
# Journal of the Association of Chartered Physiotherapists in Respiratory Care

Volume 55 • Issue 1 • 2023

www.acprc.org.uk

ACPRC

# Contents

# ACPRC editor foreword

We are delighted to bring you volume 55, issue 1 for the *Journal of the Association of Chartered Physiotherapists in Respiratory Care*.

It was wonderful to see so many of the ACPRC community in person at our recent conference *One team: meeting the challenge through people, practice and policy* in April 2023, and the wide-variety of projects being presented. All abstracts accepted for poster or presentation at the conference will be published in a supplementary edition of the journal later this year.

This volume starts with Buss et al. who present a service evaluation of a benchmarking project on mobilisation targets following oesophagectomy surgery. There are then two qualitative studies, with Hardy-Bosson et al. exploring perceptions and experiences of adults with neuromuscular disorders and their carers, in relation to airway clearance and respiratory physiotherapy in the community, and Jackson and Gardiner who explore the barriers and facilitators to physical activity, during the COVID-19 pandemic in people living with chronic respiratory disease. The experience from Leicester during the COVID-19 pandemic, in relation to upper-limb specialist input into intensive care, to prevent proning associated complications is then presented by Tunnicliffe et al.

The volume also includes an updated position statement and considerations, from the 2021 publication by Gardiner et al. for remotely delivered pulmonary rehabilitation services. There is also a further publication from the ACPRC editorial board with Eden et al., presenting a scoping review on post-operative physiotherapy in people undergoing cardiac surgery.

The final piece in the volume is an invited editorial from the outgoing chair of the editorial board Dr. Una Jones, in which she reflects on the work in the editorial board, since its inception in 2019, and the valuable resources and outputs that the board have produced. Many congratulations to Dr. Agnieszka Lewko, in being appointed new chair of the board.

As always, we hope that you enjoy reading this issue of the ACPRC journal, and that you are inspired to write-up and submit your work. 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. We are currently in the process of making changes to the journal, that will make the submission, review and editing processes easier and quicker. We'll also be making changes to the website, updating author guidance, and creating resources for reviewers. Please continue to look out for announcements in the newsletter of all these changes.

**Kind regards**

*Amy Bendall (MSc., MCSP) and Owen Gustafson (MSc Res., MCSP)*

**Email: journal@acprc.org.uk**

## Reviewers' acknowledgement

**The journal editors and ACPRC committee, would like to warmly thank the following 25 reviewers who reviewed manuscripts in 2022.**

**Annika Buss**

**Charlotte Carter-Lang**

**Deborah Church**

**Allaina Eden**

**Lucy Gardiner**

**Jonathan Grant**

**Rebekah Haylett**

**Simon Hayward**

**Elizabeth King**

**Adam Lewis**

**Mary-Ann Lyons**

**Clair Martin**

**David McWilliams**

**Jemma Mears**

**Ellie Melkuhn**

**Jason Nunn**

**Charlotte Pereira**

**Cathy Sandsund**

**Akshay Shah**

**Harriet Shannon**

**Ema Swingwood**

**Emma Tucker**

**Paul Twose**

**Lou Warnock**

**Huw Woodbridge**

# Benchmarking enhanced recovery after surgery oesophagectomy mobilisation targets: A service evaluation

**Annika Buss[1,2], Ella Sissons[3], Rebekah Haylett[2], Sarah Vollam[1,4] and Owen Gustafson[2,5]**

[1]Critical Care Research Group, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, Oxfordshire, U.K.
[2]Oxford Allied Health Professions Research & Innovation Unit, Oxford University Hospitals NHS Foundation Trust, Oxford, OX3 9DU, U.K.
[3]Department of Sport, Health Sciences and Social Work, Oxford Brookes University, Headington Campus, Oxford, OX3 0BP, U.K.
[4]Oxford NIHR Biomedical Research Centre, Oxford, OX3 9DU, U.K.
[5]Centre for Movement, Occupational and Rehabilitation Sciences, Faculty of Health and Life Sciences, Oxford Brookes University, Oxford, OX3 0BP, U.K.

*Keywords* | Oesophagectomy, mobilisation, ERAS, benchmarking.

*Correspondence author* | Annika Buss. Telephone: 01865 223059. Email: annika.buss@ouh.nhs.uk.

## Abstract

### Background

Enhanced recovery after surgery (ERAS) encompasses standardised post-operative care for a wide-range of surgical specialties. ERAS is recommended following oesophagectomy surgery to reduce the risk of pulmonary complications and enable faster return to baseline function. Current ERAS oesophagectomy guidelines advocate early mobilisation as a key component but there is no clear guidance on mobility targets to aim for, or an evidence base to support setting specific mobilisation targets for these patients. A local service evaluation over six months, revealed that 74% ($n$ = 23) of oesophagectomy patients did not achieve the ERAS day one or two post-operative mobility targets. Benchmarking mobility targets will allow comparison of the local ERAS targets in relation to those set in other upper gastrointestinal (UGI) centres and identify if the failure to achieve these is a local or national issue. Aims were to benchmark day one and two post-operative oesophagectomy ERAS mobility targets across similar sized UGI centres to the local trust determine how targets were established and identify potential reasons for failure to meet them.

**Methods**

A benchmarking design using an online survey to evaluate ERAS mobility targets and service provision following oesophagectomy. Purposive sampling was used to invite UGI centres in England with an established ERAS pathway to participate. All centres were given three weeks to complete the survey for patients admitted between 1st May 2021–31st October 2021.

**Results**

Ten centres agreed to take part with seven subsequently completing the survey. Two centres reported not having standardised mobility targets. There was no consensus among the other five centres who reported progressive ambulatory targets varying from sitting out of bed to walking 50–100 metres. There was variation in how mobility targets were determined, from expert opinion to group consensus. No centre reported using evidence to determine the targets. The most common reasons for failure were hypotension (65.5%) and pain (50%).

**Conclusions**

There was no consensus in post-operative mobility targets across centres despite mobilisation being advocated in oesophagectomy ERAS guidelines. In the absence of evidence mobility targets, they were informed by expert opinion. Future research should focus on investigating the optimum level of post-operative mobilisation on days one and two for oesophagectomy ERAS pathway patients.

## Introduction

Enhanced recovery after surgery (ERAS) is defined as a '*multimodal perioperative care programme*', which requires a multidisciplinary team approach and categorises care into pre, intra and post operative elements (1). ERAS can reduce hospital and intensive care unit (ICU) length of stay and minimise the risk of post-operative pulmonary complications (PPCs) by promoting a return to baseline functioning as efficiently as possible after surgery (2, 3). ERAS which first began following colon resections (4) has been adopted by other surgical specialties and in 2018 ERAS guidelines for oesophagectomy were published (5).

The risk of developing PPC's for patients post upper gastrointestinal surgery (UGI) is higher than other surgical specialities with oesophagectomy patients having a five-fold increased risk (6). A key aspect of all ERAS guidelines is early mobilisation (EM) which aims to reduce PPC risk by increasing tidal volume minute ventilation and aiding dependent lung recruitment (7). EM has been demonstrated to be safe and effective to implement in ICU and high dependency unit environments (8, 9).

The 2018 ERAS oesophagectomy guidelines state that a standardised EM approach should be used with '*an incremental increase in activity each day to reach predetermined targets*', however, setting the targets is open to interpretation (5). The lack of a standardised definition for early mobilisation has previously been recognised with the definition of early mobility ranging from sitting out of bed to ambulation at varying time points post admission (10, 11).

### Background

A local service evaluation over six months revealed that 74% ($n$ = 23) of oesophagectomy patients did not achieve the ERAS post-operative mobility target on days one and two after surgery. This was conducted in a cancer and organ transplant surgery specialist ICU with six beds and two isolation side rooms. The local ERAS day one target aims for the patient to sit out of bed twice for two hours, alongside two walks of over 40 metres. The day two target is to sit out of bed twice for two hours again and complete two walks of over 100 metres. The primary reason for not achieving targets was hypotension (65%, $n$ = 15) especially in patients who had an epidural (93%, $n$ = 14). Currently there is little evidence to support best practice for EM in UGI surgery ERAS programmes (11). There has been no comparison to date of the ERAS mobility targets following oesophagectomy in UGI centres in England, therefore it is unclear if failure to achieve these, is a local or national issue.

### Aims and objectives of study

The aim of this benchmarking project was to determine the ERAS mobilisation targets that UGI centres in England set for oesophagectomy patients. A secondary aim was to determine how these targets were established and determine clinicians' views for failure to meet them.

## Methods

This England based benchmarking service evaluation is reported, following the *Standards for quality improvement reporting excellence (SQUIRE) guidelines* (12).

### Setting and sample

England based UGI centres were included if they were an institution of a similar size to the local trust and had an established ERAS pathway for oesophagectomy patients. Purposive sampling was used to identify and invite the centres to participate.

### Data collection tools and methods

An online survey made up of two sections, including service provision and mobility targets was developed. The survey was piloted locally and adjusted based on feedback prior to dissemination. The survey was anticipated to take 20 minutes to complete based on the pilot with all invited centres being given a three-week period to complete the survey. The questions referred to oesophagectomy patients admitted between 1st May 2021 and 31st October 2021. This period was chosen due to pressures of the COVID-19 pandemic

causing disruption to the number of elective surgeries being conducted before this time. A follow up reminder email was sent one week before the deadline.

### Data analysis

Data was transferred to an excel document and manually checked for completeness. Demographics were summarised using descriptive statistics. Non-numerical data was arranged into tables and a narrative synthesis was used to discuss the varying responses.

### Ethical approvals

The research and development department at the local NHS trust were contacted and confirmed the project as a service evaluation which did not require ethical board review. The project was registered locally as a service evaluation (Ulysses number 5287). Participating centres were aware that participation in this project was entirely voluntary and they were free to withdraw at any point.

## Results

### Survey response

Of the twelve centres contacted, ten centres agreed to take part. Responses were received from seven centres across England, which along with data collated from the same date periods in the local trust, resulted in eight centres being included in the overall analysis (Table 1). The ten centres who agreed to participate all had established ERAS oesophagectomy pathways. All questions had a 100% completion rate with only two centres being unable to specify the number of oesophagectomies performed during the six-month period. Median survey completion time was 9.14 minutes with a minimum five and maximum 13 minutes.

**Table 1: Location of participating centres.**

| Centre number | England region |
|---|---|
| 1 | Northwest |
| 2 | London |
| 3 | London |
| 4 | Southeast |
| 5 | Northeast |
| 6 | Southwest |
| 7 | Northeast |
| 8 | Southeast |

### Service provision characteristics

Six centres provided data on the number of oesophagectomies performed in the period analysed. The number ranged from a minimum of 21 to 50 maximum, with an average of 41

procedures in the six-month time frame. Patients were predominantly admitted post operatively to a closely monitored environment, either HDU or ICU, with one centre providing no further information on post-operative location for their patients (Table 2).

**Table 2: Admission information.**

| Centre number | Are oesophagectomy patients routinely admitted to ICU or HDU post operatively? | If 'other' then where are they admitted? |
|---|---|---|
| 1 | Other | Post-operative care unit |
| 2 | Other | Critical care unit, does not specify L2/3 beds |
| 3 | ICU | |
| 4 | HDU | |
| 5 | HDU | |
| 6 | Neither | |
| 7 | Either | |
| 8 | Other | Critical care unit, with both L2 and L3 beds |

### Mobilisation provision

Two centres (25%) did not report standardising their post-operative day one and two mobilisation targets. As Table 3 demonstrates, there was wide-variation in who provided the mobilisation with the majority (67.5%) utilising an ICU/HDU physiotherapy team. Other responses included using a ward physiotherapy team with level 1 nursing staff or a combination of surgical therapists and critical care therapists. The final centre reported their nursing staff were predominantly responsible for providing mobility with physiotherapists only assessing and treating as indicated.

**Table 3: Mobilisation provision and targets.**

| Centre number | Which team provide the mobility interventions? | How were the ERAS mobility targets for your centre determined? | Is compliance to mobility targets monitored? | Who completes the monitoring of mobility targets? |
|---|---|---|---|---|
| 1 | Other | Pathway development | Yes | Other |
| 2 | ICU/HDU physiotherapy team | Experience of patient group, clinical presentation, attachments, not evidence based | Yes | Surgeon/surgical team |
| 3 | ICU/HDU physiotherapy team | Set by Band 8 based on expert opinion and audit | Yes | ICU/HDU therapy team |
| 4 | Other | Expert opinion | Yes | Dedicated ERAS team |
| 5 | A combination | Consensus of group | Yes | Dedicated ERAS team |
| 6 | Other | Unknown | No | N/A |
| 7 | ICU/HDU Physiotherapy team | Unknown | No | N/A |
| 8 | ICU/HDU Physiotherapy team | Expert opinion | Yes | ICU/HDU therapy team |

### Mobilisation targets

There was wide variation in how the ERAS targets were determined by each centre with two reporting unknown and other answers ranging from expert opinion to group consensus with no clear evidence-based approach (Table 3). All the centres reported progressive targets from day one to day two post operatively (Table 4). There was no consensus in these targets with varying intensity levels aimed for by differing centres. Most distance targets were set in metres with only one centre reporting their goal in feet and one in steps. Distance targets varied from 50 steps on day one to 100 metres on day two. An epidural was used in three of the eight centres with two others detailing that they utilised either paravertebral blocks, long-acting infusions or patient controlled analgesia as alternative analgesic

methods for their patients. The remaining centres did not specify what alternative analgesic method to an epidural was used. Reasons to not meet mobility targets were numerous with the most common answers being hypotension ($n = 5$, 62.5%) and pain ($n = 4$, 50%).

**Table 4: Mobilisation targets and reasons for failure.**

| Centre number | What is the day 1 mobility target? | What is the day 2 mobility target? | Is an epidural commonly used as pain relief? | What is the most common reason for failure to meet mobility targets? |
|---|---|---|---|---|
| 1 | Sit out-of-bed | Sit out-of-bed, mobilise on spot | Yes | Pain, attachments (epidurals and chest drains), oxygen requirements |
| 2 | Sit out-of-bed | Mobilise 50m | No | Hypotension, pain, ventilation/trache/ movement restrictions |
| 3 | 50 steps minimum, sit out-of-bed | 50–100 steps, sit out-of-bed | No | Intubation |
| 4 | 2 × walks (25/50m) | 3 × walks (25/50m) | No | Pain |
| 5 | Walk 50–100 feet | Walk 3 times (no set distance) | No | Hypotension |
| 6 | Sit out-of-bed (aiming for 6 hours) | Mobilise 10m | No | Hypotension |
| 7 | Out of bed mobilisation | Mobilise 60m × 2 | Yes | Pain, hypotension, respiratory deterioration |
| 8 | Sit out-of-bed, 2 × 2 hours, mobilise 40m × 2 | Sit out-of-bed 2 × 2 hours, mobilise 2 × 100m | Yes | Hypotension |

## Discussion

This service evaluation has demonstrated the lack of standardisation and wide-variety of post-operative mobility targets set for ERAS oesophagectomy patients across England. Mobilisation was provided by a variety of teams and professional groups with no centre

identifying a clear evidence base for how local targets were set. Failure to achieve targets was often due to pain and hypotension with epidurals being used by some centres as recommended in the 2018 ERAS guidelines for first line analgesia.

The lack of standardisation makes it difficult to compare targets between centres and establish any consensus on the optimal mobilisation target in the immediate post-operative days. This finding is consistent with other studies investigating upper GI ERAS protocols, where there is no standard definition of early mobilisation ranging from sitting out of bed to early ambulation (10, 13). This could lead to possible high interpretation bias when attempting to assess overall unified compliance rates between centres (10, 13).

ERAS adherence assessment varies with local protocols being able to be modified according to clinical requirements and centre capabilities (13). Adherence has commonly been assessed either as the proportion of patients achieving their target discharge date (14) or alternative methods include calculating the number of preoperative and postoperative elements fulfilled with high compliance suggested as fulfilling >70% and low (<70%), though again this definition can vary making comparison of protocol elements difficult (13). With no regional agreement or evidence base appearing to exist for mobility targets to be based on, it is recommended that local data collection is used establish baseline local performance and subsequent targets.

Wide-variation in the professions providing early mobilisation was reported from the survey including ICU physiotherapy teams, surgical therapists, and nursing staff. Previous research has demonstrated that mobilisation delivery time may be impacted by differing professions (15, 16). As the primary reasons reported by the centres for not achieving the targets set were pain and hypotension with oesophagectomy patients often having numerous attachments, it may be that some clinicians have a lower threshold to stop the sessions and thus not achieve the set targets. Other considerations for why reported targets are not achieved may be that published studies underestimate nurse-led activity by only focusing on physiotherapy-led activities and reported levels of mobility achieved during physio sessions. Nurses can perform out-of-bed transfers later in the day or early evening so this may lead to improved adherence to the goals, but it is not recognised in the data collection of studies (17).

Epidurals have been advocated by the guidelines as the first line approach to post-operative analgesia to enable earlier extubation, deep breathing and mobilisation (5). Complications can include postural hypotension from sympathetic blockade, that in-turn can limit mobilisation of these patients post-operatively (17, 18). The 2018 guidelines state that paravertebral blocks (PVB) can be a good alternative, given the reduced impact on mobilisation with evidence from systematic reviews stating hypotension was less of an issue when PVBs were utilised (5, 19). Only three of the surveyed centres reported using epidurals as first line analgesia although those that reported used alternative analgesic methods, such as PVB also

reported hypotension being an issue with mobilisation. This warrants further investigation along with other potential contributory factors such as intra-operative fluid restriction.

Limitations of this study include a purposive sampling method which leaves this paper open to potential researcher bias. However, all efforts were made to contact as many centres as possible that matched a similar sized oesophagectomy cohort to the local trust. Not all the contacted centres responded but those that did had 100% completion rate of questions included in the survey. Actual adherence rates to the mobilisation ERAS element were also not fully assessed with only suggestions being made by each centre for the factors contributing to failure meeting the targets set and number of oesophagectomies performed. The survey was kept short to assist with a greater response rate, so detailed data comparison was unable to be performed.

## Conclusion

There was no consensus in post-operative mobility targets across centres despite mobilisation being advocated in oesophagectomy ERAS guidelines. In the absence of evidence, mobility targets were informed by expert opinion. Future research should focus on investigating the optimum level of post-operative mobilisation on days one and two for oesophagectomy ERAS pathway patients.

### Key points

- Poor standardisation of data collection limits detailed comparison between centres and the sharing of best practise.
- Local standards continue to be informed by expert opinion.
- Audit of local pathways could help optimise delivery of enhanced patient recovery.

## Acknowledgments

The authors would like to thank the Adult Critical Care Physiotherapy Team at the John Radcliffe Hospital, and the Critical Care Research Group, at the University of Oxford for their support.

### Conflict of interest disclosure

The authors declare that there is no conflict of interest.

### Financial support

Owen Gustafson, Clinical Doctoral Research Fellow, NIHR301569, is funded by Health Education England (HEE)/National Institute for Health Research (NIHR). Annika Buss and Sarah Vollam, were supported by the NIHR Oxford Biomedical Research Centre. The views expressed are those of the authors, and not necessarily those of the NIHR, NHS or the U.K. Department of Health and Social Care.

## References


1 Ljungqvist O. ERAS – enhanced recovery after surgery: moving evidence-based perioperative care to practice. *JPEN J Parenter Enteral Nutr.* 2014;38(5):559–566. https://doi.org/10.1177/0148607114523451.

2 Fleming IO, Garratt C, Guha R, et al. Aggregation of Marginal Gains in Cardiac Surgery: Feasibility of a Perioperative Care Bundle for Enhanced Recovery in Cardiac Surgical Patients. *J Cardiothorac Vasc Anesth.* 2016;30(3):665–670. https://doi.org/10.1053/j.jvca.2016.01.017.

3 Noba L, Rodgers S, Chandler C, Balfour A, Hariharan D, Yip VS. Enhanced Recovery After Surgery (ERAS) Reduces Hospital Costs and Improve Clinical Outcomes in Liver Surgery: a Systematic Review and Meta-Analysis. *J Gastrointest Surg.* 2020;24(4):918–932. https://doi.org/10.1007/s11605-019-04499-0.

4 Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth.* 1997;78(5):606–617. https://doi.org/10.1093/bja/78.5.606.

5 Low DE, Allum W, De Manzoni G, et al. Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS®) Society Recommendations. *World J Surg.* 2019;43(2):299–330. https://doi.org/10.1007/s00268-018-4786-4.

6 Yang CK, Teng A, Lee DY, Rose K. Pulmonary complications after major abdominal surgery: National Surgical Quality Improvement Program analysis. *J Surg Res.* 2015;198(2):441–449. https://doi.org/10.1016/j.jss.2015.03.028.

7 Orfanos P, Ellis E, Johnston C. Effects of deep breathing exercise and ambulation on pattern of ventilation in post-operative patients. *Aust J Physiother.* 1999;45(3):173–182. https://doi.org/10.1016/s0004-9514(14)60348-2.

8 Hodgson CL, Berney S, Harrold M, Saxena M, Bellomo R. Clinical review: early patient mobilization in the ICU. Crit Care. 2013;17(1):207. Published 2013 Feb 28. https://doi.org/10.1186/cc11820.

9 Reid JC, Unger J, McCaskell D, Childerhose L, Zorko DJ, Kho ME. Physical rehabilitation interventions in the intensive care unit: a scoping review of 117 studies. *J Intensive Care.* 2018;6:80. Published 2018 Dec 7. https://doi.org/10.1186/s40560-018-0349-x.

10 Dorcaratto D, Grande L, Pera M. Enhanced recovery in gastrointestinal surgery: upper gastrointestinal surgery. *Dig Surg.* 2013;30(1):70–78. https://doi.org/10.1159/000350701.

11 Feldheiser A, Aziz O, Baldini G, et al. Enhanced Recovery After Surgery (ERAS) for gastrointestinal surgery, part 2: consensus statement for anaesthesia practice. *Acta Anaesthesiol Scand.* 2016;60(3):289–334. https://doi.org/10.1111/aas.12651.

12 Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf.* 2016;25(12):986–992. https://doi.org/10.1136/bmjqs-2015-004411.

13 Gustafsson UO, Hausel J, Thorell A, et al. Adherence to the enhanced recovery after surgery protocol and outcomes after colorectal cancer surgery. *Arch Surg.* 2011;146(5):571–577. https://doi.org/10.1001/archsurg.2010.309.

14 Hammond JS, Humphries S, Simson N, et al. Adherence to enhanced recovery after surgery protocols across a high-volume gastrointestinal surgical service. *Dig Surg.* 2014;31(2):117–122. https://doi.org/10.1159/000362097.

15 Lewis M, Cumming L, Twose P. Comparison of perceptions and barriers to mobilization in critical care: A comparison of nursing staff and physiotherapists – A single-site service evaluation [published online ahead of print, 2021 Apr 5]. *Nurs Crit Care.* 2021;10.1111/nicc.12625. https://doi.org/10.1111/nicc.12625.

16 Garzon-Serrano J, Ryan C, Waak K, et al. Early mobilization in critically ill patients: patients' mobilization level depends on health care provider's profession. *PM R.* 2011;3(4):307–313. https://doi.org/10.1016/j.pmrj.2010.12.022.

17 Hussey JM, Yang T, Dowds J, O'Connor L, Reynolds JV, Guinan EM. Quantifying postoperative mobilisation following oesophagectomy. *Physiotherapy.* 2019;105(1):126–133. https://doi.org/10.1016/j.physio.2018.08.004.

18 Baidya DK, Khanna P, Maitra S. Analgesic efficacy and safety of thoracic paravertebral and epidural analgesia for thoracic surgery: a systematic review and meta-analysis. *Interact Cardiovasc Thorac Surg.* 2014;18(5):626–635. https://doi.org/10.1093/icvts/ivt551.

19 Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials [published correction appears in Br J Anaesth. 2007 Nov;99(5):768]. *Br J Anaesth.* 2006;96(4):418–426. https://doi.org/10.1093/bja/ael020.

# Vicore is honoured to collaborate with the pulmonary rehabilitation community. Looking at treatments for lung disease from every angle.


Almee™ is the Vicore digital therapeutic (DTx) intended to treat anxiety in pulmonary fibrosis. Read more about this at-home personalized therapy and the ongoing clinical study here: **www.almeetherapy.com**

vicore pharma

Almee™ is an investigational medical device pending FDA clearance

vicorepharma.com | info@vicorepharma.com | Kornhamnstorg 53, SE-111 27 Stockholm, Sweden

# Perceptions and experiences of adults with neuromuscular disorders and their carers in relation to airway clearance and respiratory physiotherapy in the community

**Emily Hardy-Bosson[1], Harriet Shannon[2] and Leyla Osman[2]**

[1]Keele University, Staffordshire, U.K.
[2]University College London, London, U.K.

*Keywords* | Neuromuscular disorders, respiratory physiotherapy, airway clearance, perceptions, experiences.

*Correspondence author* | Emily Hardy-Bosson. Telephone: 07814 229600.
Email: e.hardy@keele.ac.uk.

## Abstract

### Background

Multidisciplinary care, including respiratory physiotherapy, is advocated for people with Neuromuscular disorders (NMD) to manage respiratory muscle weakness, maximise cough efficiency and support airway clearance. The experience and perceptions of adults with NMD regarding airway clearance and respiratory physiotherapy are not known.

### Methods

People with NMD and their carers participated in online semi-structured interviews. They were recruited via convenience sampling from a Neuromuscular Centre and the Motor Neurone Disease Association. Data was analysed using content analysis.

### Results

Five people with NMD and three carers were successfully interviewed. Results suggested barriers to specialised services for adults with NMD. People with NMD were either unclear about, or unable to identify what was meant by respiratory physiotherapy or airway clearance. They also reported having no access to a respiratory physiotherapist at clinics or charity settings. Conversely, all needed to clear their secretions daily and suggested that there was value in education and reassurance about their respiratory management. Fears over the potential lack of services, including physiotherapy, were expressed.

**Conclusion**

People with NMD may have unmet needs in relation to airway clearance and respiratory physiotherapy in the community. Further research is needed to explore perceptions of the role of airway clearance, and respiratory physiotherapy among other clinicians, so that barriers to accessing respiratory physiotherapy services can be understood and addressed.

## Introduction

Neuromuscular disorders (NMD) are a heterogeneous group of progressive neurodegenerative disorders with varying prevalence. For example, reported prevalence for motor neurone disease and muscular dystrophies are five and 16 people per 100,000 respectively (1, 2). People with NMD have progressive muscle wasting, often affecting either one or all the major respiratory muscle groups (3). Respiratory muscle weakness causes hypoventilation and reductions in functional vital capacity and total lung capacity (4). Airway clearance (AC) is impaired as distal lung regions are under ventilated, compromising collateral ventilation, interdependence, secretion mobilisation and cough (4). Acute respiratory infections and chronic insufficiencies can follow, causing significant morbidity and mortality (3).

A multi-disciplinary approach to the care of people with NMD is widely advocated to improve quality of life, reduce medical complications and improve survival (5, 6). Respiratory physiotherapists are integral to the multi-disciplinary team, providing expertise on non-pharmacological management, aiding symptom control, AC and cough enhancement (3). The expertise of respiratory physiotherapists encompasses skills, and knowledge in assessing and managing respiratory muscle impairment, and cough insufficiency, enhancing quality of life and end of life symptoms (7).

Exploring people's perceptions and experiences has a critical role in understanding the effectiveness of the management of chronic disease (8). The perspectives of those living with NMD (and their carers), who use mechanical insufflation-exsufflation (MI-E), one form of AC and respiratory physiotherapy, have been explored (9, 10, 11). However, the experiences of those with less advanced presentation or who do not utilise MI-E but may utilise other forms of AC and respiratory physiotherapy are currently unknown. Knowledge of the experiences and perceptions of this wider cohort of people with NMD would enhance patient-centred care. The aim of this study was to understand the perceptions and experiences of adults with NMD, and their carers, in relation to AC and respiratory physiotherapy in the community.

## Methods

### Study design

A qualitative design, using semi-structured interviews, was chosen to gain a rich understanding of people's lived experiences. This enabled focused information to be gathered with the flexibility to explore any new ideas that were raised during the interviews. Both participants and carers were interviewed as both parties are often essential in the respiratory management of those with NMD in the community setting.

### Ethics and approvals

The study was approved by the University College London (UCL) Research Ethics Committee (Ethics Project ID number 20809/001). Data were collected, handled, stored, and confidentiality maintained in-line with national General Data Protection Regulation (12) guidance and UCL ethics processes.

### Participants and setting

Participants were recruited if they matched the inclusion and exclusion criteria (Table 1).

**Table 1: Inclusion criteria for participants or carers.**

| **Inclusion criteria** | | **Exclusion criteria** |
|---|---|---|
| *Participant* | *Carer* | *Participant and carer* |
| • Self-reported diagnosis of a neuromuscular disorder*. | • A carer of an adult (over the age of 18) with a self-reported diagnosis of a neuromuscular disorder*. | • Participant's diagnosis not a neuromuscular disorder such as a traumatic brain injury or stroke. |
| • =/>18 years. | • =/>18 years. | • No participant perceived respiratory impairments or requirements. |
| • English speaking. | • English speaking. | • Non-English speaking. |
| • Able to read English. | • Able to read English. | • Unable to read English. |
| • Access to the internet. | • Access to the internet. | • No access to the internet. |
| • Able to participate in an interview via Microsoft Teams© or Zoom© (could be assisted by a carer). | • Able to participate in an interview via Microsoft Teams© or Zoom©. | • Unable to participate in an interview via Microsoft Teams© or Zoom©. |

(NINDS, 2021)

Online interviews were used for participants' convenience, and protection from risk of infection during the COVID-19 pandemic. Unfortunately, it was not possible to recruit non-English speaking participants as this was an unfunded study without access to interpreters.

### Recruitment and consent

A description of the study was posted on the Motor Neurone Disease Association research noticeboard, newsletter and social media pages, inviting people to participate. In addition, an email was sent to people on the mailing list of a regional Neuromuscular Centre (NMC), also inviting them to participate in the study.

Potential participants were invited to contact the primary researcher (EH), at which point they were screened and given the opportunity to ask questions about the study. Following this, an information sheet and consent form were sent to potential participants via email. If they wished to take part in the study they were asked to complete and return the consent form and arrangements for the interview were made.

### Study procedure

A semi-structured interview guide was developed by the primary researcher (EH), drawing on her experience of working with people with NMD, and informed by the existing supporting literature. The interview guide was scrutinised by an NMD specialist physiotherapist, and an independent research physiotherapist; adjustments were made as appropriate. The initial participant interview was utilised, as a pilot interview, no adjustments were made according to the feedback following this, consequently the interview was included in the analysis of the findings. Interviews were conducted by the researcher in English, over Zoom© and audio and video recorded.

An overview of procedure of the interview is shown in Figure 1.

**Start of call**

- The information sheet was summarised, and participants were asked to reiterate their consent verbally.
- Participants were informed that they could stop the interview at any time, and that their recordings could either be kept or destroyed, depending upon their wishes.

**Recording**

- A rapport and the health status of the person with a neuromuscular disorder, was initially established before moving on to explore the research aim and objectives.
- Questioning followed the semi-structured interview guide.
- Participants were asked whether there was any other information they would like to share.
- Participants were thanked for their time.

**End of call**

**Figure 1: Overview of the interview procedure.**

### Data analysis

Recorded data were downloaded in mp4 format and transcribed, the auto-generated Zoom© caption aided transcription. Transcription was completed by the primary researcher (EH), who also completed the interviews. This aided familiarisation with the data prior to analysis. Once the audio and video recordings were transcribed, they were anonymised and all identifiable information within their content removed. The NVivo© software package was then used to support content analysis. This system of coding allowed for categories and subcategories to be identified. Content analysis was chosen as a research technique which systematically and objectively identifies special characteristics in the data as such interpreting, coding and grouping information into categories and subcategories and then themes, in-line with the approach by (13). Following discussion with an expert peer reviewer, themes were confirmed, and no further changes were made.

### Data management and protection

Audio and video recordings were only accessed by the interviewer and were deleted once transcribed. No hard copies of data were kept. All written transcripts and information were electronically stored on the UCL University One Drive account to be kept on-file for 10 years.

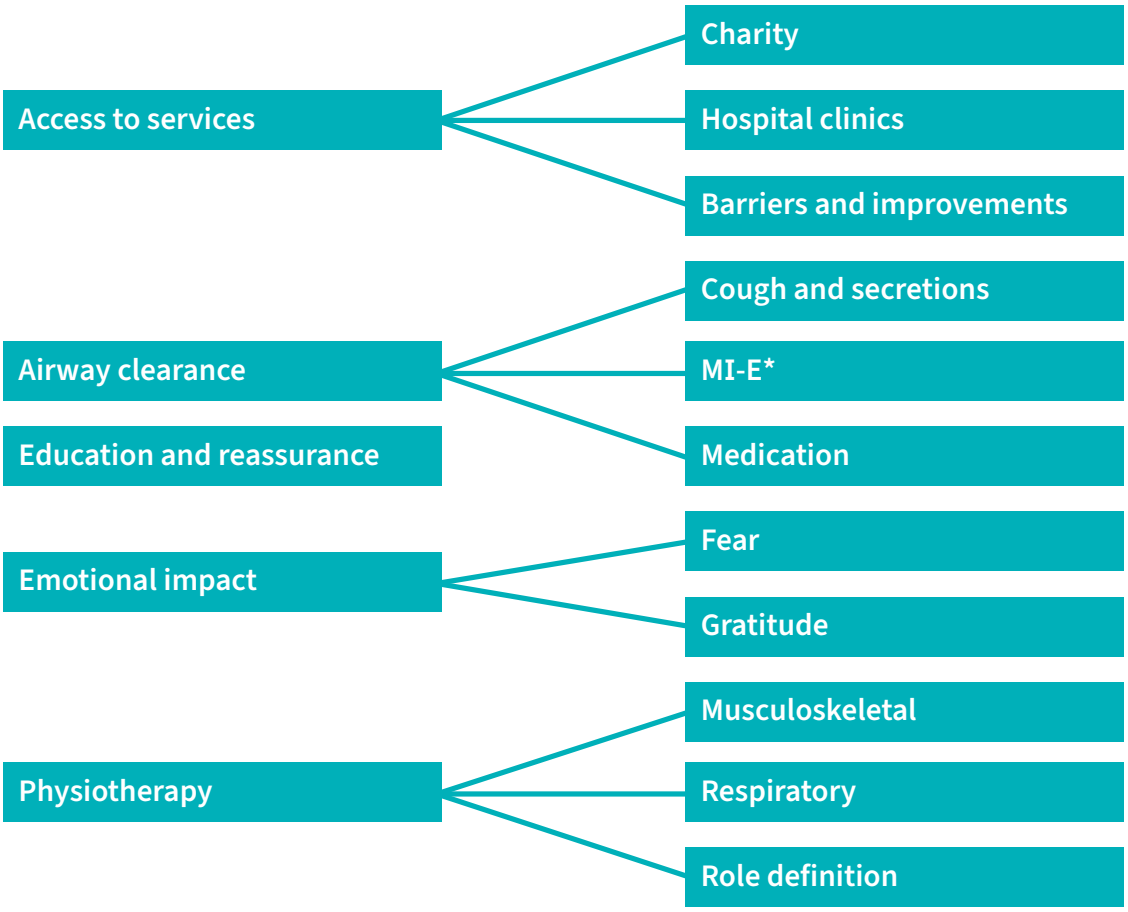
## Results

### Participant recruitment and demographics

Nine potential participants contacted the research team, seven of whom were eligible to participate. Participants included five people with NMD (four female; one male) and two carers, both relatives of two participants. Five interviews in total were conducted, with two having both the participant and relative participating. The NMD diagnoses were Pompe disease, muscular dystrophy, motor neurone disease and spinal muscular atrophy, with time from diagnosis ranging from 4–47 years (median, 32 years). Four people with NMD used overnight mechanical ventilation. Participants were interviewed between July to November 2021, interviews lasted between 25 and 54 minutes. The interview was paused for one participant, as they found discussing their disease progression emotional. Following the pause, they were happy to continue and for their data to be used.

### Thematic findings

Five key themes were identified with subthemes devised. The key themes were, 1) access to services, 2) airway clearance, 3) education and reassurance, 4) emotional impact and 5) physiotherapy (Figure 2). Quotations in relation to each of these key themes are included in Table 2.




*Mechanical insufflation-exsufflation (MI-E).

**Figure 2: Key themes and subthemes developed through thematic analysis of interview data.**

**Table 2: Quotations in relations to the five key themes.**

| Theme | Quotation/quotations |
|---|---|
| Access to services | • 'I have been going to the NMC almost since I was diagnosed, in 2002. And so I normally, without COVID-19, have regular physiotherapy.' *Participant 1*.<br>• 'So the GPs or whoever that had been dealing with mum, had never been aware of it and never referred her to it.' *Carer 2*. |
| Airway clearance | • 'I do that every day religiously, every day, at least twice a day. And if I'm not very well, I might even do it three or four times a day. And that just gives me confidence that I've tried to expel, as much as I can'. *Participant 1*.<br>• 'I think they said to take the tablets, that would help to clear the mucus'. *Carer 2*. |
| Physiotherapy | • 'If I was to ask you, what do you think respiratory physio is?' *Interviewer*. 'Erm let me think, possibly a bit of question mark. I mean, I know that with that terrible illness where they do bash on their chest, to get the rubbish up. They have respiratory physio. But other than that, I don't know much about it.' *Patient 2*. 'I don't either'. *Carer 2*. |
| Education and reassurance | • 'Do you have access to advice and education?' *Interviewer*. 'I suppose it's the world wide web now.' *Carer 2*. |
| Emotional impact | • 'You have to get referred, so you can get your GP or your neurological consultant. I was just very fortunate I was in the right place at the right time, and when I got diagnosed, my consultant had literally just been to the neuromuscular center'. *Participant 1*.<br>• 'Because of my cough now, I am always frightened to be on my own.' *Participant 4*. |

### Access to services

All participants reported attending hospital based respiratory clinics, two to three times per year. Four participants also reported relying heavily on the NMC and reported that they had been accessing the NMC services including physiotherapy, for many (10–19) years. Barriers to accessing NHS and NMC services had been a problem for four participants. Three participants explained that neither they nor their GP knew of services that were available to them, such as specialised hospital clinics (*Participant 2*) or charity services (NMC) (*Participants 1, 2 and 3*).

### Airway clearance

All participants reported excess secretions. *Participants 1, 3 and 4* reported needing routine AC, *participant 2* said they did not need support with secretions and had no airway

clearance regime, but their carer reported that every morning they continuously coughed to clear secretions. *Participant 5* identified a regular need to clear their throat and found this difficult. Three participants used MI-E daily (*participants 1, 3 and 4*), which was supplied and maintained by a hospital respiratory clinic, and their technique was reviewed in clinic. These participants reported that a family member assisted with the administration of MI-E. They expressed their dependence and appreciation of the use of MI-E. *Participant 2* reported that when excess secretions were a concern, medications had also been given.

### Physiotherapy

All five participants had accessed physiotherapy in the past from the NMC. None reported receiving physiotherapy outside of this charity, and all specified they accessed musculoskeletal physiotherapy as shown in Table 3.

**Table 3: Participant's and carer's access to and perceptions of physiotherapy.**

| | Access to physiotherapy? | Accessed physiotherapy at NMC? | Accessed physiotherapy outside of NMC? | Accessed MSK physiotherapy? | Perception of what respiratory physiotherapy entailed |
|---|---|---|---|---|---|
| *Participant 1* | ✓ | ✓ | ✗ | ✓ | • MI-E.<br>• Breathing exercises.<br>• Bed exercise. |
| *Participant 2* | ✓ | ✓ | ✗ | ✓ | • Unknown. |
| *Participant 3* | ✓ | ✓ | ✗ | ✓ | • Unclear.<br>• Hydrotherapy, massage, acupuncture reflexology. |
| *Participant 4* | ✓ | ✓ | ✗ | ✓ | • Acute hospital based respiratory physiotherapy during admissions only. |
| *Participant 5* | ✓ | ✓ | ✗ | ✓ | • Unknown. |
| *Carer 1* | NA | NA | NA | NA | • Unknown. |
| *Carer 2* | NA | NA | NA | NA | • Acute hospital based respiratory physiotherapy during admissions only. |

*Participants 1*, *2*, *5* and *carer 1* were unclear as to what respiratory physiotherapy was, no-one related their experience of physiotherapy with their airway clearance or respiratory needs.

### Education and reassurance

There was a strong theme of education and the need for reassurance amongst the narrative from all participants. Participants reported education and reassurance on respiratory management came from hospital respiratory clinics for MI-E (*participant 1* and *3*) and home mechanical ventilation use (all participants).

Participants and carers generally felt they needed to ask for support and education (*Participants 2* and *3*, *Carer 3*). The internet was identified by all participants as a primary source of information for all participants and carers with respiratory issues.

### Emotional impact

Participants expressed appreciation of the benefits of their ventilators and *participants 1, 2* and *4* were grateful for their MI-E device. *Participants 2* and *4* expressed a fear of not being able to breathe properly and *participant 1* expressed anxiety on recalling episodes when she had struggled to breathe. The concepts of fear and gratitude were also interconnected for *participants 1 and 3*, as they both were grateful for the support that they received, but feared it not being available.

## Discussion

This study explored the experiences and perceptions of respiratory care and physiotherapy in those with NMD and their carers in the community setting. All participants interviewed had sputum load and AC needs. Whilst all had access to GPs and hospital based respiratory clinics, all found accessing physiotherapy services challenging, relying upon third sector support to access musculoskeletal physiotherapy services only. There was a general lack of awareness of the role of respiratory physiotherapy. All participants identified a need for education and reassurance and reflected on the emotional impact attached to their respiratory symptoms and AC. Five key themes were identified that informed the above, and are discussed further.

### Access to services

Participants and carers perceived three key services for their respiratory care: hospital respiratory clinics, GP services and the NMC. Participants and carers were grateful for having access to the services at the NMC and relied heavily on this service for physiotherapy and emotional support. This centre is based in the northwest of England and referrals and uptake are predominately local to this region. This finding is corroborated by the findings by Rodger et al. (14) and Landfeldt et al. (15). Heavy reliance on a charity leaves this population vulnerable if services or funding are not available, as charity support should be an addition to NHS services, not instead of.

### Airway clearance and respiratory physiotherapy

This study corroborated perceived benefits and barriers of MI- E found by Siewers et al. (11) and Dale et al. (10) that included an initial lack of training and knowledge of the device. Respiratory clinics supporting the use of MI-E did not include a respiratory physiotherapist, and participants did not identify having any respiratory physiotherapy input. Outside of the use of MI-E and breathing exercises there was no mention of any management that might be included in a respiratory physiotherapist's scope of practice. This is despite all the participants reportedly needing to clear secretions daily and it being professionally recognised that AC and respiratory physiotherapy entail more than MI-E use. Respiratory services have been encouraged to include a specialist respiratory physiotherapist across the acute and community setting as a lack of specialist knowledge and unmanaged respiratory symptoms is evident (16, 17). Commissioning groups have been called on to recognise the value of specialist physiotherapy for neuromuscular participants and to commit funding to clinical support (18). This represents an area for ongoing clinical quality improvement and research.

### Respiratory physiotherapy role identification

GP support was a consistent theme throughout all the interviews. Ensuring that GPs have knowledge of referral options, and the role of respiratory physiotherapy may improve access to physiotherapy services.

NICE (6) advocated effective referrals to be a key priority for participants with NMD. However, participants and carers did not appear to be aware of the role or scope of respiratory physiotherapists. This suggests that either participants were receiving physiotherapy, but were not identifying it as such, or they were not accessing physiotherapy services. This highlights an area for potential education to raise the profile, role and benefits of respiratory physiotherapy, so that the needs of the NMD population can be met.

### Education and reassurance

Participants sought information from NMC and hospital clinics, although their main source of information was the internet. Drawbacks associated with internet use for participants include inaccurate information and access issues (19). Hence, it is important that information is disseminated clearly and unambiguously by respiratory physiotherapists working in partnership with third sector organisations to proactively provide and direct to trustworthy information sites clinicians to all participants with NMD to facilitate them in managing symptoms and to avoid hospital admissions.

### Emotional impact

Fear of choking to death is well documented in NMD and progressive respiratory diseases, as anxiety and respiratory diseases, may increase body sensations thus leading to panic (20). This anxiety is unpleasant for the person, is likely to have a negative effect on their quality of life, and has been linked to an increase in hospital admissions (21). Fear was also expressed in relation to the level of support available (or support being withdrawn). Fear surrounding cough and AC management is also a key feature of palliative care management

and it is crucial both are addressed in progressive conditions, to promote independent management (22). This further highlights the physical and psychological benefits, that access to specialised respiratory services, including respiratory physiotherapy, can have on adults with NMD.

### Strengths and limitations

Recruitment methods may have led to sampling bias in this population. Four of the five participants and carers lived within the Midlands and North-West of England, which means that their experiences may not be representative of the wider NMD community. Non-English-speaking participants were not eligible to participate, that limits the potential diversity of the populations interviewed. Positively, interviews were completed over Zoom©, with cameras on, as well as audio communication that allowed identification of non-verbal cues, and richer data to be gathered.

The understanding of AC and respiratory physiotherapy was limited and varied, between participants. This lack of identification with terms and concepts may have led to some participants and carers being deterred from volunteering for this study.

### Future practice and research

Increased advocacy for the role of AC and respiratory physiotherapy is needed for adults with NMD. Further exploration of service providers' experiences and perceptions on the same topic is suggested. Exploring reasons for the lack of clarity from participants and carers as to the role of AC and respiratory physiotherapy for adults with NMD is also needed. Research is recommended to address access to services, particularly when considering respiratory physiotherapy and AC.

## Conclusion

Respiratory hospital clinics, GP, and the NMC were key to the respiratory management of people living with NMD, yet all those interviewed had experienced barriers to accessing services. This was linked to a lack of knowledge of the services available. AC for three of the participants included the daily use of MI-E, yet beyond this, participants did not report other forms of AC, and respiratory physiotherapy. Participants were either unclear or unable to identify what respiratory physiotherapy was and did not report having access to a respiratory physiotherapist at either a clinic or charity settings. Reasons for this could include reduced exposure to respiratory physiotherapy and a lack of clarity over the role. Yet, all participants expressed the value of education and reassurance in terms of their respiratory management and the need to clear secretions daily. Participants and carers expressed fear of respiratory distress/inability to clear secretion and a fear a lack of services at the NMC. It therefore seems important that further research into the barriers to participants accessing specialised services, such as respiratory physiotherapy is needed.

### Key points

- People in the community with NMD are unclear or unable to identify the role and scope of respiratory physiotherapy and some report not having access to a respiratory physiotherapist at either a clinic or charity setting despite all identifying the need to clear secretions regularly.
- Many people with NMD are reliant on charity services and expressed fear of respiratory distress/inability to clear secretions and a fear a lack of services such as physiotherapy at the NMC.
- Further research is needed to ensure access to specialised services for NMD participants such as respiratory physiotherapy is available and accessible for participants.

## Acknowledgements

The author wishes to acknowledge Sioned Davies and Bryn Edwards, for their contribution to the interview guide reviewing and participant recruitment. Acknowledgements are made to colleagues and Keele University and Academic staff, at UCL for their support and guidance in this project. Acknowledgements are also made to the MNDA for their publication of the participant recruitment details, for this study.

### Funding

This research was part of an MSc research project, and received no specific grant from any funding agency in the public, commercial or not-for-profit sector.

## References

1 Mehta P, Kaye W, Raymond J, Punjani R, Larson T, Cohen J, Muravov O, Horton K. Prevalence of Amyotrophic Lateral Sclerosis – United States, 2015. *Morbidity and Mortality Weekly Report.* 2018;67(46):1285.

2 Mah JK, Korngut L, Fiest KM, et al. A Systematic Review and Meta-analysis on the Epidemiology of the Muscular Dystrophies. *Can J Neurol Sci.* 2016;43(1):163–177. https://doi.org/10.1017/cjn.2015.311.

3 Chatwin M, Toussaint M, Gonçalves MR, et al. Airway clearance techniques in neuromuscular disorders: A state of the art review. *Respir Med.* 2018;136:98–110. https://doi.org/10.1016/j.rmed.2018.01.012.

4 West J, Luks A. *West's pulmonary pathophysiology: the essentials.* Wolters Kluwer Health; 2021.

5 Chatwin M, Toussaint M, Gonçalves MR, et al. Airway clearance techniques in neuromuscular disorders: A state of the art review. *Respir Med.* 2018;136:98–110. https://doi.org/10.1016/j.rmed.2018.01.012.

6 National Clinical Guideline Centre (U.K.). *Motor Neurone Disease: Assessment and Management.* National Institute for Health and Care Excellence. Published February 2016. Accessed 2023 https://www.nice.org.uk/guidance/ng42.

7 van Aswegen H, Morrow B. Cardiopulmonary Physiotherapy in Trauma. Imperial College Press; 2015.

8 Pitcher AN, Doumit MA, Hutchence M, Widger J, Jones K, Butler JM. Parent, Child and Physiotherapist Perceptions of Effectiveness of Parent Performed Manually Assisted Cough on Children With Neuromuscular Disease. *Rehabilitation Process and Outcome.* 2018;7. https://journals.sagepub.com/doi/full/10.1177/1179572718803350.

9 Mahede T, Davis G, Rutkay A, et al. Use of mechanical airway clearance devices in the home by people with neuromuscular disorders: effects on health service use and lifestyle benefits. *Orphanet J Rare Dis.* 2015;10:54. Published 2015 May 6. https://doi.org/10.1186/s13023-015-0267-0.

10 Dale CM, McKim D, Amin R, et al. Education Experiences of Adult Subjects and Caregivers for Mechanical Insufflation-Exsufflation at Home. *Respir Care.* 2020;65(12):1889–1896. https://doi.org/10.4187/respcare.07534.

11 Siewers V, Holmøy T, Frich J.C. Experiences with using mechanical in–exsufflation in amyotrophic lateral sclerosis. *The European Journal of Physiotherapy.* 2013;15(4):201–207.

12 General Data Protection Regulation. Complete guide to GDPR compliance website. https://gdpr.eu.

13 Braun V, Clarke V. Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher, eds, APA handbook of research methods in psychology, 2012:57–71. https://doi.org/10.1037/13620-004.

14 Rodger S, Woods KL, Bladen CL, et al. Adult care for Duchenne muscular dystrophy in the UK. *J Neurol.* 2015;262(3):629–641. https://doi.org/10.1007/s00415-014-7585-3.

15 Landfeldt E, Lindgren P, Bell CF, et al. Compliance to Care Guidelines for Duchenne Muscular Dystrophy. *J Neuromuscul Dis.* 2015;2(1):63–72. https://doi.org/10.3233/jnd-140053.

16 Muscular Dystrophy, U.K. *Right to breathe – Access to respiratory care for people with a muscle-wasting conditions. 2015.* Available from: https://www-stage.musculardystrophyuk.org/static/s3fs-public/2021-07/PDF-Report-Right-to-Breathe-Respiratory-2015.pdf?VersionId=v7KEgFL4R3LCdeqEPzmellDUxTZ_.gxS.

17 McVeigh C, Donaghy C, McLaughlin B, et al. Palliative care for patients with motor neurone disease and their bereaved carers: a qualitative study. *BMC Palliat Care.* 2019;18(1):39. Published 2019 Apr 26. https://doi.org/10.1186/s12904-019-0423-8.

18 All Party Parliamentary Group for Muscular Dystrophy. 2023. *Impact of NHS reforms on access to neuromuscular services.* Available from: https://www-stage.musculardystrophyuk.org/static/s3fs-public/2021-07/PDF-MDUK-APPG-Impact-of-NHS-reforms-on-access-to-neuromuscular-services-report-2015.pdf?VersionId=1saGqZln5df.N4FvE0DtjCJvD2535q3d.

19 Anderson AS, Klemm P. The Internet: friend or foe when providing patient education?. *Clin J Oncol Nurs.* 2008;12(1):55–63. https://doi.org/10.1188/08.cjon.55-63.

20 Benke C, Hamm AO, Pané-Farré CA. When dyspnea gets worse: Suffocation fear and the dynamics of defensive respiratory responses to increasing interoceptive threat. *Psychophysiology.* 2017;54(9):1266–1283. https://doi.org/10.1111/psyp.12881.

21 Remes O, Wainwright N, Surtees P, Lafortune L, Khaw KT, Brayne C. Generalised anxiety disorder and hospital admissions: findings from a large, population cohort study. *BMJ Open.* 2018;8(10):e018539. Published 2018 Oct 27. https://doi.org/10.1136/bmjopen-2017-018539.

22 Quibell R, Bourke S. *Cough and Respiratory Secretions.* In: Anonymous Integrated Palliative Care of Respiratory Disease. Springer; 2019.

NUVOAIR

# ASTHMA & COPD MONITORING


NuvoAir's Asthma & COPD Monitoring Service helps you to detect exacerbations, track response to treatment, and monitor the health status of people with chronic respiratory conditions from their home.

Data and insights are available to your team in real time to enable remote care and treatment follow-up.

## Increasing your clinical capacity

**1**
Award-winning technology is shipped directly to patients

**2**
NuvoAir's team supports technical onboarding and data collection

**3**
Respiratory physiologists provide spirometry training and coaching

**4**
We monitor pMDI use, inhaler technique, lung function variability, symptom scores, and patient reported outcomes

**5**
Reminders support engagement

**6**
Your team can access real-time patient data and insights

## The NuvoAir Ecosystem

- Air Next Spirometer (FEV1, FVC, PEF, full expiratory loop)
- Aos sensor tracks inhaler use and technique
- Air quality data based on geolocation
- Medication and spirometry reminders
- Symptom tracking
- Clinician portal to access data and reports



CONTACT
sales@nuvoair.com

NUVOAIR U.S, INC.
50 Milk St. 16th Floor
Boston, MA, 02109 - USA

NUVOAIR AB
Riddargatan 17D, 114 57
Stockholm - Sweden

# Trying to remain active whilst living under threat: Exploring the barriers and facilitators to physical activity during the COVID-19 pandemic, in people living with chronic respiratory disease

**Sarah Jackson[1] and Lucy Gardiner[1,2]**

[1]University of Birmingham, Edgbaston, Birmingham, U.K.
[2]University of Leicester, Leicester, U.K.

*Keywords* | Chronic respiratory disease, physical activity, adherence, COVID-19, fear.

*Correspondence author* | Sarah Jackson. Email: sarahjackson1692@gmail.com.

## Abstract

### Background

People living with chronic respiratory disease (CRD) were advised to shield during the COVID-19 pandemic due to their perceived vulnerability. Changes in activities of daily living and exercise habits contributed to reductions in physical activity (PA); which associate with adverse health outcomes in this population. Factors affecting PA behaviour in people living with CRD during the pandemic are currently unclear.

### Aim

To explore barriers and facilitators to PA during the COVID-19 pandemic amongst people living with CRD and provide insight into measures that may support engagement with PA in the future.

### Method

A qualitative design using interpretative phenomenological analysis (IPA) was used to gain in-depth understanding of lived experiences during the pandemic. Ten people living with CRD were interviewed using semi-structured interviews. Verbatim interview transcripts were analysed as per IPA steps: 1) case-by-case review 2) identify emergent themes for each individual 3) identify master themes from across all cases. Trustworthiness was enhanced through use of researcher triangulation, member checking, and use of a reflexive diary.

### Results

All participants reported reduced PA during the pandemic. Five master themes were

identified: (1) fear of COVID-19 (2) influence of government restrictions (3) top priority or on the backburner (4) reinforcing or reducing motivation (5) personal context is key.

**Conclusion**

Adherence to PA during the pandemic was affected by fear of COVID-19 and the prolonged effects of social isolation. Healthcare providers must seek to provide individualised support, for the CRD population, addressing physical, mental and social health needs.

## Introduction

In the U.K., approximately nine million people are living with a chronic respiratory disease (CRD), including asthma, chronic obstructive pulmonary disease (COPD), bronchiectasis and interstitial lung disease (ILD) (1). In comparison to those without, people living with CRD tend to be less physically active and spend more of their day sedentary; which is associated with increased risk of hospitalisation and mortality (2). Limited exercise capacity and increased breathlessness on exertion can lead to a vicious cycle of inactivity, deconditioning and increasing breathlessness (3).

Pulmonary rehabilitation (PR) is a programme of exercise training and education, which improves exercise capacity and reduces symptom burden in people living with CRD. PR promotes self-management and adherence to health-enhancing behaviours, including physical activity (PA), however sustained adherence to PA in daily life post-PR has not been demonstrated thus far (4). This may reflect the complexity of PA behaviour; with physical symptoms, emotions, environmental factors, motivation, peer interaction and opportunities to engage in PA being identified as key factors affecting PA adherence in some CRD populations (5, 6).

### COVID-19 and PA

People living with CRD in the U.K. were strongly advised to shield between March and August 2020 due to heightened risk of severe COVID-19 (7). Whilst restrictions protected the most vulnerable, this likely had a significant impact on stress levels, and overall physical and mental health (8).

PA can be an adaptive coping strategy during periods of stress, however, the closure of recreation facilities and PR programmes, restricted opportunities to be active. Reductions in self-reported PA, and daily step count (compared to pre-pandemic) (9, 10).

Some evidence suggests people living with CRD have maintained a degree of physical and social isolation since the shielding period ended (11, 12); possibly attributable to ongoing fear, anxiety, and social isolation contributing to sustained reductions in PA (13).

Currently there is no published in-depth exploration of the personal experiences of people living with CRD during the pandemic; factors that may have affected PA during the pandemic are currently unknown. Exploring these factors may identify measures to support adherence to PA during the ongoing pandemic and beyond.

### Aim

The aim was to identify facilitators and barriers to PA in people living with CRD during the COVID-19 pandemic. A secondary aim was to explore how this population can be supported to increase adherence to PA during the ongoing pandemic and beyond.

## Method

### Research design

A qualitative approach using interpretive phenomenological analysis (IPA) was used to enable an in-depth exploration of how individuals understand their own lived experiences. IPA was considered appropriate to address the aim in seeking to understand the experiences of people living with CRD and their associated interpretations (13).

### Ethics

Ethical approval was granted by the University of Birmingham School of Sport Exercise and Rehabilitation Sciences Ethics Committee (EX2122_02).

### Inclusion criteria

Individuals were eligible to participate if they were: (a) 18 years old or over (b) diagnosed with asthma, bronchiectasis, COPD or ILD, (c) living in the U.K., (d) able to communicate effectively in English, (e) able to participate in an online interview.

### Exclusion criteria

Individuals were not eligible if they: (a) had a severe mobility impairment that were dependent on equipment for transfers, or (b) were a transplant recipient (due to their immunocompromised status).

### Sample size

In keeping with the IPA approach, a small sample (up to ten participants) was sought to enable exploration of similarities and differences between each individuals' lived experience and detailed analyses of each individuals' experiences (13).

### Recruitment

Convenience sampling was used to recruit participants from non-NHS support groups through online advertisements. With permission, the recruitment poster was distributed by email to Action for Pulmonary Fibrosis regional support groups and posted on U.K. Facebook support groups for people living with CRD. Participants provided informed written consent and were free to withdraw at any time.

### Data collection

An online form was used to collect demographic information including age, diagnosis, time since diagnosis, and previous completion of PR programme prior to interview.

Semi-structured one-to-one interviews with the lead researcher via video conference, were used to gather accounts of each individual's PA experience throughout the pandemic. An interview guide (Table 1) was developed based on COVID-19 research and qualitative PA studies in CRD populations (5, 6, 11).

**Table 1: Final interview guide.**

| | Questions |
|---|---|
| 1 | Prior to COVID-19, what was your relationship like with physical activity? |
| 2 | What impact, if any, did COVID-19 have upon your relationship with physical activity? |
| 3 | Can you describe how the pandemic has impacted your physical activity? |
| 4 | What were/are your main concerns relating to COVID-19, and how do you feel those impacted your physical activity? |
| 5 | What impact did shielding have on you, and how do you think it impacted your physical activity? |
| 6 | How do you feel COVID-19 has impacted your ability to manage your condition? |
| 7 | What are your thoughts and feelings, with regards to your future physical activity, with COVID-19 still circulating in the community? |
| 8 | If the U.K. went into another lockdown, how would you maintain your physical activity? |
| 9 | What support do you think may help, with being physically active in the future? |
| 10 | What advice regarding physical activity, would you give to someone diagnosed with your chronic lung condition, during the pandemic? |
| 11 | Is there anything else you would like to add, that we've not covered? |

Interviews took place between 4th January 2022 and 25th February 2022. To orientate participants to the types of PA being considered, the lead researcher provided a definition of PA and its domains; occupational, domestic, transportation and leisure time (14, 15). Each participant gave permission for the interview to be audio-recorded.

### Data analysis

Demographic data is reported descriptively; numerical data is reported as mean and standard deviation (± SD).

Interviews were transcribed verbatim and member checked. Data triangulation was completed with two researchers: the lead researcher (SJ) and study supervisor (LG).

Analysis was divided into two phases as per IPA steps (13). During phase one, the lead researcher (SJ) familiarised themselves with each transcript on a case-by-case basis to immerse themselves in the data. Exploratory comments were recorded in the transcript margin. During phase two, SJ and LG independently reviewed the individual transcripts to interpret the meaning of each participant's experience and identify emergent themes. Patterns in emergent themes across all interviews were identified to produce master themes. SJ and LG met to discuss and reflect upon independent analyses and to agree on the final master themes and sub-themes.

### Reflexivity

The lead researcher was a third-year undergraduate physiotherapy student at the University of Birmingham with practice placement experience of delivering community-based PR during the pandemic. Participants were not known to the lead researcher prior to the study. Trustworthiness of the research was optimised with use of a reflexive diary, data triangulation and an audit trail of results.

## Results

### Participant characteristics

Ten participants living with CRD were recruited to the study with a mean age of 57 ± 20 years; eight were female, further participant characteristics are presented in Table 2. Average interview duration was 57 ± 11 minutes. All participants completed the study.

**Table 2: Participant characteristics.**

| Participant | Age (years) | Gender | Diagnosis | Years since diagnosis | Completed pulmonary rehabilitation course |
|---|---|---|---|---|---|
| 1 | 65 | Female | COPD | 16 | Yes |
| 2 | 32 | Female | ILD | 7 | Yes |
| 3 | 43 | Female | Asthma | 18 | No |
| 4 | 57 | Female | ILD | 4 | No |
| 5 | 27 | Female | Asthma | 26 | No |
| 6 | 62 | Female | Asthma | 62 | No |
| 7 | 71 | Female | ILD | 4 | Yes |
| 8 | 82 | Male | ILD | 2 | No |
| 9 | 87 | Male | ILD | 6 | Yes |
| 10 | 43 | Female | Bronchiectasis | 18 | No |

COPD = chronic obstructive pulmonary disease, ILD = interstitial lung disease.

### Themes

Overall, the COVID-19 pandemic contributed to a self-reported reduction in PA amongst all participants that extended beyond shielding and restrictions. Five master themes were identified from the data (Table 3).

**Table 3: Overview of master themes and subthemes.**

| Master themes | Subthemes | Supporting quotes |
|---|---|---|
| 1 Fear of COVID-19. | • Fearing the worst (-).<br>• Behaviour of family and friends (+/-).<br>• Safety precautions (+).<br>• Virtual support is the way forward (→).<br>• A forgotten group that needs support (→). | • 'Let's stay away from everything, then you can't get it' (*Participant 7*).<br>• 'That vaccine was my freedom' (*Participant 10*).<br>• 'Online is the right vehicle for it now…you don't have the risk' (*Participant 9*).<br>• 'There's still a group of us still feeling the after-effects we haven't moved on' (*Participant 10*). |
| 2 Influence of government restrictions | | • 'I liked being stuck in the house because I felt safe' (*Participant 6*).<br>• 'I still feel isolated and detached from the world' (*Participant 10*).<br>• 'We know people who say things like you can't put your life on hold… I'm putting death on hold that's why you have to do this stuff' (*Participant 9*).<br>• 'It's difficult to work out what is safe now' (*Participant 3*).<br>• 'I'm not going in an enclosed space where most people aren't wearing a mask' (*Participant 10*). |
| 3 Top priority or on the backburner | • Protecting themselves (+/-).<br>• Ill health (-).<br>• Competing priorities (-). | • 'I want to get myself as fit as possible… in case I do get this horrible bug' (*Participant 6*).<br>• 'I felt like my life was being robbed and I weren't going to let it win' (*Participant 4*).<br>• 'Home schooling that literally was my sole attention… I was so exhausted' (*Participant 10*). |

| | | | |
|---|---|---|---|
| 4 | Reinforcing or reducing motivation | • Health benefits (+).<br>• Enjoyment (+).<br>• Adapted physical activity (+).<br>• Peer support (+/-).<br>• Mental health decline (-). | • 'When I was walking… I just felt connected with who I was again' (*Participant 10*).<br>• 'Exercise is my drug of choice… it's something that just makes me feel fantastic' (*Participant 6*).<br>• 'With the mental health decline at that point physical activity was then minimal' (*Participant 2*). |
| 5 | Personal context is key | • Prior knowledge (+/-).<br>• Daily routine (+).<br>• Goals (+).<br>• Environment (+/-).<br>• Support for minority groups (→). | • 'I found an app with tai-chi on, so I started to do that… I still do tai chi now' (*Participant 4*).<br>• 'Gardening was another thing we did a lot of, that's ongoing and become a great passion'(*Participant 6*).<br>• 'We're quite happy… to walk providing there aren't too many people' (*Participant 8*).<br>• 'It would be nice if there was a support group for young people… that do things that young people do' (*Participant 2*). |

(+) = facilitator, (-) = barrier, (+/-) = facilitator, barrier = (→).

### *Theme 1: Fear of COVID-19*

**This theme refers to fear associated with contracting COVID-19 that has dominated the participants lives since the pandemic began. In future, holistic support is required to address the physical, mental, and social impact of the pandemic.**

#### *1.1: Fearing the worst*

**All participants expressed their greatest fear was contracting COVID-19 due to the perceived negative consequences on their health. Many participants expressed prioritising survival over PA, felt they were restricted to indoor PA, and have still exercised caution with PA despite restrictions lifting.**

#### *1.2 Behaviour of family and friends*

**The pandemic has led to participants being selective with who they engage in PA with; they participate in PA alongside trusted friends and family members who they believed had been complying with the rules, or maintaining caution when restrictions lifted.**

*1.3 Safety precautions*

**Wearing masks, visiting places at quieter times and the vaccine rollout promoted feelings of safety and reduced worry amongst all participants who perceived it to facilitate PA.**

*1.4 Virtual support is the way forward*

**In future, the safest way of adhering to PA was perceived to be virtual support as there is no risk of virus transmission. Whilst some participants expressed virtual PA could not replicate face-to-face classes, from a motivational perspective.**

*1.5 A forgotten group that needs support*

**Participants living with CRD report the pandemic had a predominantly negative impact on their physical, mental, and social health. Despite restrictions lifting and society returning to normal, multiple participants did not feel able to return to *normal life*. In future some participants wanted subsidised PA schemes to increase PA access.**

*Theme 2: Influence of government restrictions*

**This theme refers to the importance of government restrictions, that were fundamental to protecting people living with CRD. The assurance provided by the restrictions reduced over time, and it was commonly perceived the public were not following the rules, which affected PA adherence.**

*2.1 Home is a safe place*

**Shielding was reported to reduce PA due to reduced opportunities and changes to the daily routine. During this time home was perceived as a safe place because they were in control. Some participants expressed they did not feel comfortable returning to normal and have continued with a modified daily routine.**

*2.2 Effects of social isolation*

**The long-term effects of shielding included reduced motivation and ongoing social isolation due to reduced confidence engaging with others, affecting daily activities and previous PA methods.**

*2.3 Are they taking this seriously?*

**After shielding had lifted, participants believed the public adhered to social distancing and wore masks that encouraged some to engage with PA. Over time relaxing of restrictions and perceived lack of understanding of the serious health consequences for those with CRD became a source of frustration for many, therefore some believed PA was too risky.**

*Theme 3: Top priority or on the backburner*

**This theme relates to prioritising one's health, with all participants' main concern being COVID-19. For some, PA became more of a priority than pre-pandemic, whilst others perceived returning to previous PA behaviours may compromise their safety.**

#### *3.1 Protecting themselves*

**All participants prioritised protecting themselves against the risk of COVID-19. Some people with ILD prioritised maintaining PA to slow disease progression. However, some participants expressed they were protecting themselves by not engaging with PA.**

#### *3.2 Ill health*

**Some participants reported acute exacerbations reduced their ability to remain active due to fatigue.**

#### *3.3 Competing priorities*

**Changes in circumstances such as home working and home-schooling children was suggested to reduce adherence to PA due to fatigue and reduced time available.**

### *Theme 4: Reinforcing or removing motivation*

**This theme considers the importance of intrinsic motivation and its impact on PA. Intrinsic motivation contributed to adapting PA to incorporate virtual classes or digital applications. Lack of peer support and mental health decline contributed to reduced motivation for PA.**

#### *4.1 Health benefits*

**Participants that were motivated by the perceived health benefits of PA more frequently reported maintaining PA during the pandemic. Some participants adhered to PA as a coping strategy in response to the negative impact of the pandemic on their mental health.**

#### *4.2 Enjoyment*

**Participants who expressed they enjoyed PA and the way it made them feel, more frequently reported adhering to PA.**

#### *4.3 Adapted PA*

**During shielding, some made adaptations to their PA reflecting their intrinsic motivation to remain active. Adapted PA included attending virtual classes, using digital applications, starting or revisiting hobbies, such as baking and gardening that were continued after restrictions lifted.**

#### *4.4 Peer support*

**Some participants reported peer support as their main motivation to engage with PA, due to the sense of enjoyment and social support it provided, that could be incorporated into online classes.**

#### *4.5 Mental health decline*

**Declining mental health was suggested to reduce motivation to be physically active in the early stages of the pandemic, and whilst adjusting to shielding.**

### *Theme 5: Personal context is key*

**This theme considers the importance of personal and environmental factors that affected the participant's ability to engage with PA, and highlights future support suggested by subgroups of the CRD population.**

#### *5.1 Prior knowledge*

Understanding the lung specific benefits of PA appeared to facilitate adherence to PA and education was typically through previous PR programmes.

#### *5.2 Daily routine*

Incorporating PA into their daily routine provided structure and alleviated boredom of shielding. Baking, walking, gardening, crafts, and tai-chi, were activities that participants initiated during shielding and became habitual over time.

#### *5.3 Goals*

Setting regular goals with the support of virtual classes, smartwatches or charity challenges, acted as facilitators to PA by enhancing motivation.

#### *5.4 Environment*

Physical surroundings influenced opportunities to engage in PA. Access to a private garden and living near public green space, was a facilitator to PA. However, crowded green space and limited indoor space were perceived barriers to PA.

#### *5.5 Support for minority groups*

Future support is required for minority groups within the CRD population, with suggestions including age-appropriate support and condition-specific support suggesting individualised support is required for underrepresented sub-groups of the population.

## Discussion

To the authors knowledge, this study is the first to explore the barriers and facilitators affecting PA in people living with CRD, during the COVID-19 pandemic and the perceived support needed to adhere to PA during the ongoing pandemic. This should be considered in clinical practice, to support the mitigation of health implications associated with physical inactivity in this population (2).

### Barriers and facilitators to PA

The results demonstrate self-reported PA decreased at the start of the pandemic, during shielding in keeping with other studies in people living with CRD during shielding (9, 10). Despite shielding ending and restrictions easing, in the present study people living with CRD reported maintaining caution in daily life, like avoiding overcrowded spaces and limiting contact with others which may have contributed to reduced PA.

The fear of COVID-19 reported in the present study appeared to be the greatest barrier to PA amongst participants. Fear of the unknown, severe illness and death were expressed, which is reported elsewhere (12). Psychological factors such as ability to cope, risk perception and anxiety are thought to contribute to COVID-19 related fear (16). People living with CRD are at risk of severe forms of COVID-19 (7) and may be more affected by fear and anxiety due to a higher risk perception (17), which is associated with safety related behaviour, previously linked to reduced PA adherence (10). The illness perception of people living

with CRD during the pandemic is likely to have shifted towards a disease-orientated illness perspective (18). Despite shielding ending and restrictions being eased the threat to people living with CRD was still present, and people with COPD reported maintaining a degree of isolation (11). Initially safety precautions were a facilitator to PA adherence but perceived non-compliance with safety measures by the public, promoted fear in people living with CRD that discouraged PA adherence.

Health was a priority during the pandemic for people living with CRD, however the reasons for PA adherence amongst participants differed by CRD. In the present study those with asthma had taken steps to manage their condition including adherence to PA, which is reported elsewhere (19). Whilst those with ILD linked PA adherence to slowing progression of ILD, however some were still avoidant of daily activities due to the perceived risk to their health. This demonstrates there are condition-specific and individual factors contributing to PA adherence, demonstrating the complexity of PA behaviour, where barriers and facilitators are closely linked with a multitude of factors influencing each other.

### Future support

Individualised support for people living with CRD is required to counteract the negative effects of the pandemic on physical, mental, and social health. Minority groups such as the young and those with ILD may benefit from tailored support as it appears current support available does not meet their needs.

With COVID-19 still circulating in the community, virtual support was suggested as the most appropriate method of delivery for safety reasons. However further research is required to confirm the efficacy and role of virtual PR with consideration of acceptability and digital inequalities (20).

### Limitations

Over time perceptions of a phenomenon change, therefore participants may be influenced by recall bias. The use of convenience sampling increases risk of selection bias, where those not represented by the study may have had different experiences.

## Conclusion

In conclusion, this study was the first in the U.K. to identify factors that influenced adherence to PA throughout the pandemic, providing an in-depth insight into the CRD population's experience and the complexity of adhering to PA whilst living in a pandemic. Despite shielding and restrictions being lifted, people living with CRD report maintaining caution in their daily lives due to fear of COVID-19 and its perceived effects on their health. Reduced adherence to PA during the pandemic within this population has health consequences for the individual and for the NHS and must be addressed. This study raises awareness for healthcare professionals, and provides evidence when considering the physical and mental health of people living with CRD. In future individualised support is required to address the physical and mental health of the CRD population.

## References


1 Snell N, D, Hubbard R, Gibson J, Limb E, Gupta R, Martin A, Laffan M, Jarrold I. Burden of Lung Disease in the U.K.; Findings from the British Lung Foundation's Respiratory Health of the Nation' Project. *Eur. Respir J.* 2016;(48):60. https://doi.org/10.1183/13993003.congress-2016.PA4913.

2 Cordova-Rivera L, Gardiner PA, Gibson PG, Winkler EAH, Urroz PD, McDonald VM. Sedentary time in people with obstructive airway diseases. *Respir Med.* 2021;181:106367. https://doi.org/10.1016/j.rmed.2021.106367.

3 Spathis A, Booth S, Moffat C, et al. The Breathing, Thinking, Functioning clinical model: a proposal to facilitate evidence-based breathlessness management in chronic respiratory disease. *NPJ Prim Care Respir Med.* 2017;27(1):27. Published 2017 Apr 21. https://doi.org/10.1038/s41533-017-0024-z.

4 McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews.* 2015;(2).

5 Thorpe O, Johnston K, Kumar S. Barriers and enablers to physical activity participation in patients with COPD: a systematic review. *J Cardiopulm Rehabil Prev.* 2012;32(6):359–369. https://doi.org/10.1097/hcr.0b013e318262d7df.

6 Robinson H, Williams V, Curtis F, Bridle C, Jones AW. Facilitators and barriers to physical activity following pulmonary rehabilitation in COPD: a systematic review of qualitative studies. *NPJ Prim Care Respir Med.* 2018;28(1):19. Published 2018 Jun 4. https://doi.org/10.1038/s41533-018-0085-7.

7 Ahrenfeldt LJ, Nielsen CR, Möller S, Christensen K, Lindahl-Jacobsen R. Burden and prevalence of risk factors for severe COVID-19 disease in the ageing European population – A SHARE-based analysis. Preprint. *Res Sq.* 2020;rs.3.rs-73657. Published 2020 Sep 9. https://doi.org/10.21203/rs.3.rs-73657/v1.

8 Mansfield KE, Mathur R, Tazare J, et al. Indirect acute effects of the COVID-19 pandemic on physical and mental health in the UK: a population-based study. *Lancet Digit Health.* 2021;3(4):e217–e230. https://doi.org/10.1016/s2589-7500(21)00017-0.

9 McAuley H, Hadley K, Elneima O, et al. COPD in the time of COVID-19: an analysis of acute exacerbations and reported behavioural changes in patients with COPD. *ERJ Open Res.* 2021;7(1):00718–2020. Published 2021 Jan 18. https://doi.org/10.1183/23120541.00718-2020.

10 Hume E, Armstrong M, Manifield J, et al. Impact of COVID-19 shielding on physical activity and quality of life in patients with COPD. *Breathe (Sheff).* 2020;16(3):200231. https://doi.org/10.1183/20734735.0231-2020.

11 Kusk KH, Storgaard LH, Weinreich UM, Grønkjaer M, Thorup CB. Social Distancing among COPD Patients during the COVID-19 Pandemic – A Qualitative Study. *COPD.* 2021;18(5):549–556. https://doi.org/10.1080/15412555.2021.1973981.

12 Mousing CA, Sørensen D. Living with the risk of being infected: COPD patients' experiences during the coronavirus pandemic. *J Clin Nurs.* 2021;30(11–12):1719–1729. https://doi.org/10.1111/jocn.15727.

14 Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep.* 1985;100(2):126–131.

15 Strath SJ, Kaminsky LA, Ainsworth BE, et al. Guide to the assessment of physical activity: Clinical and research applications: a scientific statement from the American Heart Association. *Circulation.* 2013;128(20):2259–2279. https://doi.org/10.1161/01.cir.0000435708.67487.da.

16 Asmundson GJG, Taylor S. Coronaphobia: Fear and the 2019-nCoV outbreak. *J Anxiety Disord.* 2020;70:102196. https://doi.org/10.1016/j.janxdis.2020.102196.

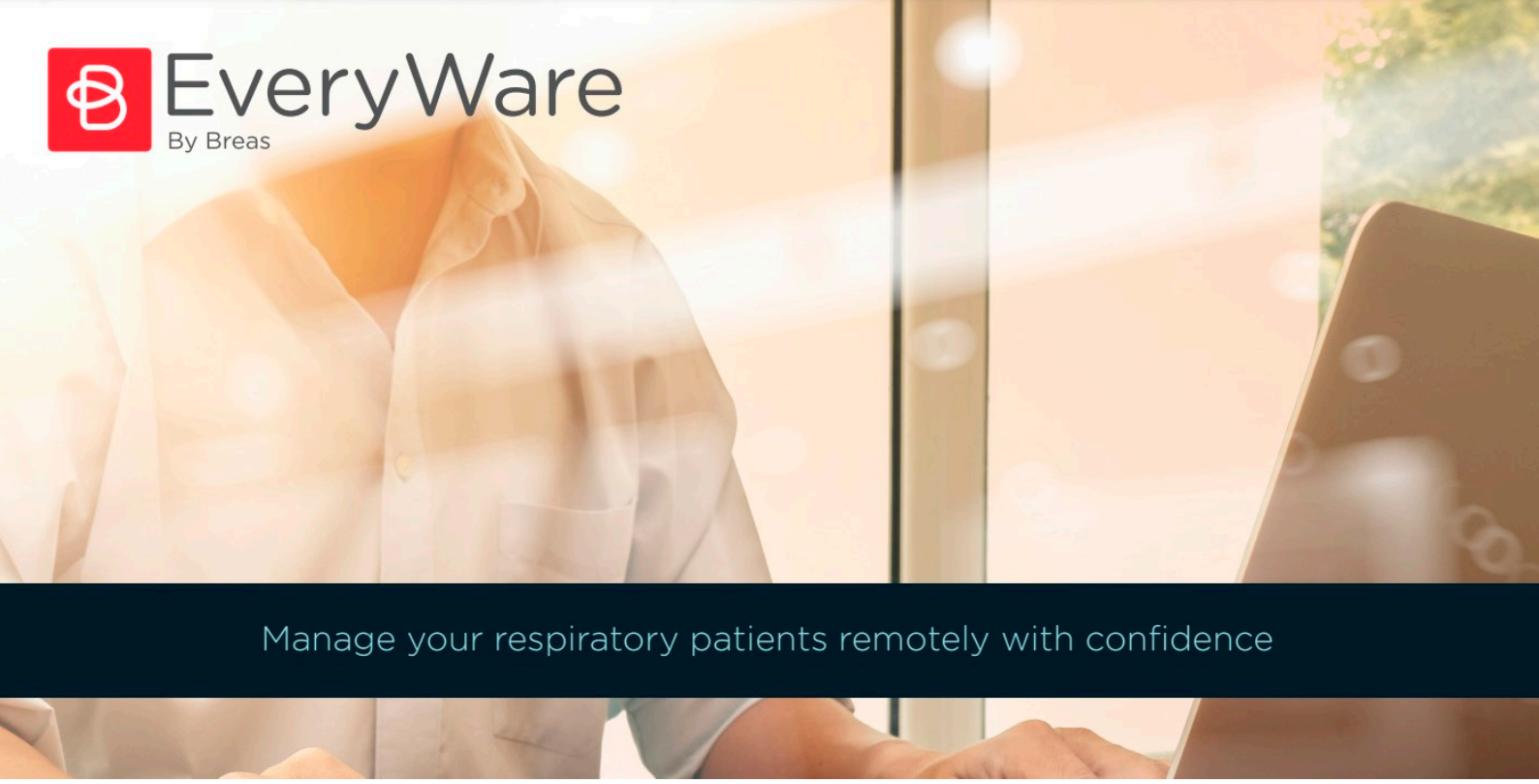
17 Kohler H, Bäuerle A, Schweda A, et al. Increased COVID-19-related fear and subjective risk perception regarding COVID-19 affects behavior in individuals with internal high-risk diseases. *J Prim Care Community Health.* 2021;12:2150132721996898. https://doi.org/10.1177/2150132721996898.

18 Audulv Å, Asplund K, Norbergh K. The influence of illness perspectives on self-management of chronic disease. *Journal of Nursing and Healthcare of Chronic Illness.* 2011;2.

19 Tyson L, Hardeman W, Stratton G, Wilson AM, Semlyen J. The effects of social distancing and self-isolation during the COVID-19 pandemic on adults diagnosed with asthma: A qualitative study. *J Health Psychol.* 2022;27(6):1408–1420. https://doi.org/10.1177/13591053211012766.

20 Polgar O, Patel S, Walsh JA, et al. Digital habits of pulmonary rehabilitation service-users following the COVID-19 pandemic. *Chron Respir Dis.* 2022;19:14799731221075647. https://doi.org/10.1177/14799731221075647.

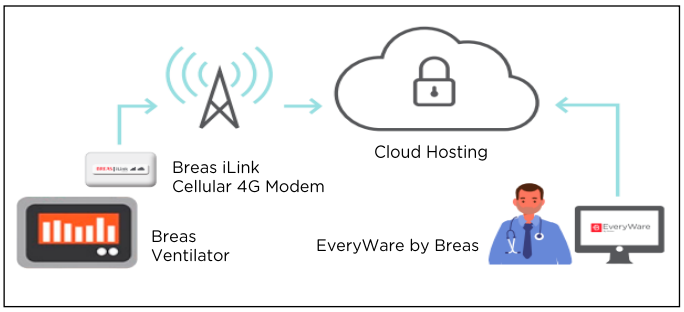
EveryWare
By Breas



# Manage your respiratory patients remotely with confidence

At Breas, we know that ageing populations and modern lifestyles can lead to healthcare access, resources and budgets being stretched to crisis point. Patients with chronic respiratory conditions compound the situation, often requiring multi-disciplinary teams and support mechanisms to manage them effectively.

Remote technology has the opportunity to not only enhance patients' quality of life and make their treatment more effective, but also help plan interactions with patients more effectively, cutting out needless and inconvenient travelling.



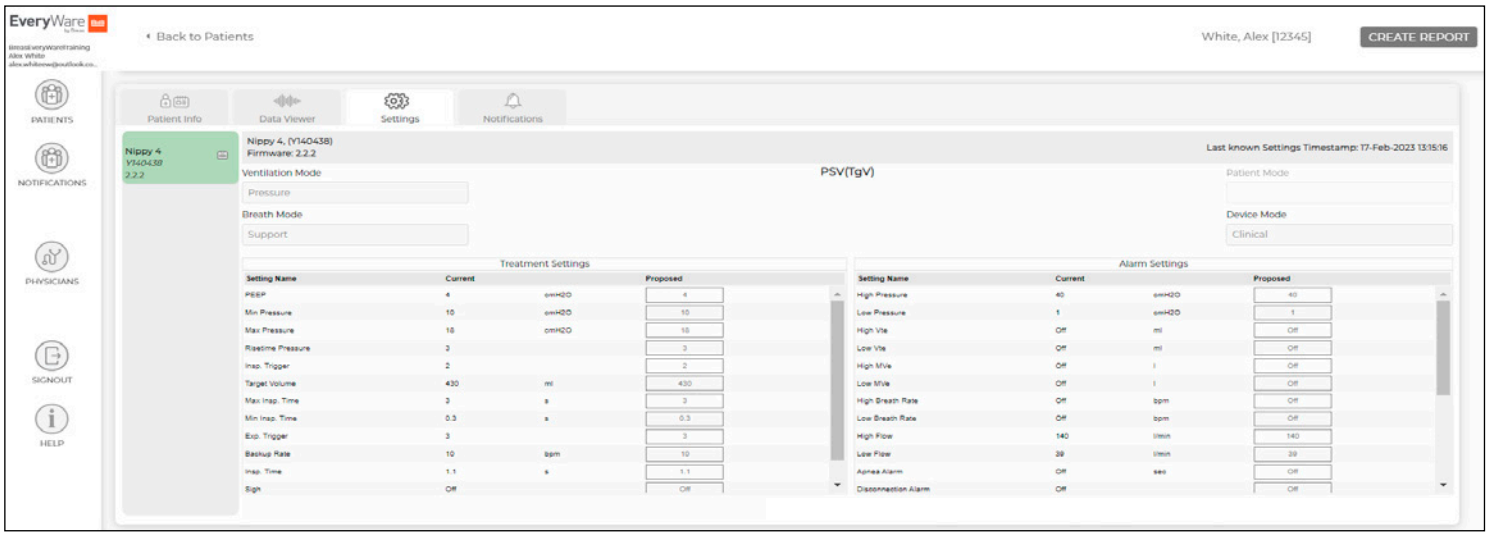

## Now available with remotely changeable settings

EveryWare has recently had an important update. It is now possible to change clinical and alarm parameters remotely for your patients' on Breas non life-support ventilators (Vivo 1/2/3 and NIPPY 4). It is this feature which truly enables the EveryWare user to act upon the patient notifications which they can receive, in order to try and help prevent patient exacerbations, and aim to reduce expensive readmissions into hospital.

Be sure to speak to your local representative for more information.

Vivo 123

NIPPY 4




SCAN ME



Unit A2, The Bridge Business Centre
Timothy's Bridge Road
Stratford-Upon-Avon, Warwickshire, CV379HW. UK

For more information:
salesUK@breas.com
Tel: +44(0)1789 293 460

BREAS

# Upper-limb specialist input into intensive care to prevent proning associated complications during the COVID-19 pandemic: Leicester's experience

**Helen Tunnicliffe[1], Phil Sykes[1] and Ross Dixey[1]**

[1]University Hospitals of Leicester NHS Trust, Leicester, U.K.

*Keywords* | Prone, upper-limb, COVID-19, brachial neuropathy, shoulder.

*Correspondence author* | Helen Tunnicliffe. Telephone: 0116 258 2596.
Email: helen.tunnicliffe@uhl-tr.nhs.uk.

## Abstract

### Background

Unilateral upper-limb complaints associated with proning presented during the COVID-19 pandemic.

The impact of musculoskeletal upper-limb specialist physiotherapy into intensive care unit (ICU) on patient outcomes, during the second wave of the pandemic, is presented.

### Method

Following the first wave of the COVID-19 pandemic, an electronic referral pathway was implemented directly to an extended scope physiotherapist (ESP) to assess/treat upper-limb complaints in post COVID-19 patients. The proning standard operating procedure was amended in response.

January 2021, the COVID-19 second wave, dramatically increased numbers on ICU. Direct musculoskeletal (MSK) therapy input on ICU was initiated focussing on optimal positioning, risks of sustained positions/compression and traction risks to the brachial plexus. Ideal positioning visual references and peripheral nerve injury screening tools were created and distributed on all units.

MSK therapists assisted with proning, repositioning and directly educating ICU staff. Sedated patients were assessed for joint stiffness/restrictions and mobilisations performed. Upon sedation reduction, assessments addressed specific upper-limb deficits, patients engaged in active upper-limb rehabilitation, and individual programmes created.

The main aims of the paper are:

1 To present a comparison of incidence of shoulder injuries in wave one to wave two, of the COVID-19 pandemic, and present the measures put in place in response to findings in wave one.
2 Review the pathologies/types of shoulder injuries presenting in wave one and two, and review if associated with proning complications. Patients' demographics and comorbidities are also reviewed, to see if any factors may predispose patients to such injuries.

**Results**

Between March 2020–2021, 598 COVID-19 positive patients were treated in Leicester's ICU's, many with prolonged length of stay. Two comparable six-week windows were examined, reflecting wave one and two of the pandemic (survivor's data). Wave one: 11 patients (19%) were identified/treated in physiotherapy post ICU discharge, (all proned) (four neuropathies, three frozen shoulder, four rotator cuff weakness/impingement presentation). In comparison, Wave two: three patients (6.9%) required post discharge follow up, for overhead weakness (cuff) and loss of elbow extension. Such presentations can be associated with prolonged length of stay, (average of 53.3 days) rather than proning complications.

**Conclusion**

Musculoskeletal therapy input to ICU focusing on education, proning, assessing and commencing early upper-limb rehabilitation was extremely positive. This has identified a role for MSK input in the acutely critically unwell patient.

## Introduction

The COVID-19 pandemic has seen immense strain put on the NHS between March 2020 to the present day (1). In severe cases, COVID-19 triggers the inflammatory process, also known as a cytokine storm (2), resulting in wide-spread diffuse alveolar damage, leading to acute lung injury and acute respiratory distress syndrome (ARDS).

Proning is recommended in the treatment of moderate or severe ARDS and was a technique widely utilised during the COVID-19 pandemic (3). Early application of the prolonged prone position may significantly decrease mortality compared to conventional supine ventilation (4). Proning is recommended for more than 16 hours to maximise effectiveness (5). However, use of proning is not without risk with associated complications including pressure sores, facial/periorbital oedema, intravenous/endotracheal tube displacement, cardiovascular system instability, ocular injury/corneal abrasions, brachial plexus injury and staff injury (5).

During the COVID-19 pandemic focal neuropathies have been identified, with a possible cause being the result of compression or traction of the plexus, peripheral nerves or arterial

structures (3). It is assumed that such presentations are possibly related to the use of prone positioning. The faculty of intensive care medicine (FICM) guidelines for prone positioning (5), recommend the elbow should be maintained at 90°, however this is a potential stretch position for the ulnar nerve at the elbow (6). Miller et al (3) also notes that the abducted and laterally rotated position of the shoulder causes traction on the infraclavicular plexus.

Locally an existing standard operating procedure (SOP) for proning was adapted to be used during the first wave of the pandemic which included head turns every eight hours and regular limb repositioning. A pathway to manage patients presenting with upper-limb complaints following discharge from intensive care (ICU) was also created. Due to the high incidence and an increased understanding of the risk of upper-limb dysfunction, several interventions aimed at reducing the prevalence of upper-limb complaints were implemented prior to and during the second wave of the pandemic.

The aims of this paper are:

1 To compare the prevalence of shoulder injuries between the first and second waves of the pandemic following the introduction of an upper-limb management intervention for patients being proned.
2 To describe the types of shoulder injuries and their presentations in the first and second waves of the pandemic.

## Method

This service evaluation was registered and approved by the University Hospitals of Leicester NHS Trust as a clinical audit (reference number 10674).

### Setting

This service evaluation was undertaken in a large U.K. University Teaching NHS Trust, with ICUs at three separate sites, one of which is an extra corporeal membrane oxygenation (ECMO) centre.

#### *Upper-limb management intervention*

The upper-limb management intervention was implemented across all three sites prior to and during the second wave of the pandemic. In addition to the interventions outlined below, the original COVID-19 proning SOP was updated to include head turns every four to eight hours.

#### *Staff education*

Education provided via Microsoft Teams was recorded and delivered to therapy, nursing and medical staff. Optimal patient positioning, the rationale for such positions and the risks that could be imposed by sustained positions of compression or traction on the brachial plexus was discussed. In addition to these sessions, laminated documents with a quick visual reference for the ideal position were produced and put with the proning SOPs in use on all units or in bed spaces (Figure 1).

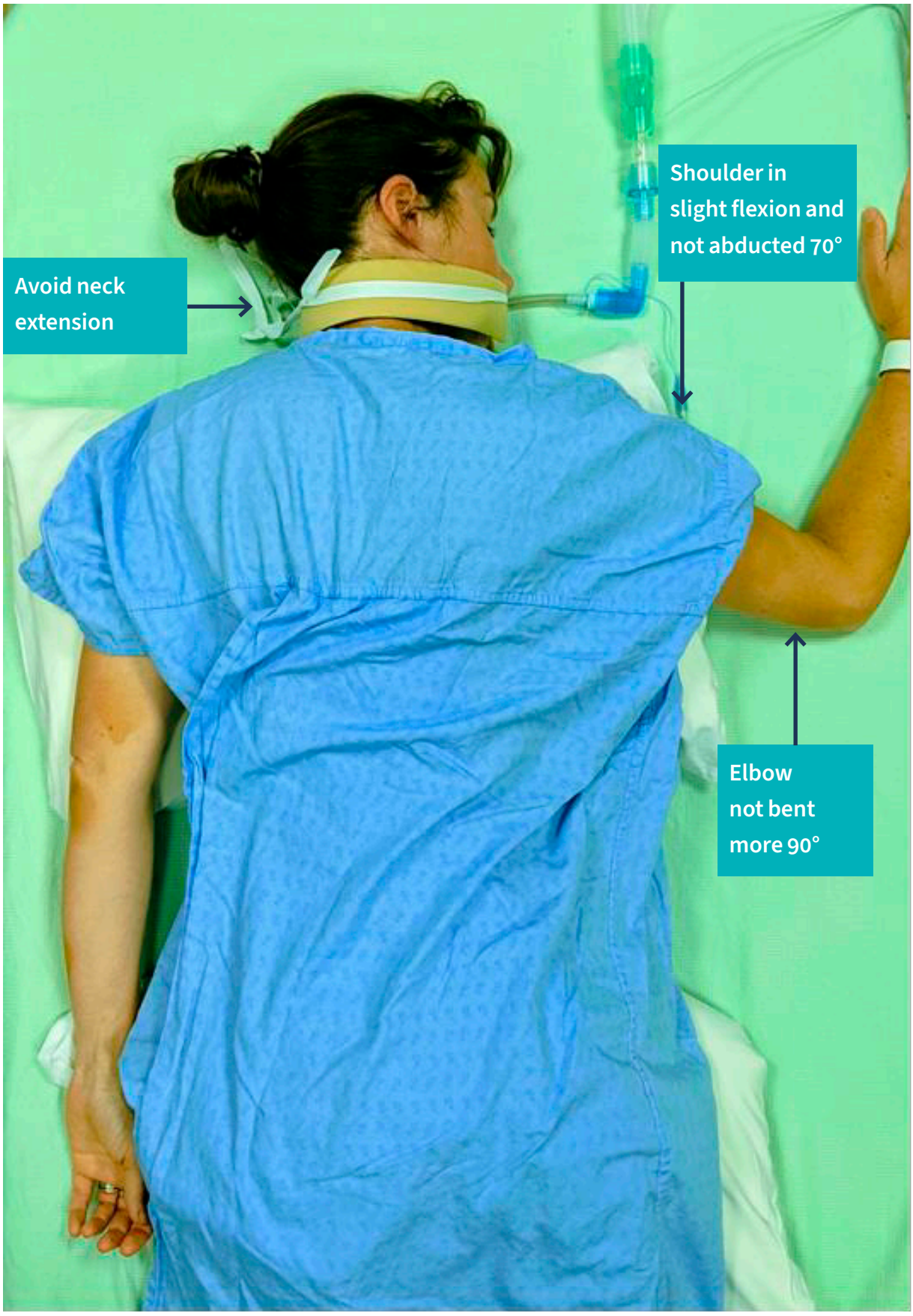



**Figure 1: Swimmers position for proning to prevent upper limb/neck problems.**

Therapists across all in-patient wards were also informed of the referral pathway to ensure early identification of any upper-limb MSK problems. Peripheral nerve injury (PNI) screening tools, were created for staff to use (Appendix 1).

### Patient assessment and intervention

To support the management of prone positioning, musculoskeletal (MSK) physiotherapy input directly on to ICU was initiated. Assistance with proning was provided, with discussion and education regarding optimal positions with nursing and medical staff. Additionally aid in general repositioning and assistance with head turns was provided. Whilst patients were still sedated, assessments for joint stiffness/restrictions were performed and passive movements provided to maintain flexibility. If there were any concerns regarding unilateral stiffness or cervical stiffness that could potentially impact on proning, assessment was made, and advice offered accordingly. As patients' sedation levels were decreased, assessments were made to review for any specific upper-limb deficit. Patients were engaged in active upper-limb rehabilitation, alongside mobility progression, and individual rehabilitation programmes created.

### Data collection

Data was collected retrospectively from the hospitals electronic database, mainly from critical care discharge letters, and prospectively from patients referred into physiotherapy requiring upper-limb treatment. Data collected included demographics, baseline comorbidities, whether they were treated with proning (conscious or unconscious) and ICU length of stay.

Data was collected during a six-week period during the height of the first (1st April–13th May 2020), and second (1st February–15th March 2021) waves of the pandemic. These six-week time periods reflect time that the trust was under the highest level of operating pressure for each wave.

### Data analysis

Data is presented as descriptive statistics and narrative commentary of the presenting pathologies.

## Results

During the data collection periods, 58 patients (69% male) were treated in ICU with COVID-19 and survived in the first wave, compared to 44 patients (66% male) in the second wave. The average ICU length of stay for these patients was longer in wave one (25.5 versus 18.9 days). The mean age was 51.8 years old (range 30–71) in the first wave, and 51.6 (range 27–76) in the second wave. The prevalence of shoulder injury was greater in the first wave (19%, $n = 11$ versus 6.9%, $n = 3$). The number of patients treated with proning was lower in the second wave (43.2%, $n = 19$ versus 50%, $n = 24$). Results are presented in Table 1.

**Table 1: Comparison of wave 1 to wave 2 patient load.**

| | Wave 1 | Wave 2 |
|---|---|---|
| Number of patients | 55 patients | 44 patients |
| Average length of stay | 25.5 days | 18.9 days |
| Male, Female | M = 69, F = 31 | M = 66, F = 34 |
| Average age | 51.8 | 51.6 |
| Proned | 50% | 43.2% |
| Comorbidities most common | DM, HTN | DM, HTN |

Main comorbidities in wave two were relatively comparable to wave one (Table 1).

During the first wave, 11 patients (19%) were identified as presenting with unilateral upper limb problems, and referred through the electronic referral pathway. Four patients (6.9%) presented with brachial neuropathies (presentation of neuropathic pain, pins and needles/numbness, weakness and wasting), three (5.2%) with frozen shoulders (stiffness and pain in the absence of glenohumeral osteoarthritis), and four (6.9%) with painful shoulders with rotator cuff weakness (subacromial impingement presentation).

All 11 of the patients that were referred into the MSK service with upper-limb conditions, were proned as part of their treatment for COVID-19. The majority were unconsciously proned while on the intensive care unit ($n = 9$) for at least one 16-hour period with repetition of proning at least five times. The other two patients were conscious and able to self-prone. One of the patients presenting with significant neural deficit following their recovery on ICU was transferred to UHL from an external centre for ECMO cannulation. It was documented in the medical notes that the patient had been prone at the referring centre for a single period of more than 24 hours prior to their transfer.

Analysis of the past medical history of those patients from wave one with shoulder pathology identified three patients had vascular related comorbidities (diabetes, hypertension and hypercholesterolaemia); six had obesity or a high body mass index; one diverticulitis; two had asthma; one had non-alcoholic fatty liver disease; one had a history of alcohol dependence and three had no significant past medical history recorded. We did not analyse whether this differed from those without shoulder pathology.

### Frozen shoulder

Two of the patients diagnosed as having developed capsulitis had vascular associated risk factors (type 2 diabetes, hypertension/hypercholesterolemia, smoking history). The third individual to present with a frozen shoulder was female in her fourth decade. These patients required outpatient physiotherapy treatment for an average of six to eight months.

### Neuropathy

There were four suspected brachial plexopathies referred for further treatment, two of whom had diagnoses of obesity and one had a past medical history of type 2 diabetes, smoking and alcohol dependence. These patients have required over one year of treatment in physiotherapy outpatients and continue to have significant pain and functional deficit.

### Weak/painful shoulder

All patients presenting with weak and painful shoulders suggestive of rotator cuff pathology ($n = 4$) resolved with physiotherapy, and were discharged from the service (treatment time four to eight months), except one out-of-area patient who was not followed up locally after repatriation to the referring centre. No comorbidities of clinical relevance were identified in this group of patients in relation to shoulder pathology.

From wave two, three patients were identified with unilateral upper-limb problems requiring outpatient input (6.9%). These were identified whilst in-patients on ICU or on step down wards and treatment initiated immediately. Two of these patients were treated in the prone position during their admission (with proning for a 16-hour period and repetition at least five times), however one was not.

Two of these patients presented with no comorbidities. One patient was initially admitted for emergency laparotomy for hernia/perforation, but contracted COVID-19 and developed pneumonitis.

Two of these patients presented with bilateral overhead weakness, and unilateral stiffness on the ventilator side. Two had loss of end of range elbow extension (30° deficit). All three patients required physiotherapy out-patient treatment, for less than one month.

## Discussion

This review found the prevalence of shoulder injury in COVID-19 survivors decreased between the first and second wave. Concluding why is difficult to ascertain, as full information regarding proning frequency, duration and numbers affected was not available for those who were not captured as having upper-limb problems and requiring follow up from our service. Preventative measures such as education regarding optimal positioning, increasing repositioning frequency and early implementation of rehabilitation may have been helpful to reduce incidences, although length of stay was lower in wave two so may have influenced outcomes.

The COVID-19 pandemic placed unprecedented demands on intensive care units, with our units expanding from usual maximum of 20 beds at two sites, up to 100 beds. With patient numbers and length of stay dramatically increasing, placing immense demands on staffing, proning SOPs were written to be feasible under the pressures. Despite the suggested links between proning and potential brachial plexus injury, only four patients were identified as having potential nerve related problems in our unit from wave one. In response to the

increasing pressures of wave two, and with the knowledge acquired from wave one, input from MSK specialists into the ICU department was initiated. Patients were also identified immediately with any upper-limb deficit and treated accordingly. Once patients are alert and stable, physiotherapy tends to focus on getting the patient up and out of bed. For many patients recovering from critical illness, once a day mobilisation is as much as can be tolerated (primarily focusing on sitting balance, progressing to sit-to-stand practice, transferring and mobilisation), but an additional session of bed exercises focusing on the upper-limb was added to help recover function in these patients. Patients reported this helped maintain their motivation for rehab. Future research on the patient experience would be beneficial to guide what functional tasks are important to them to guide rehabilitation programs. Anecdotally, especially during times of no visitors, patients regularly had a goal to be able to reach their own mobile phone and call friends and family independently without needing assistance. No data was collected on this however, but may be something to bear in mind, in terms of the requirement for reaching, grasping and using fine motor skills to operate the mobile phone.

Many patients were found to demonstrate generalised weakness and struggled with overhead activity, hand-to-mouth and elbow extension. By assessing patients on sedation reduction, individualised treatment was commenced, and programmes created.

From the identification of these three main deficits, an in-patient leaflet was developed for use for patients to help work on recovering independent functional movement (Appendix 2).

The evaluation found there was a higher prevalence of shoulder injury during the first wave. One observation made was a link with higher rates of vascular related disease (diabetes and hypertension) and obesity. Data collected on comorbidities such as raised body mass index (BMI) or obesity was gathered from documentation in medical notes, however anecdotally this number was likely to be greater in both samples. Drawing comparison with the second wave, far fewer patients presented with specific shoulder pathology, but rather generalised upper-limb weakness and unilateral glenohumeral joint and elbow joint stiffness, that is more likely to be associated with the prolonged length of stay. In addition, no clinically relevant comorbidities were identified in these patients.

Many of the comorbidities observed in the sample are established risk factors for developing shoulder pathology and are also in-keeping with those identified as risk factors for developing severe illness from COVID-19 (7).

Miller et al. (3) presented a case series of 15 patients identified as having brachial plexus neuropathies post critical care stay and found that 30 nerve injuries presented. Thirteen had multiple nerve injuries within their upper-limbs (range 1–4). Nine had injuries involving the ulnar nerve at the cubital tunnel, with 10 out of 30, having a peripheral nerve injury at the level of the cords in the infraclavicular plexus. All patients had been treated with

proning. Our results showed a much lower incidence of peripheral nerve injury, with only four presenting in wave one, and none in wave two. This may be due to our unit's experience with proning, and could be related to the implementations put in place. Miller's (3) work was very useful to provide guidance for education on positions to avoid.

### Limitations

This study is presented retrospectively, so is limited in nature. Baseline data regarding upper-limb function for each group compared was not collected, so we cannot be sure they were equal. Most of the data was collected from hospital notes and discharge letters, that is likely to have had missing data, and certainly information such as increased body mass index was limited. It would have been beneficial to have collected patient related outcome measures, both specific to their upper-limb function, and general health and anxiety, to improve depth of the data. Data has not been collected on patients who were treated in the prone position without COVID-19 either, so it is difficult to ascertain whether this problem is specifically relevant to this population.

## Conclusion

The input of musculoskeletal therapists into ICU, can help with education, proning, identify possible problems early and facilitate rehabilitation. This has identified a role for MSK input in the acutely critically unwell patient, specifically rehabilitating upper-limb function in the early days on ICU, and preventing deconditioning and common presentations of stiffness and weakness. Future research is recommended into the prevention of MSK problems, associated with proning and prolonged length of stay.

## Neuropathic screening tool

1 Pain: Yes/no

If yes:

- Neuropathic (stinging/burning/shooting/squeezing)
    - Yes/no

2 Weakness (circle if present)

Shoulder

- Flex
- Abd
- ER

Elbow

- Flex
- Ext

Wrist/hand

- Finger flexion
- Finger extension
- Finger Abduction
- Finger adduction

3 Sensation

- Normal (N)
- Absent (A)
- Decreased (D)
- Strange (S)

| |
|---|
| Regimental badge |
| Thumb |
| Middle finger |
| Little finger |
| Inner arm |

Caring at its best

NHS
University Hospitals of Leicester
NHS Trust

# Getting strength back in your arms during and after your hospital stay

## Department of Physiotherapy

Information for Patients

Produced: July 2021
Review: July 2024
Leaflet number: 1208 Version: 1

## Introduction

During your stay in hospital, it is very common to lose strength and struggle with moving your arms on your own. The following exercises are meant to help you build up your strength so that you can get back your independence.

Try to do them little and often, and even if you cannot get the full movement, you will be moving the muscles which will help you to recover.

Your therapist will tell you on how many times you need to do the exercises each session. As you get stronger you will be able to build this number up as the exercises get easier.

Doing the exercises lying down is easier than upright, so the exercises do start in this position. You can gradually raise yourself to sit in a more upright position. This makes the exercises harder. Try to add pillows to aim for an upright position as the exercises get easier for you to do.

# Shoulder raises (elevation):

## Start position

- Lying on your back (as flat as you can manage).
- Start with your elbow bent hand pointing up towards the ceiling.

## Action

- Reach arm up towards the ceiling.
- Make a circle as big as you can clockwise, not letting your arm flop .
- Repeat the other way (anti-clockwise).
- Lower the arm by bending your elbow and return to the start position slowly.

Repeat _____ times

Build up to _____

# Elbow exercises

## Start position

- Lying on your back support your upper arm with elbow bent and point elbow towards the ceiling.

## Action

- Straighten your arm as much as you can taking your hand towards the ceiling.
- Bend the elbow to take hand down towards shoulder (return to start position).

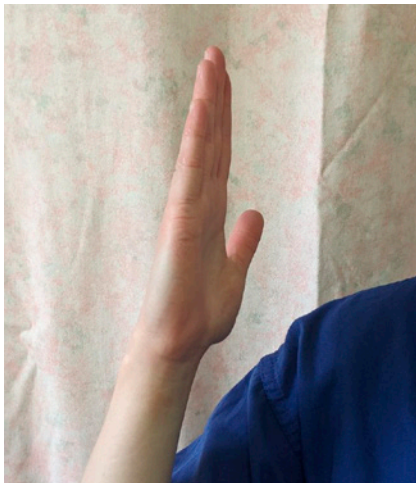
Repeat _____ times

Build up to _____

# Hand exercises

## Start position

Straighten your fingers as much as you can



## Action

Bend your fingers at the knuckles, keeping ends of your fingers straight, before continuing in to a full fist

Repeat _____ times

Build up to _____

## Contact details

If you have any questions speak to the staff on your ward or call

University Hospitals Leicester on 0300 303 1573

اگر آپ کو یہ معلومات کسی اور زبان میں درکار ہیں، تو براہِ کرم مندرجہ ذیل نمبر پر ٹیلی فون کریں۔

على هذه المعلومات بلغةٍ أخرى، الرجاء الاتصال على رقم الهاتف الذي يظهر في الأسفل

જો તમને અન્ય ભાષામાં આ માહિતી જોઈતી હોય, તો નીચે આપેલ નંબર પર કૃપા કરી ટેલિફોન કરો

ਜੇ ਤੁਸੀਂ ਇਹ ਜਾਣਕਾਰੀ ਕਿਸੇ ਹੋਰ ਭਾਸ਼ਾ ਵਿਚ ਚਾਹੁੰਦੇ ਹੋ, ਤਾਂ ਕਿਰਪਾ ਕਰਕੇ ਹੇਠਾਂ ਦਿੱਤੇ ਗਏ ਨੰਬਰ 'ਤੇ ਟੈਲੀਫੋਨ ਕਰੋ।

Aby uzyskać informacje w innym języku, proszę zadzwonić pod podany niżej numer telefonu

If you would like this information in another language or format such as EasyRead or Braille, please telephone 0116 250 2959 or email equality@uhl-tr.nhs.uk

LEICESTER'S RESEARCH

Leicester's Hospitals is a research active trust so you may find research happening on your ward or in your clinic. To find out about the benefits of research and become involved yourself, speak to your clinician or nurse, call 0116 258 8351 or visit www.leicestersresearch.nhs.uk/patient-and-public-involvement

4

Previous reference:

## References


1 Alderwick H. Is the NHS overwhelmed?. *BMJ.* 2022;376:o51. Published 2022 Jan 11. https://doi.org/10.1136/bmj.o51.

2 Ragab D, Salah Eldin H, Taeimah M, Khattab R, Salem R. The COVID-19 Cytokine Storm; What We Know So Far. *Front Immunol.* 2020;11:1446. Published 2020 Jun 16. https://doi.org/10.3389/fimmu.2020.01446.

3 Miller C, O'Sullivan J, Jeffrey J, Power D. Brachial Plexus Neuropathies During the COVID-19 Pandemic: A Retrospective Case Series of 15 Patients in Critical Care. *Phys Ther.* 2021;101(1):pzaa191. https://doi.org/10.1093/ptj/pzaa191.

4 Moscarelli A, Iozzo P, Ippolito M, et al. Cardiopulmonary resuscitation in prone position: A scoping review. *Am J Emerg Med.* 2020;38(11):2416–2424. https://doi.org/10.1016/j.ajem.2020.08.097.

5 Intensive Care Society. *Guidance for: prone positioning in adult critical care, 2019.* Accessed 2023. https://www.ics.ac.uk/ICU/Guidance/PDFs/Prone_Position_Guidance_in_Adult_Critical_Care.

6 Bozentka DJ. Cubital tunnel syndrome pathophysiology. *Clin Orthop Relat Res.* 1998;(351):90–94.

7 Zheng Z, Peng F, Xu B, et al. Risk factors of critical & mortal COVID-19 cases: A systematic literature review and meta-analysis. *J Infect.* 2020;81(2):e16–e25. https://doi.org/10.1016/j.jinf.2020.04.021.

# Introducing XtraCare™ HME-F

**XtraCare™ HME-F includes an electrostatic filter that provides filtration irrespective of the direction of airflow**

## Key features:

- Effective filtration of bacteria >99%*
- Effective filtration of viruses >99%*
- Protects you from airborne particles (such as viruses, bacteria, dust and pollen) by effective filtration of the air you breathe in through the tracheostomy.*
- An HME-F designed specifically for use in self-ventilating tracheostomy patients with minimal dead space.
- If supplemental oxygen is needed, XtraCare™ can be combined with O2 Adaptor.

It protects the patient from airborne particles such as viruses, bacteria, dust and pollen, by effective filtration of inspired air.

### Daily protection

Use it in crowded places such as schools, supermarkets and public transport – especially during the flu season. It can also be helpful while gardening, particularly during the high pollen season.

### Provides humidification and improves lung health

XtraCare™ warms and humidifies the air your patient breathes in to help reduce coughing and mucus production.

**21-22 APRIL 2023**
ACPRC CONFERENCE
Come and see our stand

**Find out more about the XtraCare™ HME by contacting our Customer Care team or visiting our website:**

Call us:
**01157 841 899**

Email us:
**info.uk@atosmedical.com**

Visit our website:
**www.atosmedical.co.uk**

Atos
Breathing–Speaking–Living
atosmedical.com

*Please note: since pathogens can enter and leave the human body in other ways (such as the mouth, nose and eyes), XtraCare can never guarantee complete protection. Please read the instructions for use for guidance.

# Position statement and considerations for remotely delivered pulmonary rehabilitation services

**Lucy Gardiner[1,2], Anna Alderslade[3], Frances Butler[4], Emma Chaplin[5], Rachael Colclough[6], Jane Douglas[7], Siobhan Hollier[8], Jack Plumbe[9], Laura Graham[10], Claire Nolan[11], Kelly Wainwright[12] and Agnieszka Lewko[13]**

[1]University of Leicester, Leicester, U.K.
[2]University of Birmingham, Birmingham, U.K.
[3]NENC Respiratory Clinical Network, NHS England.
[4]York and Scarborough Teaching Hospitals NHS Foundation Trust, York, U.K.
[5]University of Hospitals of Leicester NHS Trust, Leicester, U.K.
[6]University Hospitals Birmingham NHS Foundation Trust, Birmingham, U.K.
[7]Hywel Dda University Health Board, U.K.
[8]BOC Healthcare.
[9]RespiriCare.
[10]Homerton Healthcare NHS Foundation Trust, U.K.
[11]Brunel University London and Guy's and St Thomas' NHS Foundation Trust, U.K.
[12]Solent NHS Trust, Southampton, U.K.
[13]Coventry University.

*Keywords* | Pulmonary rehabilitation, telerehabilitation, remote delivery, chronic respiratory disease.

*Correspondence author* | Lucy Gardiner. Email: lg317@le.ac.uk.

## Abstract

### Statement and methods of development

The challenge of access to pulmonary rehabilitation (PR) and meeting associated service demand is certainly not new. However, the COVID-19 pandemic set an unprecedented challenge evoking rapid adaptation of services. An inherent spotlight has been placed on remotely delivered services. As we look beyond the height of this pandemic, it is important to reflect and consider what has been learnt, and emerging perspectives on the future of PR service delivery.

This document updates the '*ACPRC statement and considerations for the remote delivery of pulmonary rehabilitation services during the COVID-19 pandemic*' (1) and seeks to provide pragmatic practical guidance for remotely delivered models of PR for healthcare professionals that should be used alongside local guidance.

The recommendations provided are for guidance only, and may be updated in response to further national guidelines and new evidence.

An online survey of PR healthcare professionals (*ACPRC pulmonary rehabilitation provision during COVID-19 and beyond!*) was conducted in the development of this document to scope current practice in PR services across the U.K. Informed by queries received by the ACPRC, the survey was first conducted in 2020 and repeated in July 2021 with the aim of capturing a snapshot of practice, one-year post onset of the COVID-19 pandemic. The survey was publicised and disseminated via Twitter using the @theACPRC handle, with request that one team member completed on behalf of their service. A summary of the 21 responses can be found in Appendix 1 which served to inform the content of this document.

A literature review was undertaken to identify and integrate relevant published trials since the 2021 Cochrane review of telerehabilitation for people with chronic respiratory disease (2). Details of the search strategy can be found in Appendix 2 and summary of study characteristics and outcomes in Appendix 3.

Anonymous feedback from four PR services was collated and analysed to identify common themes in experiences of remotely delivered PR services. A summary of this process and collated feedback can be found in Appendix 4.

### Key terms

- **Remotely delivered models** – the delivery of pulmonary rehabilitation services at a distance; the interaction between healthcare professional and participant using communication and information technologies, that may take place in real-time (synchronously) or asynchronously (1). It may be delivered by a virtual platform, an online web application or programme, or referred to as telerehabilitation (note: this terminology is used where studies have reported it).
- **Field walking tests** are commonly employed to evaluate exercise capacity, prescribe exercise, and evaluate treatment response in chronic respiratory diseases (3). The most valid, reliable and responsive ones are the six-minute walk test (6MWT), incremental (ISWT) and endurance walk test (ESWT).
- **NACAP** – the National Asthma and COPD Audit Programme is commissioned by the Healthcare Quality Improvement Partnership (HQIP), as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP), and currently covers England and Wales. The programme is led by the Royal College of Physicians (RCP) and includes a pulmonary rehabilitation workstream.
- **PRSAS** – the Pulmonary Rehabilitation Services Accreditation Scheme was launched in April 2018, and is run by the Royal College of Physicians (RCP).

## Introduction

The COVID-19 pandemic has had an overwhelming impact on people's lives, and healthcare delivery across the world. Prioritisation of NHS resource during the first U.K. national lockdown led to a temporary suspension of *non-essential* services. Conventional face-to-face pulmonary rehabilitation (PR) programmes were widely suspended to protect vulnerable groups, and many staff redeployed in order to support the care of those acutely unwell. Technology-enabled remote delivery of healthcare services has played a significant role in the resumption of non-urgent services in the NHS. In the emergence from the height of this pandemic, PR services have needed to employ an individualised approach to the resumption of services in keeping with local contextual factors. The challenges faced created an environment rich in innovation and allowed further development of remotely delivered models of PR. With consideration of evidence-informed guidelines and quality standards (4, 5), it is important to evaluate and reflect upon, what has been learned during these unprecedented circumstances that can contribute to delivery of quality PR that meets the needs of our population. Remotely delivered models of PR have the potential to contribute to meeting growing rehabilitation need, however inequalities arising from the so called *digital divide* must be considered as the longer-term role of telerehabilitation evolves (6). The NHS England National 5-Year PR Plan (7) recognises that in-person supervised PR is the gold standard and should be offered to patients, as well as the need for action to reduce health inequalities, and optimise the provision of personalised care.

The efficacy of PR in improving health related quality of life, and exercise capacity in chronic respiratory disease populations remains undisputed and the demand for PR services remains high (8–11). Remotely delivered service models such as delivery through video conferencing (for example, Hansen et al. (12)), telephone and/or website supported programmes (for example, Chaplin et al. (13), Nolan et al. (14)), use of a mobile application (for example, Bourne et al. (15)), *hub and spoke* model, with use of remote healthcare facilities (for example, Stickland et al. (16)) aim to increase access and/or improve uptake of PR.

A recent Cochrane review (2) identified 15 trials (1904 participants) evaluating the efficacy of remotely delivered PR for people with chronic respiratory disease. Interventions were required to include exercise training with at least 50% of the intervention delivered remotely. Compared to no rehabilitation remotely delivered PR may improve exercise capacity (measured by 6MWT distance (mean difference (*MD*) 22.17 metres (m), 95% confidence interval (CI) -38.89 m to 83.23 m; 94 participants; two studies; low-certainty evidence) and also when delivered as maintenance rehabilitation (*MD* 78.1 m, 95% *CI* 49.6 m to 106.6 m; 209 participants; two studies; low-certainty evidence). No adverse events beyond any reported for in-person PR or no PR were reported. The authors concluded that there is likely little or no difference in exercise capacity (measured by 6MWT distance) between remotely delivered and in-person rehabilitation (*MD* 0.06 m, 95% *CI* -10.82 m to 10.94 m; 556 participants; four studies; moderate-certainty evidence). Similarly, little or no difference in quality of

life (QoL) (measured with the St George's Respiratory Questionnaire total score) (MD -1.26, 95% *CI* -3.97 to 1.45; 274 participants; two studies; low-certainty evidence). Participants undertaking telerehabilitation were more likely to complete their programme with a 93% completion rate (95% *CI* 90% to 96%) compared to 70% for in-person PR. The certainty of this evidence is limited by the small number of studies with relatively few participants, variance in delivery models, underperformance of the control group (in-person PR groups not achieving the minimally clinically important difference in core outcomes), and a large number of people who declined to take part in these trials leading to lack of equipoise.

A literature review was conducted in July 2022 (a summary of the search strategy can be found in Appendix 2) to identify published trials of remotely delivered PR for people living with chronic respiratory disease following the searches of this Cochrane review (2). Four relevant trials were identified: three comparing remotely delivered to standard in-person PR and/or no rehabilitation control (17–19), and one trial evaluating a remotely delivered maintenance programme (20). A summary of study characteristics and outcomes can be found in Appendix 3.

In summary, face-to-face supervised PR for people living with chronic respiratory disease remains the gold standard. Where it is not possible to deliver a face-to-face programme, a remotely delivered programme could be considered a safe and feasible alternative that may deliver clinically meaningful outcomes. Further research is required to confirm the efficacy and role of remotely delivered PR. The reported trials have depended upon reliable internet access (as well as the provision of equipment); it is essential to identify and address service-related inequity. Building comprehensive service models to progressively achieve equitable access to quality PR is a key priority in improving the quality of life of people living with chronic respiratory disease (6).

## Governance

### Risk assessment and mitigation

Prior to starting a new remote service or the delivery of any components of the service remotely, a standard operating procedure (SOP) needs to be written. Data protection and health inequalities impact assessments are recommended with the respective purposes of identifying and minimising data protection risks, and supporting identification of approaches to reduce discrimination and improve access. The SOP needs to include a comprehensive risk assessment in-line with local policy and procedures which should be reviewed regularly, for example, every 12 months for any pre-existing remotely delivered components and every six months for new services. Many PR services are offering different modes of remotely delivered care. Identification and mitigation of potential hazards associated with each type and model of remote service delivery offered must be considered in the context of the local service, as recommended by the British Thoracic Society (21). Pragmatic clinical guidance on the remote delivery of PR services is detailed in Appendix 5.

The BTS developed a checklist of safety precautions for remotely supervised interventions (21). Important considerations in mitigating risk associated with the delivery of remotely supervised PR include:

- Individual participant risk assessment; Table 1 details recommended inclusion and exclusion criteria.
- Obtain informed consent (verbal or written) to remotely supervised PR ensuring the participant has a clear understanding of the intervention and associated risks and benefits. An example consent form for remotely supervised PR can be found in Appendix 6.
- Ensure the participant has a clear understanding and awareness of potential adverse events. The procedure for a medical emergency during remotely supervised contact should be included within your SOPs. This should include appropriate review during and after the session to ensure the participant's well-being in the case of observed adverse events or sudden unexpected video disconnection.
- Ensure to provide the participant with clear information and instructions regarding the use of the video-conferencing/other digital platform.
- Where possible, providing the participant with an opportunity to do a *test run* prior to commencing their programme is advisable. Ensure to familiarise the participant with the *speaker view* function of the video-conferencing tool to facilitate optimal visualisation of the instructing clinician. Familiarisation with *live captioning* functionality may also be useful for some.
- In accordance with local privacy and data protection policy, ensure to advise participants against recording their group session as doing so in the absence of explicit consent from all members of the group would be considered a breach of confidentiality (22).
- Consider the use of a participant self-assessment checklist to prompt review of symptoms, preparation of equipment and environment, and access to support, prior to starting a session. An example checklist of this can be found in Appendix 6.
- Where remote monitoring is being used, participants should be provided with equipment that has been appropriately maintained and checked, as well as quarantined/cleaned inline with local infection control policy. Participants should be provided with the relevant guidance and instructions and technique checked prior to commencing their programme to ensure safe and effective use.
- Risk assessment of available workspace and equipment to be used for the delivery of remotely supervised interventions is essential.
- Consideration must be given to the screen size of the device to be used by the clinician (for example, laptop, desktop) in assessing staff to participant ratio requirement for group interventions. Dependent on individual participant risk assessment, a ratio of 1:4 may be appropriate when using a laptop, whereas 2:8 may be optimal in using a large TV screen, enabling one member of staff to focus on monitoring.
- The use of headsets may be beneficial in optimising audio quality.

- Consideration must be given to the background environment seen and heard by participants to ensure privacy and professionalism, avoid unwanted distractions, and optimise instructive interaction with participants. Avoid windows/mirrors being in view and take appropriate action to minimise any significant background noise. The volume of any music used in exercise sessions must be assessed to ensure the instructing clinician can be heard clearly by all, with consideration for any participants with any hearing impairment.
- Training needs of staff expected to use video-conferencing (and/or other digital platforms) must be assessed and appropriate support provided. Workforce training resources can be found within Appendix 7.
- Consideration of individual risk assessment is essential in grouping participants for exercise interventions based on monitoring requirements.
- In instances where the ability to meet service demand is significantly impacted due to imposed restrictions resulting in breach of maximum waiting times (5), this must be logged on the local trust's risk register inline with local policy and procedure.

Recommended inclusion and exclusion criteria for remotely supervised exercise testing and exercise component of PR (1):

**Table 1: Recommended inclusion and exclusion criteria for remotely supervised exercise testing and exercise component of PR.**

| Inclusion |
| --- |
| • Access to device capable of supporting the video-conferencing platform and reliable internet connection. |
| • Adequate digital literacy and competence to use video-conferencing and email, or reliable support of digitally competent family member/carer. |
| • Able to safely follow instructions in English or be supported by family/carer or remote interpreting service. |
| • Safe environment within home to perform exercise test/exercise programme. |
| • Able to mobilise and use any home exercise equipment safely and independently. |
| • Consents to participate in remote exercise testing/virtual PR programme. |
| • Able to provide informed consent and report adverse events. |

**Exclusion**

- Significant unstable cardiac or other disease, that would make exercise unsafe or prevent programme participation.
- Cognitive impairment with inability to follow instructions safely.
- Significant sight or hearing impairment (individual risk assessment where indicated).
- Impaired balance with risk of falls without supervision.
- Identified as high risk of exertional desaturation <90% (for example, resting $SpO_2$ ≤92% or home oxygen user, pulmonary fibrosis, post-acute exacerbation) and unable to remotely monitor pulse oximetry.

Please note that this is intended as a guide only; individual risk assessment as per usual protocols is required.

### Information governance

The legal framework for offering remote treatment services is governed by the *NHS Act 2006*, the *Health and Social Care Act 2012*, the *Data Protection Act 2018* and the *Human Rights Act 1998*. The aim is to allow the sharing of personal data between individuals involved in providing care whilst maintaining participant confidentiality when personal data is used for secondary purposes. Further information and support materials that can be useful when setting up a remote service can be found on the NHS England website.

Your local organisation will have their own specific information governance (IG) policy that will detail the requirements for the protection of participant sensitive data within your organisation. It is essential that you refer to these documents when implementing any remote programme. Important practical IG considerations in the delivery of remote services are appended (Appendix 8).

### Workforce

The NHS response to COVID-19 has demonstrated how rapidly and effectively staff can adapt to meet the needs of patients. A continued focus on upskilling is needed to strengthen the workforce, expand capabilities, create more flexibility, support career progression, and importantly boost morale (23). Services offering any remotely delivered components of PR, must ensure staff are suitably digitally literate and competent with digital platforms used by the trust. Appropriate training and support need to be provided. Supporting staff to develop motivational interviewing skills can ensure teams are supporting the Making Every Contact Count (MECC) agenda (24), and increased uptake of PR.

Workforce training and support resources can be found in Appendix 7. Local trust well-being services should be made accessible and signposted to all staff.

## Health and digital inequalities

The pandemic has seen a rapid shift to remote consultation in primary and secondary care, with the aim of reducing unnecessary face-to-face attendances; serving to accelerate work associated with the wide-spread implementation of technology-enabled care (25). As the healthcare landscape evolves from rapid innovation to continuation of service restoration and *business as usual* models, the NHS has been tasked to 'use what we have learnt through the pandemic to rapidly and consistency adopt new models of care that exploit the full potential of digital technologies' (26, p.5). Clinicians have a duty of care to their participants to ensure these new technologies are not worsening the digital divide, and worsening outcomes for those in lower socioeconomic groups or those in underserved populations.

This section introduces health and digital inequalities and highlights considerations relevant to remotely delivered PR. Some examples of practical strategies aiming to reduce and prevent inequalities are provided.

### Health inequalities in pulmonary rehabilitation

The *NHS Long-Term Plan* (11) called for stronger action to reduce systematic, avoidable, and unjust differences in health and wellbeing, between different groups of people (27).

Evidence continues to highlight inequalities in the prevalence and impact of chronic respiratory disease, and data demonstrate that people living with COPD in more socioeconomically deprived areas are less likely to complete PR than those in the least deprived areas (6, 28). To reduce health inequalities, factors influencing fair access and personal agency to engage in PR need to be identified and targeted. There is a lack of research on addressing health inequalities in PR in the U.K.

Remotely delivered services have the potential to play a role in improving access and uptake of PR for some people; for example those who may not be able to attend during working hours, have caring commitments, be unable to travel to rehabilitation site or consider group exercise to be culturally inappropriate. However, acceptability may be limited (29) and the reliance of some models on having a digital device and/or stable internet connection and an adequately-sized private space may limit the ability to engage.

Principles of understanding the needs of our local population, comprehensive good quality data collection, and individual and organisational reflexivity, have been proposed to effectively work toward health equity in PR (6). To help services address this, the Health Equity Assessment Tool (HEAT) (27) supports professionals to systematically identify and address health inequalities, and equity related to a service or programme of work (see Appendix 7 for further resources).

### Health literacy

Health literacy is defined as 'personal characteristics and social resources needed for individuals and communities to access, understand, appraise and use information and services

to make decisions about health' (30, p.12). Research shows that people with low health literacy are more likely to have a long-term condition; older people in England with low health literacy have higher mortality and lower literacy and lower educational levels are linked with unhealthy lifestyles (31). In the U.K. 7.1 million adults read and write at or below the level of a nine-year-old (32). In England between 43% and 61% of English working age adults routinely do not understand health information (32). This number increases to 65% if numbers are included within the text.

Strategies to improve health literacy are important empowerment tools, with potential to reduce health inequalities.

Examples of strategies to improve health literacy:

- Work with health individuals and communities.
- Ensure information and services offered are designed to be accessed by everyone.
- Understand the Accessible Information Standard (33), and how to implement into practice.
- Use the Health Education England Health Literacy e-learning resource.
- Use and provide plain English approved material.

NHS organisations must fulfil their legal duty and meet the Accessible Information Standard (33) by providing participant information in accessible formats such as Easy Read and British Sign Language.

Many people with low literacy skills can conceal their deficit and are often quite articulate when speaking. There are certain *red flags* that may indicate low health literacy skills (34); for example, when asked to complete or read forms, patients may make excuses and may demonstrate one or more of the following behaviours:

- Lifting text closer to their eyes.
- Missing appointments and/or making errors with medication.
- May tick items as 'no' to avoid follow up questions.
- Show signs of nervousness, confusion, frustration.
- Give incorrect answers when questioned about what they have read.

Level of education is not always a good indicator of health literacy (35); more targeted questions can be used with patients, such as:

- Do you ever get help from others with filling out forms, reading prescription labels?
- How much time do you spend reading each day? What do you like to read?
- Do you have problems with reading and remembering information?
- How do you prefer to learn something new? Do you prefer learning by watching TV, listening to the radio, talking with people?

People with low health literacy often have problems understanding information given verbally; research has demonstrated that patients only retain and understand about half of what the clinician tells them, and often won't ask for the information to be repeated or clarified (36). Recommended strategies to improve understanding and retention of information include (36, 37):

- Speak slowly and limit the amount of advice given.
- *Use of plain language* – writing designed to be easy-to-read and understand.
- *Keep it short* – instructions should be specific, concrete and vivid.
- *Structure the message* – organise information logically focusing on 3–5 most important *need to know* points.
- *Effective teaching methods* – using simple language, talk about what's important first, and breaking down complex information into understandable chunks, and reinforce key messages.
- *Use of visual aids* – videos, images or infographics that are culturally sensitive, linguistically appropriate, clearly labelled and support the message being told, use of participant decision aids.
- *Recommend and use technology* – participant portals, telemedicine, mobile apps.

Any information provided can be checked for the reading age using the website www.thefirstword.co.uk readability test, or in Microsoft Word by choosing:

- Home > Editor > Document stats (a dialogue box will appear letting you know that Word is calculating your document stats) > choose OK (Word will open a window that shows you information about the statistics and reading level of your document).

### Digital literacy

Digital literacy has been defined by Health Education England (HEE) as 'the capabilities that fit someone for living, learning, working, participating and thriving in a digital society' (38). The numbers of adults in the U.K. who have never used the internet (or have not used in the preceding 3 months) has nearly halved since 2011; however 5.3 million adults (10% of the adult population) were still described as *internet non-users* in 2018 (39). Five years-worth of progress in digital engagement is reported to have been made in one year during the height of the pandemic by the 2021 U.K. Consumer Digital Index (40). Whilst increased engagement across the breadth of the population was seen with 1.5 million people starting to use the internet, 2.6 million remain offline (40). Notable regional differences are reported (for example, Wales highest proportion of those offline at 13%), and over a third of benefit claimants have very low digital engagement (40).

In an increasingly digital world, this has the potential to impact people's ability to maintain social interactions, access to healthcare and use of new systems or equipment which are being increasingly accepted such as remote long-term condition monitoring. Furthermore, older people, people with disabilities and those from lower socioeconomic backgrounds,

are less likely to be engaged or have the skills to use digital devices; it is these groups who are more likely to suffer from social isolation, and be more disproportionately affected by ill-health (41). Of note, it has been observed in a U.K.-based cohort of PR service-users, that improved digital literacy does not necessarily translate to acceptability of web-based interventions (29).

Digital literacy cannot be viewed in isolation due to interdependencies with many other aspects of health, including significant overlap with health literacy (41). Therefore when implementing any virtual or digital solutions, services must be focused on whether these solutions are widening the inequalities gaps. Online resources (38, 42–44) provide the following strategies to improve digital accessibility:

- Co-production of resources to include those at risk of socioeconomic/geographic/age-related disadvantages for both participants and health professionals.
- Clear, concise information at an appropriate reading age. National recommendations are to aim for a reading age of 7 years old.
- Training for health care professionals/third party organisations delivering/teaching use of digital platforms.
- Specific interventions designed to improve use/understanding and critical assessment digital health literacy, for example gamification, artificial intelligence.
- Consideration of alternative systems such as paper-based, face-to-face options, for those who remain low levels of digital literacy or loaning of equipment.
- Initiating working relationships with external organisations.
- Consideration of easy-read information.

The spectrum of digital literacy of healthcare professionals expected to use potentially unfamiliar digital tools, and technology in the delivery of PR must also be acknowledged. The HEE Digital Capabilities Framework (38) can be used to identify and support the development of digital capabilities of healthcare staff. It can be used:

- For self-assessment.
- To help identify learning and developmental needs.
- To inform personal and professional development plans.
- To guide formal, informal, directed and self-directed learning.
- For reflection and goal setting.
- For evaluation of progress and performance.
- To support innovative digital literacy training initiatives, interventions and resources.

Further health and digital literacy resources, can be found within Appendix 7.

## Audit and evaluation

### Audit

The National Asthma and COPD Audit Programme (NACAP) Pulmonary Rehabilitation (PR) workstream (45) includes a continuous clinical audit (of people living with COPD in the U.K. referred to PR), a snapshot organisational and resourcing audit, and an accreditation scheme (England and Wales). Participation in local and national audit programmes is a requirement for accreditation (46).

When inputting data into the NACAP PR clinical audit, there is a choice to select centre-based or home-based programmes. Included within the home-based programme option are options to select *other digital communication* for email, or app-based programmes and *phone calls* when using a PR manual, such as SPACE for COPD and MyCOPD apps. The number of sessions supervised and received need to be completed.

### Evaluation

Local audit and service evaluation play an important role in assessing clinical efficacy and informing quality improvement (47). Some examples of audits and evaluations relevant to remotely delivered models of PR include:

- Participant satisfaction survey.
- Participant feedback survey.
- Audit of education sessions content and delivery in remote models.
- Waiting list evaluation.
- Uptake and completion of remotely delivery services.
- Objective outcome measure improvement in remote delivery models compared to face-to-face group model, for example walking distance, speed and strength assessment.

Guidance on getting started with quality improvement can be accessed on the British Thoracic Society website.

### Accreditation

PR is nationally recognised as a key component of the *NHS Long-Term Plan* (11) that is based on the extensive evidence. The consequences of the pandemic made it necessary to develop innovative delivery of PR to address waiting lists and offer some form of PR to participants. Despite the innovation increasing capacity in remotely delivered models, these are not necessarily recommended in the quality standards.

In alignment with NACAP, the Pulmonary Rehabilitation Services Accreditation Scheme (PRSAS) run by the Royal College of Physicians is designed to support PR services to measure and improve the quality and outcomes of care provided (46). The PRSAS standards (47) (based on the BTS quality standards (5)) can be accessed on the PRSAS website.

The accreditation assessment requires services to be able to demonstrate both face-to-face pre/post assessments (including use of validated field walking tests for exercise prescription), as well as classes at the site visit to achieve accreditation.

For the most up-to-date information on accreditation assessment, please visit the PRSAS website.

## Participant and staff experience

Person-centred care is pertinent to high-quality PR; confidential feedback from participants, supporters, and staff involved in the service is essential in facilitating this (47). A summary of feedback from 69 participants of remotely delivered PR from four services across England and Wales between November 2020 and April 2022 can be found in Appendix 4. Overall reported experience of completers was positive though notably most of those who had attended PR previously expressed a preference for face-to-face.

Inskip et al. (48) conducted focus groups with people living with chronic respiratory disease, and healthcare professionals (HCPs) involved in PR to identify critical elements of face-to-face PR, and how they can be supported remotely using technology. Four main themes of social aspects, communicating with healthcare professionals, measuring bioparameters, and evolving support were identified. In addition to group exercise sessions at home, group video chat with peers, interactive video games, and buddy system were suggested as ways to recreate the social aspect. Though HCPs reported concerned about the potential frequency of technology-enabled communication; specific check-in time windows were suggested to manage this. Of note, individuals who had either attended face-to-face PR, or did not attend due to distance limitations were purposefully selected to participate in this study; potentially limiting the breadth of ideas and generalisability.

Knox et al. (49) conducted focus groups with standard outpatient PR attendees (*hub* site), those participating remotely (in rural Wales *spoke* site) through video-conferencing link (*virtual PR*), and the staff involved in delivering the service. All spoke-site attendees reported that they would not have attended the hub site due to the distance. Staff identified *increased training needs* and the *importance of good administration* as essential to the success of virtual PR delivery. Workforce training resources can be found within Appendix 7.

Despite indicators of improved digital access and confidence in a single centre survey of PR service users (2021 cohort compared to 2020 cohort), no difference in acceptability for PR was reported (29). Technical difficulties are highlighted as being the most cited reason for poor uptake, and acceptance of telehealth interventions. With consideration of previous literature (home-based rehabilitation trials and qualitative studies), the authors deliberate the likelihood that many patients may just prefer face-to-face PR (29). See the health and digital inequalities section for further relevant considerations.

## Acknowledgements

The contribution of authors and contributors of the ACPRC '*Statement and considerations for the remote delivery of pulmonary rehabilitation services during the COVID-19 pandemic*' is gratefully acknowledged: Anna Alderslade, Frances Butler, Laura Graham, Theresa Harvey-Dunstan, Karen Ingram, Agnieszka Lewko, Claire Nolan, Helen Owen, Sam Pilsworth, Helen Stewart, Ema Swingwood, Kelly Wainwright, Christine Wright.

The contributions of Powys Teaching Health Board, Worcestershire COPD Team, Barts Health Adult Respiratory Care and Harefield Pulmonary Rehabilitation teams, are gratefully acknowledged.

### Funding declaration

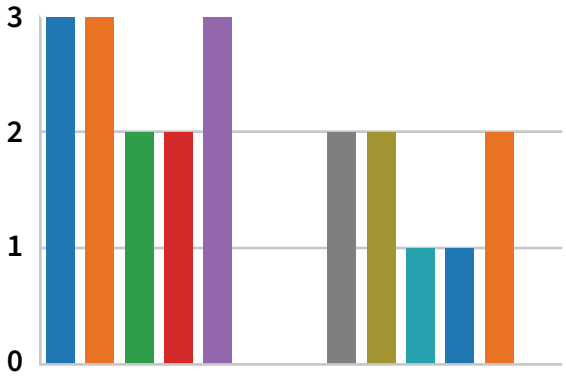
Lucy Gardiner is undertaking a Welcome Trust funded doctoral fellowship.

# Appendices

## Appendix 1 – 'ACPRC pulmonary rehabilitation provision during COVID-19 and beyond! round 2' – summary of survey responses

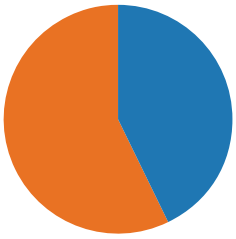
*1 Which region do you work in?*

| | |
|---|---|
| East England | 3 |
| East Midlands | 3 |
| London | 2 |
| North East | 2 |
| North West | 3 |
| Scotland | 0 |
| South Central | 0 |
| South East | 2 |
| South West | 2 |
| Wales | 1 |
| West Midlands | 1 |
| Yorkshire and Humber | 2 |
| Northern Ireland | 0 |



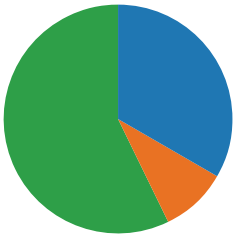

*2 Have you or any members of your pulmonary rehabilitation team been redeployed at any point since the outbreak of COVID-19?*

| | |
|---|---|
| Yes | 9 |
| No | 12 |



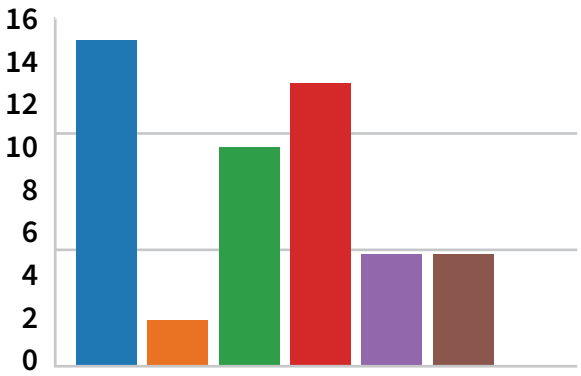
*3 If you answered Yes to Q2, has your staffing provision now returned to pre-COVID-19/'usual' levels?*

| | |
|---|---|
| Yes | 7 |
| No | 2 |
| Not applicable | 12 |



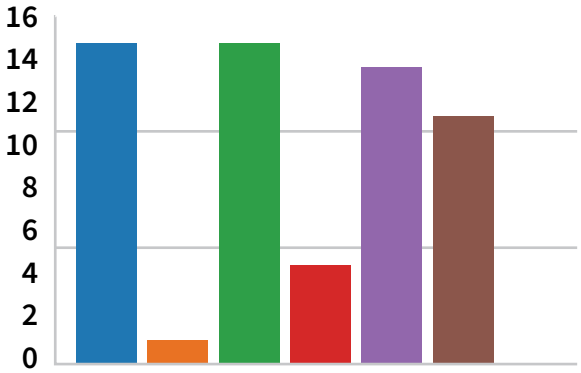
*4 What form(s) of PR delivery is your service currently offering for exercise?*

| | |
|---|---|
| Face-to-face: non home-based | 15 |
| Face-to-face: home-based | 2 |
| Virtual (live sessions using video | 10 |
| Unsupervised programme with | 13 |
| Unsupervised programme | 5 |
| Other | 5 |



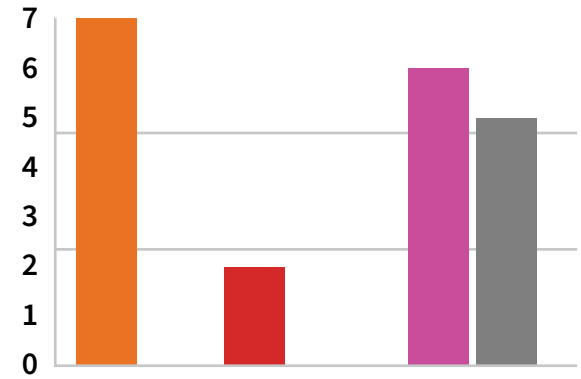

*5 What form(s) of PR delivery is your service currently offering for education?*

| | |
|---|---|
| Face-to-face: non home-based | 15 |
| Face-to-face: home-based | 2 |
| Virtual (live sessions using video | 10 |
| Unsupervised programme with | 13 |
| Unsupervised programme | 5 |
| Other | 5 |




*6 If you're providing a 'virtual' rehab service, which video-conferencing platform are you using?*

| | |
|---|---|
| Zoom | 0 |
| Teams | 7 |
| Skype | 0 |
| AttendAnywhere | 2 |
| Webex | 0 |
| Google Hangouts | 0 |
| Not applicable | 7 |
| Other | 7 |



7 *If you're providing a 'virtual' rehab service, what challenges have you experienced in delivering this? (for example, upskilling staff, limited resources, poor uptake, and so on). (Please move on to Q8 if you're not currently providing a 'virtual' service).*

**13**
responses

**Latest responses**

*'Building staff confidence. Decision making around inclusion on programme…'*

*'Poor uptake from patients'*

**8** respondents (**62%**) answered **patients** for this question.

patient max lack
patient and staff
uptake from patients
Limited resources
Poor uptake
**patients**
staff
many patients
technology
not all patients
patients ability
issues
patients who have difficulty
Labour intensive
Access to resources – patients

8 *If you answered Yes to Q8, has your service been provided with any form of additional resources to support this? (for example, staffing, equipment). (If you answered No to Q8, please move on to Q10).*

**13**
responses

**Latest responses**

*'Worked within existing resources but more staffing needed to supervise on…'*

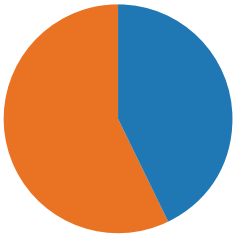
*'No'*

**2** respondents (**15%**) answered **patients for access** for this question

moving forwards
number of devices
mobile phones
virtual than face
extra equipment
copd app
copd cohort
PR packs
limited number
education leaflets
**patients for access**
face to face
pulse oximeters
staff
access to classes
Extra iPads
use of volunteers
leaflets and exercises
form patients
**staffing**

9 *Is your service currently responsible for the provision of any form of post-COVID-19 rehabilitation? (not associated with 'business as usual' participants).*

| | |
|---|---|
| Yes | 9 |
| No | 12 |



10 *Are there any changes to your service) that have occurred as a result of COVID-19) that you think will either remain in place or continue to evolve long-term?*

**19**
responses

**Latest responses**

*'Offering choice of virtual and face to face rehab. Increased staff: patient rat…'*

*'We will continue virtual PR classes alongside face to face classes'*

*'Phone initial assessment will remain. Option for virtual rehab for those who…'*

**12** respondents (**63%**) answered **virtual** for this question

virtual rehab

remote **virtual** Patient

initial assessment virtual PR face to face

## Appendix 2 – literature search strategy

An electronic literature search was conducted through AMED, CINAHL, Cochrane Library, EMBASE, MEDLINE, and PsycINFO for studies of remotely delivered pulmonary rehabilitation (PR), published since December 2020 (following the Cochrane review '*Telerehabilitation for chronic respiratory disease*' (2). Key terms used included medical subject headings related to remote delivery, rehabilitation and chronic lung disease (full search strategy below). Searches were restricted to English language. Reference lists of identified studies were checked for additional references.

Search strategy:

- Remote* OR Distance* OR Telemedicine OR Telehealth OR Telecommunication* OR Telerehab* OR Videoconferenc* OR Virtual* OR App* OR Telephone OR Web*.

AND

- Pulmonary OR (Chronic Obstructive Pulmonary Disease) OR COPD OR (Obstructive Lung Disease) OR Asthma OR Bronchiectasis OR (Interstitial Lung Disease) OR (Pulmonary Fibrosis).

AND

- (Rehab* OR Exercise* OR Therap*).

In accordance with methods used by Cox et al. (2), randomised or controlled clinical trials of remotely delivered PR in people living with chronic respiratory disease were included. The rehabilitation intervention needed to include exercise, that could be group-based or individual, and at least 50% needed to be delivered remotely. Trials that compared remotely delivered models of PR to conventional, or no PR were included. Trials of maintenance rehabilitation (for example, aiming to maintain health benefits following a primary programme of PR) were included. Outcomes of interest included: exercise capacity, health-related quality of life, and adherence.

The lead author conducted the literature search in July 2022, and screened at abstract/title and full-text level as indicated. Following removal of duplicates and appropriate exclusions, four studies were identified for review (17–20).

# Appendix 3 – study characteristics and outcomes

| | Methods | Participants | Interventions | Outcomes | Notes |
|---|---|---|---|---|---|
| *Cerdan-de-las-Heras et al.* (17) | Single-centre, non-inferiority randomised study comparing 'telerehabilitation' versus standard programme. | 54 people living with COPD in Denmark. | Standard rehabilitation: twice weekly 1-hour group training sessions and 6 hours of COPD education for 8 weeks.<br><br>Telerehabilitation: delivered through a 'virtual autonomous physiotherapist agent' (VAPA) comprising software, that serves as a platform for the HCP to create individualised telerehabilitation programme, the exercise session with the VAPA was 10–20 minutes, 3–5 times per week, with individually prescribed training aids (for example, weights, fitness step). | No significant between-group difference in 6MWT; trend for greater improvement in the telerehabilitation group (47 m, $p = 0.14$).<br><br>Telerehabilitation was non-inferior to standard rehabilitation for 6MWT (margin 35 m) post 8-week rehab and after 3 and 6 months of follow-up.<br><br>No differences in 7-day pedometry and QoL between groups.<br><br>Telerehabilitation adherence was reported to be 82% (% training time performed) and participant satisfaction 4.27 ± 0.77 (465 responses) using the 5-point Likert scale. | Reported to facilitate the 'highest workout intensity' however no further detail regarding exercise prescription is provided.<br><br>No comparative data for the standard rehab participants for adherence and satisfaction. |

| | | | | | |
|---|---|---|---|---|---|
| *Cerdan-de-las-Heras et al.* (18) | Single-centre randomised pilot trial comparing a 'telerehabilitation' programme to usual care ('no rehabilitation'). | 15 people living with idiopathic pulmonary fibrosis in Denmark. | 12-week telerehabilitation programme delivered through 'VAPA' (as detailed in Cerdan-de-las-Heras et al. (17)) plus usual care versus usual care only (no defining characteristics detailed). | Statistically significant differences between groups in 6MWD favouring the telerehabilitation group at 3 months (+39.5 m, $p = 0.03$) and 6 months (+34.3 m, $p = 0.02$) post telerehabilitation, but not at 9 months (+40.0 m, $p = 0.15$).<br><br>No significant differences between groups in 7-day pedometry and QoL.<br><br>Telerehabilitation adherence (% training time performed) was reported to be 64% in 15 participants at 0–3 months, and 110% in 3 participants at 6–9 months (not accounting for drop-out) and participant satisfaction 3.8 ± 0.5 (168 responses) on the Likert satisfaction score (1–5). | No defining characteristics of 'usual care' detailed.<br><br>The telerehabilitation group had less severe disease at baseline (significantly lower forced vital capacity % predicted) (mean difference-14.1%, $p = 0.03$) which could have led to greater improvements in 6MWD post rehabilitation. |

| | | | | | |
|---|---|---|---|---|---|
| *Cox et al.* (19) | Multi-centre assessor-blinded randomised controlled trial of centre-based PR versus 'telerehabilitation'. | 142 participants living with chronic respiratory disease in Australia. | 8-week twice-weekly programme. Participants randomised to telerehabilitation received equipment for the duration of their programme including a step-through exercise bike, tablet with mobile data with a stand for video-conferencing, and a pulse oximeter. Initial assessment was conducted in the participant's home. | No significant differences were reported between groups for any outcome at any time point and both groups achieved clinically significant improvements in dyspnoea and exercise capacity post rehabilitation.<br><br>Equivalence of telerehabilitation for the primary outcome of dyspnoea (measured by the CRQ) could not be confirmed (mean difference (95% *CI*) -1 point (-3 to 1)) and inferiority could not be excluded. At end-rehabilitation, equivalence of telerehabilitation was demonstrated for 6MWD and the emotional and fatigue domains of the CRQ.<br><br>Subgroup analysis of participants with COPD demonstrated a statistically significant difference in dyspnoea favouring the centre-based PR group at 12-month follow-up. | The authors conclude that telerehabilitation may not be equivalent to centre-based PR in all outcomes but is safe, confers clinically meaningful improvements, and may provide an alternative model when centre-based is not available. |
| *Galdiz et al.* (20) | Multi-centre parallel-group randomised trial to determine the efficacy of a maintenance 'telerehabilitation' programme (post in-person PR) in sustaining improvements in exercise capacity and QoL in comparison to usual care. | 94 participants living with COPD in Spain.<br><br>Exclusion criteria of note: 'COPD patients with a bronchodilator response, history of severe coronary artery disease'. | 8-week in-person PR programme consisting of three training sessions per week and four educational sessions.<br><br>Participants randomised to telerehabilitation were provided with an equipment kit for the 12-month follow-up period. The control group were advised to exercise regularly ('at least walking for 1 hour daily') and provided with educational materials as per usual care. | No statistically significant differences between groups were reported in any outcome. Analysis of dyspnoea (measured by CRQ) demonstrated a significant interaction between baseline score and intervention group; participants with lower baseline scores faring better in the control group in comparison to those with higher scores ($p = 0.023$). | With recognition of limitations resultant from a pragmatic approach, the authors conclude that whilst the telerehabilitation maintenance programme was feasible and safe, no clinically meaningful improvements were demonstrated. |

## Appendix 4 – Participant feedback summary

Anonymous feedback from four services identified by the authors was collated and analysed to identify common themes. The risk of bias associated with this pragmatic method is duly acknowledged and should be considered. The summary intends to provide an insight into a selection of *real-life* data.

The summary includes feedback from 69 participants of remotely delivered PR programmes (all through video-conferencing platforms) from four PR services across England and Wales between November 2020 and April 2022. Methods of feedback reporting were varied; Table 1 provides further details.

**Table 1: Details of PR service feedback.**

| Service | Service location | Time period | *N* | Non completers included | Feedback method |
|---|---|---|---|---|---|
| 1 | Urban England | November 2020 | 9 | Yes | • Telephone interview with patient experience team. |
| 2 | Rural Wales | November 2020–July 2021 | 18 | No | • Anonymous questionnaire. |
| 3 | Rural Wales | November 21–April 2022 | 27 | No | • Facilitated group discussion and individual interview. |
| 4 | Rural/ urban England | December 2020–August 2021 | 15 | No | • Anonymous questionnaires and thank you cards received. |

### Overall satisfaction with remote PR

High levels of satisfaction with the remote PR experience were reported by all participants from service three, as evidenced by *good* or *very good* (highest) ratings for *the overall experience*. All 14 participants asked from service two agreed that they would recommend remote PR to other people living with lung disease. All participant feedback described benefits in one or more of the domains of symptom management, self-efficacy, exercise tolerance, mood and motivation. Nine remote PR participants who had previously completed a face-to-face PR programme (in urban England) reported the face-to-face to be preferable (50).

### Social elements

The social aspects of in-person PR have been reported to increase participant motivation, accountability and sense of belonging (48). Feedback received from the Welsh remote PR services frequently described improved motivation, and a feeling of support from peers and staff delivering the programmes. This is encouraging, but remote support may need more facilitation than it would in a face-to-face setting, where there is greater opportunity for private and spontaneous conversations.

> 'It made me do the exercises I had been thinking about doing for months… it gave me the motivation to carry on and change my lazy ways!! I feel a lot better after doing the course'.

> 'I know that I am not alone. Tutors were friendly and understanding'.

> 'I was able to discuss and listen to people with the same problems'.

> 'Seeing others in the same position and sharing difficulties is comforting'.

> 'It would have been nice to talk to the other patients – a little bit of interaction'.

> 'I don't socialise very well but managed to talk to the people on the course'.

### Communication

Video and audio communication between PR sites were identified as challenges in a study, in *hub and spoke* PR model in rural Wales, but this improved as more sessions were delivered (49). However, staff suggested that appropriate training with video-conferencing equipment could have prevented the difficulties arising (49). Experiences reported by service one also conferred initial technical difficulties with videoconferencing platforms and communication but the extent to which this impacted completion and outcomes is not known. Only four of 21 participants from service three reported technical concerns, all of which were resolved with all participants reporting *good* or *very good* audio and visual communication in their final feedback, and high levels of satisfaction with the service.

> 'Considering quality of (my) equipment results were surprisingly good'.

### Access and inclusion

Remote rehabilitation can make access to PR possible for participants who may otherwise have been excluded due to travelling distances, time constraints, disability or psychological status. Feedback from service one suggested that people with greater physical disability, may feel less safe exercising remotely (50), and highlighted the need to ensure that the model of rehab offered inspires confidence, is effective and keeps participants safe.

> 'I don't socialise very well but managed to talk to the people on the course'.

> 'I found virtual sessions better for me as I didn't like going to the sports centre, because of the risk of infection'.

'I liked being able to do the course online, as I was able to do it in the comfort of home surroundings'.

'I like my solitude and I don't think I'd have done it face-to-face. I would not have made it (attended F2F), because of the weather and my lung condition'.

'I found face-to-face pulmonary rehab was better than virtual and with others in the room, I could push myself more'.

'Taking part virtually I was able to join in… without feeling awkward'.

### Staff survey

The impact of delivering remote PR on staff workload and the technological competencies required have been identified as concerns by PR staff (48). In the same research, staff acknowledged that remote PR had potential to improve access to previously underserved populations, and could have positive effects on their job satisfaction. The ACPRC conducted a PR staff survey in 2021 (Appendix 1) and received feedback on the experience of delivering remote PR from 13 services. Most survey respondents identified that remote PR is labour intensive, and required more resources in terms of time and staffing than face-to-face PR. Courses may take more time to organise and deliver. Training and support with the technology are required for both staff and participants. Other areas of concern highlighted were reported poor uptake of remote PR, with two services reporting 20% and 25% of patients on waiting lists accepting remote delivery. Challenges with participant access to exercise equipment and concerns regarding achieving good clinical outcomes were also mentioned.

For participants who chose remote PR, staff reported uptake was better when support was provided, for example, posting or emailing literature guides. Additionally, a clear theme emerged regarding remote PR remaining in place to support personalised care through a '*menu of options*'.

### Conclusions

- The overall experience of remote PR appears to be positive for people who have completed courses. When asked, most participants agreed that they would recommend remote PR to others, although those who had experienced both models of PR expressed a preference for face-to-face.
- Social support and enabling progression to independent self-management is an important component of the rehabilitation process, and often needs more facilitation during remote PR than in a face-to-face setting.
- Personal communication needs, access to appropriate equipment for communication and monitoring bioparameters, training and adequate internet speed all need to be considered when considering whether remote PR will be a positive experience for participants and staff.
- More information describing the participant and staff experience of remote PR could inform better service development. Anonymisation and inclusion of standardised patient

and staff experience measures could improve the validity of information gathered and ensure services develop to meet the needs of both participants and providers.
- Finally, more research needs to take place to establish how the experience and clinical outcomes compare to traditional face-to-face PR, so service providers and participants can make better informed choices about their rehabilitation options.

## Appendix 5 – Remote delivery of pulmonary rehabilitation services

Whilst the delivery of a remote pulmonary programme may be different compared to face-to-face delivery, the desired outcomes should remain the same. This section will consider what we need to do differently in these remote programmes in comparison to face-to-face.

It is the responsibility of services to keep up-to-date with current clinical governance and guidelines, especially with regards to any future COVID-19 surges or pandemics.

Although this document includes practical guidance in what should be considered when offering remote PR, services must ensure they put suitable processes in place for risk mitigations that are appropriate for their local area, participant populations and inline with local policies and procedures. Special considerations need to be made when delivering remotely to ensure safety, efficacy and accessibility. The information below is considered best practice but not exhaustive.

### Assessment

Some services may decide to conduct a pre-initial assessment phone call to check for suitability and interest whilst participants are on the waiting list. The following topics might be useful to address at this point:

- Whether a participant is digitally confident and capable with access to appropriate equipment, or has a willingness to be supported to use any loaned equipment.
- Any prehab/ground rules.
- Please ensure you check the most up to date NHS infection control guidance (51), to assist with clinic/home visits if the participant is assessed as requiring additional support.
- Screening of the referral for potential exclusion criteria or concerns, that may affect ability to participate in a remote programme such as:

    a Communication: visual, hearing or literacy issues.
    b Safety: balance, clinical frailty or physical mobility problems which may result in a falls risk or a history of falls.

### Initial assessment: subjective

The participant may be invited to complete their subjective initial assessment in a variety of ways that may include telephone, virtual consultation or face-to-face in a clinic, or on a home visit, as it might be deemed appropriate to separate this from the objective assessment.

- Obtain a good quality medical, holistic history from participant, their supporters and/or other healthcare professional as required. Use existing clinical records where possible to verify information including whether there are outstanding medical investigations or treatments (52).
- Consider whether any other onward referrals and/or screening tools may be required at this point, such as *Nijmegen questionnaire for breathing pattern disorder*.
- If unable to complete physical observations, screening to identify red flags/onward referrals must include:
    - Headaches.
    - Diplopia.
    - Dizziness.
    - Blackouts.
    - Palpitations.
    - Chest pain.
    - Falls screening.

### Objective assessment

The first part of an objective assessment should be screening for safety before proceeding to field exercise testing. A face-to-face objective assessment is the gold standard where circumstances permit. If this is not possible (rurality, isolation, for example), then consider the following:

- Consider the use of *Make Every Contact Count* (MECC) (24). For example, streamlining appointments. Can other staff members be utilised if they are visiting the participant to obtain baseline observations as part of their visit, rather than have multiple visits?
- Consider using the participant's own equipment to obtain readings, or the use of loaned equipment for this purpose.
- Consider looking at previous trends in physical health measurements on shared record systems.
- Complete a blood pressure and manual pulse check to assess cardiac status/rhythm, in the month prior to starting the programme if possible.
- If a participant has a home oxygen prescription, check oxygen usage pre-physical assessment/course commencement, using concordance data.
- Can you support the participant to risk assess their physical environment, or have you completed a risk assessment? The assessment may include questions on the following (see the section *Governance: Risk assessment and mitigation* for further details):
    - Is there space and the area free of clutter?
    - Suitable flooring and check for trip hazards, for example, loose rugs.
    - Does the patient have suitable clothing and footwear, for example, no flip flops.

- Pets put away to minimise trips or interruptions.
- Do they have appropriate exercise equipment including suitable seating to use during classes?
- What access arrangement are there in case of emergency, including next of kin/emergency contact details, especially for those exercising alone.

The *BTS PR Quality Standards* (5) list 3 outcome domains (to include as a minimum): exercise capacity, dyspnoea and health status.

### Field exercise testing (exercise capacity)

Field exercise tests such as the six-minute walk test (6MWT), incremental (ISWT) and endurance walk test (ESWT) have multiple purposes (3):

1. To ascertain the physiological response to exercise.
2. Use as an outcome measure to assess participant's progress.
3. To provide a baseline for exercise prescription.

Completion of a face-to-face physical exercise test in accordance with technical standards (3) is the gold standard. If physical exercise testing cannot be completed face-to-face, then consider the following:

- Ability to monitor the participant:
  - Observing or listening for audible breathlessness (for example, use speakerphone on telephone consultations).
  - Where required, ensure the participant has someone available nearby in case of emergency.
  - Ensure the team and participant are clear of the emergency procedures, if an incident was to occur during appointment, including loss of communication.
- If no physical observations are available, clinical judgement should be used to determine if the test should go ahead, and the participant instructed to stop the test if they experience any adverse symptoms, for example dizziness, chest pain, intolerable breathlessness, pain, for example (participants will usually self-limit their activity level as required).
- Ensure participants on home oxygen are fully optimised with therapy prior to starting the programme.
- For participants not on home oxygen, good practice would be to obtain an oxygen saturation at baseline where possible.
  - If this is not possible use clinical judgement to determine whether it is safe to proceed with testing, or whether the participant would require onward referral for further assessment/investigation (53), (refer to local guidelines/pathways).

### Functional outcome measures

In instances where it may not be possible to conduct a technically correct field walking test, (see *Technical Standards* (3)), clinicians may choose to conduct a functional outcome

measure. The 4-metre gait speed has been reported to have the highest correlation, with routine measures of exercise capacity, but standardisation in a remote assessment and ability to prescribe exercise may be limited (54). Commonly used as a measure of functional capacity, sit-to-stand (STS) tests (for example, one-minute STS) may be easier to standardise in a remote assessment. Evidence supports the validity, reliability and responsiveness of STS tests, as an alternative measure of exercise capacity in people living with COPD (55, 56).

Consider:

- Reference to instructions (for example, the *Primary Care Respiratory Society One-Minute STS Test Protocol*).
- Ensure the participant has been appropriately monitored, for recovery after test completion, returning to baseline parameters.
- Encourage active recovery in participants with increased cardiac risk (57).
- Ensure standardisation (for re-assessment purposes).

### Measurement of dyspnoea and health status

Services will need to consider how participants can be supported to complete valid and reliable outcome measures, if completed remotely.

Consider:

- Selecting self-reported questionnaires wherever possible, for example CAT, PHQ-9/GAD-7, Clinical Frailty Scale and MRC Dyspnoea.
- Methods to support participants with learning and communication needs to ensure they can complete the questionnaire and the answers that are reflective of their personal perception of their condition (without undue influence on anyone helping to complete them).
- The delivery mode and method of return, for example, by post, by email, web-based or over the phone.

### Exercise

Delivery of remote exercise and remote exercise prescription present specific communication, supervision and safety challenges for participants and staff. The following should be considered:

*1 Emergency protocols*

- Services must have an emergency protocol, to follow if a participant becomes unwell. This includes actions to take during in the event of chest pain, severe shortness of breath, sudden severe pain or any other medical emergency.
- Clear red flag symptoms should be identified as part of a participant information leaflet, to support self-escalation of concerns before, during or post exercise session as well as on completion of home programme.
- Services should consider how to mitigate increased risk of adverse cardiac event for

a certain period after the exercise class has ended if there are no further supervised activities planned, for example, a subsequent education session.
    - Therefore, services should be mindful to adapt programmes to include graduated cool-downs of at least 15 minutes, and working within an appropriate heart rate training zone, (no more than 80% maximum heart rate, or lower for very deconditioned individuals), plus use of the BORG scale to monitor perceived exertion (57).
- Services must have a plan for technology failures, and staff and participants must be aware of the protocols.
- A next of kin or emergency contact for the patient, should be documented in the patient's notes.
- Services must have up to date service details in an easily accessible format, to ensure participants are able to contact the service, if the service is unable to contact the participant.

2 *Staffing*

*Ratios*

- Staffing ratios should ensure that all participants can be seen on screen at the same time, if using video-group.
- Screen size may affect group size due to ability to safety supervise for example, using a laptop screen compared to a large TV screen.
- Participant peer supervision, may be limited in remote groups which may be less effective compared to face-to-face groups.
- There should be a minimum of 2 members of staff to run a group, and consideration must be made with regards to risk mitigation in larger groups. For example, the group can continue to run with 1 member of staff, and there should be capacity for 1:1 support for group members.
- Consideration of staff confidence to use the chosen platform, and ability to provide basic troubleshooting advice to participants.
- Consider reducing group sizes when inducting new staff.

**Communication**

- One staff member should be designated as lead for the duration of the session.
- Each staff member should be given a specific role/task(s) for the duration of the group, to ensure clear lines of responsibility and communication for example:

1 Demonstration of exercise.
2 Exercise progression, modification and technique/performance supervision.
3 1:1 participant support/communication, to include escalation/emergency responses.

- Agree private means of communication between staff members during sessions.
- Agree private means of communication with individual participants during sessions, if needed (please refer to the section *Governance: information governance for further information*).

- Patients should be provided with a contact number, for the staff in case of any issues that may arise during the session.

3 *Equipment*

- Participants and staff should be comfortable using their IT equipment, and the remote platform. The device should be positioned appropriately (see the section *Governance: placement of video equipment*).
- Participants must have the appropriate equipment to perform and progress their exercise programme. For example, chairs/free weights/resistance band, for example.
- As per individual assessment, if prescribed essential medical equipment such as reliever inhalers, GTN and oxygen, participants must ensure these are easily accessible.
- An alternative means of communication should be easily accessible, such as mobile phone/land line in case of emergency, or support for technical issues.
- Participants should ensure they have water nearby, for adequate hydration.
- Blood sugar monitoring kits – participants with diabetes who routinely monitor blood sugars should check their blood sugar levels, before starting exercise classes. If a diabetic participant who does not routinely check their blood sugars feels unwell, they should not exercise and contact their GP or Diabetic nurse for a review.
- Those who are diabetic should have their rescue diabetes kits available, in case of hypoglycaemic event.

4 *Environment*

*General*

- It is good practice to support participants to risk assess their environment and themselves at the beginning of each session (see Appendix 6 checklist, for example). In addition, participants are not to exercise after drinking alcohol and leave at least one hour after completing exercise before having any alcoholic drink.
- Physical environment assessment needs to be as per local risk assessment guidelines.

**Temperature**

- The American College of Sports Medicine (58) recommend a temperature of 68–72°F (20–22.2°C) in a gym environment (with consideration of appropriate humidity and air circulation levels).
- People exercising in their home environment may not monitor or consider this. Appropriate precautions and advice must be given, that includes considerations for clothing, hydration, exercise intensity and duration (including frequency of monitoring). This will help to maintain the expected physiological responses that would normally occur within the more ideal and recommended environmental parameters (57, 58).

5 *Programme content*

- All programmes require suitable exercises supported by an appropriate warm-up and cool down suitable for a remote platform.

- Consider how the service will offer individualised programmes to maintain motivation, and allow for participant progression. Some services may consider stratifying participants according to diagnosis/condition severity/exercise tolerance.
- If new participants are joining an existing a cohort programme or a rolling programme, consider an individual induction prior to attending the main group.

### Education

The *BTS Quality Standards* (5) state PR programmes must include 'defined, structured education', that is typically included within the same session as the exercise component in a traditional face-to-face programme. The COVID-19 pandemic accelerated the focus of technology-enabled learning including in the context of PR. There is some evidence to suggest improved patient experience with technology-enabled learning for people with chronic respiratory disease, however the variability in approaches and methods of evaluation and barriers affecting access limit interpretation and generalisability (59).

### Considerations for delivery of remote education

- Digital literacy and equipment access for both participants and staff including 'how to use guides' or providing technical support to participants who require help (please refer to the section *Health and digital inequalities*).
- Clinicians must have an appropriate workspace to deliver remote education for example, a shared office is not an appropriate space due to potential information governance breaches.
- Consideration must be given to staff providing remote services in terms of health and safety/DSE assessments.
- Inclusion of resources/ability for carers/families to ask questions and be supported.
- Consideration must be given to those who do not have remote access. They should not be disadvantaged because of lack of access.
- Consideration of sight or hearing difficulties that might be exacerbated by poor sound quality/small screens, dependant on device.
- Plan sufficient time for responding to participant questions when delivering remote education.
- Any new forms of educational material must be checked for readability, clarity, and appropriateness (see health inequalities section).
- Consideration of available material for participants who cannot speak English, or use sign language.

- Remote delivery gives opportunity for utilisation of extensive learning tools to encourage active participation, motivation, and peer support rather than didactic delivery methods.
    - Tools might include interactive quizzes, live voting, live whiteboards, polls, short video clips, gameshow quizzes/trivia, for example.

It is encouraged to consider different learning styles within a group to make learning more effective and efficient for the patient. There are many different learning theories and learning styles (60). Using *VARK* (61) as an example, a combination of different strategies can be used to enhance learning in PR classes:

- Visual: for example, pictures, videos, models, colour, shapes.
- Auditory: for example, video/podcasts, lectures, discussion.
- Reading/writing: for example, written information, looking at data, lists, rewriting ideas into own words.
- Kinaesthetic: for example, trial and error learning, task-based learning, case studies.

Studies do show that learners adapt their learning style dependent on the task, just as educators can adapt their teaching styles to become more holistic and facilitatory (62). By doing this and using a range of tools and other strategies, this allows for adaptability and a richer learning experience for patient and keeps education more interesting for staff:

- Reflection.
- Problem solving.
- Role play/simulations.
- Group discussions using different delivery methods.
- Coaching.
- Reinforcing key messages.

Resources to support the remote delivery of education can be found in Appendix 6.

### Managing waitlists

It is acknowledged that variation in approaches in managing waiting lists during the height of the pandemic and beyond has been required due to factors such as:

- Staff redeployment (ACPRC survey Appendix 1) showed >70% services had some staff redeployment).
- Services shutting down completely and/or closed to new referrals for a period.
- Many services required to offer face-to-face PR upon resumption to those who completed a remotely delivered programme (and some services already have 12 month recalls as part of standard contracts).
- Some services held participants who declined, or were inappropriate for remotely delivered PR in a separate caseload, and some services discharged these participants.

- Some services had additional contract variations added such as post-COVID-19 related activity, with/without additional resource.
- Some services have multiple waiting lists according to suitability, preference or other factors now facing the challenge of how to prioritise or merge lists (if appropriate), as face-to-face services resume.

### Possible solutions (identified by authors)

- Caseload cleansing activity (particularly if not using an electronic shared record system) – check for any participants who may be deceased or have moved out of area. Use admin/support staff where possible.
- Send out an opt in/activation letter: participant sent a letter, detailing service offerings and contacts service to provide preference. Discharged if no response. Requires admin support to receive and log calls and maintain waiting lists.
- Pre-calls: telephone call by support/admin staff member (ideally with some training in motivational interviewing/health coaching, and with an understanding of PR models, risks and benefits) to discuss PR and the offerings the service has available, encourage participant motivation for participation and ascertain model/offering preference.

For awareness: services need to consider how they might manage participant expectations about potential start dates. When a participant is initially contacted by a service, they often expect to receive an appointment shortly thereafter, or they may enquire about wait times and *hang on* to timescales provided. The timing of the calls should be considered, particularly where waiting lists are lengthy. For example, an opt in letter or pre-call on referral, will need greater consideration around how to deal with wait times as participants may have a longer wait, whereas the same activities carried out when the participant reaches the top of a waiting list, may mean that the participant can be immediately booked into an appointment slot on contact with the service; this may also help to reduce DNA's if the wait to appointment time is short, however it will likely not reduce waiting lists significantly, at the point of referral.

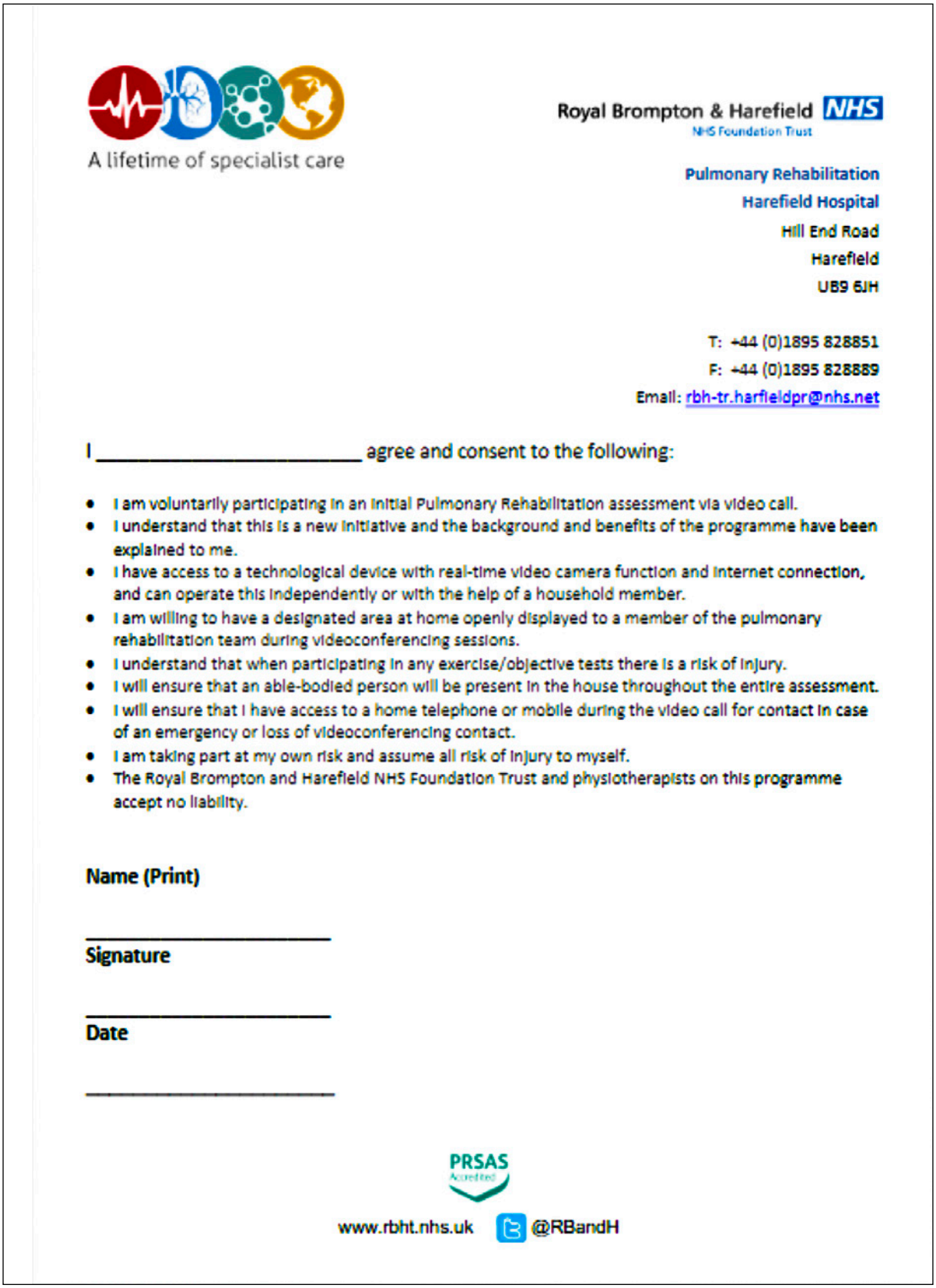
### Considerations

- If sending an opt in letter, health literacy and identification of health inequalities need to be taken into account (see *Health and digital inequalities* section).
- Where referrals are longer than 3 months old, up-to-date medical information should be sought prior to assessment – this will vary per service as to how this is obtained. For example, request updated summary care record from primary care or review shared record if available, such as SystmOne or EMIS (if share agreement in place – consider adding consent to open share section to referral form, in areas where shared record systems are used).
- Consider case stratification to identify priorities for the waiting list, such as:
    - Post-admission for respiratory exacerbation (particularly in the last 4 weeks).
    - Post-respiratory exacerbation related A&E attendance, 999/111 call.

    - Referral following admission avoidance for respiratory exacerbation.
    - Recent respiratory exacerbation (managed at home).
    - Recurrent respiratory exacerbation.
    - Pre/post lung surgery.
    - ILD diagnosis.
    - Routine – 1st attendance.
    - Routine – repeater (>12 months since previous course).
- Consideration should be given to who is available to support and who has responsibility for waiting list caseload management. Does the service have sufficient administrative support?
- Where waiting lists are lengthy, and there is a requirement for updated medical information to be sought prior to the assessment appointment, clinicians need to be given appropriate time to review and potentially follow-up this new information for any changes to participant suitability in order to avoid wasted appointments.

# Appendix 6 – example consent form and self-assessment checklist for remotely delivered pulmonary rehabilitation services

## Example consent form



A lifetime of specialist care

Royal Brompton & Harefield NHS
NHS Foundation Trust

Pulmonary Rehabilitation
Harefield Hospital
Hill End Road
Harefield
UB9 6JH

T: +44 (0)1895 828851
F: +44 (0)1895 828889
Email: rbh-tr.harfieldpr@nhs.net

I _____ agree and consent to the following:

- I am voluntarily participating in an initial Pulmonary Rehabilitation assessment via video call.
- I understand that this is a new initiative and the background and benefits of the programme have been explained to me.
- I have access to a technological device with real-time video camera function and internet connection, and can operate this independently or with the help of a household member.
- I am willing to have a designated area at home openly displayed to a member of the pulmonary rehabilitation team during videoconferencing sessions.
- I understand that when participating in any exercise/objective tests there is a risk of injury.
- I will ensure that an able-bodied person will be present in the house throughout the entire assessment.
- I will ensure that I have access to a home telephone or mobile during the video call for contact in case of an emergency or loss of videoconferencing contact.
- I am taking part at my own risk and assume all risk of injury to myself.
- The Royal Brompton and Harefield NHS Foundation Trust and physiotherapists on this programme accept no liability.

**Name (Print)**

_____

**Signature**

_____

**Date**

_____

PRSAS Accredited

www.rbht.nhs.uk @RBandH

## Example self-assessment checklist

A lifetime of specialist care

Royal Brompton & Harefield NHS
NHS Foundation Trust

**Virtual Pulmonary Rehabilitation Self-Assessment Checklist**

You must complete this checklist before each video pulmonary rehab class.

**Equipment to have ready:**

| | | | |
|---|---|---|---|
| 1. I have my reliever inhaler to hand | Yes _____ | No _____ | N/A _____ |
| 2. I have my GTN spray/tablets to hand | Yes _____ | No _____ | N/A _____ |
| 3. I have a glass of drinking water ready | Yes _____ | No _____ | |
| 4. There is a sturdy chair against a wall | Yes _____ | No _____ | |
| 5. My telephone/tablet/computer is charged and working | Yes _____ | No _____ | |

**Environment:**

| | | |
|---|---|---|
| 1. The room is a comfortable temperature | Yes _____ | No _____ |
| 2. There is adequate lighting | Yes _____ | No _____ |
| 3. Trip hazards e.g. rugs, pets, children have been moved | Yes _____ | No _____ |

**Other:**

| | | |
|---|---|---|
| 1. My able-bodied household member is within earshot | Yes_____ | No_____ |
| 2. I have informed the team of any changes to my health | Yes_____ | No_____ |
| 3. I have informed the team of any changes to my medications | Yes_____ | No_____ |
| 4. I have had a recent light meal or snack | Yes_____ | No_____ |
| 5. I am wearing appropriate clothing and flat shoes/trainers | Yes_____ | No_____ |

**Symptoms:**

It is your responsibility to monitor your symptoms and only exercise if you feel well enough.

You must check your symptoms before **each** class. You must not join in the class if you have a temperature, feel ill or become suddenly unwell.

If you have increased breathlessness, worsening symptoms or new/worsening joint pain prior to exercising you should not join the class for that session but return when the symptoms have settled.

You must stop exercising immediately if you experience any of the following:

1. Chest Pain
2. Dizziness
3. Nausea
4. Extreme Breathlessness
5. Excessive Wheezing
6. Coughing up blood

If there is any other reason you feel you should not exercise today, you must let the team know. Please call us on 01895 828851 or email rbh-tr.harefieldpr@nhs.net if you wish to speak to someone before the class.

**Now please enjoy your class!**

www.rbht.nhs.uk

PRSAS Accredited

@RBandH

## Appendix 7 – resources for remote delivery of pulmonary rehabilitation services

Video-conferencing platforms:

- Microsoft Teams.
- Attend Anywhere.
- Zoom.
- Webex.
- OneConsultation.
- AccuRx.

### Workforce training and support

*Training*

- Health Education England: training and educating the workforce: https://www.hee.nhs.uk/our-work/population-health/training-educational-resources.
- https://www.e-lfh.org.uk/programmes/coronavirus/.
- https://learninghub.nhs.uk/.
- https://learninghub.leadershipacademy.nhs.uk/.
- https://transform.england.nhs.uk/covid-19-response/technology-nhs/web-based-platform-which-offers-video-calls-services/ (NHSE Transformation, 2022b).
- Digital Health Academy: foundation level modules freely available at orcha-academy.com, and on the Health Education England NHS Learning Hub (learninghub.nhs.uk) at learninghub.nhs.uk/Catalogue/ORCHA.
- https://www.hee.nhs.uk/our-work/digital-literacy.
- https://www.e-lfh.org.uk/programmes/digital-learning-solutions.
- https://www.vc.scot.nhs.uk.
- www.makingeverycontactcount.co.uk.
- https://www.personalisedcareinstitute.org.uk.

*Well-being*

- England: https://www.england.nhs.uk/supporting-our-nhs-people/support-now/staff-mental-health-and-wellbeing-hubs/.
- Northern Ireland: https://www.publichealth.hscni.net/covid-19-coronavirus/guidance-hsc-staff-healthcare-workers-and-care-providers/questions-and-answers.
- Scotland: https://wellbeinghub.scot, https://www.nhs24.scot/staff-information/staff-wellbeing/, https://www.nes.scot.nhs.uk/news/staff-wellbeing-resources/.
- Wales: https://heiw.nhs.wales/support/colleague-health-and-wellbeing/.
- NHS People Plan: https://www.england.nhs.uk/ournhspeople/.

## Health and digital literacy

### *Health equity assessment*

- Health Equity Assessment Tool (HEAT): https://www.gov.uk/government/publications/health-equity-assessment-tool-heat/health-equity-assessment-tool-heat-executive-summary.
- Training to use Health Equity Assessment Tool (HEAT): https://www.e-lfh.org.uk/programmes/health-equity-assessment-tool-heat/.
- Equality Impact Assessment toolkit for research: https://arc-em.nihr.ac.uk/clahrcs-store/equality-impact-assessment-eqia-toolkit, https://forequity.uk/.

### *Health literacy*

- Public Health England: Improving health literacy to reduce health inequalities: https://www.gov.uk/government/publications/local-action-on-health-inequalities-improving-health-literacy.
- Health Education England: Improving health literacy: https://www.hee.nhs.uk/our-work/knowledge-library-services/improving-health-literacy.

### *Digital literacy*

- Barclay's Digital Eagles.
- Vodafone's Buy One Give One commitment.
- Digital Poverty Alliance.
- National Literacy Trust.
- Department of Education – essential digital skills framework.
- Royal College of Nursing – improving digital literacy.
- The Good Things Foundation – learn my way, make it click.
- Department for Digital, Culture Media & Sport: Digital Skills and inclusions – given everyone access to the digital skills they need.

## Delivery of education

- ACPRC: patient information leaflets https://www.acprc.org.uk/publications/patient-information-leaflets/.
- Asthma and Lung UK: www.blf.org.uk/support-for-you.
- Asthma and Lung UK: www.asthma.org.uk/advice/inhaler-videos.
- Stay Active and Stay Well (Asthma and Lung U.K.): www.blf.org.uk/support-for-you/keep-active/exercise-video.
- British Thoracic Society: PR resource pack: https://www.brit-thoracic.org.uk/covid-19/covid-19-information-for-the-respiratory-community/.
- European Lung Foundation (ELF): www.europeanlung.org/en/lung-disease-and-information/lung-diseases/.
- Lung Foundation Australia: https://pulmonaryrehab.com.au/importance-of-education/education-topics/.

- Supporting Someone with Breathlessness: https://supporting-breathlessness.org.uk/.
- Living well with COPD: https://www.livingwellwithcopd.com/.

*Digital resources*

- UCL Partners: Digital resources for Asthma and COPD.
- myCOPD app: NICE medical technologies guidance MTG68.
  - Related evidence: Bourne et al. (2017), Crooks et al. (2020), North et al. (2020), Platt & Jackson (2022).
- SPACE for COPD: Self-management Programme of Activity, Coping and Education for COPD – manual and online self-management programme.
  - Related evidence: Chaplin et al. (2017), Horton et al. (2018), Bourne et al. (2020), Houchen-Wolloff et al. (2021).

**Other resources**

- Example programme: https://www.uhdb.nhs.uk/pulmonary-rehabilitation-virtual-pulmonary-rehabilitation.
- Examples of PR standard operating procedures: https://www.respiratoryfutures.org.uk/resources/regional-and-local-resources/pulmonary-rehabilitation-standard-operating-procedures-sops/.
- Managing questionnaires online:
  - LimeSurvey: www.limesurvey.org/en/.
  - Microsoft Forms (requires purchase of Office 365): www.microsoft.com/en-gb/microsoft-365/online-surveys-polls-quizzes (can be used for surveys, polls, and quizzes).
  - REDCap: www.project-redcap.org (secure web application for building and managing online surveys and databases).
- Student placement guidance: https://www.csp.org.uk/professional-clinical/practice-based-learning.

# Appendix 8 – practical information governance considerations

### Data Protection Impact Assessment (DPIA)

Information and guidance on conducting DPIAs, can be found on the Information Commissioner's Office website: Data Protection Impact Assessments (DPIAs) | ICO.

### General IG equipment

All devices require a minimum of password and or biometric protection. Other secure methods include a physical USB device, or external security card.

- Passwords should be unique and used only once. Use long passwords, a minimum or 12 characters are recommended, with a mixture of characters and punctuation marks. Phrases that incorporate characters and punctuation marks, are easier to remember.
- Use a secure password manager with two-factor authentication, to store passwords or store any written password in an offsite secure site.
- Do not save passwords in an unencrypted file, or on an unencrypted device.
- Ensure that any anti-viral and anti-malware is up-to-date, or preferably on automatic updates on all devices.
- Ideally all devices should be encrypted, this includes desktops, laptops, phones, tablets or any other mobile device.
- If any recording or transferring of personal data is to occur, then the device must be encrypted.
- Devices should be set to automatically time out if not accessed, however, this time needs to be extended when using for a remote session, to prevent lock-outs occurring during a remote session.
- It is advisable not to use your personal devices for remote sessions unless they meet the IG standards of your organisation. Check with your local IG policy documentation, if it is permissible to use your own personal device.
- Each user must have an individual account on each device. Accounts must not be shared between different individuals.

### Placement of video equipment

Consider using a mains-powered laptop with either a built-in camera or an external USB camera (plugged into the laptop) that will provide greater freedom of camera placement. An external USB camera with a tripod offers the greatest flexibility.

- Consider the use of a hands-free headset and earphones, to reduce the likelihood of participants being overheard.
- Ensure that displays and video equipment are not visible to the public. The use of screens may be useful, if a closed room is not available.
- Ensure that video equipment is placed to prevent *photo bombing* opportunities.
- Place video equipment at a suitable distance to allow participants to see a full body view of the physiotherapist, if appropriate. Ensure that the field of view minimises the

recording of the external environment, to protect external individuals from being seen or participants being overseen.
- Ensure the area visible on screen presents a professional setting and role models a safe working and exercise environment.
- Advise participants to place their video equipment in order that carers, or relatives are unable to see other individuals on screen as much as is practical.
- It is difficult to guarantee that no other individual will be able to oversee or overhear a remote session, as participants often require additional support when accessing IT equipment at home, or do not have a separate area to access equipment.
- The fact that other participants or carers maybe able to see individuals must be discussed with all participants at the initial assessment, and practical advice on how to minimise this should be given.

### Participant modesty

Advise participants on appropriate clothing and placement of cameras, to minimise the potential for embarrassing situations to arise.

- An additional staff member should be available to discontinue a remote session immediately, should inappropriate behaviour be noticed. A follow-up phone call, can then be made to correct the behaviour.
- Participants may be tempted to use blurring of their own backgrounds. If this is the case, then they must be reminded to stand closer to the camera to avoid being blurred out themselves.

### Recording sessions

If a session is to be recorded, you must ensure that the local recording device is encrypted, and password protected.

- Consent must be sought from each individual and discussed before any such recording occurs.
- External recording must be discouraged by participants and will need to be discussed before commencing sessions. Most remote services will warn that an external recording has been started. In this instance the assistant or physiotherapist should immediately discontinue the remote session with the individual recording the event, and follow-up with an explanatory phone call.
- If a remote system is used that does not warn of external recordings occurring, then an alternative remote system must be used. Microsoft Teams has been validated as secure by the NHS, and should be used as the gold standard when comparing remote services.

### Emergency access

- To reduce the effect of power failures an uninterrupted power supply (UPS) maybe used, in combination with a mains-powered laptop. In the event of a temporary power failure, the laptop will automatically switch to battery backup, and the UPS will allow power

to remain to the router device, thus allowing the remote session to continue. The UPS will provide power for a limited time dependent on the wattage of the router, however, this should be sufficient to allow for a seamless switch to another device, or for a temporary glitch in power to be corrected.

- If a remote session is interrupted, then a switch to an alternative remote device maybe indicated such as a phone or tablet device. However, this device must be encrypted and password or biometrically protected, if any recording of a session is to occur.
- Individuals must have access to an individual account, with an individualised password on the back-up device to prevent multiple users accessing sensitive material.
- Conversations on encrypted social media are only protected end-to-end, meaning that the conversations cannot be read whilst in transit. However, if either of the receiving devices are not encrypted then the entire conversation maybe read if access is gained to either of the devices. The device must be encrypted.
- Social media also allow access to be gained to messages through web access, that will be password protected. However, if any device that is used that is not encrypted, then access to those messages maybe possible. Examples are internet cafés or home computers, that allow guest user access. Do not use any device that allows for guest users and ensure that accounts are individually accessible through a secure password.
- Check your local IG policy documentation for permitted devices, as personal devices are often not allowed to be used within local organisations.

## References


1 Gardiner L, Alderslade A, Butler F, Graham L, Harvey-Dunstan T, Ingram K, Lewko A, Nolan C, Owen H, Pilsworth S, Stewart H, Swingwood E, Wainwright K, Wright C. Statement and Considerations for The Remote Delivery of Pulmonary Rehabilitation Services During The COVID-19 Pandemic. *Journal of the Association of Chartered Physiotherapists in Respiratory Care.* 2021;53(2):151–186.

2 Cox NS, Dal Corso S, Hansen H, et al. Telerehabilitation For Chronic Respiratory Disease. *Cochrane Database Syst Rev.* 2021;1(1):CD013040. Published 2021 Jan 29. https://doi.org/10.1002/14651858.cd013040.pub2.

3 Holland AE, Spruit MA, Troosters T, et al. An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. *Eur Respir J.* 2014;44(6):1428–1446. https://doi.org/10.1183/09031936.00150314.

4 Bolton CE, Bevan-Smith EF, Blakey JD, et al. British Thoracic Society Guideline on Pulmonary Rehabilitation In Adults. *Thorax.* 2013;68 Suppl 2:ii1–ii30. https://doi.org/10.1136/thoraxjnl-2013-203808.

5 British Thoracic Society. Quality Standards for Pulmonary Rehabilitation in Adults. 2014. Available from: https://www.brit-thoracic.org.uk/quality-improvement/quality-standards/pulmonary-rehabilitation/.

6 Gardiner L, Singh S. Inequality in Pulmonary Rehabilitation – The Challenges Magnified By The COVID-19 pandemic. *Chron Respir Dis.* 2022;19:14799731221104098. https://doi.org/10.1177/14799731221104098.

7 NHS England National Respiratory Programme. *Pulmonary Rehabilitation – Five Year Vision.* Version 1.2 April 2022. Unpublished.

8 McCarthy B, Casey D, Devane D, Murphy K, Murphy E, Lacasse Y. Pulmonary Rehabilitation for Chronic Obstructive Pulmonary Disease. *Cochrane Database Syst Rev.* 2015;2015(2):CD003793. Published 2015 Feb 23. https://doi.org/10.1002/14651858.cd003793.pub3.

9 Dowman L, Hill CJ, May A, Holland AE. Pulmonary Rehabilitation for Interstitial Lung Disease. *Cochrane Database Syst Rev.* 2021;2(2):CD006322. Published 2021 Feb 1. https://doi.org/10.1002/14651858.cd006322.pub4.

10 Lee AL, Hill CJ, McDonald CF, Holland AE. Pulmonary Rehabilitation in Individuals With Non-Cystic Fibrosis Bronchiectasis: A Systematic Review. *Arch Phys Med Rehabil.* 2017;98(4):774–782.e1. https://doi.org/10.1016/j.apmr.2016.05.017.

11 NHS England. *The NHS Long Term Plan. Version 1.2.* 2019. Available from: https://www.longtermplan.nhs.uk/.

12 Hansen H, Bieler T, Beyer N, et al. Supervised Pulmonary Tele-Rehabilitation Versus Pulmonary Rehabilitation in Severe Copd: A Randomised Multicentre Trial. *Thorax.* 2020;75(5):413–421. https://doi.org/10.1136/thoraxjnl-2019-214246.

13 Chaplin E, Hewitt S, Apps L, et al. Interactive Web-Based Pulmonary Rehabilitation Programme: A Randomised Controlled Feasibility Trial. *BMJ Open.* 2017;7(3):e013682. Published 2017 Mar 31. https://doi.org/10.1136/bmjopen-2016-013682.

14 Nolan CM, Kaliaraju D, Jones SE, et al. Home Versus Outpatient Pulmonary Rehabilitation in Copd: A Propensity-Matched Cohort Study. *Thorax.* 2019;74(10):996–998. https://doi.org/10.1136/thoraxjnl-2018-212765.

15 Bourne S, DeVos R, North M, et al. Online Versus Face-To-Face Pulmonary Rehabilitation for Patients With Chronic Obstructive Pulmonary Disease: Randomised Controlled Trial. *BMJ Open.* 2017;7(7):e014580. Published 2017 Jul 17. https://doi.org/10.1136/bmjopen-2016-014580.

16 Stickland M, Jourdain T, Wong EY, Rodgers WM, Jendzjowsky NG, Macdonald GF. Using Telehealth Technology to Deliver Pulmonary Rehabilitation in Chronic Obstructive Pulmonary Disease Patients. *Can Respir J.* 2011;18(4):216–220. https://doi.org/10.1155/2011/640865.

17 Cerdán-de-Las-Heras J, Balbino F, Løkke A, Catalán-Matamoros D, Hilberg O, Bendstrup E. Effect of a New Tele-Rehabilitation Program Versus Standard Rehabilitation in Patients with Chronic Obstructive Pulmonary Disease. *J Clin Med.* 2021;11(1):11. Published 2021 Dec 21. https://doi.org/10.3390/jcm11010011.

18 Cerdán-de-Las-Heras J, Balbino F, Løkke A, Catalán-Matamoros D, Hilberg O, Bendstrup E. Tele-Rehabilitation Program in Idiopathic Pulmonary Fibrosis – A Single-Center Randomized Trial. *Int J Environ Res Public Health.* 2021;18(19):10016. Published 2021 Sep 23. https://doi.org/10.3390/ijerph181910016.

19 Cox NS, Dal Corso S, Hansen H, et al. Telerehabilitation for Chronic Respiratory Disease. *Cochrane Database Syst Rev.* 2021;1(1):CD013040. Published 2021 Jan 29. https://doi.org/10.1002/14651858.cd013040.pub2.

20 Galdiz JB, Gómez A, Rodriguez D, et al. Telerehabilitation Programme as a Maintenance Strategy for COPD Patients: A 12-Month Randomized Clinical Trial. *Arch Bronconeumol (Engl Ed).* 2021;57(3):195–204. https://doi.org/10.1016/j.arbres.2020.03.034.

21 Singh S, Bolton C, Nolan C, Harvey-Dunstan T, Connolly B, Man W, Walker P. *British Thoracic Society Guidance for pulmonary rehabilitation – Reopening services for the 'business as usual' participants. Version 2.1. 2021.* Available from: https://www.brit-thoracic.org.uk/covid-19/covid-19-resumption-and-continuation-of-respiratory-services/.

22 NHS England Transformation Directorate. Using Video-Conferencing and Consultation Tools. 2022. Available from: https://transform.england.nhs.uk/information-governance/guidance/using-video-conferencing-and-consultation-tools/#healthcare_worker.

23 NHS England. We are the NHS: People Plan 2020/21 – action for us all. 2020. Available from: https://www.england.nhs.uk/ournhspeople/.

24 Health Education England. Making Every Contact Count. 2022. Available from: https://www.makingeverycontactcount.co.uk/.

25 NHS England Transformation Directorate. *Video Conferencing Technology in Primary and Secondary Care.* 2022. Available from: https://transform.england.nhs.uk/covid-19-response/technology-nhs/web-based-platform-which-offers-video-calls-services/.

26 NHS England. *2022/23 Priorities and Operational Planning Guidance.* Version 3. 2022. Available from: https://www.england.nhs.uk/publication/2022-23-priorities-and-operational-planning-guidance/.

27 Public Health England. *Health Equity Assessment Tool (HEAT): Executive Summary, GW-1167.* 2021. Available from: https://www.gov.uk/government/publications/health-equity-assessment-tool-heat/health-equity-assessment-tool-heat-executive-summary.

28 Royal College of Physicians. *National COPD Audit Programme (NACAP): Pulmonary rehabilitation 2019 Audit Report.* London: Royal College of Physicians; 2020. Available from: http://www.rcplondon.ac.uk/projects/outputs/reports-pulmonary-rehabilitation.

29 Polgar O, Patel S, Walsh JA, et al. Digital Habits of Pulmonary Rehabilitation Service-Users Following The COVID-19 Pandemic. *Chron Respir Dis.* 2022;19:14799731221075647. https://doi.org/10.1177/14799731221075647.

30 Dodson S, Good S, Osborne RH. Health Literacy Toolkit For Low and Middle-Income Countries: A Series of Information Sheets to Empower Communities and Strengthen Health Systems. New Delhi: World Health Organization; 2015. Available from: https://www.who.int/publications/i/item/9789290224754.

31 Health Literacy U.K. Group. *What is Health Literacy Important?* 2022. Available from: https://healthliteracy.org.uk/why-is-health-literacy-important/.

32 Rowlands G, Protheroe J, Winkley J, Richardson M, Seed PT, Rudd R. A Mismatch Between Population Health Literacy and the Complexity of Health Information: An Observational Study. *Br J Gen Pract.* 2015;65(635):e379–e386. https://doi.org/10.3399/bjgp15x685285.

33 NHS England. *Accessible Information Standard Specification, DCB1605.* Version 1.1. 2017. Available from: https://www.england.nhs.uk/about/equality/equality-hub/patient-equalities-programme/equality-frameworks-and-information-standards/accessibleinfo/.

34 Cornett S. Assessing and Addressing Health Literacy. *Online Journal of Issues in Nursing.* 2009;14(3). Available from: https://doi.org/10.3912/OJIN.Vol14No03Man02.

35 Kutner M, Greenburg E, Jin Y, Paulsen C. The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy, NCES 2006–483. National Center for education statistics: 2006. Available from: https://eric.ed.gov/?id=ED493284.

36 Schillinger D, Piette J, Grumbach K, et al. Closing the Loop: Physician Communication With Diabetic Patients Who Have Low Health Literacy. *Arch Intern Med.* 2003;163(1):83–90. https://doi.org/10.1001/archinte.163.1.83.

37 Nous Foundation. *The My ACP Decisions Platform.* 2021. Available from: https://acpdecisions.org/.

38 Health Education England. *Digital Literacy Capability Framework.* 2018. Available from: https://www.hee.nhs.uk/our-work/digital-literacy.

39 Office for National Statistics. *Exploring the U.K.'s digital divide.* 2019. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/articles/exploringtheuksdigitaldivide/2019-03-04.

40 Lloyds Bank. *Lloyds Bank U.K. Consumer Digital Index.* 2021. Available from: https://www.lloydsbank.com/banking-with-us/whats-happening/consumer-digital-index.html.

41 University of Manchester. *On Digital Inequalities.* 2021. Available from: https://www.policy.manchester.ac.uk/publications/on-digital-inequalities/.

42 Beaunoyer E, Dupéré S, Guitton MJ. COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies. *Comput Human Behav.* 2020;111:106424. https://doi.org/10.1016/j.chb.2020.106424.

43 NHS Digital. A*ccessibility for Digital Services.* 2022. Available from: https://digital.nhs.uk/about-nhs-digital/standards-for-web-products/accessibility-for-digital-services.

44 NHS Education for Scotland. *TURAS: Digital Health and Care.* 2022. Available from: https://learn.nes.nhs.scot/2198/digital-health-and-care.

45 Royal College of Physicians. *National Asthma and COPD Audit Programme.* 2018. Available from: https://www.nacap.org.uk.

46 Royal College of Physicians. *Pulmonary Rehabilitation Services Accreditation Scheme.* 2022. Available from: https://www.prsas.org.

47 Royal College of Physicians. *Pulmonary Rehabilitation Accreditation Scheme: Accreditation Standards and Guidance For The Public.* 2020. Available from: https://www.prsas.org/standards.

48 Inskip JA, Lauscher HN, Li LC, et al. Patient and Health Care Professional Perspectives on Using Telehealth to Deliver Pulmonary Rehabilitation. *Chron Respir Dis.* 2018;15(1):71–80. https://doi.org/10.1177/1479972317709643.

49 Knox L, Gemine R, Dunning M, Lewis K. Reflexive Thematic Analysis Exploring Stakeholder Experiences of Virtual Pulmonary Rehabilitation (Vipar). *BMJ Open Respir Res.* 2021;8(1):e000800. https://doi.org/10.1136/bmjresp-2020-000800.

50 Simpson J, Davies S, Baluyut G, Harries S, Tsim J. *Qualitative Evaluation of Virtual Pulmonary Rehabilitation in Tower Hamlets (Id 291).* In: PCRS Respiratory Conference; 2021 Sept 24–25; Telford. Primary Care Respiratory Society; [cited 27 Oct 2022]. Available from https://www.pcrs-uk.org/conference-abstract-gallery/abstract/291.

51 NHS England. *National Infection Prevention and Control Manual for England.* C1676. [internet]. London. NHS England. 2022. Available from: https://www.england.nhs.uk/publication/national-infection-prevention-and-control/.

52 BTS Pulmonary Rehabilitation Quality Improvement Advisory Group. *Assessment template. London. Respiratory Futures.* 2019. Available from: http://www.respiratoryfutures.org.uk/resources/regional-and-local-resources/pulmonary-rehab-patient-information-leaflets-examples/.

53 Hardinge M, Annandale J, Bourne S, et al. British Thoracic Society Guidelines for Home Oxygen Use in Adults. *Thorax.* 2015;70 Suppl 1:i1–i43. https://doi.org/10.1136/thoraxjnl-2015-206865.

54 Houchen-Wolloff L, Daynes E, Watt A, Chaplin E, Gardiner N, Singh S. Which Functional Outcome Measures Can We Use as a Surrogate for Exercise Capacity During Remote Cardiopulmonary Rehabilitation Assessments? A Rapid Narrative Review. *ERJ Open Res.* 2020;6(4):00526–2020. Published 2020 Dec 7. https://doi.org/10.1183/23120541.00526-2020.

55 Vaidya T, Chambellan A, de Bisschop C. Sit-to-Stand Tests for Copd: A Literature Review. *Respir Med.* 2017;128:70–77. https://doi.org/10.1016/j.rmed.2017.05.003.

56 Bohannon RW, Crouch R. 1-Minute Sit-to-Stand Test: Systematic Review of Procedures, Performance, and Clinimetric Properties. *J Cardiopulm Rehabil Prev.* 2019;39(1):2–8. https://doi.org/10.1097/hcr.0000000000000336.

57 Association of Chartered Physiotherapists In Cardiac Rehabilitation (ACPICR). ACPICR Standards for Physical Activity and Exercise in the Cardiovascular Population. 3rd Edition. 2015. Available from: https://www.acpicr.com/publications/.

58 American College of Sports Medicine (ACSM) Health/Fitness Facility Standards and Guidelines. 2nd Ed. Illinois: Human Kinetics in International Fitness Association. Temperature Standards. 2021. Available from: https://www.ifafitness.com/health/temperature.htm.

59 Blackstock FC, Roberts NJ. Using Telemedicine to Provide Education for the Symptomatic Patient with Chronic Respiratory Disease. *Life (Basel).* 2021;11(12):1317. Published 2021 Nov 29. https://doi.org/10.3390/life11121317.

60 Dantas LA, Cunha A. An Integrative Debate on Learning Styles and The Learning Process. *Social Sciences & Humanities Open.* 2020;2(1):100017.

61 Fleming ND, Mills, C. Not Another Inventory, Rather a Catalyst for Reflection, To Improve the Academy. 1992;(11):137.

62 Zacarés JJ, Serra E, Torres F. Becoming an Adult: A Proposed Typology of Adult Status Based On a Study of Spanish Youths. *Scand J Psychol.* 2015;56(3):273–282. https://doi.org/10.1111/sjop.12205.

# NEW | POWERbreathe® Expiratory Muscle Trainer

## POWERbreathe EX1 hand-held expiratory muscle training (EMT) devices are drug free and easy to use.

The EX1 provides resistance as users breathe out through the device, making the expiratory muscles work harder to improve breathing muscle strength, function and endurance.

- Four models providing the widest range of resistance available
- Precisely calibrated spring-loaded resistance mechanism
- Easy to hold, adjust and clean
- Particularly beneficial for patients with dysphagia, dysarthria and dysphonia, as well as, for older adults as they begin to lose muscle strength due to advancing age

POWERbreathe EX1™ Expiratory Muscle Trainer

DESIGNED AND DEVELOPED IN THE UK

UK CA CE

POWERbreathe's **Gold Standard range of Inspiratory Muscle Training devices** are market-leading products in the Human Performance and Health & Medical sectors. For further details on the complete range, please visit the POWERbreathe website.

**POWERbreathe Plus**
The calibrated, spring-loaded 'pressure threshold' valve is easily adjustable and simple to use.

**POWERbreathe K-Series**
Patented, electronically tapered flow with biofeedback provides a more meaningful training and testing experience.

**POWERbreathe KH-Series**
Medically certified, patented, electronically tapered flow, with industry recognised MIP testing provides an invaluable tool for Healthcare Professionals.



**Further information and research for Healthcare Professionals available at:**
**powerbreathe.com • email: enquiries@powerbreathe.com**
**Tel: +44 (0)1926 816100**

# ACPRC scoping review of post-operative physiotherapy in people undergoing cardiac surgery

**Allaina Eden[1], Emma Matthews[2], Alicia Page[3], Izzie Easton[4] and Una Jones[5]**

[1]Physiotherapy Service Lead, Royal Papworth Hospital, Cambridge, CB2 0AY, U.K.
[2]Cardiac Surgery, Transplantation and Cardiology Team Lead, Royal Papworth Hospital, Cambridge, CB2 0AY, U.K.
[3]Specialist Physiotherapist, Royal Papworth Hospital, Cambridge, CB2 0AY, U.K.
[4]Senior Lecturer, University of Essex, School of Sport, Rehabilitation and Exercise Sciences, Wivenhoe Park, Colchester, CO4 3SQ, U.K.
[5]Reader, Cardiff University, School of Healthcare Sciences, Heath Park, Cardiff, CF14 4XN, U.K.

*Keywords* | In-patient, mobilisation, post-operative, respiratory physiotherapy, cardiac surgery.

*Correspondence author* | Allaina Eden. Telephone: 01223 638215. Email: allaina.eden@nhs.net.

## Abstract

### Introduction

This scoping review was produced by the ACPRC editorial board. Surgery was considered one of five key priorities for review and was subsequently separated into surgical specialities.

### Objective

The objective of this scoping review was to report the extent and methodological type of evidence associated with post-operative physiotherapy in people who underwent cardiac surgery.

### Inclusion criteria

Studies with adult patients undergoing cardiac surgery, requiring post-operative physiotherapy intervention, as part of the recovery process, and published between 2014 and 2021 were included.

### Method

Searches were undertaken in PEDro, CINAHL, EMBASE, MEDLINE, PubMed, Google Scholar and the Clinical Trials Registry. Article titles and abstracts were screened by one reviewer, and full text articles appraised by two reviewers. Quality was assessed and data was extracted using the relevant tools.

**Results**

Initially, 2795 articles were retrieved, 41 articles were included in this scoping review. The most frequent study methodologies were randomised control trials ($n$ = 21), observational studies ($n$ = 8), systematic reviews ($n$ = 3) and qualitative studies ($n$ = 2). The sample sizes tended to be small and single centred.

Included studies explored mobilisation ($n$ = 18), respiratory physiotherapy ($n$ = 12), sternal wound precautions ($n$ = 7), staff or patient experience ($n$ = 3) and adverse events ($n$ = 1). Targeted respiratory physiotherapy may be beneficial for patients who are at high-risk of developing or have developed post-operative complications. Early mobilisation shows good evidence to reduce length of stay. Allowing patients more liberal use of their upper-limbs has also been shown to expedite recovery and reduce care needs on discharge without increasing sternal wound breakdown, infection or pain.

**Conclusion**

The literature showed positive outcomes for physiotherapy interventions involving early mobility and allowing an increase in upper-limb usage. Respiratory physiotherapy techniques are beneficial when used with appropriate patients. Cost effectiveness analysis should be undertaken. There is scope for an increase in qualitative studies to be undertaken to focus on patient experience and patient reported outcomes.

## Introduction

The ACPRC editorial board is comprised of respiratory physiotherapy clinicians and academics. The purpose of the board is to lead scoping, commissioning, co-ordination and delivery of all new ACPRC guidance documents and resources, to facilitate knowledge sharing and drive improvements in the quality of care for people with respiratory conditions. A preliminary scoping day in March 2018 identified surgery as a priority area for guidance. This was subsequently separated into cardiac, thoracic, and upper-gastrointestinal surgery.

For the purpose of this scoping review, cardiac surgery included valve replacements, valve repairs, coronary bypass grafts, and other invasive cardiac procedures requiring a large incision such as median sternotomy. The rationale for this, is that physiotherapy recovery pathways are comparable between surgeries.

There has been a decline in the number of cardiac surgery operations performed in the U.K. This has decreased from 41,586 procedures performed in 2008 and 2009 to 34,000 in 2019. Mortality rates are low at 2.59%, and average post-operative length of stay is 7.8 days (1). During this time there has been an increase in less invasive procedures such as percutaneous coronary interventions. Consequently, patients undergoing surgery have an increased age, co-morbidities and more complex surgery (2).

Systematic reviews have been undertaken for cardiac surgery and physiotherapy, and have either incorporated other types of surgery, for example, thoracic and abdominal surgery (3) or focussed solely on mobilisation after cardiac surgery (4, 5).

The aim was to undertake a scoping review to identify all types of post-operative physiotherapy research, to provide a comprehensive representation of available evidence (6–8).

## Objective

The objective of this scoping review is to report the extent and type of evidence, associated with post-operative physiotherapy in people who undergo cardiac surgery.

## Scoping review question

The primary scoping review question is:

- *What evidence exists for the post-operative physiotherapy management of people who have undergone cardiac surgery that require a hospital stay?*

The secondary scoping review questions are:

- What number of studies and research methodologies have been carried out in relation to post-operative physiotherapy, in adults undergoing cardiac surgery?
- What is the quality of the research carried out?
- What are the findings of the studies?

## Definition of key terms

**Physiotherapy intervention** – treatment that is prescribed or carried out by a registered physiotherapist, or an unregistered member of the physiotherapy team.

**Surgical intervention** – invasive surgery that requires admission to hospital, (not performed as a day case).

**Mobilisation** – to support and encourage patients to move. This may be to mobilise out-of-bed, to march on the spot or walking.

**Respiratory physiotherapy** – physiotherapy interventions aimed to mobilise and remove airway secretions, increase lung volume, reduce breathlessness and work of breathing. This may include physical exercise, active cycle of breathing techniques, resistive training, positive and negative pressure devices, and adjuncts.

## Eligibility criteria

### *Participants*

#### *Inclusion criteria*

- Adult patients undergoing invasive cardiac surgery requiring access through a chest wound, for example, sternotomy, and that requires a post-operative hospital stay.
- Study includes acute post-operative physiotherapy.

- Study published between 2014 and 2021. The start date of 2014 was chosen, as it allowed a slight overlap in studies captured within published systematic reviews identified by the scoping review search.
- Article written in English.

*Exclusion criteria*

- Animal studies.
- Paediatrics – defined as children less than 18-years-of-age.
- Day case surgery.
- Cardiology interventions such as percutaneous coronary intervention, transcatheter aortic valve implantation.
- Physiotherapy intervention prior to admission, for example prehabilitation and intervention after hospital discharge, for example out-patient follow up.

### Concept

Procedures that require post-operative physiotherapy intervention as part of the recovery process.

### Context

The context is in-patient, hospital-based surgery, based in any country of origin, within state or privately funded healthcare.

## Method

The scoping review objective was developed and agreed by the ACPRC editorial board. The scoping team was formed, and the inclusion criteria agreed by the scoping team.

### Search strategy

The search strategy was developed and agreed by the scoping team, with input from local hospital and university library services (Appendix 1). A full search was undertaken of PEDro, CINAHL, EMBASE, MEDLINE, PubMed, and Google Scholar. The Clinical Trials Registry was also searched for any unpublished literature. All articles with search strategy terms contained in the titles and abstracts were shortlisted. The search strategy, including all identified keywords and index terms, were adapted for each database.

### Types of sources

The scoping review considered all available evidence using experimental, and quasi-experimental study designs including randomised controlled trials (RCT), observational studies including prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies. Other designs included systematic reviews, descriptive observational study designs including case series, individual case reports and descriptive cross-sectional studies. Qualitative studies that focused on qualitative data, such as phenomenology, grounded theory, ethnography, qualitative description, and action research were considered, as were text and opinion papers.

### Source of evidence selection

Following the search of databases and registries, all identified citations were uploaded into web-based Endnote (9). Initially, 2795 articles were retrieved from the database searches (*n* = 2736) and clinical trial registers (*n* = 59). Following removal of 53 duplicate records, one reviewer screened the titles and abstracts against the inclusion criteria. This process excluded 2602 studies as they did not fulfil inclusion criteria. Full texts were retrieved for 140 articles, with 19 being unavailable. Each full-text article was screened by two reviewers, and of the 121 full text articles reviewed, 80 were excluded due to a lack of focus on physiotherapy specific treatment, or the intervention was conducted in the pre-operative or post-discharge phases of care. Subsequently, 41 studies were selected for inclusion into the scoping review.

Any ambiguity was discussed with the topic lead. The results are presented in Figure 1 the *Preferred Reporting Items for Systematic Reviews and Meta-analyses Extension for Scoping Review* (PRISMA-ScR) flow diagram (10).

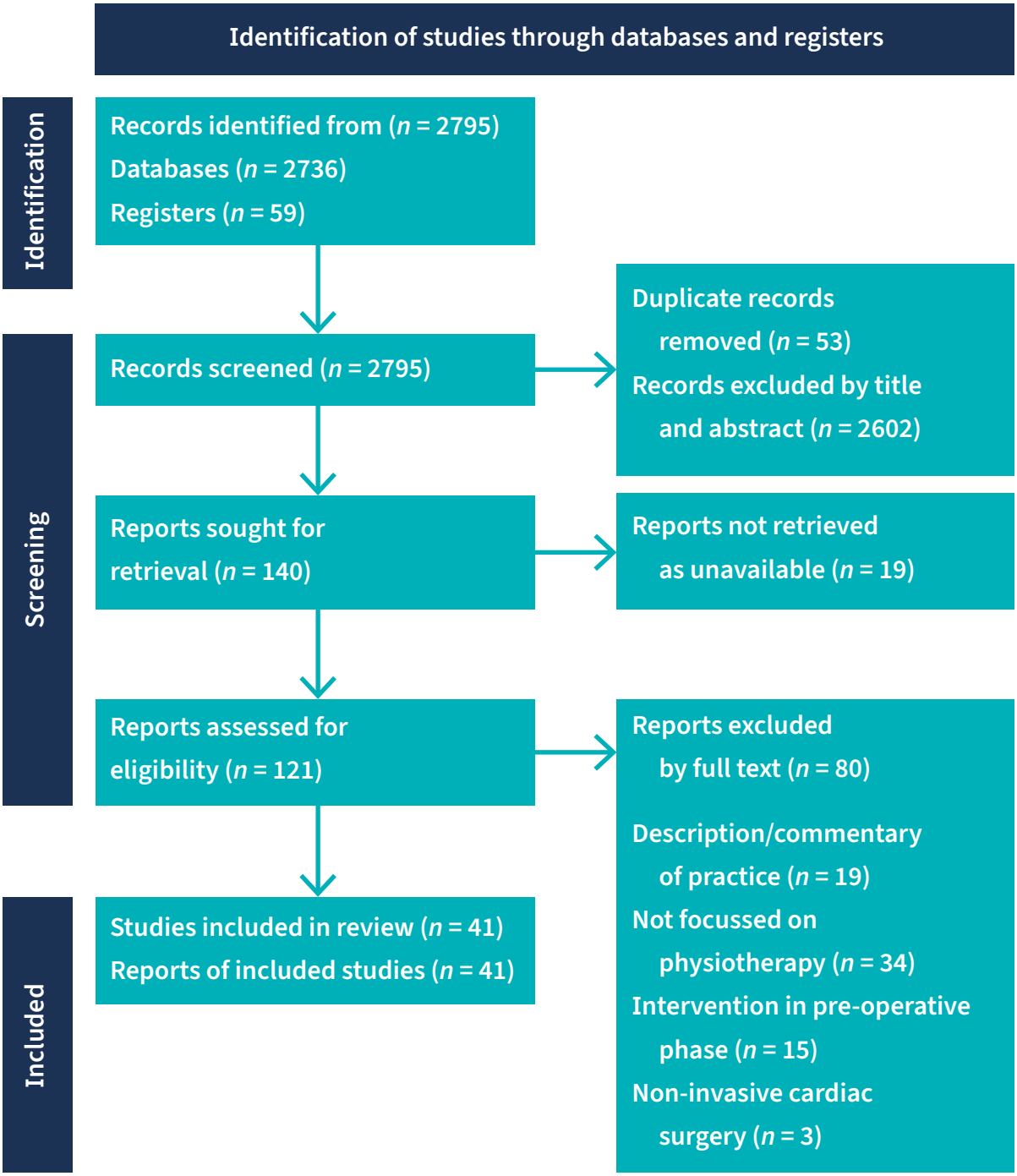



**Figure 1: PRISMA-ScR flow chart.**

### Data extraction

All articles were reviewed by two independent reviewers and data was extracted and collated. Study quality was assessed using appropriate Critical Appraisal Skills Programme (11) or Joanna Briggs Institute (12) tools. An appraisal tool template was completed for each study, and submitted to the topic lead.

## Results

### Number of studies and research methodologies

In total, 41 studies researching the post-operative physiotherapy management of people who had undergone cardiac surgery and required a hospital stay were included in this scoping review. This included a total of 7824 participants, ranging from 13 participants (13) to 1419 participants (5). This did not include the number of participants in the systematic review by Sullivan et al. (3) as it was not possible to differentiate participant numbers between cardiac, thoracic and abdominal surgery. The most frequent types of study design were RCTs ($n = 21$) of which three were pilot RCTs, observational studies ($n = 8$) and systematic review ($n = 3$). Two qualitative studies were included for review. The methodology types and number of studies can be seen in Figure 1.

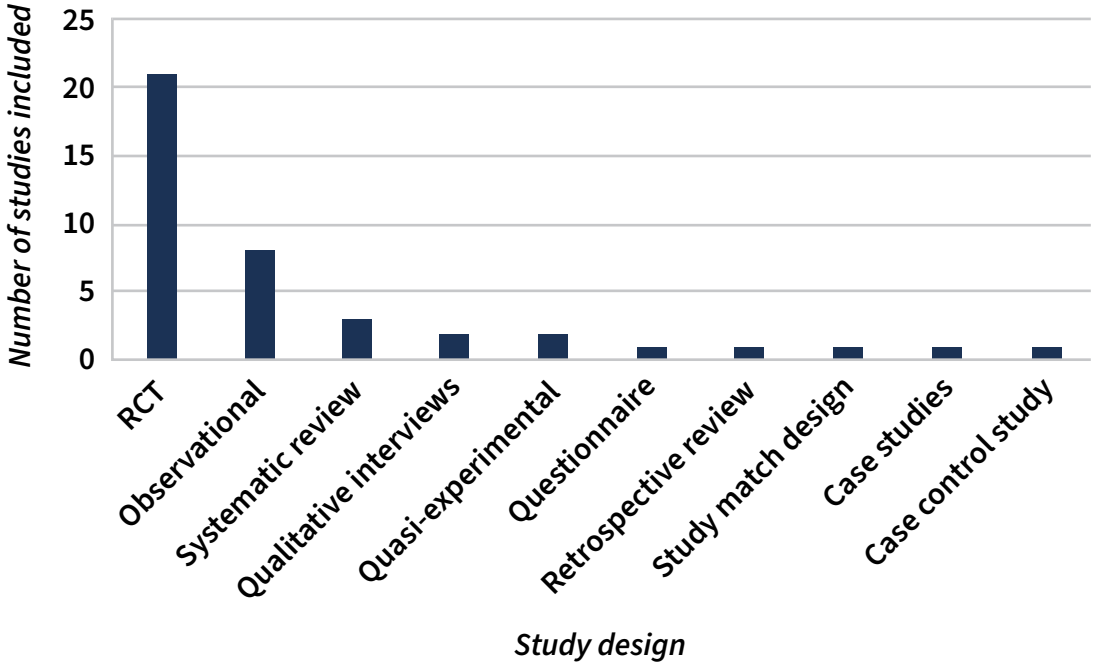



**Figure 2: Methodology types and number of studies included.**

The 41 studies were categorised by type of physiotherapy intervention. This included 18 studies (45%) investigating post-operative mobilisation, 12 studies (29%) reviewing respiratory physiotherapy and respiratory interventions, seven studies (17%) exploring sternal wound precautions and associated pain, three studies (7%) investigating staff and patient experience and one study (2%) reporting adverse events during physiotherapy. See Figure 2.

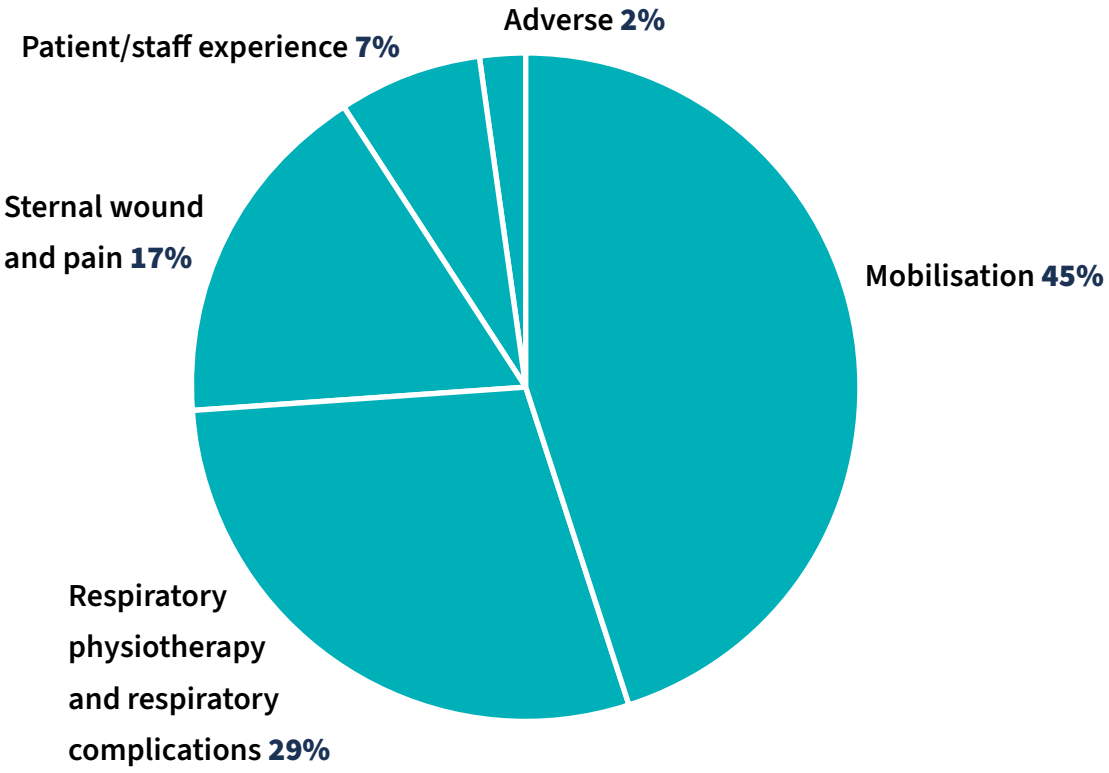



**Figure 3: Methodology types and number of studies included.**

### Quality of research

Many of the studies (with some exceptions) had small sample sizes and were based in single centres. For the RCTs, blinding was inconsistent across studies resulting in potential risk of bias within the methods. The participants were appropriately selected and accounted for through the pathway of the studies and the study protocols were outlined in nearly all studies. The outcome measures were largely easily replicable and appropriate to the patient groups being investigated, however overall, there was little consideration of cost-benefit analysis.

### Study findings

A detailed summary of the studies is presented in the literature review table (Appendix 2).

The themes identified were respiratory physiotherapy, mobilisation and sternal wound precautions.

*Respiratory physiotherapy*

Research relating to respiratory physiotherapy covered a range of interventions. Three studies (14–16) looked at positive pressure interventions alongside early mobilisation following cardiac surgery. Kamisaka et al. (14) found that delivering pressure support may have a role in improving dyspnoea in early mobilisation. Dholaki et al. (15) compared Bi-level positive airway pressure and high-flow nasal oxygen (HFNO) on ambulation and found both groups doubled the distance mobilised with ventilatory support. Pantoni et al. (16), found continuous positive airway pressure (CPAP) on ambulation demonstrated increased

exercise tolerance, tidal volumes, and oxygen saturation, as well as reduced dyspnoea in comparison to the control group.

Three studies (17–19) investigated positive expiratory pressure (PEP) devices. They found no benefit of PEP (17) or Acapella® (18) over conventional physiotherapy on pulmonary function, post-operative pulmonary complications (PPCs), radiological changes or length of hospital stay (17–18). Petterson et al. (19) found deep breathing exercises performed with bubble PEP demonstrated significantly higher $SpO_2$ in standing versus sitting.

Incentive spirometry has been investigated with mixed results. In a systematic review, Sullivan et al. (3) reported that incentive spirometry alone did reduce PPCs. However, a pilot RCT concluded that there was no statistically significant difference in lung function tests, at post-operative day (POD) seven or on six-minute walk distance (6MWD) in incentive spirometry versus diaphragmatic breathing (20).

Wu et al. (21) found the use of mechanical insufflation:exsufflation post-operatively, had significantly improved lung function, but patients reported significantly more pain compared with the Intermittent Positive Pressure Breathing Group. There was no difference in PPCs between groups.

Zochios et al. (22) found that prophylactic use of HFNO in patients with pre-existing respiratory conditions resulted in lower hospital length of stay and reduced intensive care unit (ICU) readmissions in comparison to a standard care control group.

Cargnin et al. (23) found the use of post-operative inspiratory muscle training demonstrated significant improvement in maximal inspiratory pressure and non-significant improvement in 6MWD, with no difference in length of stay, lung function or quality of life. Another study found that ACBT did not lead to physiological improvements compared to routine physiotherapy (24).

*Mobilisation*

Studies have established that early mobilisation is beneficial compared to bedrest, but there was no evidence of the optimal exercise prescription, or definition of *early mobilisation* (5, 25).

Early mobilisation significantly reduced hospital length of stay (LOS) in five studies (26–30), but not in other studies that reported no significant difference in LOS (4, 31–32). Intensive care LOS was shown to have been significantly reduced by Afxonidis et al. (26), and was also reported to be reduced, but not significantly by Chen et al. (4).

Four studies (29, 31, 33–34) all found no significant difference in 6MWD between control and intervention groups whereas one study (35) showed a significant improvement in 6MWD in their small sample intervention groups. Kubitz et al. (36) reported that 80% of patients fully adhered to their post-operative mobility protocol. Outcomes of supervised exercise are variable, with one study showing a significant increase in step count when supervised

by physiotherapists (37), but another showed no significant difference between orderly led ambulation (31).

Physiological measures showed no significant differences following the interventions of cycle ergometry (34). However, Tariq et al. (28) showed a significant improvement in $SpO_2$ following mobilisation and respiratory physiotherapy within four hours of extubation. Studies found no significant difference in left ventricular ejection function (29), respiratory muscle strength (35) or lung function (35, 38) between an exercising intervention group and the control group.

Miwa et al. (30) and Floyd et al. (32) showed no differences between control and intervention groups, and the incidence of adverse events. Takei et al. (39) reported an incidence of 18% of physiological abnormalities or potential safety events during physiotherapy, but only 2% requiring treatment. The main adverse effects reported were altered blood pressure and vertigo. The study by Sousa et al. (40) found the majority of physiological abnormalities or adverse events were mild or near misses occurring more so with mechanically ventilated patients.

Other interventions reporting positive impact on recovery are targeted exercise and education (41) and distance walked based on wall art (42). There was a significant reduction in costs in an early rehabilitation (<8 days) intervention group compared to the control or delayed (>8 days) intervention group (29).

### *Sternal wound precautions*

Work reviewing the long-established practice of strict sternal wound precautions has been compared to modified sternal precautions, such as *Keep your Move in the Tube* (KYMITT) (43–45). KYMITT is a post-sternotomy protocol that allows load bearing movement through the upper-limbs whilst avoiding excessive stress to the sternal wound. This is achieved by keeping upper-limbs at close range to the trunk, or as if you were placed in a tube. Both Gach et al. (43) and Radfar et al. (44) found that implementing KYMITT was associated with an increased proportion of cardiac surgery patients discharged home, opposed to inpatient rehabilitation or nursing facilities. The use of KYMITT did not increase wound complication or readmission rates. Katjjahbe et al. (45) study showed substantial improvement with KYMITT, but no significant difference at weeks four and 12. LaPier et al. (46) found the majority of physiotherapists would implement wound support immediately after median sternotomy to reduce pain and to protect sternal healing. Restrictions related to the arms lifting weights and heights were commonly employed but varied greatly in degree and duration.

Thoracic exercises showed a significant reduction in early (0–6 weeks) sternal pain post cardiac surgery. However, there was no difference at three months (47). A systematic review of continuous local anaesthetic in post-cardiac surgery patients (48) found no significant differences in pain scores, distance walked, or for time to physiotherapy discharge.

Boitor et al. (49) found hand massage in the critically ill cardiac surgery patients significantly reduced pain immediately post intervention compared to active and passive control groups, but they were unable to assess longer term benefit.

The qualitative studies explored patient's experiences following cardiac surgery (13, 50). They concluded that cardiac surgery causes both physical and emotional disturbance. Relationships developed with healthcare professionals built safe spaces for discussion, to prepare patients and families adequately for discharge.

## Discussion

This scoping review outlines research published in key areas of physiotherapy and post cardiac surgery management. There is a variety of respiratory treatment techniques and interventions studied which makes concluding the impact of respiratory physiotherapy more difficult. There is some evidence that initiating positive pressure such as CPAP or HFNO in the early phase of care does positively impact patient recovery. However, physiotherapy delivered pressure treatment such as PEP and incentive spirometry are less likely to improve outcome in the absence of PPCs. In patients who do not develop PPCs or have pre-operative respiratory conditions, physiotherapy adjuncts do not expedite recovery and that these treatment options should not be routinely delivered.

Research supports that mobility provides a multi-faceted impact on recovery including enhancing re-ambulation, cardiovascular improvement and contributes towards prevention of PPCs.

There is strong evidence for early mobilisation, in reducing ICU and hospital LOS. However, the optimal timings and frequency of mobility remains unanswered. There is evidence to support that staff and a culture dedicated to mobilisation impacts step count and frequency of mobility. These findings support the more holistic post-operative recovery approach, involving patient experience and patient accountability for their care, in addition to physiological recovery.

The pioneering work around sternal precautions has been a significant change in post-operative cardiac care, over the past few years. Due to the increasing age and frailty of patients, the inability to use the upper-limbs to facilitate bed transfers, and aid sit-to-stand has an impact on recovery, hospital length of stay and ongoing care needs on discharge. Evidence provides assurance that the KYMITT approach does not lead to an increase in sternal wound breakdown, infection or pain (51). It would be interesting to assess adoption of this practice in cardiac centres.

The literature includes mainly quantitative research, however qualitative consideration of the impact of staff and patient experience in recovery after cardiac surgery was included. Additional consideration for further research would be multi-centred trials to enable

greater sample sizes, and cost-benefit analysis in terms of both hospital and patient benefit would allow for greater weight for supporting change in practice.

A limitation to this scoping review was that the search criteria excluded prehabilitation and post-discharge exercise prescription such as cardiac rehabilitation programmes. Further scoping reviews would be beneficial to identify studies relating to these areas.

## Conclusion

In conclusion, the objective of this scoping review was to report the extent and methodological type of evidence associated with post-operative physiotherapy in people who undergo cardiac surgery.

The initial search returned 2795 articles and following screening 41 studies were included in the scoping review. A variety of different research methodologies were included in the review which demonstrates diversity of evidence available.

The literature showed positive outcomes for physiotherapy interventions involving early mobility, a culture that supports holistic post-operative recovery and allowing increased use of the upper-limbs. It is more difficult to conclude which respiratory intervention provides the most benefit, and targeted use in patients with respiratory compromise appears to be better than routine application. Cost effectiveness analysis needs to be undertaken. There is scope for an increase in qualitative studies to be undertaken to focus on patient experience and reported outcomes.

In addition to this cardiac scoping review, the editorial board has published separate gastrointestinal and thoracic scoping reviews and plan to publish a combined ACPRC surgical position statement.

## Acknowledgements

Thanks to Becky Scott, Royal Papworth Hospital library services, and Rebecca Rowe, Royal Papworth Hospital library services.

### Funding

There was no funding provided in this scoping review. All participants gave their time voluntarily.

### Conflicts of interest

There are no conflicts of interest with the authors listed on this manuscript.

## Appendix 1 – search strategy

*Search 1*

**Heart.**

**Cardiac.**

**Aortic.**

*Search 2*

**operat#.**

**OR surg#.**

**OR (postoperative or post operative or post-surgery or post-surgical).**

*Search 3*

**(physiotherap# or physical therap# or rehabilitati*).**

**OR (mobilisation or mobilization or mobilize or mobilise).**

**OR (exercis* or physical activity or fitness).**

**OR ambulat# OR walk# OR recovery.**

# Appendix 2 – cardiac surgery and physiotherapy literature summary

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| **Respiratory physiotherapy and respiratory complications** | | | | | | | |
| Alaparthi, 2021 | India | Effect of different breathing techniques on PFTs after valve surgery. | Pilot RCT. | *n* = 30, IG1, *n* = 10, mean age 63, male 70%.<br>IG2, *n* = 9, mean age 62, male 78%.<br>IG3, *n* = 10, mean age 54, male 90%. | IG1 – flow-oriented incentive spirometry.<br>IG2 – volume-oriented spirometry.<br>IG3 – diaphragmatic breathing.<br>In addition to airway clearance and progressive mobility and stairs. | PFTs, 6MWT, functional difficulty. | No statistically significant difference in PFTs at POD7 except FVC in IG3 ($p = 0.024$). No statistically significant difference in 6MWT.<br>Volume spirometry group (IG2) scored statistically significantly better on the functional difficulty questionnaire when compared to the IG3 group ($p = 0.001$) but not when compared to IG1 ($p = 0.04$). |
| Sullivan, 2021 | Canada | Use of IS in cardiac, thoracic and abdominal surgery. | SR. | 9 cardiac studies *n* = ? – unable to differentiate cardiac, thoracic and abdominal patients. | IS versus respiratory PT. | PPCs, mortality, hospital LOS. | IS alone compared with other strategies did not reduce PPCs (95% *CI* 0.80–1.43; $p = 0.64$, mortality (95% *CI* 0.04–3.17, $p = 0.36$, $Z = 0.91$), or hospital LOS (95% *CI* -1.42–1.20, $p = 0.87$, $Z = 0.17$). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Wu, 2021 | Taiwan | Compare effect of MI:E versus IPPB on lung function after cardiac surgery. | Retrospective observational study. | *n* = 51, MI:E group *n* = 21, mean age 64, male 67%.<br><br>IPPB group *n* = 20, mean age 63, male 57%. | Selection based on availability of device. Treatment for 5 days MI:E group.<br><br>IPPB group. | PFTs, PPCs. | The post-operative percentage of predicted FVC (58.4 ± 4.74 versus 46.0 ± 3.70%, *p* = 0.042), and $FEV_1$ (62.4 ± 5.23 versus 46.8 ± 3.83%, *p* = 0.017) were significantly less in IPPB group. Statistically significant higher reported chest pain in MI:E group (61.9% versus 16.7%; *p* = 0.002).<br><br>No statistically significant difference in PPCs; pneumonia (95% *CI* 0.12–16.86; *p* = 0.777), atelectasis (95% CI 0.20–1.91; *p* = 0.402), pleural effusion (95% *CI* 0.46–4.43; *p* = 0.544). |
| Pieczkoski, 2020 | Brazil | Effect of PEP in patients after cardiac surgery. | RCT. | *n* = 48.<br><br>IG1 *n* = 16, mean age 61, male 69%.<br><br>IG2 *n* = 16, mean age 65, male 69%.<br><br>CG *n* = 16, mean age 67, male 100%. | IG1 – PEP blow bottle device.<br><br>IG2 – Expiratory positive airway pressure.<br><br>CG – conventional physiotherapy. | Compared pre-op and POD3: PFTs, Respiratory muscle strength, CXR changes, pulmonary. complications, ICU and hospital LOS. | No difference between groups in PFTs, MIP and MEP, pain, PPCs, ICU or hospital LOS.<br><br>Unable to statically compare CXR changes due to small sample size. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Cargnin, 2019 | Brazil | Does IMT after heart valve replacement improve recovery. | RCT. | *n* = 25.<br><br>IG *n* = 13, mean age = 62, male = 69%.<br><br>CG = 12, mean age = 60, male = 50%. | IG – IMT 2 × day from POD3 to 4 weeks post op.<br><br>CG – IMT placebo group. | Lung function, MIP, functional capacity, QoL measured pre-op and at 4 weeks post-op. | Significantly improved MIP in IG ($p = 0.005$), improvement in 6MWD for IG compared with CG ($p = 0.019$). Correlation between MIP and 6MWD ($r = 0.72$; $p = 0.001$). Significant association between MIP and lung function test ($FEV_1$ $p = 0.003$; $FEV_1/FVC$ $p = 0.38$).<br><br>No difference between groups in lung function or QoL. |
| Derakh-tanjani, 2019 | Iran | Comparison of ACBT and routine PT on pain and respiratory parameters. | RCT. | *n* = 70.<br><br>IG *n* = 35, mean age = 53, male = 74%.<br><br>CG *n* = 35, mean age = 52, male = 74%. | IG – ACBT 1 × day in addition to early mobility.<br><br>CG = chest wall vibration and manual percussion in addition to early mobilisation. | $PaO_2$, HR, RR, pain score. | No significant difference in $PaO_2$, $SaO_2$, RR and pain between groups. |
| Dholakia, 2018 | USA | Does transport BiPAP or HFNO impact mobility, PPCs, and short-term morbidity and mortality. | Retrospective review abstract. | *n* = 20, Group 1 *n* = 8, Group 2 *n* = 12<br><br>No demographic details available. | Group 1 – Transport BiPAP.<br><br>Group 2 – HFNO. | Distance mobilised, reintubation rate. | Both groups doubled their mobility distance with additional respiratory support.<br>No numerical data or statistical analysis was presented in the abstract.<br><br>No detail on control group or previous ability. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Zochios, 2018 | U.K. | Effect of HFNO on hospital LOS in cardiac surgery patients with pre-existing respiratory disease. | RCT. | *n* = 100.<br><br>IG *n* = 51, mean age – 67, male – 61%.<br><br>CG *n* = 49, mean age – 69, male – 62%. | IG – HFNO for the first 24 hours.<br><br>CG – standard oxygen therapy. | Hospital LOS, ICU readmission, 6MWD, PFTs, PROMs. | Mean hospital LOS lower in IG (95% *CI* 11–44%; *p* = 0.004). Risk of prolonged stay higher in CG (38%) versus IG (18%) (*p* = 0.03).<br><br>IG had fewer ICU readmissions (*p* = 0.02).<br><br>No difference in ICU LOS, 6MWD, lung function tests, PROMs between groups. |
| Naswa, 2017 | India | Comparing ACBT and Acapella® on PPC incidence following cardiac valve surgery. | RCT. | *n* = 30, male = 60%.<br>IG *n* = 15, mean age = 33.<br><br>CG *n* = 15, mean age = 31. | IG = Acapella® × 10 breaths for 15 minutes or until tired.<br><br>CG = ACBT for 15 minute or until tired. | CXR, hospital LOS. | No significant difference in CXR appearance or hospital LOS, 3 patients in CG developed pneumonia.<br><br>(Note- young mean age). |
| Kamisaka, 2016 | Japan | Does mechanical ventilatory support reduce dyspnoea during walking after cardiac surgery. | Prospective case series. | *n* = 56.<br><br>Mean age – 68, male – 73%. | Walked without VA (session A), followed by walking with VA (HFNO to 3 cm $H_20$) (session B), or in reverse order.<br><br>Classed as dyspnoea group if Borg increased by 1 point. | Dyspnoea, leg fatigue, ventilatory parameters, lung function, physical function, CXR. | 35 patients (63%) reported dyspnoea on first walk. 18 (51%) of these patients responded to VA support by demonstrating a reduction in dyspnoea on walking. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Pantoni, 2016 | Brazil | Effect of CPAP on $POD_1$ mobility. | RCT. | *n* = 27.<br><br>IG *n* = 13, mean age – 58, male – 38%.<br><br>CG *n* = 14, mean age – 57, male – 71%. | IG – as CG plus CPAP 10–12 cm $H_2O$) during all exercises.<br><br>CG – early mob, respiratory exercises. | Breathing pattern variables, exercise time, dyspnoea, $SpO_2$. | Statistical improved outcomes in IG in some respiratory parameters; $V_T$ ($p = 0.001$), minute ventilation ($p = 0.005$); exercise time ($p = 0.04$), dyspnoea ($p = 0.008$), $SpO_2$ ($p = 0.016$).<br><br>No difference for leg effort scores. |
| Pettersson, 2015 | Sweden | Evaluate if DBEs are better performed in sitting or standing. | RCT. | *n* = 189.<br><br>IG *n* = 94 mean age – 65, Male -79%.<br><br>CG *n* = 95 mean age – 67, Male – 87%. | IG- 3 × 10 deep breaths with PEP device in standing.<br><br>CG – 3 × 10 deep breaths with PEP device in sitting. | $SpO_2$, subjective breathing ability, BP, HR, pain at rest, pain on deep breathing. | Significantly higher $SpO_2$ in standing group directly after exercises ($p = 0.0001$) and 15 minutes after ($p = 0.027$).<br><br>IG able to take a deeper breath ($p = 0.004$).<br><br>No significant difference in HR, BP, pain at rest or on deep breathing. |
| **Mobilisation/enhancement of physical ability** | | | | | | | |
| Afxonidis, 2021 | Greece | Effect of early and enhanced PT after cardiac surgery. | RCT. | *n* = 78.<br><br>IG *n* = 39, mean age 64, male 87%.<br><br>CG *n* = 39, mean age 65, male 80%. | IG as CG plus additional session of PT POD0–3.<br><br>CG – conven-tional PT 2 × day. DBE, IS, chest percussion, chest binder, coughing, progressive mobility. | ICU LOS.<br><br>Hospital LOS. Haemodynamics and lab tests; sodium, potassium, calcium, glucose, haemoglobin, lactate. | Mean number of treatment sessions: IG 16.6 ± 1.2, and 12.3 ± 0.8.<br><br>LOS statistically significant less in IG group (8.1 days versus 8.9; 95% *CI* 0.6–1 days, $p < 0.001$)<br><br>ICU LOS statistically significant less in IG (23.2 hrs versus 25 hrs; 95% *CI* 1.3–3.2 hours; $p = < 0.001$). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Chen, 2021 | China | SR and meta-analysis of effect of early mobilisation after cardiac surgery. | SR and meta-analysis. | *n* = 652, 5 studies (one study pre-op). | | ICU LOS, hospital LOS, physical function, adverse events. | 3 of 5 studies demonstrated beneficial effect of early mobilisation on ICU LOS (95% *CI* -2.01–0.04) however overall effect not significant ($p = 0.06$).<br><br>3 of 5 studies demonstrated beneficial effect of intervention on hospital LOS is beneficial (95% *CI* -3.96–0.71) however overall effect not significant ($p = 0.17$). |
| Pizzorno, 2020 | Italy | Early post-op rehabilitation in patient >75 years old. | Retrospective case control study. | *n* = 160.<br><br>Early rehabilitation *n* = 80, mean age 79, male 56%.<br><br>Delayed rehabilitation *n* = 80, mean age 79, male 53%. | Both group: aerobic, flexibility, resistance, neuromotor training.<br><br>Early rehabilitation = <8 days from cardiac procedure.<br><br>Delayed rehabilitation = >8 days from cardiac procedure. | 6MWT, LVEF, LOS, cost. | No significant difference between groups for 6MWT, LVEF or post-op complications.<br><br>Early rehabilitation group had a significantly lower LOS (25.8 days versus 34.1 days; $p < 0.0001$) compared to the delayed rehabilitation group.<br><br>Early rehabilitation group also showed significant reduction in costs ($p < 0.0001$). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Ribeiro, 2020 | Brazil | Impact of different PT protocols on heart rate variability and LOS after CABG. | RCT | *n* = 48, CG *n* = 16, mean age 60, male 69%.<br><br>IG1 *n* = 15, mean age 58, male 87%.<br><br>IG2 *n* = 17, Mean age 62, Male 59%. | Protocols from POD1–3<br>CG – respiratory PT and ankle exercises.<br><br>IG1 – early mobilisation group – cycle ergometry and ambulation.<br><br>IG2 – virtual reality group – as IG1 plus 2 × Wii games to increase UL strength and cardiovascular fitness. | Heart rate variability, hospital LOS. | IG1 and IG2 demonstrated improved autonomic response on $POD_4$ than CG ($p$ <0.05).<br><br>LOS shortest in IG2 (8.1 days), versus IG1 (10.2 days), versus CG (16 days) ($p$ 0.03).<br><br>Note – 28 patients lost to follow up. Initial *n* = 76, data analysed for 48 patients. |
| Kubitz, 2020 | Germany | ERAS in minimally invasive heart valve surgery. | Retrospective observational study. | *n* = 50, mean age 52, male 76%. | Protocol<br>POD0 – PT 3 hours after Sx, aim to mobilise<br>POD1 – 4 × PT mobility sessions<br>POD2 – Stairs or cycling<br>POD3 & 4 – Independent exercise. | Adherence to protocol, post-operative complications. | 47 patients undertook mobilisation 3 hours after surgery on $POD_0$.<br><br>Full adherence to protocol in 80% patients.<br><br>Non adherence due to nausea/ vomiting, arrythmia, pain, neurological events.<br><br>Post-operative complications impacting early phase of the ERAs project; disabling pain (30%), nausea and vomiting (35%), compared with 7% each by late phase of the ERAS project. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Zanini, 2019 | Brazil | Outcomes of different rehabilitation protocols after CABG. | RCT. | *n* = 40.<br>G1 *n* = 10 mean age 58, male 90%.<br>G2 *n* = 10, mean age – 57 male 70%.<br>G3 *n* = 10 mean age – 59, male 60%.<br>G4 *n* = 10, mean age – 61, male 70%. | Conventional PT plus<br>G1 – active UL & LL exercises, early ambulation, IMT.<br>G2 – active UL & LL exercises, early ambulation<br>G3 – IMT<br>G4/ CG – conventional PT (DBEs, EPAP, chest clearance), encouraged to walk from $POD_2$.<br>All groups seen 2× day for 6 days. | 6MWT, CPET variable, PFTs, respiratory muscle strength. | G3 & G4 had greater impairment in functional capacity (6MWD) immediately post-op compared to baseline vs G1 & G2 ($p$ = <0.001).<br>30 days post op – G4 had least amount of recovery. G1,2 3 had significant improvement in post-op 6MWD compared to pre-op baseline ($p$ = <0.001).<br>No significant difference between groups in lung function (FVC $p$ = 0.18; $FEV_1$ $p$ = 0.055) or respiratory muscle strength (MIP $p$ = 0.90, MEP $p$ = 0.68).<br>Mean ICS LOS longer in CG ($p$ <.05), no difference in hospital LOS across the 4 groups. |
| Borzou, 2018 | Iran | Effect of inpatient cardiac rehabilitation on patient self-efficacy. | RCT. | *n* = 60.<br>IG *n* = 30, mean age 62, male 53%.<br>CG *n* = 30, mean age 58, male 53%. | IG – 3 sessions (education and exercise) commenced 72 hours after surgery until discharge.<br>CG – routine care. | Self-efficacy questionnaire. | At discharge and 1 month after discharge feeling of general self-efficacy, feeling self-efficacy, exercise self-efficacy and total self-efficacy significantly better in IG ($p$ = <0.001). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Cerqueira, 2018 | Brazil | Effect of NMES after cardiac valve surgery. | RCT. | *n* = 59.<br>IG *n* = 26, mean age 42, male 69%.<br>CG *n* = 33 mean age 42, male 70%. | IG – received twice daily NMES in additional to regular PT. Total of NMES sessions.<br>CG – usual physiotherapy 2 × day. | 6MWT. | No statistical difference between groups 6MWD (95% *CI* -64.87–65.97) and walking speed (95% *CI* -0.55–0.57). |
| Miwa, 2017 | USA | Effect of ambulation orderlies following cardiac surgery. | Quasi-experimental prospective design. | *n* = 925.<br>Post – implementation *n* = 478, mean age 69 Male 69%.<br>Pre-implementation *n* = 447, mean age 67, male 67%. | Post. implementation – ambulation orderlies mobilised patients 1–4 × day for 3–10 minutes.<br>Pre-implementation – encouraged to walk by ward team, no set guidelines, ambulation not recorded. | LOS, mortality, readmission rates, discharge location, hospital. complications. | The implementation of ambulation orderlies showed a statistically significant reduction in LOS by 1 day (median and mean) ($p = 0.001$).<br>No statistically significant difference in discharge location, hospital readmission rate, hospital complications or mortality. |
| Mungovan, 2017 | Australia | Determine amount of physical exercise undertaken immediately after cardiac surgery. | Prospective observational study. | *n* = 83.<br>Mean age 66, male 70%. | Twice daily PT sessions; respiratory, musculoskeletal movement, walking up to 10 mins per session. | Step count, physical activity intensity in metabolic equivalents, 6MWD. | PT supervised 50% of physical activity. Significant increase in step count from $POD_1$ to POD5 ($p = <0.001$). |
| Pack, 2017 | USA | Evaluation of ambulation orderlies on recovery. | RCT pilot. | *n* = 36.<br>IG *n* = 18, mean age 62, male 72%.<br>CG *n* = 18, mean age 69, male 78%. | IG – ambulation orderly directed ambulation. 4 × day for 3–10 minutes.<br>CG – usual care, nurse directed (no mention of PT involvement). | Average daily steps, 6MWD, LOS. | No statistical significance between groups for average daily steps, 6MWD, LOS. IG noted to have more preferable baseline characteristics. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Santos, 2017 | Brazil | Effects of early mobilisations after cardiac surgery. | SR | 9 studies included Total *n* = 1419. | | | Lack of definition on early mobility, however early mobilisation is beneficial compared with bed rest. No evidence of optimal prescription. |
| Takei, 2017 | Brazil | Is PT safe in early post op cardiac surgery patients. | Conference abstract of observational study. | *n* = 258. | 698 PT interventions observed. | HR, BP, $SpO_2$, temperature, RR, Haemoglobin. | 18% of interventions had physiological abnormality or potential safety events (95% *CI* 15–21%), these occurred most commonly during ambulation (40%) and NIV (37%). The main adverse events were altered BP, and vertigo. Only 2% (95% *CI* 1–4%) required additional treatment. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Tariq, 2017 | Pakistan | Effects of early exercise after cardiac surgery. | RCT. | *n* = 174, mean age – 52, male 76%.<br>IG *n* = 87.<br>CG *n* = 87. | IG – mobilised to chair on POD0 (within 4 hours of extubation) and chest PT.<br>CG – as IG but starts on $POD_1$. | HR, BP, $SpO_2$, RR, temperature, dyspnoea, PPCs. | POD0: Following exercise, the IG showed significant improvement in $SpO_2$ ($p$ = <0.001) and reduced RR ($p$ = <0.001) compared to the CG.<br>POD1: Following exercise, the IG demonstrated significant reduction in HR ($p$ = <0.001) and the CG showed significant improvement in $SpO_2$ ($p$ = <0.001).<br>Reduced ICU LOS in IG (no $p$ value; ICU LOS at 5 days IG 31% versus CG 2%). |
| Borges, 2016 | Brazil | Effect of aerobic exercise after CABG. | RCT. | *n* = 34.<br>IG *n* = 15<br>Mean age – 63<br>Male 80%.<br>CG *n* = 19<br>Mean age – 73<br>Male 53%. | IG – aerobic exercise (cycle ergometery) in addition to conventional PT.<br>CG – conventional PT. DBEs, UL and LL exercises, progressive ambulation. | PFTs, respiratory muscle strength, 6MWT. Assessed pre-op and at hospital discharge. | Both groups experienced sig-nificant reduction post-op PFTs ($p$ = 0.001–0.27) but no difference between IG & CG.<br>Both groups maintained MIP ($p$ = 0.14–0.16), but reduction in MEP ($p$ = 0.004–0.006).<br>6MWD maintained in IG ($p$ = 0.06), but reduced in CG ($p$ = 0.01). Statistically significant difference between both groups at discharge ($p$ = 0.03). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Floyd, 2016 | USA | Evaluate effectiveness of progressive mobility protocol on PROM related to immobility. | Retrospective study matched design. | *n* = 30.<br><br>IG *n* = 15, mean age 65, male 87%.<br><br>CG *n* = 15, mean age 67, male 80%. | IG – progressive mobility protocol.<br><br>CG – no standard activity protocol for post-op therapy. | ICU LOS, ICU readmission, pressure ulcers, DVT. | Results not statistically significant for hospital LOS ($p = 0.502$), ICU readmission ($p = 0.301$) or DVT ($p = 0.492$) or pressure ulcer ($p = 0.313$).<br><br>Note – some results combined cardiac and thoracic surgery. |
| Monte-leone, 2015 | Italy | Assessment of ability post cardiac and thoracic surgery and recovery. | Prospective observational study. | *n* = 375.<br><br>Mean age 66<br>Male 63%. | Introduction of rehabilitative protocol.<br><br>No CG. | Assessment of post op disability and impact of rehabilitative protocol. | 25% patients had no post-op disability, 63% patients classed as simple deconditioning and 12% as complex deconditioning. Number of PT sessions received was associated with severity of deconditioning ($p = 0.01$). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Trevisan, 2015 | Brazil | Use of cycle ergometer in post CABG recovery. | RCT. | *n* = 24.<br><br>IG *n* = 14<br>Mean age – 58<br>Male 71%<br><br>CG *n* = 10<br>Mean age – 63<br>Male 80%. | IG – as CG but substituting walking with cycle ergometery.<br><br>CG – POD3. Chest PT, POD4–7 addition of mobility, POD5 stairs. 2 × 20 mins per day. | 6MWT. | IG non statistically significant longer distance walked in 6MWT (312.2 ± 80.6 versus 249.7 ± 61.4; *p* = 0.06)<br>No statically significant difference in HR, $SpO_2$, and Borg. |
| **Sternal wound and pain** | | | | | | | |
| Gach, 2021 | USA | KYMITT impact on discharge. | Before and after observational study. | n = 1104.<br><br>IG *n* = 477, mean age 63, male 69%.<br><br>CG *n* = 627, mean age 67, male 71%. | IG – adoption of KYMITT.<br><br>CG – sternal precautions to avoid pushing, pulling, lifting for 6–8 weeks. | Discharge location, incidence of sternal wound complications, functional status at discharge. | IG more independent at discharge for bed mobility (49% versus 11%) and transfers (66% versus 35%) (*p* = 0.001).<br><br>Significantly more IG patients were discharged home (*p* = 0.001), with decrease in referrals to inpatient rehabilitation or nursing facilities.<br>No significant difference in LOS (*p* = 0.97).<br><br>No significant difference in sternal wound complications between the groups (*p* = 0.68; 95% *CI* 0.52–3.09). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Radfar, 2019 | USA | Examine if KYMITT impacts LOS following surgery. | Abstract of retrospective observational study. | *n* = 856.<br><br>Pre imple-mentation of KYMITT *n* = 356.<br><br>Post imple-mentation of KYMITT *n* = 509. | Standard sternal restrictions versus KYMITT. | Case mixed index, length of stay. | Decrease in LOS by 0.10 days (no information on statistical significant). |
| Boitor, 2018 | Canada | Evaluate the effectiveness of hand massage on pain and anxiety following cardiac surgery. | RCT. | *n* = 60.<br><br>IG1 *n* = 20<br>Median age 64<br>Male 70%.<br><br>IG2 *n* = 19<br>Median age 68<br>Male 84%.<br><br>CG *n* = 21<br>Median age 63<br>Male 77%. | IG1–2 × 20 mins hand massage.<br><br>IG2–2 × 20 mins hand holding.<br><br>CG – standard care with 20 rest period. | Pain intensity, pain unpleasant-ness, anxiety, muscle tension, vital signs. | Pain intensity ($p = 0.011$), pain unpleasant-ness ($p = 0.009$), anxiety ($p = 0.015$) and muscle tension ($p = 0.053$) significantly lower immediately after hand massage, compared with hand holding and standard care.<br>No difference between hand holding and control group.<br><br>No difference between groups after 30 minutes or POD1. No changes in vital signs. |
| Katijjahbe, 2018 | Australia | Comparison of standard restrictive sternal precautions and modified sternal precautions following sternotomy. | RCT. | *n* = 72.<br><br>IG *n* = 36, mean age – 63, male – 86%.<br><br>CG *n* = 36, mean age – 64, male – 94%. | IG = modified sternal precautions for 4–6 weeks.<br><br>CG = usual restrictive sternal wound precautions. | SPPB, upper-limb function, pain, kinesiophobia, QoL, sternal stability and adherence at week 0, 4 and 12. | No significant difference between groups SPPB at week 4 (95% *CI* -0.2–2.3) or week 12 (95% *CI* -0.9–1.6), nor secondary outcomes.<br>Both groups measurements improved with time after surgery.<br><br>No difference in sternal complications. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| LaPier, 2018 | USA | Survey physio-therapists application of sternal precautions. | Question-naire. | *n* = 29. | NA. | Descriptive questionnaire; type of sternal precautions, RoM restriction, weightlifting restriction, duration of restrictions, occurrence of dehiscence, sternal instability and pain. | Sternal precautions are commonly prescribed to patients following sternotomy, their application is highly variable. |
| Hong, 2017 | Australia | Does a continuous local anaesthesia improve pain control and walking distance post CABG. | RCT. | *n* = 75.<br><br>IG *n* = 26<br>Mean age 60<br>Male 81%.<br><br>Sham group *n* = 25.<br>Mean age 62<br>Male 80%.<br><br>CG *n* = 24<br>Mean age 58<br>Male 83%. | IG – received 0.5% Ropivacaine solution via two tunnelled parasternal catheters.<br><br>Sham group – as above with saline solution.<br><br>CG – standard pain therapies (PCA and oral analgesia). | Pain VAS score, walking distance, proportion of patients discharged on $POD_4$. | No differences in pain before or after PT from POD1–4 ($p = 0.110$).<br><br>No difference in distance walked between groups ($p = 0.230$).<br><br>No difference in number of patients discharged from PT on POD4 ($p = 0.510$). |
| Sturgess, 2014 | Australia | Do thoracic exercises improve pain, RoM and HRQoL following cardiac surgery. | RCT (pilot). | *n* = 38.<br><br>IG *n* = 23, mean age – 63, male – 74%.<br><br>CG *n* = 15 mean age – 59, male – 93%. | IG = individualised thoracic exercise programme plus walking programme.<br><br>CG = 2 × daily walking programme. | Shoulder and thoracic ROM, pain, HRQoL. | At 4 weeks IG group reported statistically significant less sternal pain ($p = 0.03$; 95% *CI* -0.28–0.0). No difference at 3 months ($p = 0.79$). IG perceived home PT contributed more to recovery ($p = 0.04$; 95% *CI* -2.1–0.0). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| **Patient and staff experience** | | | | | | | |
| Chang, 2017 | Taiwan | Early illness experiences of unexpected heart surgery. | Qualitative descriptive Semi structured interviews. | *n* = 13. | NA. | NA. | Themes: symptoms, physical and emotional disturbances, establishing new life and support after surgery. MDT input and education should be initiated as soon as possible to facilitate recovery. |
| Lapum, 2016 | Canada | Facilitation and barriers to discharge post heart surgery. | Narrative account via 2 interviews. | *n* = 17, 10 patients 7 nurses. | NA. | NA. | Cognitive ability post-op impeded so pre-op education optimal time for education. Recommend group and scenario based education. Support needed at home post discharge. |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| Bowen, 2015 | USA | Does visual art displayed on walls motivate patients to walk more frequently and further distances. | Quasi-experimental design. | *n* = 86 (included lower extremity. revascular-isation).<br><br>CG1 *n* = 34, mean age – 61, male – 80%, cardiac surgery – 47%.<br><br>CG2 *n* = 25, mean age – 63, male – 63%, cardiac surgery 96%.<br><br>IG *n* = 31, mean age – 63, male – 76%, cardiac surgery 100%. | CG1 – usual hospital artwork on walls.<br><br>CG2 – no artwork on walls.<br><br>IG – artwork created by hospital staff on walls. | Distance walked, frequency walked, art experience. | Statistically significant difference in distance walked on day 1 in IG ($p = 0.052$).<br><br>No difference in frequency walked. No statistically significant difference in LOS. Statistically significant IG walked further on POD1 (median 370 feet), than CG1 and CG2 (median 270 feet) ($p = 0.052$).<br><br>No statistical significance difference in number of times walked per day. No statistically significant difference was found in total mood disturbance among the three groups at discharge ($p = 0.78$).<br><br>Patients in IG reported higher positive art experience compared to CG1 ($p < 0.05$). |

| First author | Source origin | Aim/purpose | Design/ method-ology | Sample size | Comparison | Outcome measures | Key findings |
|---|---|---|---|---|---|---|---|
| **Adverse events** | | | | | | | |
| Sousa, 2021 | Brazil | Adverse events during PT in ICU after cardiac surgery. | Prospective observational study. | *n* = 323 patients, mean age – 59, male 57%. | | Assessed against 12 physiological abnormalities or adverse events, plus severity rating. | 935 PT sessions observed<br>46% of patients had at least 1 adverse event.<br>20% incidence (95% *CI* 18–23%).<br>Incidence of adverse events: suction 44%, walking 40%, NIV 37%, sitting on edge of bed 28%, IPPB 26%.<br><br>Type of adverse events: 74% haemodynamic changes, most rated as near miss or mild severity. |

6MWD = six minute walk distance, 6MWT = six minute walk test, ACBT = active cycle of breathing techniques, BiPAP = bilevel positive airway pressure, BP = blood pressure, CABG = coronary artery bypass graft, CG = control group, CPAP = continuous positive airway pressure, CPET = cardiopulmonary exercise test, CXR = chest XRay, DBEs = deep breathing exercises, DVT = deep vein thrombosis, EPAP = expiratory positive airway pressure, ERAS = enhanced recovery after surgery, $FEV_1$ = forced expiratory volume in the first second, FVC = forced vital capacity, HFNO = high flow nasal oxygen, HR = heart rate, HRQoL = health related quality of life, ICU = intensive care unit, IG = intervention group, IMT = inspiratory muscle training, IPPB = inspiratory positive pressure breathing, IS = incentive spirometry, KYMITT = Keep your move in the tube, LL = lower limb, LOS = length of stay, LVEF = left ventricle ejection fraction, MI:E = mechanical insufflation:exsufflation, MIP = maximal inspiratory pressure, MEP = maximal expiratory pressure, NIV = non-invasive ventilation, NMES = neuromuscular electrical stimulation, PCA = patient controlled analgesia, PEP = positive expiratory pressure, PFT = pulmonary function test, POD = post operative day, PPC = post operative pulmonary complications, PROMs = patient reported outcome measures, PT = physiotherapy, QoL = quality of life, RCT = randomised control trial, RoM = range of movement, RR = respiration rate, $SpO_2$ = peripheral oxygen saturation, SPPB = short performance physical battery, SR = systematic review, UL = upper limb, VA = ventilator assistance, VAS = visual analogue scale, $V_T$ = tidal volume.

## References


1 National Institute for Cardiovascular Outcomes Research. *National Adult Cardiac Surgery Audit (NACSA). 2020 Summary Report (2016/17–2018/19 data).* 2020. https://www.nicor.org.uk/wp-content/uploads/2020/12/National-Adult-Cardiac-Surgery-Audit-NACSA-FINAL.pdf.

2 Specialty Advisory Committee and Society for Cardiothoracic Surgery in Great Britain and Ireland. *U.K. Cardiothoracic Surgery Workforce Report.* 2019. https://scts.org/_userfiles/pages/files/sctsworkforcereport2019.pdf.

3 Sullivan KA, Churchill IF, Hylton DA, Hanna WC. Use of Incentive Spirometry in Adults following Cardiac, Thoracic, and Upper Abdominal Surgery to Prevent Post-Operative Pulmonary Complications: A Systematic Review and Meta-Analysis. *Respiration.* 2021;100(11):1114–1127. https://doi.org/10.1159/000517012.

4 Chen B, Xie G, Lin Y, Chen L, Lin Z, You X, Xie X, Dong D, Zheng X, Li D, Lin W. A systematic review and meta-analysis of the effects of early mobilization therapy in patients after cardiac surgery. *Medicine (Baltimore).* 2021 Apr 16;100(15):e25314. https://doi.org/10.1097/md.0000000000025314.

5 Ramos Dos Santos PM, Aquaroni Ricci N, Aparecida Bordignon Suster É, de Moraes Paisani D, Dias Chiavegato L. Effects of early mobilisation in patients after cardiac surgery: a systematic review. *Physiotherapy.* 2017;103(1):1–12. https://doi.org/10.1016/j.physio.2016.08.003.

6 Peters M, Godfrey C, McInerney P, et al. Chapter 11: Scoping Reviews. In: Aromataris E, Munn Z (Editors). JBI Manual for Evidence Synthesis, JBI. 2020. Available from https://synthesismanual.jbi.global. https://doi.org/10.46658/JBIMES-20-12.

7 Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic Review or Scoping Review? Guidance for Authors When Choosing Between a Systematic or Scoping Review Approach. *BMC Med Res Methodol.* 2018;18(1):143. Published 2018 Nov 19. https://doi.org/10.1186/s12874-018-0611-x.

8 Khalil H, Peters M, Godfrey CM, McInerney P, Soares CB, Parker D. An Evidence-Based Approach to Scoping Reviews. *Worldviews Evid Based Nurs.* 2016 Apr;13(2):118–23. https://doi.org/10.1111/wvn.12144.

9 Clarivate Analytics. *Endnote software.* 2021. Available at https://endnote.com. Accessed Jan–March 2021.

10 Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D. The PRISMA 2020 statement: an updated

guideline for reporting systematic reviews. *BMJ.* 2021 Mar 29;372:n71. https://doi.org/10.1136/bmj.n71.

11 Critical Appraisal Skills Programme. *CASP Checklist.* 2020. Available at: https://casp-uk.net/casp-tools-checklists/. Accessed: January–March 2021.

12 Joanne Briggs Institue (JBI). *Critical Appraisal Checklist for Systematic Reviews and Research Syntheses.* https://jbi.global/critical-appraisal-tools. Accessed: January–March 2021.

13 Chang YL, Tsai YF. Early Illness Experiences Related to Unexpected Heart Surgery: A Qualitative Descriptive Study. *Aust Crit Care.* 2017;30(5):279–285. https://doi.org/10.1016/j.aucc.2016.11.005.

14 Kamisaka K, Sakui D, Hagiwara Y, et al. Mechanical Ventilatory Assistance May Reduce Dyspnea During Walking Especially in Patients With Impaired Cardiopulmonary Function Early After Cardiovascular Surgery. *J Cardiol.* 2016;67(6):560–566. https://doi.org/10.1016/j.jjcc.2015.08.003.

15 Dholakia K, Hemli J, Gill H, et al. Transport Bipap and High-Flow Nasal $O_2$ During Early Mobility Accelerate Recovery Aafter Cardiac Surgery. *Critical Care Medicine.* 2018;47(1):1138.

16 Pantoni CB, Di Thommazo-Luporini L, Mendes RG, et al. Continuous Positive Airway Pressure During Exercise Improves Walking Time in Patients Undergoing Inpatient Cardiac Rehabilitation After Coronary Artery Bypass Graft Surgery: A Randomized Controlled Trial. *J Cardiopulm Rehabil Prev.* 2016;36(1):20–27. https://doi.org/10.1097/hcr.0000000000000144.

17 Pieczkoski SM, de Oliveira AL, Haeffner MP, Azambuja ACM, Sbruzzi G. Positive expiratory pressure in postoperative cardiac patients in intensive care: A randomized controlled trial. *Clin Rehabil.* 2021;35(5):681–691. https://doi.org/10.1177/0269215520972701.

18 Naswa S, Tuteja R, Gupta VP, et al. Comparison of Acapella Versus Active Cycle of Breathing Technique in Post-Operative Pulmonary Complications After Valve Replacement Surgeries [With Consumer Summary]. *Indian Journal of Physiotherapy and Occupational Therapy.* 2017;11(2):24–29.

19 Pettersson H, Faager G, Westerdahl E. Improved Oxygenation During Standing Performance of Deep Breathing Exercises With Positive Expiratory Pressure After Cardiac Surgery: A Randomized Controlled Trial. *J Rehabil Med.* 2015;47(8):748–752. https://doi.org/10.2340/16501977-1992.

20 Alaparthi GK, Amin R, Gatty A, et al. Contrasting effects of three breathing techniques on pulmonary function, functional capacity and daily life functional tasks in patients following valve replacement surgery – A pilot randomized clinical trial. *Heliyon.*

2021;7(7):e07643. Published 2021 Jul 22. https://doi.org/10.1016/j.heliyon.2021.e07643.

21 Wu MF, Wang TY, Chen DS, et al. The Effects of Mechanical Insufflation-Exsufflation on Lung Function and Complications in Cardiac Surgery Patients: A Pilot Study. *J Cardiothorac Surg.* 2021;16(1):350. Published 2021 Dec 9. https://doi.org/10.1186/s13019-021-01738-x.

22 Zochios V, Collier T, Blaudszun G, et al. The Effect of High-Flow Nasal Oxygen on Hospital Length of Stay in Cardiac Surgical Patients at High Risk For Respiratory Complications: A Randomised Controlled Trial. *Anaesthesia.* 2018;73(12):1478–1488. https://doi.org/10.1111/anae.14345.

23 Cargnin C, Karsten M, Guaragna JCVDC, Dal Lago P. Inspiratory Muscle Training After Heart Valve Replacement Surgery Improves Inspiratory Muscle Strength, Lung Function, and Functional Capacity: A Randomized Clinical Trial. *J Cardiopulm Rehabil Prev.* 2019;39(5):E1–E7. https://doi.org/10.1097/hcr.0000000000000409.

24 Salehi Derakhtanjani A, Ansari Jaberi A, Haydari S, Negahban Bonabi T. Comparison the Effect of Active Cyclic Breathing Technique and Routine Chest Physiotherapy on Pain and Respiratory Parameters After Coronary Artery Graft Surgery: A Randomized Clinical Trial. *Anesth Pain Med.* 2019;9(5):e94654. https://doi.org/10.5812/aapm.94654.

25 Monteleone S, Dalla Toffola E, Emiliani V, et al. Recovery of Deambulation After Cardiothoracic Surgery: A Single Center Experience. *Eur J Phys Rehabil Med.* 2015;51(6):763–771.

26 Afxonidis G, Moysidis DV, Papazoglou AS, et al. Efficacy of Early and Enhanced Respiratory Physiotherapy and Mobilization After On-Pump Cardiac Surgery: A Prospective Randomized Controlled Trial. *Healthcare (Basel).* 2021;9(12):1735. Published 2021 Dec 15. https://doi.org/10.3390/healthcare9121735.

27 Ribeiro BC, Poça JJGD, Rocha AMC, et al. Different physiotherapy protocols after coronary artery bypass graft surgery: A randomized controlled trial. *Physiother Res Int.* 2021;26(1):e1882. https://doi.org/10.1002/pri.1882.

28 Tariq MI, Khan AA, Khalid Z, Farheen H, Siddiqi FA, Amjad I. Effect of Early ≤3 Mets (Metabolic Equivalent of Tasks) of Physical Activity on Patient's Outcome After Cardiac Surgery. *J Coll Physicians Surg Pak.* 2017;27(8):490–494.

29 Pizzorno M, Desilvestri M, Lippi L, et al. Early Cardiac Rehabilitation: Could t Improve Functional Outcomes and Reduce Length of Stay and Sanitary Costs In Patients Aged 75 Years or Older? A Retrospective Case-Control Study. *Aging Clinical and Experimental Research.* 2020. https://doi.org/10.1007/s40520-020-01589-x.

30 Miwa S, Visintainer P, Engelman R, et al. Effects of an Ambulation Orderly Program Among Cardiac Surgery Patients. *Am J Med.* 2017;130(11):1306–1312. https://doi.org/10.1016/j.amjmed.2017.04.044.

31 Pack QR, Woodbury EA, Headley S, et al. Ambulation Orderlies and Recovery After Cardiac Surgery: A Pilot Randomized Controlled Trial. *J Clin Exerc Physiol.* 2017;6(3):42–49. https://doi.org/10.31189/2165-6193-6.3.42.

32 Floyd S, Craig SW, Topley D, Tullmann D. Evaluation of a Progressive Mobility Protocol in Postoperative Cardiothoracic Surgical Patients. *Dimens Crit Care Nurs.* 2016;35(5):277–282. https://doi.org/10.1097/dcc.0000000000000197.

33 Fontes Cerqueira TC, Cerqueira Neto ML, Cacau LAP, et al. Ambulation Capacity and Functional Outcome in Patients Undergoing Neuromuscular Electrical Stimulation After Cardiac Valve Surgery: A Randomised Clinical Trial. *Medicine (Baltimore).* 2018;97(46):e13012. https://doi.org/10.1097/md.0000000000013012.

34 Trevisan MD, Lopes DG, Mello RG, Macagnan FE, Kessler A. Alternative Physical Therapy Protocol Using a Cycle Ergometer During Hospital Rehabilitation of Coronary Artery Bypass Grafting: a Clinical Trial. *Braz J Cardiovasc Surg.* 2015;30(6):615–619. https://doi.org/10.5935/1678-9741.20150085.

35 Zanini M, Nery RM, de Lima JB, Buhler RP, da Silveira AD, Stein R. Effects of Different Rehabilitation Protocols in Inpatient Cardiac Rehabilitation After Coronary Artery Bypass Graft Surgery: A Randomized Clinical Trial. *J Cardiopulm Rehabil Prev.* 2019;39(6):E19–E25. https://doi.org/10.1097/hcr.0000000000000431.

36 Kubitz JC, Schulte-Uentrop L, Zoellner C, et al. Establishment of An Enhanced Recovery After Surgery Protocol in Minimally Invasive Heart Valve Surgery. *PLoS One.* 2020;15(4):e0231378. Published 2020 Apr 9. https://doi.org/10.1371/journal.pone.0231378.

37 Mungovan SF, Singh P, Gass GC, Smart NA, Hirschhorn AD. Effect of Physical Activity in The First Five Days After Cardiac Surgery. *J Rehabil Med.* 2017;49(1):71–77. https://doi.org/10.2340/16501977-2165.

38 Borges DL, Silva MG, Silva LN, et al. Effects of Aerobic Exercise Applied Early After Coronary Artery Bypass Grafting on Pulmonary Function, Respiratory Muscle Strength, and Functional Capacity: A Randomized Controlled Trial. *J Phys Act Health.* 2016;13(9):946–951. https://doi.org/10.1123/jpah.2015-0614.

39 Takei M, Nozawa E, Sousa ML, et al. Physiotherapy Intervention Is Safety in Early Postoperative Patients After Cardiac Surgery? *European Respiratory Journal.* 2017;50(61). https://erj.ersjournals.com/content/50/suppl_61/PA2560.

40 Sousa MLA, Coimbra VRM, Takei MT, Melo CCA, Feltrim MIZ, Nozawa E. Physiological abnormalities and adverse events during physical therapy in the intensive care unit after cardiac surgery: A prospective observational study. *Braz J Phys Ther.* 2021;25(5):623–631. https://doi.org/10.1016/j.bjpt.2021.04.001.

41 Borzou SR, Amiri S, Salavati M, Soltanian AR, Safarpoor G. Effects of the First Phase of Cardiac Rehabilitation Training on Self-Efficacy among Patients Undergoing Coronary Artery Bypass Graft Surgery. *J Tehran Heart Cent.* 2018;13(3):126–131.

42 Bowen MG, Wells NL, Dietrich MS, Sandlin V. Art to Heart: The Effects of Staff-Created Art on the Postoperative Rehabilitation of Cardiovascular Surgery Patients. *Medsurg Nurs.* 2015;24(5):349–355.

43 Gach R, Triano S, Ogola GO, et al. 'Keep Your Move in The Tube' Safely Increases Discharge Home Following Cardiac Surgery. *PM R.* 2021;13(12):1321–1330. https://doi.org/10.1002/pmrj.12562.

44 Radfar J, Fuchs L, Cahalin LP. An Alternative Approach to Sternal Precautions Improves Length of Stay After Median Sternotomy. *Cardiopulmonary Physical Therapy Journal.* 2019.

45 Katijjahbe MA, Granger CL, Denehy L, et al. Standard Restrictive Sternal Precautions and Modified Sternal Precautions Had Similar Effects in People After Cardiac Surgery Via Median Sternotomy ('Smart' Trial): A Randomised Trial. *J Physiother.* 2018;64(2):97–106. https://doi.org/10.1016/j.jphys.2018.02.013.

46 LaPier T, Perilli P, Solly K, et al. Physiotherapists' Descriptions and Perceptions of Wound Protection and Arm Activity Restrictions Following Median Sternotomy: An International Perspective. *Cardiopulmonary Physical Therapy Journal.* 2018.

47 Sturgess T, Denehy L, Tully E, et al. A Pilot Thoracic Exercise Programme Reduces Early (0–6 Weeks) Sternal Pain Following Open Heart Surgery [With Consumer Summary]. *International Journal of Therapy and Rehabilitation.* 2014;21(3):110–117.

48 Hong SS, Alison JA, Milross MA, Robledo K, Dignan R. Does Continuous Infusion of Local Anaesthesia Improve Pain Control and Walking Distance After Coronary Artery Bypass Graft Surgery? A Randomised Controlled Trial. *Physiotherapy.* 2017;103(4):407–413. https://doi.org/10.1016/j.physio.2017.02.002.

49 Boitor M, Martorella G, Maheu C, Laizner AM, Gélinas C. Effects of Massage in Reducing the Pain and Anxiety of the Cardiac Surgery Critically Ill: A Randomized Controlled Trial. *Pain Med.* 2018;19(12):2556–2569. https://doi.org/10.1093/pm/pny055.

50 Lapum JL, Fredericks S, Liu L, et al. Facilitators and Barriers of Heart Surgery Discharge: Patients' and Nurses' Narrative Accounts. *J Cardiovasc Nurs.* 2016;31(4):350–356. https://doi.org/10.1097/jcn.0000000000000253.

51 El-Ansary D, LaPier TK, Adams J, et al. An Evidence-Based Perspective on Movement and Activity Following Median Sternotomy. *Phys Ther.* 2019;99(12):1587–1601. https://doi.org/10.1093/ptj/pzz126.

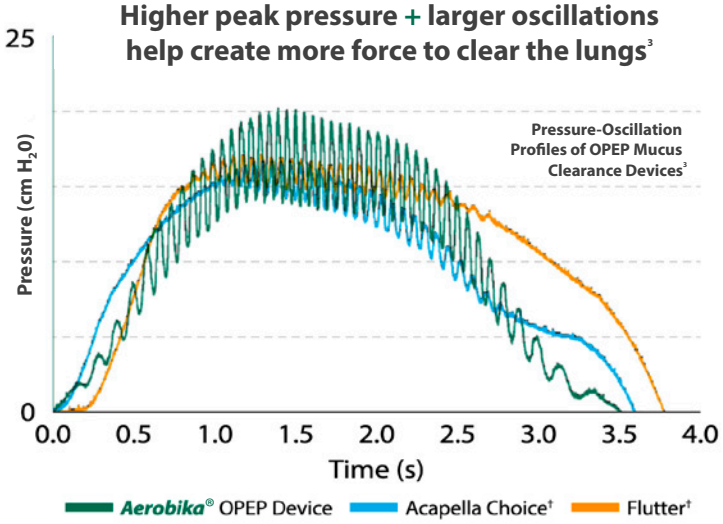
# For patients with mucus hypersecretion

# There's a *Clear* Choice


## Latest GOLD and BTS guidelines recommend **OPEP therapy** for mucus hypersecretion[1,2]

## The most efficient and effective OPEP device[3,4*]

**Higher peak pressure + larger oscillations help create more force to clear the lungs**[3]




**20-30%** MORE EFFICIENT PER BREATH

\+

**Up to 4×** MORE EFFECTIVE[3,4**]

= Greater mucus clearance potential and optimal patient benefit.[3,4]

TRUDELL MEDICAL UK LIMITED

ATTENDING **ACPRC Conference** 21st - 22nd April 2023 #ACPRC23

AerobiKA Oscillating Positive Expiratory Pressure Device

Learn More

*In vivo data, compared to Acapella and Flutter **greater pressure amplitude is related to therapeutic effectiveness

**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.

# The ACPRC editorial board: driving high-quality of care, for people with respiratory problems

**Una Jones**[1]

[1]School of Healthcare Sciences, Heath Park, Cardiff University, U.K.

*Correspondence author* | Una Jones. Email: JonesUF@cardiff.ac.uk.

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. The purpose of the documents and resources is to facilitate knowledge sharing and drive improvements in the quality of care for respiratory patients. And what a fantastic job the board and topic teams have done in the last four years, which of course included a global pandemic with respiratory physiotherapy being at the forefront of healthcare.

The initial hot topics were lung ultrasound, blunt chest trauma, physiotherapy management of people post cardiac thoracic and cardiac surgery and airway clearance in adults who were intubated. Each of the topic leads co-ordinated and supported a team to scope the literature in the relevant areas and then decide the type of document that would best summarise the information and provide guidance for the ACPRC members. The output of the board over the last four years has been a commentary (1), a position statement (2) and four scoping reviews (3, 4, 5, 6). These outputs have only been possible due to the incredibly hard work, of the topic leads and teams.

So, what have we learnt from the first round of topics? Each task was a lot bigger than anticipated! This was particularly so for the scoping exercise, and advice for future topic leads is to have a streamlined process for the search, for example Joanna Briggs Institute, and set aside more time than you would think to read and extract data from each study. Deadlines were difficult to keep with other work priorities especially COVID-19, so flexibility and getting the right people at the right time is needed to ensure that the task does get finished. Having a mix of clinicians and academics on the teams was very helpful to provide a broad skill set. Going forward, we could be more explicit about the skills, experience and realistic time availability when recruiting team members. This does not mean that all team members need to be highly experienced in every aspect of the process – all ACPRC members have the skills that are needed, and support is there for you to develop.

Each output has research recommendations, some highlights are: the use lung ultrasound outside critical care, effect of positioning for airway clearance in the intubated adult, cost effectiveness of physiotherapy post-surgery, and qualitative studies exploring patient and staff experiences.

And so, we move to the next round of topics and a new chair to guide the board and teams in their work. Congratulations to Agnieszka Lewko in being appointed new chair of the board. The new topic teams are led by Izzie Easton – *dysfunctional breathing pattern*; Stephanie Mansell – *simulation*, and Agnieszka Lewko – *inspiratory muscle training*. These topics are shaping up to produce some very exciting resources to support ACPRC members.

I have thoroughly enjoyed my four years as chair of the editorial board, learning more about evidence-based healthcare and working with wonderful people. I have no doubt of the excellent value of these resources for ACPRC members in all areas of their work and in supporting students and newly qualified physiotherapists as they pursue their careers.

## References


1 Wade C., Battle C, Barrett-Brown Z, Haylett R, Leat R, Jones U. Physiotherapy following blunt chest trauma. ACPRC Journal. 2019;53(2):187–190. https://www.acprc.org.uk/publications/acprc-journal/2021-journal-vol-53-issue-2/association-of-chartered-physiotherapists-in-respiratory-care-commentary:-physiotherapy-following-blunt-chest-trauma/.

2 Gustafson O, Hayward S, Helmsley A, Grant J, Smith M, Tait C, Pickering N, Hardy J, Atkin K, Jones U. ACPRC Journal. Association of Chartered Physiotherapists in Respiratory Care position statement: Physiotherapists use of lung ultrasound. ACPRC Journal. 2021;53(2):147–150. https://www.acprc.org.uk/Data/Resource_Downloads/PhysioLUS-COVID-19.pdf?date=17/03/2020%2021:55:53.

3 Cork G, Wade C, Gordon A, Vaughan-France A, Palmer A, Walker K, Jones U. Airway clearance techniques for the intubated adult: a scoping review. ACPRC Journal. 2022;54(3):120–139. https://rc.rcjournal.com/content/65/8/1174.

4 Eden A, Matthews E, Page A, Easton I, Jones U. Association of Chartered Physiotherapists in Respiratory Care scoping review: Post-operative physiotherapy in people undergoing cardiac surgery. ACPRC Journal. 2023;55(1).

5 Eden A, Gilbert N, Bendall A, Easton I, Lewko A, Page A, Tait C, Jones U. Association of Chartered Physiotherapists in Respiratory Care scoping review: Post-operative physiotherapy in people undergoing thoracic surgery. ACPRC Journal. 2022;54(1):89–113. https://www.acprc.org.uk/publications/acprc-journal/2022-journal-vol-54-issue-1/association-of-chartered-physiotherapists-in-respiratory-care-scoping-review:-post-operative-physiotherapy-in-people-undergoing-thoracic-surgery/.

6 Grafton K, Wheldon C, Stiger R, Robbins N, Baker C, Jones U. Association of Chartered Physiotherapists in Respiratory Care scoping review: Post-operative physiotherapy management in upper gastrointestinal (GI) surgery. ACPRC Journal. 2022:54(2):92–106. https://www.acprc.org.uk/publications/acprc-journal/2022-journal-vol-54-issue-2/

association-of-chartered-physiotherapists-in-respiratory-care-scoping-review:-post-operative-physiotherapy-management-in-upper-gastrointestinal-gi-surgery/.

Vitalograph®

# Respiratory Muscle Strength *& More*

The **Pneumotrac™ with RMS** (Respiratory Muscle Strength) measures inspiratory and expiratory muscle strength, helping assess a patient's ability to generate the muscular pressure necessary to breathe.

## *There's more.*

It also measures how much breath a person has and how fast they breathe with detailed spirometry testing.

Evaluate **diaphragmatic, intercostal,** and **abdominal muscle** strength:

MIP/MEP/SNIP

+

Assess volume and flow of breath with **detailed spirometry**:

VC/FVC/PCF


**Find Out More**

**For more information: 01280 827110 sales@vitalograph.co.uk**

**www.vitalograph.com**

A Global Leader in **Respiratory Diagnostics**



CE 2797

# Inspiring *excellence* in cardio-respiratory care



**Publication design and typesetting by**
User Design, Illustration and Typesetting
www.userdesignillustrationandtypesetting.com


www.acprc.org.uk

ISSN 2059-0199 (Online)