recovering from critical illness whilst in critical care.

METHODS

APPROVALS

The study was approved by the Wales Research Ethics Committee 3 (reference: 18/WA/0086) (IRAS: 238464). Both University College London (UCL) Joint Research Office (ID:18IR06) and Cardiff and Vale Research and Development office (ID:7237) reviewed this study and gave their approval. The study was registered with UCL data protection (reference: Z6364106/2018/02/52) prior to data collection.

PARTICIPANTS

This feasibility study was a single-centre, prospective observational study. It was conducted within the 33-bed critical-care unit at University Hospital of Wales, Cardiff; a tertiary referral centre with a case mix of general medical, surgical, neurosurgical and trauma patients. Screening of potential participants was completed through routine daily reviews of new patients admitted to the unit. Inclusion and exclusion criteria are summarised in Table 1.

With the exception of age, pre-existing neuromuscular disease and unable to wear the activPAL^{TM}, the exclusion criteria were the same criteria used by the physiotherapy team to decide if a patient was appropriate for rehabilitation input. Determining if a patient was at risk of physical morbidity according to NICE[14] guidelines was completed using the short clinical assessment tool within the guidelines. Patients 'at risk' were included as their length of admission was likely to be longer, therefore allowing comprehensive assessment of the device.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Age ≥18 years 2. 'At risk' of physical morbidity as determined by NICE (2009) guidelines 3. Advice from consultee for participation and patient re-consent if appropriate for continuing participation	1. Age < 18 years 2. Expected to die during admission 3. Unable to obtain consent/ advice 4. Pre-existing neuromuscular disease 5. Unable to wear device 6. Open abdomen 7. Active neurological event requiring intervention 8. Acute spinal cord injury 9. Lower extremity fractures 10. Bedbound prior to admission

NICE = National Institute for Health and Care Excellence

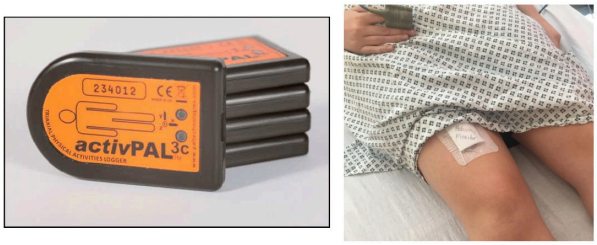

Figure 1. activPAL4^{TM} device and device in situ

INTERVENTION

The activPAL4^{TM} (PAL Technologies Limited) was the wearable device used in the study. This tri-axial accelerometer attaches to the thigh and records data in 15 second epochs. Using position and acceleration information it can differentiate between sitting/lying, standing and stepping. Step count is also recorded. Figure 1 shows the device and its position on the thigh.

The device was applied within 48 hours of admission to allow comprehensive evaluation of device feasibility at all stages of the critical care stay. Participants were not required to do anything different to their usual care apart from wearing the activPAL^{TM} device on their thigh for the duration of their critical care admission. Nursing staff completed standardised data collection sheets during the day shift at the same time as routine observations to document the participant's activity during the preceding hour.

Raw data from the devices were downloaded into Microsoft Excel^{TM} [version 16.13.1] and exported to IBM SPSS^{TM} [version 22] for analysis. As there was no hypothesis testing, no statistical tests were performed. Feasibility included successful recruitment and retention of participants, wear time (downloaded from the device), number of adverse events (as reported in the medical notes), reasons

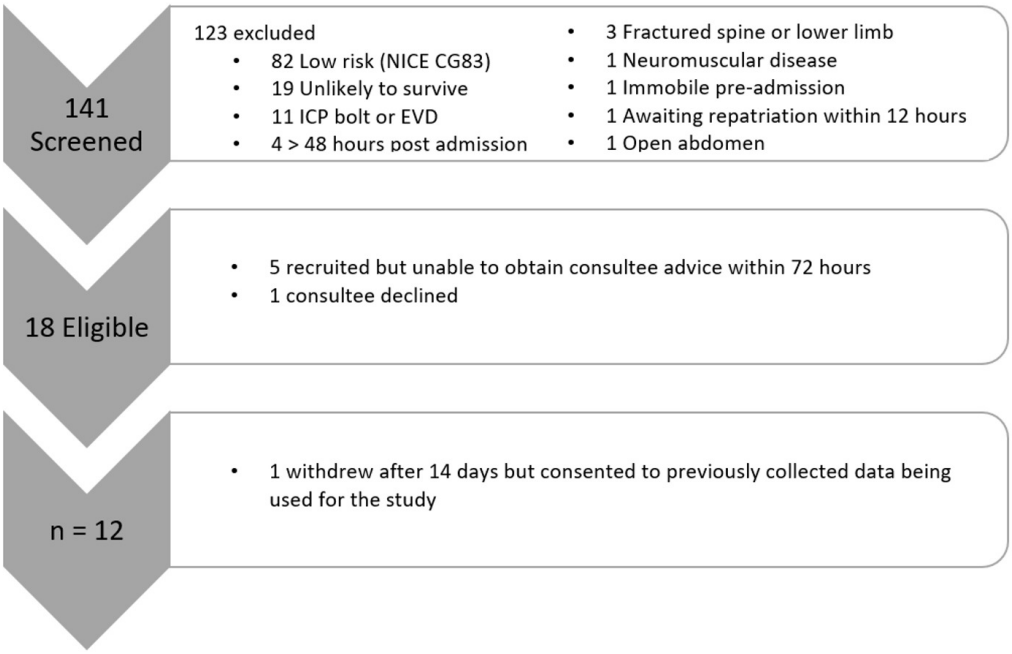

Figure 2. Recruitment flow chart

EVD = external ventricular drain, ICP = intracranial pressure, NICE CG83 = National Institute of Health and Care Excellence clinical guideline 83

for device removal and percentage agreement between device-recorded and nurse-observed activity. Feasibility outcomes were compared against a-priori criteria for success. They were based on data from previous studies and the recommended data needed for analysis of physical activity.[15, 16] A wear time of ten hours per day and at least three days of data were considered as the criteria for feasibility success.

RESULTS

Data were collected between April and June 2018. Of 141 patients screened for participation, 12 were successfully recruited (Figure 2). One device was removed during preparation for discharge and lost, therefore no data were available. Analysis is based on 11 participants.

The demographic characteristics of the sample are displayed in Table 2. Due to the small sample size, non-parametric summaries were calculated.

WEAR TIME

The median (IQR) duration of device wear time was 268.34 (299.15) hours. This equated to a median (IQR) percentage wear time of 99.58% (5.69) of critical care admission. Adequate wear time was achieved for every participant (Figure 3). In total, there were nine days in which sufficient wear time was not reached. Initial application of the device late in the day was responsible for six of these days.

No adverse events occurred. In total devices were removed on nine separate occasions, most commonly for recharging (n=3). Reasons for unplanned device removal (n=6) included imaging procedures, surgery and independent removal secondary to agitation. One device was removed from a participant before they were placed in a prone position. Additionally, it was noted that some activity was recorded in participants who were sedated and not moving.

Table 2. Sample demographics

Demographic characteristics	
Gender, n (%)	
Female	9 (75)
Male	3 (25)
Age (years), median (IQR)	56.67 (14.33)
APACHE II score, median (IQR)	23.50 (11.75)
Ventilation status, n (%)	
Mechanically ventilated	12 (100)
Admitting diagnosis, n (%)	
Respiratory failure	4 (33.3)
OOHCA	3 (25)
Seizures	2 (16.7)
Pneumonia	1 (8.3)
Urosepsis	1 (8.3)
VATS	1 (8.3)
Ventilated days, median (IQR)	9.00 (6.75)
Critical care LOS (days), median (IQR)	11.79 (10.62)

APACHE II = acute physiology and chronic health evaluation 2, IQR = interquartile range, LOS = length of stay, OOHCA = out of hospital cardiac arrest, VATS = video-assisted thoracoscopic surgery

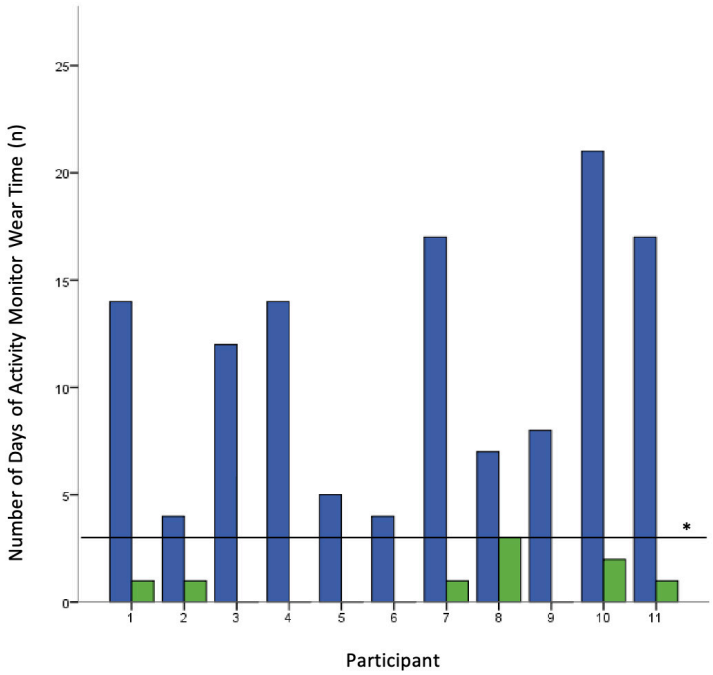

Figure 3. Bar chart showing number of days device wear above and below 10 hours

* Line represents a priori feasibility success criteria of 3 days
Blue bar = Days above 10 hours wear time
Green bar = Days below 10 hours wear time
Adverse events and device removals

DISCUSSION

This study aimed to investigate the feasibility of using a thigh worn accelerometer to measure physical activity levels of patients recovering from critical illness during critical care admission. To the author's knowledge this was the first study to specifically investigate this, adding to the current literature regarding wearable technology use in this population. The key findings were that device wear time satisfied a-priori feasibility criteria, no adverse events occurred and device removal was required to allow recharging or a small range of procedures.

Results suggest that achieving a wear time of sufficient duration to estimate activity levels may be feasible in a select number of patients in critical care (8.5% of those screened for the study were recruited). Owing to time and resource constraints the inclusion and exclusion criteria allowed the researcher to focus the study on participants who would likely to be participating in active rehabilitation during the early phase of their critical care admission. Any future study design would need to allow inclusion of a wider range of participants for a more comprehensive evaluation in this population.

Wear time criteria were achieved for every participant, although there were days when ten hours of wear time was not reached. Unplanned removals were only responsible for three of these occasions. Circumstances demanding device removal are unavoidable in critically ill patients who may require scans and surgery as part of their care. However, these did not significantly impact overall wear time as devices remained in situ for 99.58% of the time. Two previous studies evaluated device wear time in a critical care population. Beach et al.[9] and Kamdar et al.[4] reported a mean (SD) wear time of 4.4 (0.8) days and 46.5 (2.3) hours respectively equating to 97% wear time. As wear time in the current study was measured throughout admission, a longer median (IQR) wear time of 268.34 (299.15) hours was achieved. As the devices remained in situ throughout admission, the effect of short periods of removal on overall wear time were less potent.

In agreement with previous studies, no adverse events were reported, supporting the safety of device use within critical care.[4,9,10,13] In critical illness survivors, removal of limb-worn devices due to oedema has been reported.[5] This was not an issue for the activPAL^{TM}, which was applied to participants with different sized legs without needing to adjust the fit of the device. There were no requirements for the device to be moved for insertion of lines during the study as previously described.[4,9,10] The number of purposeful device removals was higher than previously reported for wrist and ankle devices in a critical care population. This is likely a reflection of the longer data collection phase for the current study. Participants were excluded from one study if they required any procedures necessitating device removal.[4] The current study may provide a more representative evaluation of instances during critical illness that impact upon the ability to wear an activity monitor.

Although not directly related to the study's primary aim, it was noted that as only a single device was used, distinguishing between sitting and lying positions was not possible, and on two occasions activity was detected in a partic-

ipant who was sedated. Sitting may form a significant part of a patient's rehabilitation and represent improvement in their recovery, therefore identification of both positions would be an important distinction to make. Occasions when activity was identified by the device while the patients were fully sedated require further investigation and raise concerns regarding its validity.

One important limitation of this study was the small sample size, which was primarily a result of time constraints. Reduced resources meant screening of 48 potential participants was not possible. Consequently, the sample was less likely to be representative of the population. As this was a single-centre study, external validity is reduced and results cannot be generalised to the wider critical care population.[17] Only a single thigh-worn device was employed, therefore no robust conclusions can be made about the feasibility of similar devices. In addition, qualitative aspects of feasibility were not investigated. This would have provided a more comprehensive evaluation of the device in this unique population and is an area for further research.

CONCLUSION

This study offers some preliminary information to researchers and clinicians seeking to utilise wearable devices to monitor physical activity in patients recovering from critical illness. Results suggest the practical application of this device is feasible throughout critical care admission. Generalisability to the wider critical care population is reduced due to the small sample and single-centre design. Additional research is warranted to further investigate the validity of this device in these patients and explore the feasibility of such devices to inform the rehabilitation of patients recovering from critical illness.

Key points

1. The activPAL^{TM} accelerometer appears feasible to use with patients recovering from critical illness.
2. The lack of ability to distinguish between lying and sitting may limit its use within a critical care population.
3. Areas for further research, including validity of the activPAL^{TM} in this population have been highlighted.

FUNDING

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ACKNOWLEDGEMENTS

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Balls J, Shannon H. Ventilator hyperinflation in paediatric critical care: a survey of current physiotherapy practice in the United Kingdom and Ireland. *ACPRC Journal*.:10-18. doi:10.56792/GRWE1249

Paediatrics

Ventilator hyperinflation in paediatric critical care: a survey of current physiotherapy practice in the United Kingdom and Ireland

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Keywords: Ventilator hyperinflation, Manual hyperinflation, Paediatric, Physiotherapy

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Journal of the Association of Chartered Physiotherapists in Respiratory Care

Introduction

Physiotherapists in paediatric intensive care units (PICUs) use a variety of techniques to remove retained bronchopulmonary secretions and improve work of breathing in children who are mechanically ventilated. Ventilator hyperinflation (VHI) is commonly used in adults to aid secretion removal without disrupting the integrity of the ventilatory circuit. This study aimed to identify current practice of VHI within paediatrics in the United Kingdom (UK) and Ireland.

Methods

A survey was designed and distributed via email to senior physiotherapists in all 22 PICUs across the UK and Ireland. Physiotherapists working in adult critical care were excluded. Responses were analysed via descriptive statistics, with content analysis used for free text open questions.

Results

Twenty-nine surveys were completed, of which 17 individuals (58%) indicated that they used VHI. VHI was used infrequently (commonly less than once per month, N=13 76.5%) and techniques were generally taught at the bedspace by senior colleagues. Indications for using VHI rather than manual hyperinflations included concerns over de-recruitment on disconnection from the ventilator (N=11, 64.8%), patients with COVID-19 and those with a high respiratory infection risk (N=8, 47%). Approaches to applying VHI varied, with target peak inspiratory pressures between 28cmH_2O and 42cmH_2O.

Conclusion

The survey responses returned suggest that the use of VHI in PICU is infrequent, with no standard approach to its use. However, response rate is unknown owing to survey distribution method. There appear to be some occasions where respondents would choose VHI over manual hyperinflations and further research is needed to explore these further.

INTRODUCTION

Physiotherapists are an integral part of the multi-disciplinary team within the Paediatric Intensive Care Unit (PICU). Children are admitted to PICU following life-saving interventions such as surgery, anaesthesia, sedation and invasive mechanical ventilation. Although these can be vital for survival, they may be accompanied by negative secondary effects such as reduced natural cough reflex, partial or total alveolar collapse (atelectasis), inability to clear secretions and abnormal gas exchange. The role of the physiotherapist in PICU is to address the negative effects of prolonged immobility and to remove retained bronchopulmonary secretions, reducing airway resistance and improving work of breathing.[1] Various techniques may be utilised, including manual hyperinflation (MHI), chest wall vibrations, instillation of saline and suctioning.[2]

The use of MHI is reported in many chest physiotherapy studies and typically involve delivering a low flow, large volume inspiratory breath with a brief inspiratory hold followed by a quick release of the bag to enhance peak expiratory flow.[3] The process requires disconnection of the patient from the ventilator circuit, which can cause loss of peak end expiratory pressure and potentially poses a risk from airborne infections.[4]

An alternative technique of ventilator hyperinflation (VHI) is frequently utilised in adult intensive care units.[5] Ventilator settings are manipulated to aid secretion clearance via an increase in peak inspiratory flow to peak expiratory flow ratio (PIF:PEF). No disconnection is required, thereby potentially reducing the risks associated with MHI.

Despite these documented benefits, MHI is still the most frequently utilised technique by physiotherapists in PICU.[3]

To the author's knowledge, there has been no published research investigating the physiological effects of VHI and subsequent recommendations for its use within a paediatric population are lacking. The COVID-19 pandemic required a swift response to minimise the risk of airborne infection from ventilated patients. Anecdotally, paediatric critical care physiotherapists quickly adapted VHI recommendations from adult studies and implemented them within their PICU. This study aimed to explore the current use of VHI within PICUs in the UK and Ireland, including the training received and implementation of use. The objectives were:

- Investigate the practice of VHI in PICU's across the UK and Ireland
- Determine the frequency and clinical reasoning for VHI use
- Explore the education and preferred technique for VHI.

METHODS

PERMISSIONS AND APPROVALS

The study was registered as a service evaluation (005431) at the primary author's place of work.

SURVEY DEVELOPMENT

A survey was developed based on a previous adult VHI survey by Hayes et al,[6] which had utilised experts in the field and previous surveys to ensure face, content and construct validity. The survey was adapted with permission of the authors to include specific questions relevant to the paediatric population. A pilot study was undertaken with four paediatric physiotherapists, one working in clinical academia and three working in paediatric intensive care who used VHI within their practice. Following feedback, minor amendments were made with additional demographic and clinical questions added. The final 27-item survey contained both closed and open-ended questions and was transcribed for electronic use via Google forms (see Appendix). Key domains included frequency of use, presence of a protocol, indications and contraindications, clinical decision making, choice of technique and outcome measures.

SAMPLE

Inclusion criteria were qualified physiotherapists, of any level of clinical experience, currently working in a paediatric intensive care unit in the United Kingdom or Ireland. Exclusion criteria were physiotherapy staff working solely in adult intensive care.

DATA COLLECTION

The author obtained details of all 22 PICUs within the UK and Ireland via the PICANet database.[7] In April 2022, a named senior physiotherapist (Agenda for Change Band 7 or above) was contacted directly via email under the "legitimate interest" section of the General Data Protection Regulation. An explanation of the survey, including management of the data, was included alongside a link for survey completion. The physiotherapist was asked to share the survey with other physiotherapy team members within their department to ensure that different perspectives and experience levels could be explored. A weekly reminder was sent to the named senior physiotherapist for four weeks, when the survey link closed. Consent was implied by completion of the survey.

DATA ANALYSIS

All survey responses were inputted to Microsoft Excel for analysis and are detailed below. Demographic and quantitative responses were analysed via descriptive statistics and presented as means and standard deviations (or median and range as appropriate) as a measure of spread, alongside percentages. Open-ended questions, which provided free-text data, were analysed via content analysis. A coding framework was created by both authors collaboratively, based on the nature of the questions. Codes were assigned to the content independently by both authors, compared and discussed. Themes were identified.

RESULTS

DEMOGRAPHICS

Completed surveys were received from 29 respondents. Responses were received from all areas, except the North East and Northern Ireland. Due to the unknown potential number of respondents, a response rate could not be calculated. The physiotherapists who completed the survey had been working in a level 3 PICU, providing intensive and critical care, for a median of 6-10 years, ranging from less than two years to greater than 20 years (Table 1). The mean (SD) number of PICU beds on their units was 18 (5.8).

USE OF VHI IN PICU

Seventeen (58.6%) individuals used VHI within their practice, with band 7 (highly specialist) physiotherapists being the most likely to undertake the intervention (100%). Eight respondents (27.6%) did not currently use VHI but were interested in using it in the future. The following results are from the 17 individuals using VHI, all 27 items are represented and there was no missing data for any question. The frequency with which VHI is utilised in PICU was low, with 23.5% (n=4) of those who used VHI using it less than once per week and the majority (n=13, 76.5%) using VHI less than once per month. Of those who used VHI, the majority of respondents (n=13, 76.5%) were able to apply the technique without the need for additional medical approval. Seven respondents (41.2%) stated that they used a paediatric protocol to guide their practice, one (5.9%) followed an adult protocol and nine (52.9%) did not utilise a VHI protocol.

Table 1. Demographics of respondents

Demographic information (N=29)		N (%)
Years qualified as a physiotherapist	0-2	1 (3.4)
	3-5	4 (13.8)
	6-10	8 (27.6)
	11-15	6 (20.7)
	16-20	3 (10.3)
	>20	7 (24.1)
Years of paediatric ICU experience	0-2	6 (20.7)
	3-5	4 (13.8)
	6-10	7 (24.1)
	11-15	7 (24.1)
	16-20	1 (3.4)
	>20	4 (13.8)
Highest level of qualification	Diploma of Physiotherapy	2 (6.9)
	Bachelor of Physiotherapy / Graduate entry Masters in Physiotherapy	23 (79.3)
	Post graduate Diploma	1 (3.4)
	Postgraduate Masters degree	3 (10.3)
	PhD / Doctorate of Physiotherapy	0 (0)
Geographical location	East Anglia	1 (3.4)
	East Midlands	1 (3.4)
	Greater London	11 (37.9)
	Ireland	1 (3.4)
	North East	0 (0)
	Northern Ireland	0 (0)
	North West	6 (20.7)
	Scotland	1 (3.4)
	South East	2 (6.9)
	South West	2 (6.9)
	Wales	1 (3.4)
	West Midlands	2 (6.9)
	Yorkshire and the Humber	1 (3.4)

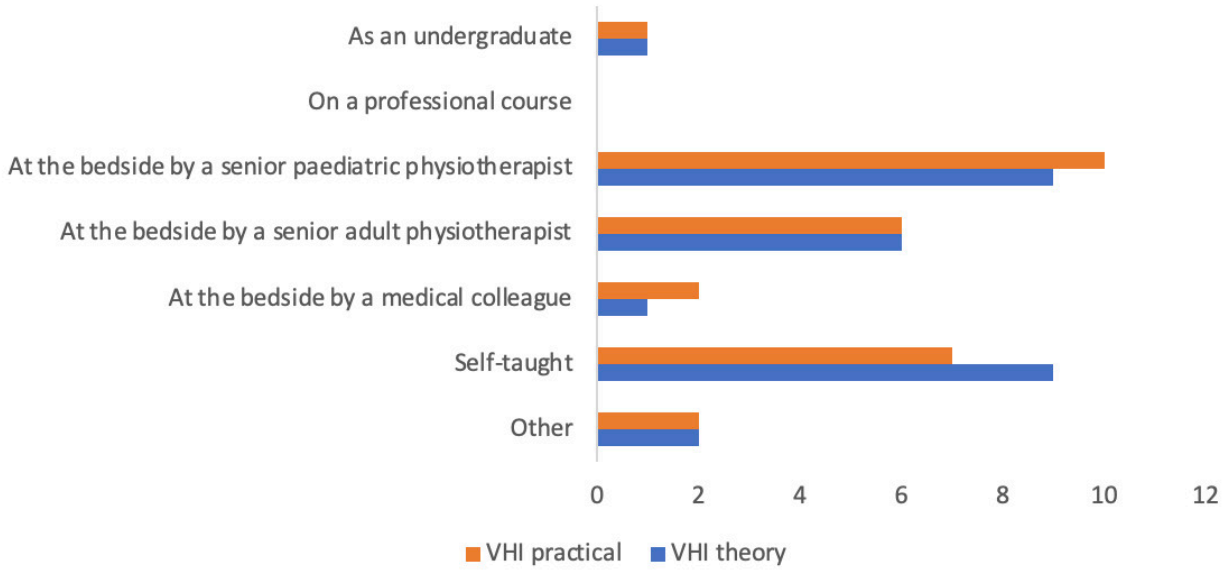

Figure 1. Responses to the question, "where did you learn the practical and theoretical technique of VHI?"

Regarding VHI training, one physiotherapist was taught the theoretical and practical aspects of VHI as an undergraduate whilst the majority were taught either at the bedside by a senior physiotherapist or were self-taught (Figure 1).

Respondents were asked to consider their own practice and state when they would choose to undertake VHI rather than MHI, which is the more commonly used intervention in PICU (Table 2, Figure 2).

Table 2. Main indications and contraindications for VHI

Main indications for VHI	Number	Main contraindications for VHI	Number
Poor tolerance to disconnection	11 (64.8%)	Undrained pneumothorax	14 (82.4%)
High risk of de-recruitment	11 (64.8%)	Significant cardiovascular instability	8 (47%)
High ventilation pressures	10 (58.8%)	Bullae / surgical emphysema	6 (35.3%)
Infection control	8 (47%)	High peak airway pressures	4 (23.5%)

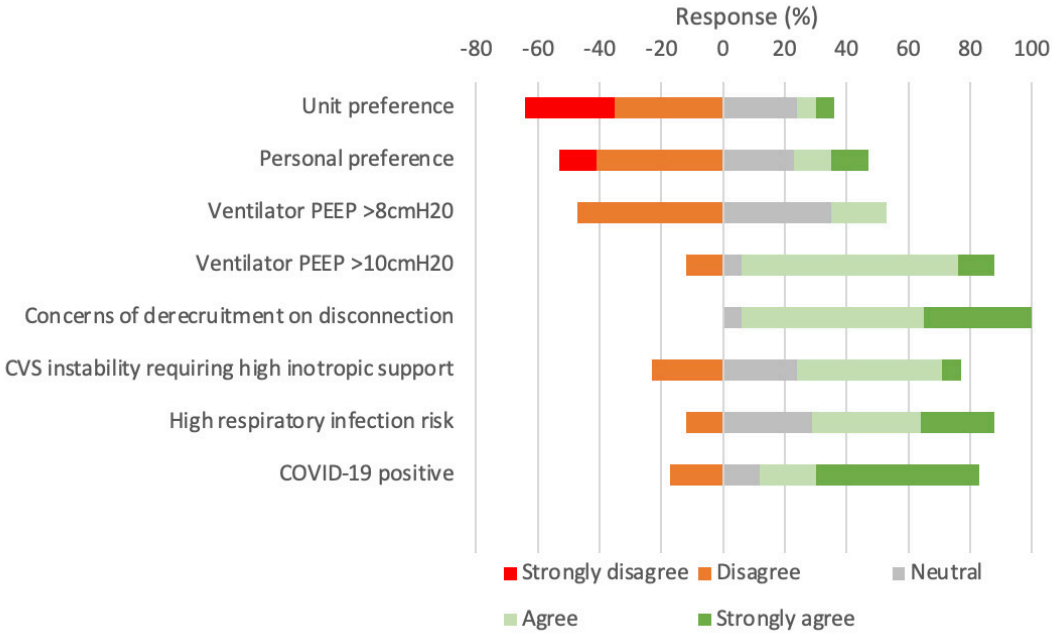

Figure 2. Responses to the question, "to what extent do the following factors influence your decision to use VHI?"

TECHNIQUE

One respondent routinely requested pharmacological paralysis for their patients prior to undertaking VHI (n=1, 5.9%). Four main ventilation modes were commonly used during VHI; synchronised intermittent mandatory ventilation (SIMV) pressure control (n=11, 64.7%), SIMV volume control (n=10, 58.8%), pressure regulated volume control (n=10, 58.8%) and bi-level mode (n=8, 47.1%). Three individuals (17.6%) used VHI during continuous positive airway pressure (CPAP) and pressure support modes.

In preparation for VHI, respondents variously stated that they would calculate target tidal volume, agree maximal peak airway pressure, adjust ventilator alarm limits and reduce respiratory rate to maintain minute ventilation. Adjusting the inspiratory time was mentioned by two individuals (11.8%). The majority of respondents (n=14, 82.4%) stated that they would position the patient according to their assessment findings and subsequent treatment aims. Four respondents (23.5%) advised that they would use position changes during the treatment session if the patient was able to tolerate it. A maximum peak inspiratory pressure was identified by eight individuals, which ranged between 28cmH_2O to 42 cmH_2O. The most common responses were 30cmH_2O (n=3, 37.5%) and 40cmH_2O (n=3, 37.5%).

During an average treatment session with VHI, either three to four hyperinflation breaths were delivered to the patient (n=10, 58.8%), or five to ten hyperinflation breaths (n=4, 23.5%) per set. The majority of individuals stated that they would repeat each set of hyperinflation breaths three to four times (n=14, 83.4%). Table 3 documents the individual responses regarding VHI technique with answers grouped using content analysis.

The commonest outcome measures used to assess the effectiveness of the treatment was a change in tidal volume (n=13, 76.5%) or a change in auscultation findings (n=13, 76.5%).

DISCUSSION

The use of VHI in PICU's in the UK and Ireland appears low, with high variability in the technique. Of the 29 physiotherapists who responded to the survey, 17 stated that they utilised the technique, with the majority (n=13, 76.5%) using it less than once per month. Training and skill acqui-

Table 3. Responses to the question, "how would you most commonly perform VHI?"

	Ventilation	Pressure	Volume	Inspiratory hold	Duration of each cycle	Additional information
1						Patient specific
2	<10kgs SIMV PC set RR, set i time	Set PIP to 20% above delivered PIP			1 minute, return settings to baseline	
2	>10kgs SIMV VC set RR, set i time		Gradually increase Vt by 10mls to target a peak pressure of 40cmH_2O		1 minute, return settings to baseline	
3		Increase PIP		Yes		Depends on situation
4			Increase Vt by 20%			
5		Increase PS/PC by 2 at a time to obtain 1.5x increase from baseline Vt	Aiming 1.5x increase from baseline Vt	Yes		Add manual techniques and manually assisted cough
6		Increase PC to achieve 20-50% increase in Vt dependent on starting pressures and chest wall compliance	Aiming 20-50% increase of Vt	3-5 seconds depending on age of child, followed by normal ventilator breaths x2		Vibrations on expiration
7						Depends on patient and stability. Use saline and vibrations as well if indicated
8		Increase PIP by 2cmH_2O until reach desired peak pressure			7-8 breaths with or without vibrations, return pressures and alarms to pre-treatment settings	Monitor minute ventilation and etCO_2 through-out to keep in target range
9	PC or Vt increased (no set amount) Rate decreased			Yes, used to increase frequency of breaths and increase i time		
10						No specific guidance, used with COVID adults
11					3 breaths	

	Ventilation	Pressure	Volume	Inspiratory hold	Duration of each cycle	Additional information
12	Only use pressure ventilation on our unit	Increase PIP to increase Vt by 50%. If PIP is already 38cmH_2O then preference is to increase inspiratory time to achieve more volume		Yes	10 breaths	Vibrations on expiration after inspiratory holds, inline suction with vibrations
13						Follow guidelines kindly shared by another PICU
14			Increase Vt to 1.25-1.5 times above baseline settings	Yes	Multiple inspiratory holds at higher tidal volume until secretions are felt more centrally	Expiratory vibrations after inspiratory hold if indicated. Suction
15		Alter ventilation to achieve desired Vt, including inspiratory time, respiratory rate and Vt		Yes, 2-3 secs		Return all settings to baseline and ask nursing staff to verify
16		Increase by increments of 2cmH_2O to achieve 50% increase in Vt from starting volume	If in pressure mode increase volumes by increments of 10% of starting volume to achieve Vt 50% greater than starting volume	Yes, length dependent on patient		Assess stability through-out, utilise flow loops to assess expiratory flow rate generated. Can use expiratory manual techniques in synch with VHI to increase expiratory flow rate
17		Increase PIP		Yes		

Key: <=less than, >=greater than, etCO_2=end tidal carbon dioxide, i time=inspiratory time, PC=pressure control, PIP=peak inspiratory pressure, PS=pressure support, RR=respiratory rate, SIMV=synchronised intermittent mandatory ventilation, VC=volume control, Vt=tidal volume, VHI=ventilator hyperinflation.

sition of VHI theory and technique was via teaching from senior physiotherapists, or by independent learning. This is comparable to a survey of VHI in adults by Hayes et al[6] which showed that 69% of individuals were taught the technique by a senior physiotherapist at the bedspace.

A recent systematic review of chest physiotherapy for mechanically ventilated children did not identify any studies which included VHI as part of a chest physiotherapy intervention.[3] Paediatric physiotherapists are therefore limited to the information found in adult literature and applying their knowledge regarding physiological differences between children and adults. VHI was first described in the literature in 2002[8] and there remains limited quality evidence of the effect of VHI in adults. A systematic review by Anderson et al[9] identified four studies and reported no significant differences between manual hyperinflation (MHI) and VHI with regard to cardiovascular stability, oxygenation, lung compliance and sputum weight.

Peak inspiratory pressure is a key safety consideration and children are at a higher risk of barotrauma and volutrauma than adults.[1] The range of PIP recommended by physiotherapists in this survey varied from 28cmH_2O to 42cmH_2O. In a randomised crossover study in 48 adults, Jacob et al[5] found that VHI with a peak pressure of 30-32cmH_2O yielded a significant increase in sputum weight compared to MHI (median 2.84g, IQR 1.81 to 4.22). Conversely, Linnane et al[10] used a higher PIP of 35 to 40 cmH_2O to compare the effects of MHI and VHI on restoring end-expiratory lung volume (EELV) after suctioning. This pilot study (N=10) used electrical impedence tomography to measure EELV and concluded that both MHI and VHI were effective, although post MHI the EELV declined within the first minute possibly due to disconnection of the MHI circuit from the ventilator. Studies in adult populations should be extrapolated to paediatrics with caution.

Whilst PIP is important when treating atelectasis, flow is an important factor to aid sputum clearance. In a laboratory study, Chapman et al.[11] report significant increases in sputum movement (2.42cm, 95% CI 1.59 to 3.94) when the inspiratory rise time was increased between 5% and 20% to achieve the optimal PIF:PEF ratio of 0.9. In this survey, only two individuals mentioned altering the inspiratory time during VHI but did not specifically mention the rise time.

Adult studies show no significant difference between MHI and VHI regarding cardiovascular stability, oxygenation and lung compliance. The safety profile must therefore be considered. MHI requires disconnection of the patient from the ventilator circuit with subsequent loss of peak end expiratory pressure (PEEP) and possibly end expiratory lung volume, alongside potential increased risk of airborne infections. Respondents from this survey identified loss of PEEP and infection control risk as primary indicators for using VHI although uptake of the technique remained low.

LIMITATIONS

Distribution of the survey was via email to a named senior physiotherapist of each PICU in the UK and Ireland. A request for the survey to be disseminated amongst all members of staff within each team means that a response rate could not be calculated. There is also a risk of response bias, in that only those interested in VHI may have completed the survey. Finally, there is a risk that responses were received from a higher proportion of physiotherapists from some larger hospitals, leading to local practices being over-represented.

CONCLUSION

This survey has identified that the use of VHI in PICU appears low, with a preference towards MHI. Application of the technique is varied, with some respondents utilising protocols to assist in their decision-making. Robust, quality research is needed to help physiotherapists make informed choices regarding the safety, efficacy and optimal technique of VHI in paediatrics.

Key points

- VHI is used infrequently by paediatric physiotherapist in PICU.
- Indications for using VHI over MHI include patients who are ventilated with a high peak end expiratory pressure (PEEP), where frequent disconnections from the ventilator could have a deleterious effect on the patient and concerns over infection risk.
- The way that VHI is applied, including manipulating rise time, volumes and pressures, varies between physiotherapists and is a key area for future research

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SUPPLEMENTARY MATERIALS

Appendix 1

Download: https://acprcjournal.scholasticahq.com/article/90181-ventilator-hyperinflation-in-paediatric-critical-care-a-survey-of-current-physiotherapy-practice-in-the-united-kingdom-and-ireland/attachment/187005.pdf?auth_token=gLeLpNnlmiPKETvD3mKk

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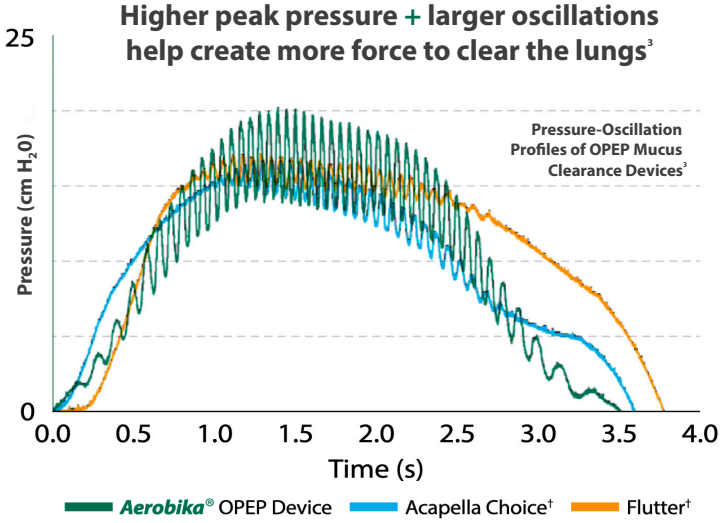

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1 GOLD 2023 Report. **2** Hill AT et al., British Thoracic Society Guideline for bronchiectasis. **3** Suggett, J. et al. CHEST 2017. **4** Van Fleet H, *et al*. Respiratory Care 2017;62(4):451-458.

Vasilopoulou A, Bendall A. Exploring physiotherapists' experiences in delivering care remotely to adults with Cystic Fibrosis during the COVID-19 pandemic in the United Kingdom. *ACPRC Journal*.:20-27. doi:10.56792/KHPR1321

Long term conditions

Exploring physiotherapists' experiences in delivering care remotely to adults with Cystic Fibrosis during the COVID-19 pandemic in the United Kingdom

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Keywords: Cystic Fibrosis, COVID, remote delivery, experiences

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Background

The COVID-19 pandemic resulted in a rapid change in physiotherapy service delivery for people with cystic fibrosis (CF), with the transition from face-to-face to remote provision. Experiences of physiotherapists working in CF at this time have not yet been reported.

Aim

To gain an insight into physiotherapists' experiences of delivering remote care to people with CF during COVID-19 and to consider how this may influence future care for people with CF.

Research question

What are physiotherapists' experiences in delivering care remotely to adults with CF during the COVID-19 pandemic in the United Kingdom?

Methodology

Qualitative, interpretive methodology was used to collect data via semi-structured interviews with three participants. Participants were recruited from across the United Kingdom (UK) via the professional networks. Interviews were completed on-line and were digitally recorded and transcribed verbatim. Respondent validation was completed prior to using Thematic Analysis.

Results

Participants had a mean of 20 years of experience working with adults with CF. Three main themes were identified (1) Delivering care in the pandemic; (2) Impact of pandemic on physiotherapists; (3) Post-pandemic future planning. Sub-themes were presented within these and supported by participant quotations.

Conclusion and Implications for practice

Physiotherapists working during the COVID-19 pandemic treating patients with CF experienced rapid changes to service delivery. Significant findings included the importance of a hybrid clinic, patient education and the need to screen patients for appropriateness of either virtual or in-person reviews. Areas suggested for future research include the use of remote assessment tools and the use of hybrid clinics.

INTRODUCTION

Control measures during the COVID-19 pandemic resulted in patients with chronic diseases and clinically extremely vulnerable populations, including those with Cystic Fibrosis (CF), needing to shield.[1] Physiotherapy for patients with CF is a mainstay of condition management.[2,3] During the pandemic, National Institute for Health and Care Excellence (NICE) guidelines[4] were remodelled and emphasised moving from face-to-face to remote delivery of care. Similarly, a publication on behalf of the European Cystic Fibrosis Society published during the pandemic encouraged patients to maintain good adherence to treatments at this time.[5] The way that health care professionals were required to deliver care remotely during the pandemic resulted in different physiotherapy approaches to condition management through using online means, such as videos, or telephone consultations.[6,7]

The literature has focused on the perspectives of patients and caregivers, emphasizing mostly how this popu-

lation coped with the restriction measures, the impact on mental health or the benefits and limitations of remote delivery as part of their care.[8,9] There are only a few studies on physiotherapists' experiences in delivering care during this time, including their role in the COVID-19 ward[10] or physiotherapy in the intensive unit care (ICU).[11] Exploration of physiotherapists' experiences who worked remotely with patients with CF during the pandemic remains unrepresented in the literature.

This study aims to explore, from the physiotherapists' perspectives, the changes to the physiotherapy approach and the barriers, enablers and challenges that were encountered from working remotely with adults with CF during the pandemic, and to consider how this may influence future care.

The research question asks: *What are physiotherapists' experiences in delivering care remotely to adults with Cystic Fibrosis during the COVID-19 pandemic in the United Kingdom?*

METHODS

STUDY DESIGN

A qualitative method was used and underpinned by an interpretive approach, which recognises the subjectivity of the researcher and views this of great value and integral to the analysis process.[12] One-to-one interviews were identified as a suitable method of data collection to explore sensitive issues such as the impact of the COVID-19 pandemic and to provide in-depth information on the topic.[13] Completing the interviews via an online platform were primarily chosen due to infection control measures in place but had secondary benefits of being cost effective and to enable greater accessibility for researcher and participant, which would also support in data being collected from across the UK. Semi-structured interviews were used as this was considered the most appropriate method to obtain valuable information and disclose previous unknown issues.[12] An interview topic guide based on the findings of the literature was used to structure the semi-structured nature of the interviews.[13]

PARTICIPANT SELECTION/RECRUITMENT

Participants were recruited via purposive sampling through the *Association of Chartered Physiotherapists in Respiratory Care* (ACPRC) using their social media channels. The names of people interested in participating were collated by the supervisor and then given to the researcher. Inclusion and exclusion criteria of participants listed in Table 1.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Excluding Criteria
Experience of more than two years of working in the speciality of adult CF.	Unable to partake in data collection via online means.
HCPC registered and working in the UK during the pandemic with CF patients.	
English speaking.	

Mason (2010)[14] recommended that a small sample size with a maximum number of 15 participants can be appropriate when the interviews include a specialist group of people on a chosen topic. It was, however, not possible to aim to recruit 15 participants from the outset due to the limits of a MSc project and time/recourse constraints. A small size of participants was considered more realistic and feasible.

DATA COLLECTION AND ANALYSIS

A pilot study was completed with one participant and as the questions did not need altering from the pilot to the main data collection, the data from the pilot study was included in analysis. In total, three participants were recruited and participated in this study.

The online interviews were completed using Zoom and Microsoft Teams from November 2020 to February 2021, with participants selecting their preferred platform. The duration of all interviews was between 30-60 minutes. Before the start of the interview participants were asked by the researcher if they consent to use the video function, to support in building rapport.[15] Only the audio file was kept for data analysis to uphold confidentiality.[16] A reflexive diary was also used by the researcher throughout the study.

Respondent validation was completed,[17] and no amendments or clarifications were needed.

Thematic Analysis (TA) is a flexible method for analysing different perspectives creating themes or patterns of meaning. Data was analysed using Braun and Clarke's[18] approach using the six phases of thematic analysis focusing on both semantic and latent features of the data. Themes and subthemes were presented and considered alongside existing literature. Investigator triangulation was completed be-

Table 2. Demographics of participants

Participation Number (P)	Gender	Years of experience of working with adults with CF	Work Position	Location
1	Female	20	Lead physio	Scotland
2	Female	14	Band 7	England
3	Female	28	Lead physio	England

tween researcher and project supervisor to increase confirmability of findings.[16]

RESULTS

All participants were females working across the UK (England and Scotland), with a mean of 20 years of working post-qualification and with expertise in delivering care to the CF population (Table 2).

The themes and sub-themes are shown in Figure 1.

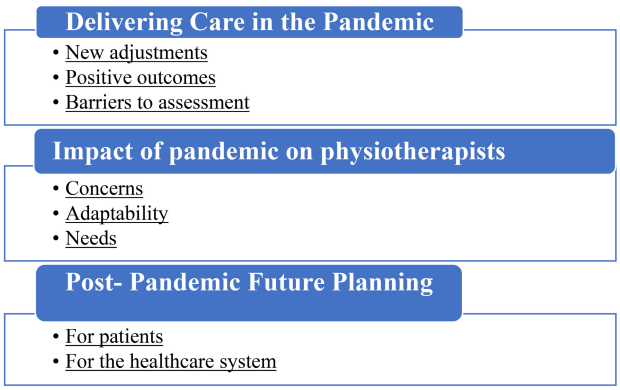

Figure 1. Themes and sub-themes.

Theme 1: Delivering care in the pandemic

Explores any alteration of delivering care during the pandemic, how the physiotherapists found the use of online means and any positive outcomes or barriers that physiotherapists faced working remotely.

Theme 2: Impact of pandemic on physiotherapists

Narrates the pros and cons to how physiotherapists dealt with this new reality of a rapid change in service delivery during the pandemic, what they feel was gained and what is needed moving forwards.

Theme 3: Post-Pandemic Future Planning

Explores aspects that physiotherapists feel could continue in the post-pandemic era, and the need for further progression in key aspects relating to remote provision, not only in relation to CF care but also for the wider healthcare system to best succeed in delivering high quality care.

DELIVERING CARE IN THE PANDEMIC

NEW ADJUSTMENTS

Regarding physiotherapy assessment, participants discussed adopting new ways of working. One such adjustment was the use of home spirometry, which has also been included in key guidelines updated for use during the pandemic.[4]

> *''We need to know their lung function and if they are not coming to clinic, we need to get a different way. We bought loads of home spirometers, and we rolled them out as quickly as possible'' (P2).*
> *''Many of the patients have home spirometers which are one of the key ways we have got of seeing how somebody is doing, measuring their lung function. They do their home spirometry over the video link'' (P3).*

Furthermore, another assessment tool that was reported was the need to obtain a sputum sample via the post:

> *''We have developed a way of trying to do postal sputum" (P3).*

The use of online exercise classes was reported, which also included online education sessions also.

> *"We are also doing online exercise classes specifically for CF patients, so that is the biggest change, ...the virtual clinics and the fact that we offer an exercise class between three and four times a week" (P1).*
> *".....doing a Facebook live exercise session, every week doing a different session that people can join in. She's [another senior physiotherapist] made videos for people and sent to them like if people had an individual need" (P2).*

A further realisation that prevailed among participants was how patients transitioning from paediatric to adult services could be best supported. Participants shared that to facilitate this transition an in-person visit in the home environment or attendance at a face-to-face clinic was being offered:

> *"There is a new development and I have started doing home visits for transitional purposes with the paediatrics physio because all our transitional appointments were virtual in the beginning of the pandemic" (P1).*
> *"We have a whole transition clinic, a special transition planning clinic, they come to us" (P2).*

POSITIVE OUTCOMES

One major positive outcome was the increased number of patients who have been seen by online clinics, with participants reporting better patient attendance uptake than face-to-face clinics. This indicates that health care professionals during the pandemic had the opportunity to stay connected with their patients more easily compared to prior.

> *"I think to a degree some of patients have attended more virtual clinics than would have attended face to face. Give us a bigger reach to those people who geographically aren't close to us" (P1).*
> *"People that we have not seen for the longest time, we have seen regularly during the pandemic on the screen. So, it changed who we see in a clinic a little bit which is interesting. It allows us to provide our service to everybody and every corner" (P2).*

Other positive outcomes were the convenience with physiotherapists being able to work from home and the minimization of their worries regarding cross infections among patients with CF.

> *"It is easier for me to deliver because I do not have to worry about the cross infection in the room" (P1).*
> *"So, people have been able to work from home. I got given a laptop at the start of the pandemic which has enabled me to do a lot of my work from home. If I was sick, one of my children was sick. I could still log in and do a clinic*

> *from home on my laptop, which is something that had never, ever been a possibility before" (P1).*

Additionally, the online platforms were felt to better facilitate people with CF being able to meet with each other online:

> *"Peer support online, gives the CF patients an opportunity to have safe open discussion with their peer group, whereas they have not been allowed to have face to face before." (P1)*

BARRIERS TO ASSESSMENT

The absence of hands-on clinical assessment was a recurrent barrier:

> *"I mean as physiotherapist, I'm very used to doing hand on things. I can assess somebody's chest by listening to their chest, by putting my hands on feeling how it feels. It is really hard to tell if somebody's chest is sounding crackly or they're coughing a lot because you can't hear." (P3)*

Another disadvantage was the accuracy of results from home spirometers because the machines were not calibrated.

> *"We're not calibrating these home spirometers; they're not being serviced. We don't know how accurate they are." (P2)*

The need to move to postal sputum samples was the result of the concern regarding the lack of in-person assessment and the inability to gain sputum samples otherwise to gain a full picture of patients' health:

> *"Regular sputum samples from these patients to able to monitor how their chests are and how they are. Well, you can't do that when you're seeing somebody virtually." (P3)*

Continuing to the accuracy of results, another limitation that has been presented is that virtual examination might be less reliable compared to the in-person:

> *"Now they can pretend that they are ok, that they've lost a lung function machine and their video is not working. I think if you can't see them, they can mask a lot of things. So, to a degree, it is less reliable." (P1)*

IMPACT OF PANDEMIC ON PHYSIOTHERAPISTS

CONCERNS

The first challenge that the physiotherapists faced was regarding the remote assessment, expressing worries in terms of safety.

> *"Some safeguarding must be taken into consideration. So, if you come to my class and you don't want to be seen, it's ok for you to turn the video off but I need to be able to see you at the end. What happens if you collapse?" (P1)*
> *"There is still time when I see somebody online, I can't solve or advise them properly. I call a patient for the clinic, and they'll be sitting in their van on the side of the motorway somewhere. Trying to do a consultation in that situation. It is tricky." (P3)*

Furthermore, moving forward in the post-pandemic recovery, all participants expressed uncertainty regarding the future of CF care:

> *"We have to sit together and work out a way through this. What's going to be the most efficient use of our time and the patients' time. Everything is about change at the minute, we're just managing change and working out the best way forward. It's a work in progress." (P2)*
> *"Virtual intervention is not going to go away for some people, how best to manage virtual consultation would be useful to give individual confidence." (P1)*
> *"We're still evolving our system and how we think the service is going to look in future because we really don't know. It's a very challenging time because we do not know what the future is. It's a really mixed picture." (P3)*

With the use of CF Transmembrane Conductance (CFTR) modulator therapies – designed to correct the malfunctioning protein made by the CFTR gene - prescribed to patients at the same time as the move to telehealth, participants expressed concern that the evaluation of outcomes is challenging:

> *"Very difficult to evaluate telehealth properly given that the modulator came along at the same times as COVID." (P1)*
> *"They both, COVID and Kaftrio, were at the same time and it's really hard to separate one from another. I do not know how you're going to pull that one from other because I think it's almost impossible." (P3)*

ADAPTABILITY

A realisation among participants was that physiotherapists should be ready to cope with every change. The need for adaptability and resilience being key:

> *"I think we've got to be ready for change and you know although the pandemic feels like it's over, there might be another one next year. We need to be adaptable and resilient." (P2)*
> *"I always thought as physios, we were quite adaptable, we've had to be super adaptable. We, you know, we've been taken out of our roles. Then, we've had to come up with new ways of working. Adaptability is extremely key. We've just kept up and changed and grabbed hold of these new technologies and new ways of doing things." (P3)*

NEEDS

Expressing their worries in delivering care, the uncertainty about the future, and the skills that they gained with this experience, participants also explained what they need to provide good quality care to CF patients from now on. The need for training in specific areas, now that online delivery of care seems to be part of the future in CF, were expressed:

> *"For us in CF we didn't do group actively, so I haven't done any group exercises for a long time. It was quite challenging. I think some information around that is really good." (P1)*

> *"So, obviously, training is needed. I suppose if I saw something that looked relevant, I'd book into it, but I haven't come across anything that I feel would help me in my quest." (P2)*

A guide or checklist regarding the remote assessment and the use of online means for consultation was also felt to be a useful development, especially for physiotherapists that have not worked in online clinics:

> *"So, having a kind of checklist that you go through, like a good guide for the novice physio that's never done it before, because I think it's different when you are more experienced, you've got more experience of a consultation, making an adaptation to an online one it's slightly easier than trying to as young, novice physio to be able to pick up all the things." (P1)*
> *"There's a lot of information to let somebody know and I guess I've always been doing it; I probably don't think about the in's and out. It would be helpful to be a guideline for physios of what's expected of them and how things need to go. I'll be getting a new band 6 in June, so I don't think she's done CF in virtual clinics." (P2)*

POST-PANDEMIC FUTURE PLANNING

FOR PATIENTS

All participants felt that moving forwards online clinics would prevail and that education of patients need to be in place to maximise patients' adherence and engagement:

> *"Preparing the area, make sure the patient is aware what equipment they need and making sure that it's a safety thing." (P1)*
> *"We still very much want them to do those antibiotics, nebulizers. Trying to work hard to educate and support them. We still probably negotiate with them that the rest of the time, they have virtual because a lot of people if we go fully face-to-face would just never see them again. We've got to have a contract with them. They need to understand what we expect from them." (P2)*

P3 also suggested that CF patients should visit the clinic in person at least once a year to have a full assessment:

> *"We're gradually trying to get all our CF patients to come back for annual review, once a year. They have lots of tests done, they see the whole team and you can only do that face to face."*

FOR THE HEALTHCARE SYSTEM

The major recommendation that emerged from all physiotherapists is the amelioration of online platforms to facilitate the process of delivering care:

> *"There's gonna be a lot about funding, putting the funding in place to develop the right infrastructure for remote care. What platforms do we use? How do we do it?" (P2)*
> *"We've got to find a better way of monitoring somebody's chest and the microbiology in their chest. We need to develop more virtual services. Getting the patient to upload certain data like their weight, their lung function on to some sort of virtual platform or cloud or something like that." (P3)*

Similarly, it was added that apart from online platforms it is important to ensure the accuracy and the maintenance of lung function machines in patients' houses:

> *"Main means of surveillance is going to be remote. It's gonna be lung function machines in people's houses. And if we can't rely on them, we're gonna have a problem." (P2)*

P1 also believed that physiotherapists should ensure the safety of the CF patients who use online means, especially in group activities suggesting that more physiotherapists should participate online:

> *"I can keep an eye on six people on the screen. Any more than six patients then two physios have to be in attendance. Small adjustments to ensure the safety of the patient when you're caring for them. Those are the things that we need to make sure we don't miss."*

A suggestion that was put forward by all participants was the need for hybrid clinics as part of CF care moving forwards.

> *"I think we have to do possibly hybrid clinics. Do not lose sight of those people that need to see us on a face-to-face basis and don't blanket on telehealth." (P2).*
> *"There still a need and a place for face-to-face clinics and we're never going to be able to do it all online, it will have to do a mixture of both." (P3)*

The participants discussed how physiotherapists should select which patient they will see more in person or more virtually. Priority groups for the face-to-face clinics were felt to be patients transitioning from paediatrics to adult services and the patients who are not eligible for the CFTR modulators. The criteria should be personalized however to the needs of each patient with CF.

> *"It depends on the degree of disease progression of the individual. If a person had really poor lung function and had an increase in the frequency of exacerbation, and I was concerned about them, then I'd want to see them much more often. I think it has to be more precision medicine, and individualistic and you can't have a blanket four times a year. I think you have to be variable." (P1)*
> *"For transition patients, we want their first couple visits to be face to face so they can come to the unit, see who we are. We've got a number of patients who weren't eligible for Kaftrio. I feel they are a priority group whom we should see in person." (P2)*

DISCUSSION

In delivering care remotely during the pandemic, participants explained that the use of online means was the predominant method for CF care during the pandemic, as echoed in the literature.[9,19] One adjustment that was highlighted by participants was the use of home spirometry, which was also included in NICE guidelines (2020)[4] published during the pandemic. The physiotherapists in this

study also discussed the benefits of online clinics. One major positive outcome that was stated was the increased number of patients that attended online, highlighting that this mode of clinical delivery enabled more patients with CF to attend regardless of their location and reduced the burden and costs associated with travelling to a face-to-face clinic. In line with the literature[20-23] the convenience of remote working was also a successful outcome that was identified in this study.

Participants in this study also expressed some limitations with the use of online clinics where the lack of opportunity for physical examination and visual cues were identified, and these limitations are also reported in the literature.[20-23] However, an interesting differentiation is that Gifford et al. (2020)[24] and Perkins et al. (2021)[25] reported that remote means allowed early identification of health issues in the CF population. This could be considered in contrast with the current study as the physiotherapists felt that the online assessment was less reliable compared to the in-person assessment. The low sample size in this study could however have resulted in this aspect not being reported.

Another disadvantage identified by participants was the accuracy of results from home spirometers as participants agreed that the home devices are not as sensitive as the ones in a hospital environment, and they are not calibrated. For this reason, it might lead to false or unrepresentative results. No further papers were identified investigating the accuracy of remote assessments in patients with CF, either before or during the pandemic and this is an area recommended for future research.

A concern that was also expressed by physiotherapists was the difficulty in evaluating outcomes as telehealth and the emergence of the CFTR modulator therapies occurred at the same time. Calls for more research is also recommended in the literature[24] on the evaluation of outcomes using telehealth and remote means for people who are prescribed CFTR modulator therapies.

A suggestion that was put forward by all participants was the need for hybrid clinics as part of CF care moving forwards. Perkins et al. (2021)[25] recognized that among clinicians some indicated that none or a few patients with CF, who have been assessed by online means, should have been evaluated in person. However, considering the transitioning of patients from paediatrics to adult services, the patients who are not eligible for CFTR modulators, and the related concerns from physiotherapists in this study regarding the perceived lack of reliability in virtual physiotherapy assessment, a hybrid clinic seems to be a more appropriate approach, compared to the use of only online clinics. More exploration is recommended concerning the type of clinics and interventions that should be used in CF care post-pandemic.

LIMITATION OF THIS STUDY

One limitation of this study is the transferability of the findings, as only three physiotherapists participated in total. Another aspect is that participants in this study had a mean of 20 years of working in delivering care to the CF population. To reflect a range of experience, it would be useful to have included physiotherapists with less years of working in CF.

The recruitment strategy aimed to include physiotherapists from across the UK. Considering the small sample size this aim could not be fulfilled and does limit the ability to obtain experiences from a demographically diverse population from across the UK and across different health delivery systems.

CONCLUSIONS

During the last three years, the health care system has faced many changes in its operation because of the emergence of COVID-19. The experienced physiotherapists in this study stated that home spirometers, online classes and postal sputum were changes in the physiotherapy CF care model. Emphasizing that apart from the benefits of virtual clinics, some limitations need to be considered and improved moving forward. Specifically, the accuracy of assessment tools when used remotely should be further investigated to provide a reliable, full examination of patients with CF. Moreover, the concerns of physiotherapists regarding the safety of patients who use online means and the worries regarding the transitioning of children to adult clinics. Agreement across participants was that moving forwards there needs to be hybrid ways of working in place for providing care for people with CF. Areas for training and development were indicated, as were the need for investment in the infrastructure for online platforms.

Even though the findings of this study provide an exploration of experiences of physiotherapists in delivering CF care during the pandemic, and how post-pandemic CF care might be shaped, the small number of participants in this study may limit the transferability of the findings. Further research is recommended with a larger sample size, with representation from across the UK to further explore the post-pandemic CF model of care.

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KEY POINTS

1. Physiotherapists working during the COVID-19 pandemic treating patients with CF remotely reported the use of home spirometry, online classes and obtaining postal sputum samples were the significant changed in the care model.
2. The use of online clinics also saw improved patient attendance uptake in comparison to face-to-face clinic held pre-pandemic.

3. Moving forwards, hybrid ways of working are advised ot support people with CF alongside the need for investment in the infrastructure for online platforms and recommendations are made for more research to investigate the use of remote assessment tools.

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Long term conditions

What is the Minimal Clinically Important Difference in the One-Minute Sit-to-Stand Test During Remote Interventions?

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Background

Pulmonary rehabilitation (PR) is the most effective therapeutic strategy to improve health status in people with chronic obstructive pulmonary disease (COPD). With poor uptake and adherence to PR, a home-based rehabilitation programme could improve exercise capacity in these patients. A suitable outcome measure for home settings is required to assess such a programme's effectiveness.

Purpose

The one-minute sit-to-stand test (1-min STS) can easily be performed within home settings, and has been validated for other clinical scenarios. This service evaluation aimed to calculate the minimal clinically important difference (MCID) for the 1-min STS following a remote exercise-based intervention.

Methods

Anonymised data were analysed retrospectively from a comprehensive remote exercise-based intervention for patients with COPD. The 1-min STS, COPD Assessment Test and MRC dyspnoea scale were completed before and after the programme. Change in health status was recorded using the Global Rating of Change Questionnaire (GRCQ). Anchor-based methods were used to evaluate the MCID of the 1-min STS.

Results

Data were available from 106 patients. The median (IQR) improvement in 1-min STS after the programme was three (1-5) repetitions. Changes in 1-min STS repetitions were non-significantly and only weakly correlated with changes in MRC dyspnoea scale, COPD Assessment Test and GRCQ (r=-0.15, -0.12 and 0.09, respectively). The estimated MCID for the 1-min STS was three repetitions.

Conclusions

An improvement of at least three repetitions in the 1-min STS was considered meaningful in this service evaluation. Anchors that display stronger correlations would be required to increase the robustness of the MCID estimates.

INTRODUCTION

Pulmonary rehabilitation (PR) is the most effective therapeutic strategy to improve dyspnoea, health status and exercise tolerance in people with chronic obstructive pulmonary disease (COPD).[1] Despite the beneficial effects of PR, adherence and uptake remain poor.[2] During the COVID-19 pandemic, some UK NHS Trusts trialled alternative home-based self-management exercise programmes to improve uptake to exercise. We are now in a transition period whereby physiotherapists are considering the advantages of remote self-management programmes, whilst not wanting to lose the benefits of traditional PR. Thus, there is the need for research into remote interventions and outcome measures to assess their effectiveness.

The six-minute walk test (6MWT) is used to prescribe individualised PR exercises and evaluate changes in exercise capacity. It has high validity and reliability and is sensitive to changes post-PR.[3] However, the 6MWT requires space to walk and the direct supervision of trained staff. Alternative tests such as the one-minute sit-to-stand (1-min STS) test have also been considered, to allow physiotherapists to monitor the progress of patients undertaking self-management programmes.

The 1-min STS assesses patients' functional capacity.[4] Studies have found strong correlations between the 1-min STS and the 6MWT. Thus, the 1-min STS could be a feasible

outcome for home-based settings. This service evaluation aimed to evaluate the minimally clinically important difference (MCID) of this instrument for a home exercise-based self-management programme. The secondary aim was to evaluate whether the outcome measures selected for the programme were responsive to changes following the programme.

METHODS

STUDY DESIGN

This was an evaluation of the remote exercise intervention service provided at Guy's and St Thomas' NHS Foundation Trust, permissions for this service evaluation were granted from the St Thomas' audit department. As this study used retrospective data that were routinely collected from an existing service, did not involve randomization of patients and findings were not generalized, this study was not classified as 'research'. An anonymised spreadsheet of data (with no patient identifiers) was provided to the primary author for data analysis.

HOME-BASED SELF-MANAGEMENT EXERCISE PROGRAMME

Patients with a confirmed diagnosis of COPD were invited to join the programme between November 2019 to January 2021. Participants had to be medically stable with no contraindications to exercise. Individuals unable to walk ten metres even with a walking aid, those who had recurrent falls in the last six months, had developed an abdominal aortic aneurysm exceeding 5.50cm or had a recent myocardial infarction were excluded from the programme.

The programme was a six-week non-supervised exercise programme conducted at the patient's home with one weekly telephone call for follow-up and exercise progression. Exercise training was individualised and consisted of seven aerobic and strengthening exercises. A maximum of three telephone calls were conducted over each week.

The 1-min STS test was performed by patients before and after the exercise programme. It was carried out during a telephone consultation with the physiotherapist according to a standardised protocol.[5] Oxygen saturations were noted before the test at rest, monitored during the test and for one minute afterwards.

MINIMAL CLINICALLY IMPORTANT DIFFERENCE

To determine the MCID for the 1-min STS, anchor-based methods were used. Changes in the 1-min STS were compared against changes in the external anchors – MRC scale and CAT. For the GRCQ, the median (IQR) change in 1-min STS score with remote interventions was calculated in those reporting feeling "a little better". Those reported feeling "much better" were not included to avoid the overestimation of the MCID.

Table 1. Baseline characteristics of patients

Variables	Baseline
Age (years)	67 (59-74.3)
Sex (n)	
- Male	54 (50.9)
- Female	52 (49.1)
Height (m)	1.65 (1.57-1.76)
Weight (kg)	76.4 (58.8-94.0)
BMI (Kg/m^2)	25.9 (21.1-34.0)
Smoking status (n)	
- Never	6 (5.7)
- Ex-smoker	69 (65.1)
- Current smoker	31 (29.2)
FEV_1 (% predicted)	50.0 (39.3-68.8)

Data are median (IQR) or n(%) unless otherwise specified. BMI: Body mass index; FEV_1: Forced expiratory volume in one second.

STATISTICAL ANALYSIS

Continuous variables that were normally distributed were displayed as mean (SD), while non-normally distributed variables were displayed as median (first quartile, third quartile) unless otherwise specified. Categorical variables were displayed as numbers (percentages).

Analysis was performed using the IBM Statistical Package for Social Sciences (SPSS) Version 27 (IBM, New York, USA). Pairwise deletion was applied to missing data. In the estimation of the MCID for the 1-min STS, only data from participants who obtained paired 1-min STS measurements were included. Spearman's correlation and linear regression were used to compare the change in 1-min STS with other outcome measures. ROC curves were used to estimate the MCID of the 1-min STS test, the number of 1-min STS repetitions cut-off that best distinguished between patients who improved their health status by the established MCID in the CAT total score (-2 point change), MRC score (-1 point change), and change in GRCQ to feeling "a little better" (score of 2) was identified, with equal weighting in both sensitivity and specificity.[6,7]

Responsiveness to the programme was measured by comparing data for outcome measures collected before and after the programme. A Wilcoxon test was applied to assess for significant differences.

RESULTS

In total, data were successfully retrieved from 106 patients who agreed to take part in, and completed, the remote exercise programme. Data were collected between May 2020 and September 2021. Baseline characteristics are displayed in Table 1.

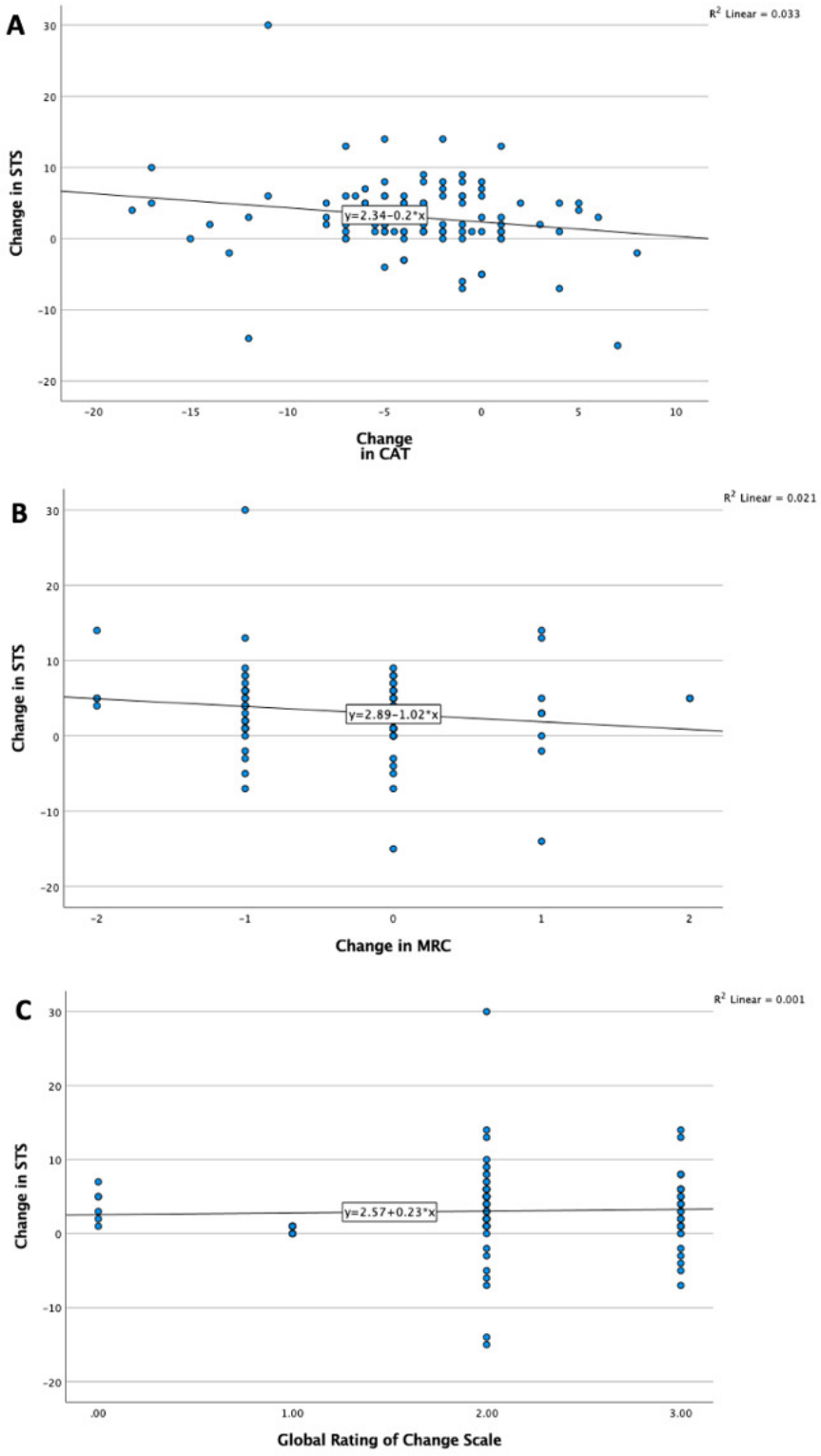

Figure 1. Correlation between the change in 1-min STS test and (A) change in CAT, (B) change in MRC and (C) GRCQ

CAT: COPD assessment test; MRC: Medical Research Council dyspnoea scale; STS: sit-to- stand. Anchor question is the Global Rating of Change Questionnaire (GRCQ), 0 – "no change", 1 – "much the same", 2 – "a little better", 3 – "much better". None of the participants reported feeling "worse", therefore it was not displayed in Figure 1(C)

DETERMINATION OF THE MCID

Figure 1 demonstrates the correlation between the 1-min STS and other patient-reported outcomes, no significant correlations were found between the outcomes.

By using a change of -1 in the MRC dyspnoea scale as a cut-off to determine the minimum clinically important improvement, 38 of 96 (39.6%) patients had a total change score exceeding the anchor MCID of -1. Linear regression analysis estimated the MCID of the 1-min STS as 3.9 rep-

Figure 2. Individual patients' change scores in 1-min STS test after the remote exercise programme

1-min STS: one-minute sit-to-stand

etitions when anchored against the MRC dyspnoea scale. A similar MCID estimate was found using ROC; an improvement of 3.5 repetitions in the 1-min STS best distinguished patients who improved by the MCID or more in the MRC scale, with the best sensitivity of 60.5%, specificity of 62.1%, and an area under curve (AUC) of 0.60.

A total change of -2 in the CAT was used as a cut-off to determine the MCID of the 1-min STS. 71 of 106 (67.0%) patients had a total change in CAT score equal to or greater than -2. For those who improved their CAT score, linear regression analysis estimated the MCID of the 1-min STS as 2.7 repetitions. A similar MCID of 2.5 repetitions was also found using the ROC plot, with the best sensitivity of 54.9% and specificity of 54.3%, and an AUC of 0.58.

For the GRCQ, a score of two (defined by "feeling a little better") was used as a cut-off to determine the MCID. 56 of 106 (52.8%) patients reported feeling "a little better". Linear regression analysis derived an MCID estimate of 3.3 repetitions. Whilst the ROC plot demonstrated the change in 1-min STS repetitions that best distinguished patients feeling "a little better" was 1.5, with the best sensitivity of 73.2%, specificity of 68.7% and an AUC of 0.64.

Since none of the external anchors had a significant correlation with the change in 1-min STS repetitions after a remote exercise programme, the median value is considered as the MCID of the 1-min STS, which is three repetitions. 55 of 106 (51.9%) patients achieved an improvement of three repetitions or more in the 1-min STS after a remote exercise programme (Figure 2).

RESPONSIVENESS TO THE REMOTE EXERCISE-BASED INTERVENTION

There was a significant increase in 1-min STS repetitions between baseline and the end of the programme (Table 2). Changes in MRC and CAT were also statistically significant, although the change in MRC score is unlikely to be clinically meaningful due to the slight change of less than one point.

More than half of the patients (52.8%) reported feeling "a little better" after the remote exercise programme. Median changes in 1-min STS repetitions, CAT scores and MRC scores were statistically significant in those that reported feeling "a little better", with p-values less than 0.01 (Table 3).

DISCUSSION

METHODS USED TO DERIVE THE MCID

Using anchors that are widely used in the COPD population to measure patients' HRQoL, the MCID estimates for the 1-min STS test ranged from 1.5 to 3.9 repetitions. After careful consideration, the authors estimated the MCID to be three repetitions. This corresponds with the multicentre validation study of the 1-min STS test in COPD.[5]

Methods for determining the MCID of clinical instruments remain controversial. Challenges of employing anchor-based methods include a meaningful relationship between the outcome of interest and the external anchors. There is also a lack of agreement on the threshold strength of the correlation between the outcome of interest and anchors. Some researchers have suggested the requirement of a minimum correlation coefficient of 0.50 between outcome measures to be eligible for analysis to calculate the MCID,[8] while others have suggested 0.30.[9]

CORRELATION OF THE 1-MIN STS TEST WITH EXTERNAL ANCHORS

Only minimal and insignificant correlations were found between changes in the 1-min STS and the external anchors in this service evaluation. The weak correlations could have resulted from the external anchors being strongly based on the patient's health status at the time of undertaking the questionnaire rather than the amount of change from baseline, which is a common criticism for patient-reported outcomes.[8,9] Little or no correlation was found between the GRCQ and patients' health status at baseline (r=0.00 to 0.18).[10] Hence, the GRCQ is not a valid measure of change over time, which could explain the poor correlations between the GRCQ and the 1-min STS since this service evaluation analysed the change in 1-min STS repetitions over six weeks and quantified the amount of change from baseline. Therefore, to ensure the credibility of the MCID derived using anchor-based methods, it is essential to select an anchor that measures the same or similar constructs as the targeted outcome to ensure a substantial correlation.

Table 2. Baseline, follow-up and change scores for the 1-min STS test and patient-reported outcomes

	Baseline (a)	End of remote exercise programme (b)	Change (b-a)	p-value
1-min STS	17.5 (13-21)	20 (16-24)	3 (1-5.3)	<0.001
MRC	4 (3-4)	3 (2-4)	0 (-1 -0.0)	<0.001
CAT	21 (16.8-27.0)	18 (12-23)	-3 (-6 – -1)	<0.001

Data are median (IQR). CAT: COPD assessment test; MRC: Medical Research Council dyspnoea scale; 1-min STS: one-minute sit-to-stand.

Table 3. Changes in the different outcome measures according to the different categories of the GRCQ

GRCQ	Change in 1-min STS	Change in CAT	Change in MRC
The same	4.0 (1.75 to 5.5)**	0.0 (-2.0 to 2.0)	0.5 (-0.25 to 2.0)
Much the same	0.0 (0.0 to 1.0)*	-4.0 (-7.0 to 0.0)*	0.0 (-0.5 to 0.0)
A little better	4.0 (1.0 to 6.0)***	-3.0 (-5 to -1)***	-0.3 (-1.0 to 0.0)**
Much better	4.0 (1.0 to 6.0)***	-4.0 (-7.25 to -1.75)***	0.0 (-1.0 to 0.0)***

Data are median (IQR). CAT: COPD assessment test; GRCQ: Global rating of change questionnaire; MRC: Medical Research Council dyspnoea scale; 1-min STS: one-minute sit-to-stand;. * denotes statistical significance p<0.05; **p<0.01:***p<0.001. None of the participants reported feeling "worse", therefore it was not displayed in table 3.

RESPONSIVENESS TO REMOTE EXERCISE-BASED INTERVENTION

Findings from this service evaluation demonstrated that the 1-min STS is responsive to change after a remote exercise programme for patients with COPD. This corresponds with a recent study investigating the effects of a ten-week non-supervised remote PR programme in patients with COPD; a mean difference of 3.8 repetitions was found in the 1-min STS before and after the programme,[11] which was slightly higher than the mean change of 3.1 repetitions in this service evaluation. The longer duration could have impacted on the effectiveness of the programme. Our service evaluation proposes an MCID of three repetitions for the 1-min STS.

STRENGTHS AND LIMITATIONS

The strengths of this service evaluation included the different anchor-based methods used to derive the MCID for the 1-min STS after remote exercise-based interventions. Despite the multiple methods used, the range of valid MCID estimates generated was relatively narrow; therefore, it was practical to determine one value for the MCID. On the contrary, only weak correlations were found between the 1-min STS and the chosen external anchors, impacting the reliability of the MCID estimates. Therefore, different external anchors could be used in future studies to derive MCID estimates with higher credibility.

CONCLUSION

This service evaluation study suggested an improvement of at least three repetitions to be the MCID of the 1-min STS after a remote exercise-based intervention. However, this is only a tentative value based on poor correlations with external anchors. Results also showed the 1-min STS to be responsive to changes resulting from remote interventions, making it a potential alternative to the 6MWT.

Key points

- The 1-min STS test was responsive to change after a remote exercise-based programme, making it a potential alternative to the 6MWT.
- Although the proposed MCID was three repetitions, further studies are required to increase the credibility of this MCID.
- A remote home-based self-management programme was found to be beneficial in improving exercise capacity and HRQoL.

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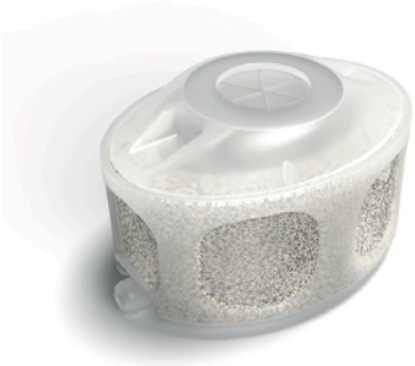

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*Longobardi Y, Galli J, Di Cesare T, D'Alatri L, Settimi S, Mele D, et al. Optimising Pulmonary Outcomes After Total Laryngectomy: Crossover Study on New Heat and Moisture Exchangers. Otolaryngol Head Neck Surg. 2022.

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Education

Simulation-based education within respiratory physiotherapy training: a scoping review

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Keywords: Simulation based education, Part task trainer, Pre-registration education, Post graduate education, Interprofessional learning

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Objective

The aim of this scoping review is to provide respiratory physiotherapists with guidance on the implementation of simulation-based education

Introduction

In recent years there has been a widespread rise in the adoption of simulation-based education. A scoping review was decided upon by the ACPRC Editorial Board to focus on any new evidence or guidance in the field.

Inclusion criteria

1) Studies investigating the use of simulation-based education within respiratory physiotherapy 2) Meta-analyses, systematic reviews, scoping reviews, randomised controlled trials and observational studies.

Methods

A literature search was developed and refined through testing. Nine databases were searched between 01/01/2014 and 31/10/2022. Data regarding study design, population, intervention, comparator and control were extracted into a data extraction table. Results were grouped by study design, intervention or context.

Results

141 sources were retrieved from the searches. After initial screening 27 sources were included and after full-text review, 25 were included. Sources included: meta-analyses and systematic review and studies considering pre-registration education, interprofessional learning, part-task trainers and postgraduate education.

Conclusion

There is increasing research output in the simulation-based education field for respiratory physiotherapy. The evidence continues to focus on learner experience. More resources and support are required to increase access to simulation-based education for respiratory physiotherapists.

INTRODUCTION

In recent years there has been an increase in the adoption of simulation-based education (SBE) in healthcare disciplines across both pre-registration and postgraduate environments, including physiotherapy. There are numerous definitions available for simulation used as a pedagogical approach but there is no universally agreed definition. Hawker et al[1] has perhaps the most comprehensive and recent explanation:

> *"Simulation is a learning tool that supports development through experiential learning by creating or replicating a particular set of conditions which resemble real life situations. It should provide a safe environment where participants can learn from their mistakes without any danger to patients, allowing individuals to analyse and respond to these realistic situations, with the aim of developing or enhancing their knowledge, skills, behaviour, and attitudes."*

The Association of Chartered Physiotherapists in Respiratory Care (ACPRC) Editorial Board is comprised of respiratory physiotherapy clinicians and academics who lead scoping of latest evidence, commissioning, co-ordination

and delivery of all new ACPRC guidance documents and resources. The aim of this work is to facilitate knowledge sharing and drive improvements in the quality of care for respiratory patients.

The Editorial Board discussed potential areas for investigation and agreed that the area of SBE should be prioritised. A member of the Editorial Board (SKM) was nominated to lead the topic group and other respiratory physiotherapists were approached to be part of the team. A scoping review was the most appropriate method for exploring new evidence or guidance in the simulation-based education field.

AIMS/OBJECTIVES

The aim of this scoping review is to provide respiratory physiotherapists with guidance on the effectiveness of SBE in respiratory physiotherapy.

REVIEW QUESTION

How effective is simulation-based education as a pedagogical approach in both pre-registration and postgraduate respiratory physiotherapy?

METHODS

This scoping review was conducted in accordance with Joanna Briggs Institute Guidance for Conducting Scoping reviews[2] and has been reported in accordance with the PRISMA extension for Scoping Reviews.[3] The scoping review was registered on Open Source Framework (reg number: ps8a7).

INCLUSION CRITERIA

The following were included in the scoping review: 1) studies investigating the use of SBE within respiratory physiotherapy, both at pre-registration and postgraduate level 2) Meta-analyses, systematic reviews, scoping reviews, randomised controlled trials (RCT), prospective and retrospective observational studies including case-controlled studies, cohort studies and cross-sectional studies. The following exclusion criteria were applied: 1) studies that were narrative reviews, non-research letters, abstracts, case reports, conference proceedings, theses and books; 2) studies involving non-human subjects; 3) studies that did not include respiratory physiotherapists and 4) studies not reported in English as there was no funding for translation.

TYPES OF PARTICIPANTS

Studies were included that considered the application of SBE within respiratory physiotherapy, both at pre-registration and postgraduate level.

CONCEPT

For the purpose of this scoping review, we considered SBE to be a broad umbrella term and included studies that used all SBE techniques including high fidelity simulation using mannequins, in-situ simulation, part task trainers, actors and team based/interprofessional simulation.

CONTEXT

The authors identified that previous scoping review, systematic reviews and meta-analyses had limited their context to pre-registration education or included respiratory physiotherapists within a broader context. This scoping review therefore sought to limit the context to respiratory physiotherapists but to include both pre-registration and postgraduate education.

SEARCH STRATEGY

The literature search was developed and refined through piloting, during which the search criteria was used to test if known papers were identified with the search strategy. The search terms included: high fidelity simulation, physio*, resp*, physical therapy and simulation

Nine databases were searched between 01/01/2014 and 31/10/2022: AMED, BNI, CINAHL, EMBASE, HEALTH BUSINESS ELITE, HMIC, MEDLINE, PsycINFO and PubMED. These databases were chosen as they are the most commonly used in the physiotherapy field. The search strategy was limited to the dates given as previously reported work was published prior to 2014. Database searches were supplemented by screening reference lists and hand searching. ResearchRabbit (www.researchrabbit.ai) was used to identify additional references. ResearchRabbit is an innovative citation-based literature mapping tool available online which optimises time compared to hand searching.

SOURCE OF EVIDENCE SELECTION

References were imported into Rayyan.[4] Duplicates were removed. Two authors (SKM and KG) independently screened the title and abstract for inclusion. Discrepancies were resolved through discussion. Full text sources were retrieved and assessed against the inclusion criteria.

DATA EXTRACTION AND SYNTHESIS

Data regarding study design, population, intervention, comparator and control were extracted into a data extraction table. Results were grouped by study design, intervention or context. Quality assessments were not undertaken as this was not the intention of this scoping review.

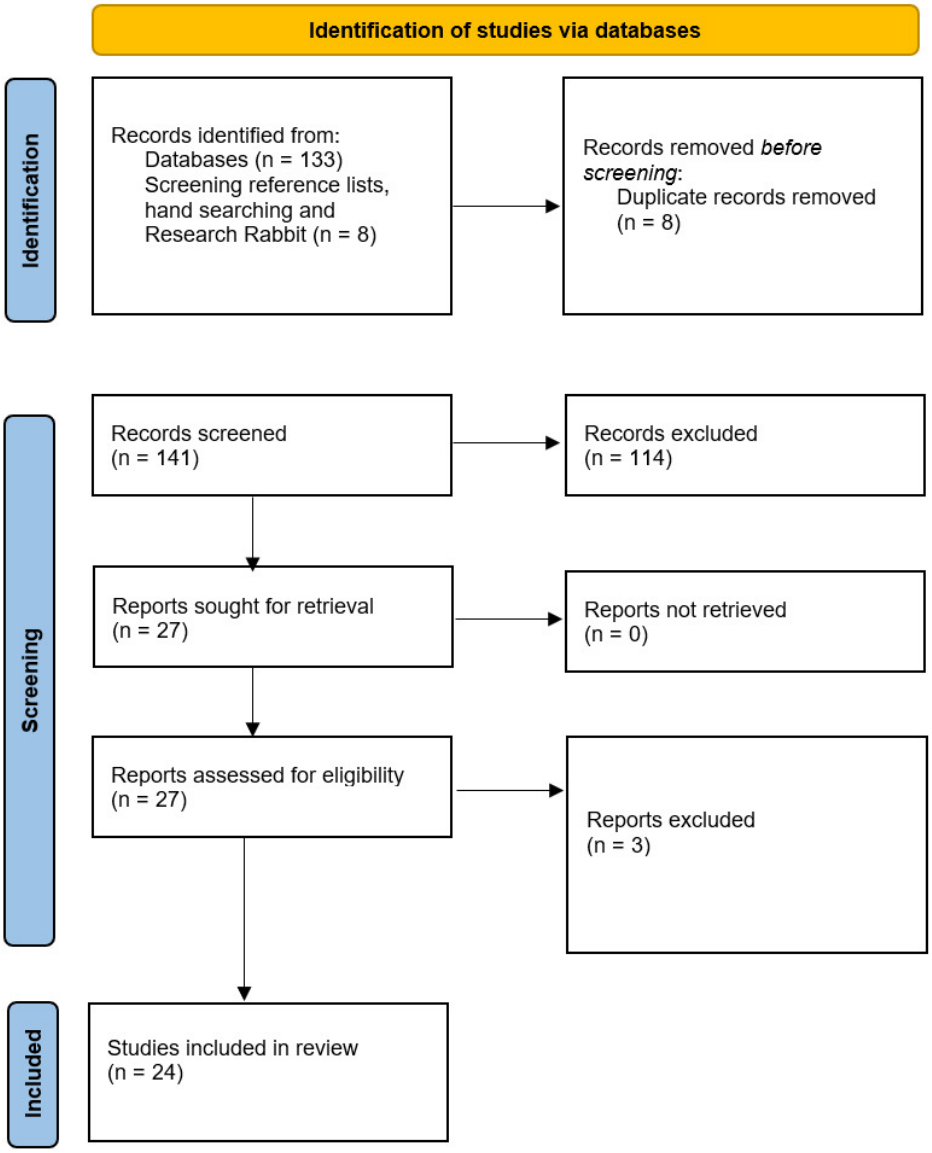

Figure 1

RESULTS

141 sources were retrieved from the searches. As per figure 1. 24 studies were included.

META-ANALYSIS AND SYSTEMATIC REVIEWS

Five meta-analyses and systematic reviews[5-9] were sourced.

PRE-REGISTRATION USE OF SBE

Ten studies[10-19] were sourced investigating SBE in pre-registration respiratory physiotherapy pedagogy.

INTERPROFESSIONAL LEARNING (PRE-REGISTRATION)

Five studies[20-24] were sourced investigating SBE in interprofessional learning.

PART TASK TRAINERS

One study[25] investigated the use of part task trainers.

POSTGRADUATE USE OF SBE

Three studies[26-28] were sourced that investigated SBE in postgraduate respiratory physiotherapy pedagogy.

DISCUSSION

This scoping review provides an overview of the current knowledge base for the use of SBE within pre-registration and postgraduate respiratory physiotherapy training. Kirkpatrick's evaluation framework classifies training outcomes into 4 levels of reaction or satisfaction, learning or knowledge, behaviour or practice change and results or impacts.[29-31] There has been an increase in publication of SBE evidence within the last 10 years, however the evidence base continues to focus on learner experience (Kirkpatrick

Table 1. Summary of meta-analyses and systematic reviews included in the scoping review

AUTHOR, YEAR, COUNTRY	STUDY DESIGN	PARTCIPANTS	INTERVENTION	COMPARISON	KEY FINDINGS
Brown, 2021, Australia	Mixed-Methods Systematic Review	11 papers • RCT (n=5) • Observational study (n=1) • Cross sectional study (n=5) Participants • Graduate entry level (n = 612) • Undergraduate physiotherapy students (n=64) • Practicing physical therapists (n=10)	Studies that used high-fidelity simulation defined as "full-body computerized mannequins that are capable of real time physiological parameters"	Studies that did not use high-fidelity simulation Minimal information regarding comparisons from individual studies included.	The quantitative findings suggest high fidelity simulation improves students' preparedness. However negligible to small and not statistically significant improvements in clinical performance were reported. Qualitative data found students perceived they were able to become more familiar and learn better in a simulated environment. As a result, they were more safety conscious with their patients, and expressed a higher level of confidence and self-efficacy.
Heuer, 2022, Canada	Systematic literature review	33 papers • Paramedics (n=22) • Respiratory Therapists (n=6) (Respiratory Therapists participant total = 286) 1 survey, 5 observational studies	Studies that used SBE in Allied Health Professionals (AHPs) training. Minimal information regarding inclusion of what SBE encompasses.	Minimal information regarding comparisons from individual studies included.	Unable to extract only respiratory therapist data. The most used modalities of simulation were: • Manikins (37%) • Combination of manikins and simulated patient/actor (33%) • Simulated patients (15%) • Other (9%) • Not stated (6%) Setting for performing SBE: • Stationary simulation centres (34%) • Prehospital/ ambulance (21%) • Mobile simulation unit (18%) • Healthcare environment (12%) Six (18%) of studies described a sustained impact on objective or subjective measures, ranging from 4 weeks to 1 year after the SBT intervention. This project demonstrated that there are many SBT applications employed in skill-building. However, there appears to be relative unevenness in terms of the professions which report

AUTHOR, YEAR, COUNTRY	STUDY DESIGN	PARTCIPANTS	INTERVENTION	COMPARISON	KEY FINDINGS
					their use, the common features of SBT, and the perceived and actual impact on practice.
Mori, 2015, Canada	Systematic literature search	23 papers No further information given.	Studies that used simulated learning environments (SLEs) in physical therapy, in which the learner had the opportunity to interact with the simulated clinical scenario.	Minimal information regarding comparisons from individual studies included.	Studies do seem to indicate using simulators to provide feedback during learning confers an advantage in skill development; and appears to improve learners confidence and decrease anxiety. SLEs have the potential to replace up to 25% of a clinical internship. However, current research does not review long term follow up and benefits are associated with a cost.
Rezayi, 2022, Iran	Qualitative Systematic Review	16 papers published between 2008-2022. Country published: USA 43% Australia 25% Sweden 18% No further detail provided.	Studies that used technology-based simulated training settings as an intervention to train physiotherapy students.	Comparing physiotherapy students who underwent training by technology-based simulated tools with other training tools.	Physiotherapy students reported the positive effect of computerized simulation methods on improving basic knowledge, clinical reasoning, and practical and interprofessional communication skills. Suggests computer simulation could be a suitable method to replace the traditional simulation method.
Stockert, 2022, Canada/ USA	Scoping review	182 papers No further information provided.	Studies that involved the use of SBE with student physical Therapists (Simulation was defined to include the use of manikins, standardized patients, part task trainers, virtual reality applications and/or virtual patient cases)	Minimal information regarding comparisons from individual studies included.	This literature suggests that SBE in physical therapist education can be used to address numerous learning objectives. 4 common content areas: • orthopedics (n = 64) • neurological (n = 40), • cardiovascular (n = 37) • general medicine (n =35) Patient communication skills were the most commonly reported objectives for simulation with 53% reporting it as a learning objective. 31% included task/skill training as an objective and 47% included clinical reasoning. The review identified substantial limitations in the reporting of Standards of Best Practice (SOBP) related to SBE.

Table 2. Summary of included studies that investigated SBE in preregistration respiratory physiotherapy pedagogy

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
Bednarek, 2014, USA	Cohort	To illustrate how a physical therapist education program at a small university, previously without access to HFS, was able to partner with a local simulation center	n=28 4th year physical therapy students	3 simulation scenarios	Self-assessed confidence and interest in treating patients in an acute care setting	Nil	Increased confidence levels and interest in acute care

Table 3. Summary of included studies that investigated SBE in interprofessional learning

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
King, J., B, 2016, Canada	Quasi-experimental pre-post intervention study design.	Compare two different methods of patient simulation in improving competencies for students in Registered nursing, Physical Therapy and Respiratory Therapy programs.	13 Students (4 Respiratory Therapists, 5 Registered Nurses, 4 Physical Therapists) 2013 and 201443 students (19 Respiratory Therapists, 15 Registered Nurses and 9 Physical Therapists) from 3 institutions.	3 hour facilitated workshops covering topics that included hip fracture / COPD and difficulty in breathing treatment. All facilitated workshops included a debrief.	Standardised patients and mannequins	Standardised patients	Simulation improves competence (shown in conflict resolution $p<0.001$ and roles / responsibilities $p=0.03$) as judged by the Interprofessional Collaborative Competencies Attainment Scale (ICCAS) pre-post. No significant differences noted between conditions in communication, collaboration, patient/family-centred approach and team functioning.
Lefebvre, 2015, USA	Experimental Study	Examine the changes in Physical Therapy and Nursing student beliefs and attitudes toward learning from and collaborating with each other after an opportunity to engage professionally around a learning simulation involving a patient simulator and problem-solving patient code scenario.	2nd year Physical Therapy students plus volunteer 4th Year nursing students. Mean age 25 yrs. 56% female 67% white 36% no Interprofessional	Students interacted with a high-fidelity manikin, that was undergoing a cardiac arrest during a Physical Therapy treatment session in a simulated intensive care	Compared attitudes toward Interprofessional collaboration (IPC), Interprofessional Learning (IPL) and teamwork pre and post simulation.		Interdisciplinary education perception scale used. (Competence and autonomy $p=0.032$) Readiness for Interprofessional Learning scale used. (Teamwork and

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
			Education exposure 56% no previous Interprofessional Collaboration for providing direct patient care.	unit.			collaboration p=0.033) Attitudes toward healthcare teams' scales used. (Team value and Admin / MD role showed significant p-values) Teams Skills scale used (showed highly significant results).
Rossler, 2016, USA	Mixed Methods Research Study.	Four research questions which were 1. Do perceptions of readiness to learn among pre-licensure students enrolled in a health professions program of study change following an interprofessional education simulation experience? 2. Are these difference among health profession pre-licensure students in perceptions of readiness to learn and collaboration following an interprofessional education simulation experience? 3. What are the pre-licensure health professions student participants perceptions of the interprofessional education simulation experience? 4. To what extent do the quantitative and qualitative results converge?	An interprofessional sample (n=53) pre-licensure health professions students. T 50% nursing students.	A high-fidelity patient simulation scenario translated from a geriatric role play case study.	Collected demographic data, two self-report instruments; revised Readiness for Interprofessional Learning Scale (RIPLS) and the Health Professional Collaboration Scale (HPCS).		Significant differences in RIPLS subscale of negative professional identity (p=0.01) and health professional collaboration scale (p=0.01). Qualitative data explored three themes that included 'exposure to experimental learning,' 'Acquisition of interactional relationships' and 'presence of chronology in role preparation.'
Thomas,	Quasi	Examined the impact of an Intensive Care	2nd Year	Intensive Care	Confidence and		87% of clinical

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
2017, USA	experimental design. Pre and Post measures used.	simulation lab using a patient simulator and standardised patients on students' perceptions of their confidence and preparedness to work in acute care settings.	Doctoral Physical Therapy students (n=105) with 51 clinical instructors; 2nd year Occupational Therapists (MSc) (n=127). Mean age 25 years, majority of participants were white and female. Data collected over 3 years for DPT and 2 years for Clinical Instructors and Master of Occupational Therapy.	simulation lab using a patient simulator and standardised patients	Preparedness Surveys developed by investigators prior to and following the ICU lab. Using 5-point Likert scale and open-ended questions.		instructors found students were either prepared or very prepared for the acute setting in the first 2 weeks. Those not taught skills prior to simulations felt less prepared than those who did. Pressure situations were seen as valuable by a few students and 67% of students felt more prepared to practice in an ICU setting, with increased feelings of confidence and competence.
Wellmon, 2017, USA	Pre and Post Experimental Design.	To examine changes in nursing and physical therapy students' attitudes towards Interprofessional learning and interprofessional collaboration following an opportunity to engage in a simulated cardiac arrest scenario using high fidelity simulation.	2nd year students enrolled on a 3-year full time, entry level DPT program (n=41) at 1 institution and from the same institution 4th year UG BSc in nursing (n=33). Learning	90 mins Interprofessional learning experience using high fidelity simulation that was designed to address gaps in student knowledge on teamworking.	Interprofessional Education Perception Scale (IEPS), Readiness for Interprofessional Learning Scale (RIPLS) and Attitudes toward Health Care Teams Scale (ATHCTS).	Control Group (n=74) which did not have the opportunity to participate in the Interprofessional Learning experience was also included in data analysis.	Supports the effectiveness of high-fidelity simulation experience toward interprofessional learning and interprofessional collaboration. Nurses demonstrated the evidence was

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
			Intervention group (n=77) vs Control Group (n=74).				valued and positively perceived the simulation activity.

Table 4. Summary of included studies that investigated part task trainers

AUTHOR, YEAR, COUNTRY	STUDY DESIGN	PARTCIPANTS	INTERVENTION	COMPARISON	KEY FINDINGS
Hassam 2003, Hong Kong	Observational study, used a within-subject, repeated measures design with a follow-up questionnaire	37 subjects (14 males and 23 females. mean age, 21.35 ± 2.18 years) Final year physiotherapy students.	A 20-minute education session using a part-task trainer (Adapted paediatric model)	Percussion technique pre-education session conducted 2 days prior to intervention.	The findings show a clear difference between overall acceptable technique between pre- and post-education sessions (3% vs 97%) was evident Significant improvement in overall technique following the education session ($p = 0.05$). The inclusion of active practice, combined with new specific theoretical knowledge, resulted in more specific and longer retention of key components than provision of specific theoretical knowledge alone.

Table 5. Summary of included studies that investigated SBE in postgraduate respiratory physiotherapy pedology

Author(s), Year, Country	Study design	AIMS	Population	Intervention	Comparison	Control	Key findings
Gough, 2012, UK	Survey	Investigate the application and extent of SBE being utilised in post-graduate (in-service) cardiorespiratory physiotherapy training.	280 NHS trusts 155 responses were received (55%)	NA	N/A	N/A	SBE being used in a variety of competency and on-call training, skills development, refreshers and on-call training however there was an inconsistent approach across the UK.

level 1 and 2) and does not consider translation into clinical practice (Kirkpatrick level 3), patient outcomes or patient safety (Kirkpatrick level 4). Therefore, it remains challenging for some to justify the need for SBE.

META-ANALYSES AND SYSTEMATIC REVIEWS

There was heterogeneity within the studies included in the meta-analyses and systematic reviews in the populations included, the modality of SBE and the outcome measures utilised. It is clear that a range of SBE modalities have been deployed in educating respiratory physiotherapists. The optimal duration and frequency of SBE is unclear. There was a trend in all meta-analyses towards an improvement in confidence and self-efficacy as a result of SBE.

PRE-REGISTRATION

It is recognised that there is a shortage of clinical placements to meet the current demands of pre-registration physiotherapy education, and this is especially apparent in acute respiratory settings.[32] The evidence base presented in this scoping review suggests it might be possible to replace up to 25% of traditional clinical time with SBE without a detrimental impact on student attainment.[11] However, SBE is resource intense in terms of equipment, time to prepare and faculty to deliver the training. Cost-effectiveness of SBE in this model of education has not been considered and may be one of the limitations to implementing this pedagogical approach successfully.

INTERPROFESSIONAL LEARNING

Studies sourced for this scoping review revealed that the current evidence specifically for interprofessional learning SBE is limited to pre-registration in the respiratory physiotherapy field. There was a suggestion that interprofessional learning SBE improved aspects of teamwork. Uni-professional SBE may be considered appropriate when introducing SBE to a profession, or when developing specific skills. However, current educational theories encourage SBE to be delivered in multi-professional ways, which more closely represent the clinical environment.[33-35] Anecdotally, the deployment of multi-professional SBE is being incentivised, for example via funding routes.

PART TASK TRAINERS

Part task trainers are physical replicas of a body part used to help train specific skills. Part task trainers in SBE have been most widely used as a surgical pedagogical intervention. Studies included within this scoping review have indicated that part task trainers are used within respiratory physiotherapy education. They are most commonly deployed to allow the repetition of a specific skill and are most useful to allow the learner to increase proficiency and confidence in specific tasks that are invasive.[36] Part task trainers allow the learner to make mistakes in a safe environment.[37] The impact of part task trainers is limited to one study, which demonstrated improved competence. Measuring the impact on patient safety and outcomes could prove an ethically challenging methodology for many of the invasive interventions conducted by respiratory physiotherapists. Part task trainers can be costly to establish and maintain, perhaps one way to increase access would be for collaboration across organisations and geographical locations.

POSTGRADUATE

Whilst there has been an increase in research outputs in the respiratory physiotherapy arena, these are disproportionately in pre-registration contexts. This suggests there are still barriers to respiratory physiotherapists accessing SBE in the workplace. Barriers might include a lack of trained faculty (educators trained specifically in SBE to deliver it safely and effectively), access to facilities and equipment and perceived cost.[26] As SBE pedagogical approaches adapt to suit the needs of the workforce, innovations such as in-

situation scenarios, virtual/augmented reality and 360 degree videos may help to increase access to SBE. Application of these innovations has progressed rapidly in response to the COVID-19 pandemic, however they are still in their infancy. Whilst increased access to equipment is potentially on the horizon, without faculty adequately trained to deliver SBE access will remain poor. The sources presented in this scoping review have demonstrated SBE increases confidence and self-efficacy. There is a known association between confidence, self -efficacy, stress and competence but not attainment.[13,38-41] Where staff are more stressed there is a perceived need for more support, it is feasible therefore that SBE could result in reduced need for support, thus reducing pressure on senior staff.

LIMITATIONS

It was outside of the aims of this scoping review to undertake a quality assessment of the included studies. There is heterogeneity within the included studies with regards to the populations recruited, the design of the simulation based education and the outcome measures used, thus making it challenging to synthesize the results and draw conclusions. This scoping review provides an overview of the current literature and has not included the depth of analysis that a meta-analysis would provide.

FUTURE RESEARCH

None of the studies included in this scoping review have considered evolving modalities of SBE such as virtual reality, 360 degree video or gamification. The studies conducted continue to focus outcomes on learner experience. There continues to be paucity of evidence demonstrating translation of knowledge or skills learnt in SBE into clinical practice. Similarly, the impact on patient outcomes and safety specifically within the respiratory physiotherapy field has not been examined or reported. Regardless the benefits of SBE on patient safety is well documented in other fields, and whilst research in this area is encouraged this should not be considered a limitation or barrier to the further development and deployment of SBE for respiratory physiotherapists. The optimal modality and frequency of SBE remains unclear. There is increased emphasis on interprofessional education and there have been no studies considering this in a post graduate setting.

CONCLUSION

There is an increasing research output in the SBE field for respiratory physiotherapy. The evidence continues to focus on learner experience with paucity of evidence exploring impact on translation into clinical practice or patient safety. There is an increasing focus on Inter professional learning and the benefits this pedagogical approach has on teamwork. More resources and support are required to increase access to SBE for respiratory physiotherapists.

Key points

- There is an increasing research output in the simulation-based education field for respiratory physiotherapy
- The evidence continues to focus on learner experience with paucity of evidence exploring impact on translation into clinical practice or patient safety
- There is an increasing focus on inter-professional learning and the benefits this pedagogical approach has on teamwork
- There are very few research outputs considering simulation-based education in postgraduate respiratory physiotherapy training

DECLARATION OF INTEREST

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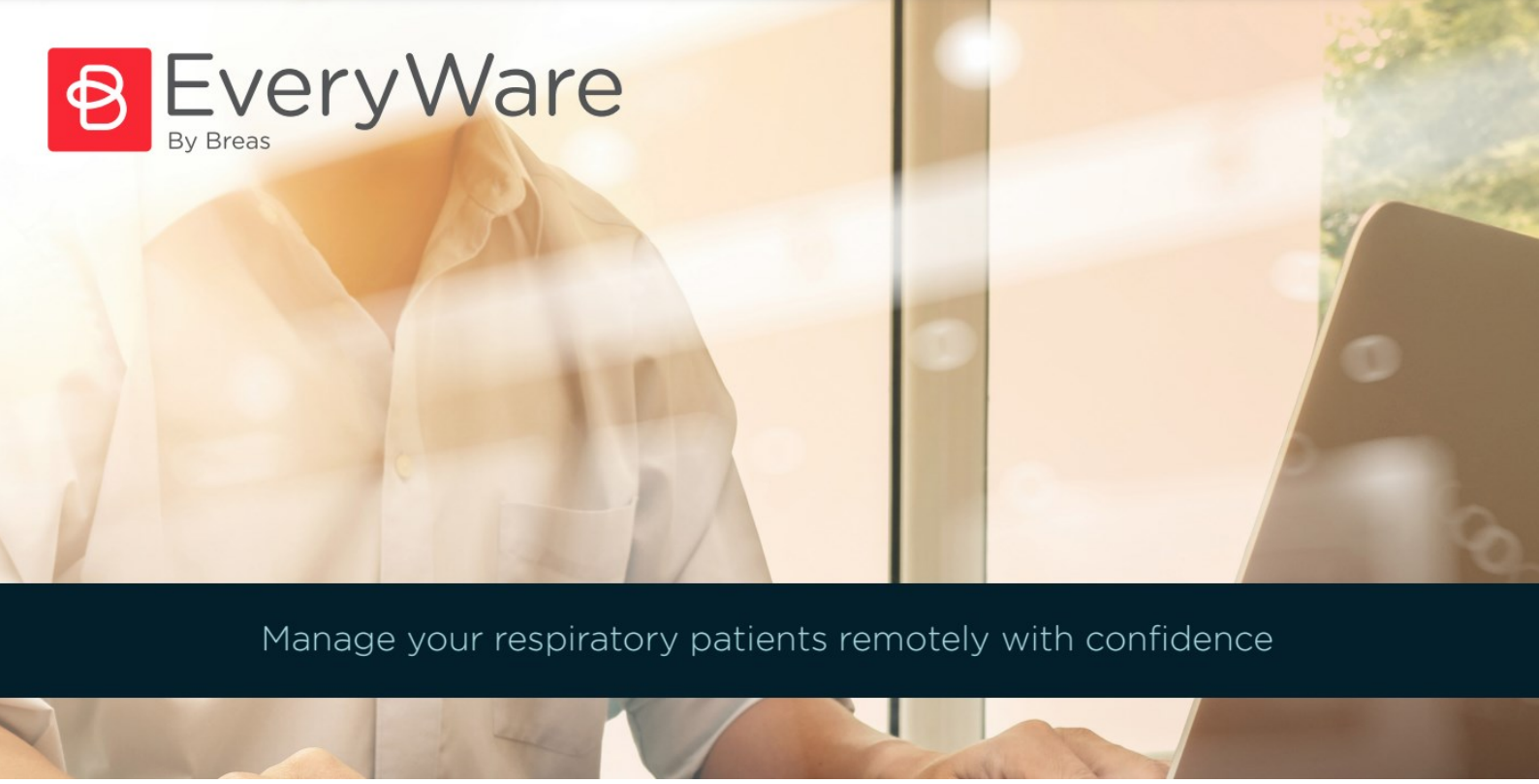

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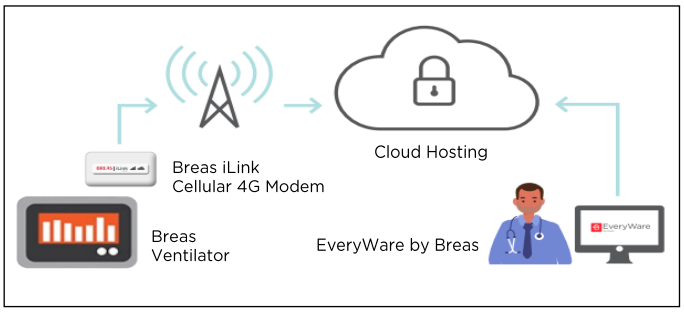

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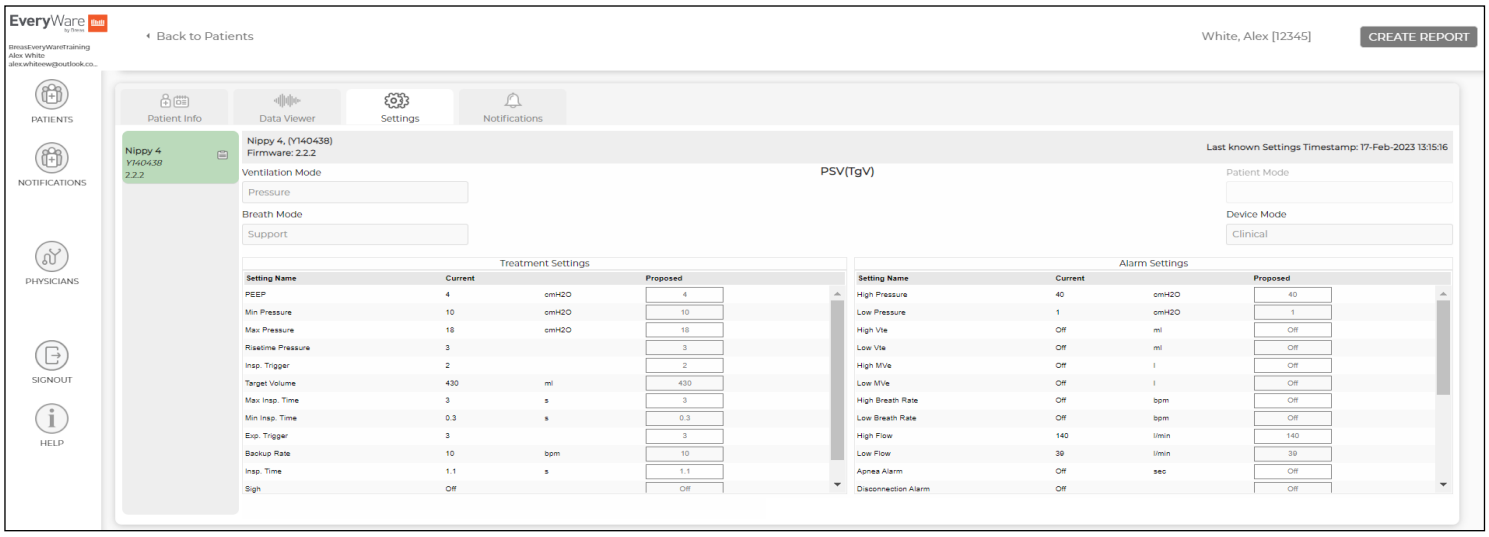

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BREAS

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Surgery

ACPRC Editorial Board Surgery Scoping Review Synthesis

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Journal of the Association of Chartered Physiotherapists in Respiratory Care

The ACPRC editorial board was established in 2019 with the purpose of leading the scoping, commissioning, co-ordination and delivery of all new ACPRC guidance documents and resources. One of the first priorities was to produce a resource around surgery and physiotherapy. This topic was subsequently separated into cardiac, thoracic and upper-gastrointestinal (GI) surgery, and with 14 contributors these have culminated in three published scoping reviews.[1-3]

The objective of each scoping review was to report the extent and type of evidence associated with post-operative physiotherapy in people undergoing surgery. The inclusion criteria for all scoping reviews comprised of invasive surgery that required post-operative hospital admission (not day surgery). Within cardiac surgery all cardiology procedures were excluded and chest wall surgery was excluded in thoracic surgery.

The search results found 2795 articles for cardiac surgery, 1809 for thoracic surgery and 4978 upper GI surgery. From these, 41 articles were included for cardiac surgery, 28 for thoracic surgery and 12 for upper GI surgery. The majority of study designs were randomised control trials, and all had a small number of systematic reviews. There were no observational studies within the upper GI scoping review. There was a wide range of different outcome measures used with some consistency across the different surgeries. It was noted that cardiac surgery included two qualitative studies, there were no qualitative studies in the thoracic and upper GI surgery search results.

The main themes identified across all surgeries were respiratory physiotherapy and mobilisation. Themes within cardiac surgery also included sternal wound and pain, patient/ staff experience and adverse events. Within thoracic surgery, themes also included taping and outcomes, and within upper GI surgery, themes included current practice and pre-operative education.

Across all surgeries early mobilisation was found to improve re-ambulation, reduce post-operative pulmonary complications (PPCs), reduced morbidity, and reduced length of stay (LOS). The thoracic surgery review also reported that pre-operative fitness correlates to post-operative outcomes.

Respiratory physiotherapy following thoracic surgery showed positive outcomes in PPCs, lung function, LOS and physical activity, but no benefit with incentive spirometry as a treatment method. Incentive spirometry and inspiratory muscle training showed positive results in upper GI surgery. However, there was little consensus across cardiac surgery studies with some evidence of the benefits of positive pressure interventions.

The cardiac surgery scoping review also covered sternal wound precautions and showed that the 'Keep your move in the tube' technique has a positive effective on recovery, LOS and reduced ongoing care needs on discharge.

Suggestions made following the scoping reviews included for cost effectiveness analysis studies to be undertaken to ascertain the best practice whilst considering expense. More qualitative studies should be undertaken with a focus on staff and patient experience, and patient reported outcome measures. This would provide insight on the success of treatment and care focussing on what is important to patients, thus improving patient engagement with services and recovery.

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Haylett R, Martin C, van Willigen Z. The challenge of defining 'safe staffing' for physiotherapists in critical care. *ACPRC Journal*.:55-57. doi:10.56792/ZHKE3048

Critical care

The challenge of defining 'safe staffing' for physiotherapists in critical care

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Journal of the Association of Chartered Physiotherapists in Respiratory Care

Physiotherapy provision is integral to the intensive care unit (ICU) multiprofessional team.[1] National guidance for the United Kingdom (UK) recommends physiotherapists play a key role in respiratory care and rehabilitation, seven days a week.[2] However, significant variation exists in patient populations and structure of ICU services across the UK. Therefore, determining recommendations for robust and responsive physiotherapy services remains a challenge.

THERAPEUTIC NEED

Currently one whole-time (WTE) equivalent physiotherapist for every four Level 3 beds is recommended.[2] However, surveys of the UK therapy workforce report that ICUs fail to achieve this ratio.[3] This indicates the limited utility of this metric for determining physiotherapy service capacity-demand. Use of staffing-to-bed ratios with reference to levels of care does not account for the complexity of critically ill patients' physiotherapeutic needs. The speed and extent to which critical illness affects body structures and function has generated focus on delivery of therapeutic interventions as early as possible following ICU admission, particularly for mechanically ventilated patients.[4,5] Although these patients require Level 3 care, we recognise they do not always have the greatest physiotherapeutic need. Often, the severity and complexity of morbidity in patients requiring Level 2 care presents the greatest demand on physiotherapy services. Combined with the heterogeneity of both the ICU population and service structure across the National Health Service (NHS), this makes quantifying physiotherapy service-demand challenging.[3]

There is urgent need for accurate physiotherapy service-demand modelling using standardised measures of complexity, to develop national workforce recommendations that are meaningful to patients, clinicians, and funders. Although some measures, such as the Rehabilitation Complexity Scale-Acute exist, they do not assess all clinical needs requiring physiotherapy resource.[6] A combined assessment including rehabilitation complexity, frailty, comorbidity, and illness severity is a reasonable starting point.[7] For effective comparisons across services and timepoints further measures that accurately and holistically capture physiotherapeutic needs of ICU patients are required. The UK and international Trauma Registries provide examples of how this is achievable at scale. Through innovation and investment, measures of complexity and outcome are consistently and accurately collected, with responsibility for data collection removed from clinicians.[8] We welcome ongoing work to establish national data collection of rehabilitation outcomes in collaboration with the Intensive Care National Audit and Research Centre (ICNARC).

IMPACT

An overarching issue in developing meaningful recommendations is succinctly demonstrating the impact of physiotherapy services on outcomes for patients, staff, and the wider healthcare system. The challenge remains to identify 'safe' and 'effective' staffing levels, and by whom this is defined. The complexity of delivering ICU rehabilitation has been described, alongside the variety of metrics by which impact could be measured.[7] There is benefit in reporting measures that encompass multiple stages of recovery and aspects of service delivery. We recommend the reporting of service delivery and demand metrics alongside those relating to patient outcome. Without this, therapy services cannot robustly defend requests for increases in capacity through investment, identify areas of good practice, or areas for improvement.

It is recognised that a focus on survival is insufficient to describe outcomes from ICU.[9] However, outcome measures commonly used in physiotherapy interventional trials may not describe the quality of life (QoL) patients most value.[10] The complexity of patients' experiences of critical illness, and the value of integrating patient-reported measures to datasets has been described.[11] Future work to establish health-related QoL and patient perspectives will be valuable in informing wider adoption of such measures.[12]

Direct measures of patient outcomes are not the only drivers for optimising the ICU physiotherapy workforce. A recent survey demonstrated that improved staffing ratios were associated with increased staff satisfaction.[13] The link between staff satisfaction, retention, and the quality of care that is provided is well-established.[14] Additionally, the majority of physiotherapy activity is dedicated to direct clinical care, and variation in funding of roles exists.[15] This limits clinicians' ability to engage in essential non-clinical activity required to deliver effective and fulfilling ICU services, thereby reducing capacity for leadership, service development, and research. We would advocate for accurate representation of the non-clinical requirements of phys-

iotherapy roles through job-planning as recommended by NHS England.[16]

EDUCATION

Variability exists in the Agenda for Change banding of ICU physiotherapists, and availability of ring-fenced funding for dedicated physiotherapy services.[3] Guidance specifies the level of postgraduate training and provision of clinical educators and supernumerary periods for nursing staff,[2] but not allied health professionals (AHPs). Workforce planning is required to ensure that clinicians with appropriate skills are available. This relies on the structured development of staff in the specialism of critical care. The Intensive Care Society Critical Care Professional Development Framework (CCPDF) provides this structure.[17,18] We recommend that physiotherapists utilise this to support development of staff and demonstrate the impact of the workforce through its integration into appraisals, strategy, and education.

Guidelines highlight the need for robust capacity-demand models to ensure physiotherapy capabilities are matched to the case-mix complexity.[2] Our profession needs innovation, beyond traditional methods of local competencies that remain isolated, and at risk of becoming out-of-date or irrelevant to practice. We advocate physiotherapists access critical care postgraduate education, and there are UK exemplars. The Capital AHP collaborative have developed competencies for novice physiotherapists, and Liverpool University in conjunction with Health Education England have developed an integrated postgraduate course for AHPs and nursing staff. We support building on these models to develop UK-wide integrated courses. However, workforce development requires support through appropriate infrastructure, investment, and prioritisation by clinicians and Trusts/Health Boards. Key advancements include establishment of physiotherapy clinical educator roles in ICU and ensuring access to appropriate qualifications across all CCPDF pillars of practice.

The optimisation of ICU physiotherapy workforce provision remains a complex issue. Meaningful capacity-demand models are essential to the provision of sustainable high-quality services. There are opportunities to make progress. We have an increasing understanding of workforce through research, and individual units have the capability to consider how best to quantify demand, impact, and staffing requirement. With a focused and collaborative approach between all stakeholder groups, we can sustain an effective, valuable, and responsive workforce.

Key points

- Collaborative approaches are required to define and establish a safe and effective physiotherapy workforce
- Post-graduate education and/or training should be accessible for all critical care AHPs to achieve a minimum standard of practice
- Innovation is required to ensure consistent collection of measures of impact, relating to service delivery, staff capability, and meaningful patient outcomes
- Future workforce recommendations should move beyond sole use of staffing ratios to define minimum staffing standards

DECLARATION OF INTEREST

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Commentary

Greenshoots to Chief Investigator: Physiotherapy led research in critical care

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BACKGROUND

The delivery of evidence-based practice (EBP) underpins improvement in patient care, an essential component of which is the individual clinician's research capability.[1] Numerous schemes have been developed by organisations such as the National Institute of Health and Social Care Research (NIHR)[2] to enable clinicians to engage in research. Many of these schemes provide clinical staff with the opportunity to gain practical research experience while continuing their day-to-day clinical roles.

More recently, there has been a focus on actively engaging allied health professionals and nurses in clinical research. Within this evolution, physiotherapists have tended to support medically lead research through tasks such as data collection, however physiotherapy led research remains relatively novel.

The MSK-ICU Study[3] is an NIHR funded, multi-centre observational study aiming to determine and characterise the musculoskeletal (MSK) health state of intensive care unit (ICU) survivors. The study ran over four sites with one Chief Investigator (CI), five Principal Investigators (PI), three Associate PIs and one Greenshoots Scheme member. Those involved are all physiotherapists who undertook their respective roles for the first time. The CI is responsible for the whole study conduct. There is one PI at each study site responsible for their local conduct. In this commentary, we describe our experiences as the physiotherapists undertaking these roles as part of a physiotherapy led critical care study.

NEW OPPORTUNITIES

The schemes described in this commentary include the NIHR Associate PI (API) and Greenshoot opportunities. The Greenshoots Scheme runs over three to six months with a protected half day per week to develop skills required to contribute to research delivery and needs to be sponsored by an NIHR portfolio study. The API Scheme runs over six months aligned to a registered NIHR study and does not require any protected time. Both schemes offer opportunities to gain exposure and experience to develop research governance knowledge, leadership skills and relevant application. APIs are mentored by the local PI while continuing their clinical roles, to better understand the challenges and structure required to actively undertake research activity. The five PIs were responsible for the conduct of the study at their individual sites. The PIs were closely supported by the CI who provided direction and guidance for their development to enable this research leadership role.

LEARNING FROM NEW OPPORTUNITIES

From very early in this study, it was evident there was a strong interest for physiotherapists to contribute to research and there was enthusiasm for physiotherapy led research. This was likely driven by the real-world exposure we gained by recruiting to the specific patient populations we treat daily.

Additional benefits arose through enhanced multidisciplinary working with the research nurses. This allowed for direct learning of skills such as participant screening, recruitment and documentation from expert practitioners.

The schemes advise on possible learning opportunities to seek experience across the breadth of study duration. In addition to local MDT working, the schemes were excellent vehicles to gain experience in a variety of research delivery roles.

Many of us who undertook the formal schemes wished we could repeat them as the study progressed into different stages to allow for broader experiences of the research process.

Inherently, as we soaked up the learning opportunities, reflected on the discussions and became more familiar with the study processes, confidence in research activity began to blossom. This included the CI who embraced the challenges of juggling the oversight of a multicentre study.

STAFF DEVELOPMENT AND NETWORKING

This physiotherapy-led study has facilitated staff development of research during the clinical week. Only the CI and one PI are in dedicated clinical academic roles. Beyond awareness and experience of study delivery, some of us have had opportunities to deliver research related presentations to local clinical teams and attend related courses.

By making research less daunting, it has ignited an interest for many and created awareness for future development opportunities. These opportunities have been enabled by peer and senior discussion and support.

Outside of the immediate investigators, such as PIs and APIs, research opportunities have also been extended to clinical colleagues. Some of the local physiotherapy teams who completed their Good Clinical Practice training and once on the delegation log, supported the study on an ad-hoc basis. We also benefited from networking opportunities across the four study sites beyond the increased research activity at individual sites. These encouraging collaborations may have the potential to feed into future physiotherapy focused or led studies being developed and undertaken.

RESEARCH GOVERNANCE AND LEADERSHIP

Relative to the respective scope of our study roles, we all increased our understanding of research governance and associated processes. For example, these may have included discussions on relevant eligibility checks for APIs supported by PIs. The PIs and CI developed leadership skills such as foresight, planning and troubleshooting to enable efficient study operations. This ensured comprehensive research standards and conduct. By actively engaging, we all gained an insight and more so an appreciation of the reality of research and its rigour. We would advocate that effective communication was pivotal to this, and we were encouraged to have open, regular, and timely contacts with the CI.

CONCLUSION

This commentary has described a physiotherapy led research study facilitating increased exposure and experience across a range of study roles. It highlights the rich opportunities enjoyed across education, through local networking and contributing to high level research. We have gained an insight into how research can be clinically based and directly involve our patient populations within local hospitals to improve EBP delivery. We would advise anyone interested in gaining exposure to research to investigate the various schemes discussed or contact research active teams within their local Trust for opportunities to be involved.

DECLARATION OF INTEREST

Nil conflicts to declare.

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