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Contents

Introduction

We are pleased to present the 2021 Volume 53 Issue 1 for the *Journal of the Association of Chartered Physiotherapists in Respiratory Care*. Given the current pressures on us all at this present time, we are delighted to have received so many submissions to the ACPRC journal. On behalf of the committee, we would like to thank all of the authors and reviewers who have contributed to the journal.

Since the last publication you'll notice that there has been a change of co-editor. We thank Laura Moth for her contributions to the journal over the last few years; particularly we want to acknowledge her commitment and work on the indexing status for the journal. We also want to welcome Owen to the team; we look forward to working with you!

We also want to take this opportunity to highlight the ACPRC conference *A Blank Canvas: navigating the future of cardiorespiratory physiotherapy* that will be held on Friday 23rd and Saturday 24th April 2021. The conference will be an online event and will bring together clinical expertise, cutting edge research and patient experience within an exciting and interactive programme. It is our intention that all of the abstracts that are accepted for presentation at the conference will be included in a journal supplement that will be published later in the year. We look forward to seeing you (albeit virtually) at the conference later this year!

We really hope you enjoy this issue of the ACPRC Journal and we want to remind that author guidelines are available on the ACPRC website www.acprc.org.uk and we accept submissions throughout the year. Please remember that we also provide members with support through the Research Officer and as editors we are very happy to discuss any potential articles ideas with you too.

Kind regards

Amy Bendall and Owen Gustafson

journal@acprc.org.uk

An evaluation of physiotherapy-led inhalation testing in chronic respiratory disease at a tertiary centre

Rachel Young[1], Georgia Goode[2], Annie Jacques[2], Alex Long[2], Paul Wilson[2]

Abstract

Background

Inhaled medications improve health outcomes in chronic respiratory patients. Guidelines and pharmaceutical licensing agreements recommend a drug response trial prior to use. Evidence to support this recommendation is of poor quality; adverse events are rare, and the trial process has a considerable impact on physiotherapy clinical time and patient experience. Current literature suggests using percentage predicted forced expiratory volume in 1 second (FEV_1) >55% as a predictor of trial success.

Aims

1 To identify the failure rate of inhaled therapy trials in the chronic respiratory cohort.
2 To predict risk factors associated with trial outcome to establish those who could avoid a trial due to low risk stratification.

Methods

An evaluation of service was completed which involved a retrospective review of 204 chronic respiratory participants who completed an inhaled therapy trial between September 2017 and September 2019. Spirometry and other anthropometric measurements were recorded at the time of the drug response trial. Data was analysed using multivariable logistic regression to identify variables linked to passing inhaled therapy trials.

Authors

[1]All Wales Adult Cystic Fibrosis Centre, University Hospital Llandough, Cardiff and Vale NHS Trust, Penlan Road, Llandough, CF64 2XX, UK.
[2]St. Bartholomew's Hospital, Therapies Department, London EC1A 7BE, UK.

Keywords

Drug reaction assessment, inhaled therapy, cystic fibrosis, FEV_1, pulmonary function testing.

Correspondence author

Georgia Goode. Email: georgia.goode1@nhs.net. Telephone: 077130 99174.

Discussion and conclusion

FEV_1% predicted was significantly less for those that failed (35.5%) compared to those that passed (53.18%) $p = 0.012$. Those with an FEV_1 predicted >55% had a higher likelihood to pass $p = 0.005$, $R^2 = 0.039$.

The evaluation identified a low failure rate (4.9%) overall to inhalation therapy trials, with the most significant risk factor for failure being identified as FEV_1 predicted <55%. Patient screening could significantly reduce the burden of inhaled therapy trials for patients.

Introduction

Inhaled medications are an integral part of the long-term treatment and management for patients with chronic respiratory disease and are associated with improved patient health outcomes through lower respiratory exacerbation rates (Steinfort & Steinfort 2007), improved spirometry and reduced microbial burden (Kellet & Robert 2011). A trial dose is recommended for patients starting a new antibiotic therapy, or mucoactive agent, due to the risk of bronchoconstriction (Wark et al. 2005; Quon et al. 2014), however the evidence is rated poorly in all guidelines with previous study heterogeneity for bronchiectasis (Pasteur et al. 2010). Bronchoconstriction and symptomatic events during treatment with these medications is minimal across different chronic respiratory diseases (Bathoorn et al. 2007; Brodt et al. 2014).

A literature search specifically reviewing the need for an inhaled therapy trial found only one study by Dennis et al. (2018) which demonstrated that for patients with various respiratory conditions including cystic fibrosis (CF), non-CF bronchiectasis and asthma, a pre-trial FEV_1 predicted >55% was associated with passing the trial. The authors showed that by excluding these patients it would reduce the need to test by 83% over the five-year study period. The study was conducted in a single centre and further research is required to understand potential risk factors. Taube et al. (2001) also found that patients with more severe chronic obstructive pulmonary disease (COPD) (FEV_1% pred 42 ± 9.5) had more stark reactions to 3% hypertonic saline compared to 0.9% saline with added histamine release. The low baseline FEV_1% predicted in this study also reflects findings reported by Dennis et al. (2018) in terms of highlighting those patients that may be more at risk of bronchoconstriction. In selecting patients dependent on their risk factors, it has the potential to reduce hospital appointment time and allow early implementation of treatment. Reducing the number of trials required in all settings would also provide more time to manage disease-specific physiotherapy issues.

The aims of the project therefore were to:

1 Identify the failure rate of inhaled therapy trials in the chronic respiratory cohort seen at St. Bartholomew's Respiratory Medicine and Cystic Fibrosis services.
2 Predict risk factors associated with trial outcome to establish those who could avoid a trial due to low risk stratification.

Methods and materials

Project design

A service evaluation was completed that utilised retrospective data collection and analysis of inhaled therapy trial results from September 2017 until September 2019. Data was collected for all adult respiratory patients with chronic respiratory disease at a tertiary hospital by two senior physiotherapists. The justification for employing a retrospective review was due to:

1 Consent had been obtained from patients as part of their assessment as part of their standard care for the completion of the trial and collection of the measures.
2 Data is routinely recorded and available due to the high level of documentation standards around inhaled therapy trials.

The sample included in the evaluation was reflective of the St. Bartholomew's adult chronic respiratory disease patient cohort which include the conditions of COPD, asthma, bronchiectasis and CF. All patients who undertook a trial during the timescales for the evaluation were analysed. Those patients that were excluded were not eligible to have a trial based on local guidance, that is that the individuals were unable to perform spirometry, and/or had presented in mid-exacerbation of their condition.

In a previously published study, a power calculation had identified a minimum of 194 patients was required (p <0.05) (Dennis et al. 2018); this figure was therefore used as the minimum number of subjects that would be required for adequate power for statistical analysis. No ethics committee approval was required as it was identified as an evaluation of service and it was registered within the trust's research and development department: *Bart's Health CEU reference ID 9676*. The study was not collaborative and did not involve another organisation.

Inhaled therapy trial protocol

Inhaled therapy trials were carried out following the St. Bartholomew's standard operating procedure (Appendix 1), as part of either an inpatient admission or outpatient appointment, for all new inhaled therapies, or inhaled therapies restarted after more than a twelve-month break. Anthropometric measurements were documented at the time of the trial for all patients, including sex, age, ethnicity. Results were represented using means and standard deviations (SD). Spirometry (FEV_1) was recorded along with monitoring of symptoms including the BORG Scale of Perceived Breathlessness. FEV_1% predicted was calculated using the Global Lung Function Initiative 2012 formula (Quanjer et al. 2012). A bronchodilator

was administered pre-trial based on clinical examination. The trial was completed by a competent respiratory physiotherapist requiring >6 months post-qualification experience that included completion of a respiratory rotation. The trial process usually takes up to 2 hours in total. All measures were repeated immediately after the trial, including FEV_1 and the change was calculated using a percentage change equation (Equation 1).

A failure of the inhalation therapy trial was classified as a FEV_1 drop greater than 15% from initial FEV_1 (British Thoracic Society 1997). Patients that failed an inhalation therapy trial were treated with salbutamol and assessed by the physiotherapist, with all measurements repeated; and the protocol was that examination by a medic would be requested if the patient did not return to base line observations and spirometry within 20 minutes of completing the trial.

$$\frac{Pre\ FEV_1 - Post\ FEV_1}{Pre\ FEV_1} \times 100 = percentage\ (\%)\ constriction$$

Equation 1.

Statistical analysis

Statistical analysis was performed using SPSS version 25.0 (Chicago, IL, USA); characteristic differences between success and failure groups were identified using independent *t* tests (*p* values documented).

Univariate regression analysis was performed for spirometry (FEV_1 and FEV_1% predicted), age, gender, inhaled therapy and disease group as a precursor for multivariate regression models. FEV_1% predicted was grouped into 5% increments from 40% to 60% to ascertain a risk point for conducting an inhaled therapy trial.

Results

During the two-year review period 204 patients performed an inhalation therapy trial at St. Bartholomew's Hospital, with 106 as inpatients and 98 as outpatients (Table 1). The sample consisted of 114 females (55.9%). Mean age of 43.4 years (*SD* 19.4), FEV_1 of 1.65ℓ (litres) (*SD* 0.86) and a FEV_1% predicted 52.3% (*SD* 21.9). Inhaled therapy trials were completed for antibiotic therapy (*n* = 132, 64.7%), then hypertonic saline (*n* = 64, 31.4%) and rhDNase (*n* = 8, 3.9%).

The failure rate was calculated as ten patients (4.9%) of the total inhaled therapy trials, with a statistically significant difference identified in age (42.6 years versus 57.8 years *p* = -0.027), FEV_1 (1.68ℓ versus 1.06ℓ *p* = 0.026) and FEV_1% predicted (53.18% versus 35.5% *p* = 0.012) between patients that passed compared to those that failed respectively. The regression analysis showed that those with an FEV_1 predicted <55% were statistically more likely to fail *p* = 0.005, R^2 = 0.039 (Table 2). There was no statistically significant difference found between gender, ethnicity, type of nebulised drug and outcome. Patients with CF

were more likely to pass the inhaled therapy trial compared to patients without CF (98.0% versus 83.0% respectively) however this was not statistically significant ($p = 0.06$).

There were six patients who failed the trial due to being unable to tolerate the medication. This was due to medication taste or symptoms of coughing or tight chest. All six had an acceptable change in FEV_1. Two of these patients had an FEV_1 predicted >55% and these were for patients with bronchiectasis trialling hypertonic saline 6% and had a small change in FEV_1 post trial (-2%). There were five trials with a significant drop in FEV_1 with no symptoms experienced by the patient, all had an FEV_1 less than 55% predicted.

Table 1: Summary of outcomes (mean and standard deviation).

	Total	Passed	Fail	*p* value
N (%)	204	194 (95.1)	10 (4.9)	
Demographics				
Age (SD)	43.4 (19.4)	42.6 (19.2)	57.8 (18.0)	**0.027**
Gender (% female)	114 (55.9)	97.4 ($n = 111$)	2.6 ($n = 3$)	0.092
Ethnicity (%)				
Caucasian	150 (73.5)	143 (95.3)	7 (4.7)	0.831
Asian	36 (17.6)	34 (94.4)	2 (5.6)	
Other	18 (8.8)	17 (94.4)	1 (5.6)	
Inpatient (%)	106 (52.0)	99 (93.4)	7 (6.6)	0.24
Use of pre-dose bronchodilator (%)	157 (77.0)	153 (97.5)	9 (2.5)	0.191
Medical co-morbidity				
CF (%)	98 (48.0)	96 (98.0)	2 (2.0)	0.06
Non-CF (%)	106 (52.0)	88 (83.0)	8 (17.0)	
Inhaled drug therapy				
HTS (%)	64 (31.4)	61 (95.3)	3 (4.7)	0.743
Antibiotic (%)	132 (64.7)	125 (94.7)	7 (5.3)	
rhDnase (%)	8 (3.9)	8 (100)	0	
Respiratory function				
FEV_1	1.65 (0.86)	1.68 (0.87)	1.06 (0.45)	**0.026**
FEV_1% predicted	52.3 (21.9)	53.18 (21.91)	35.5 (12.23)	**0.012**

SD = standard deviation; CF = cystic fibrosis; HTS = hypertonic saline; FEV_1 = forced expiratory volume in 1 second.

Table 2: Grouped FEV_1% predicted.

Grouped regression	Significance	R^2
FEV_1% pred <40	0.119	0.012
FEV_1% pred <50	0.012	0.031
FEV_1% pred <55	0.005	0.039
FEV_1% pred <60	0.011	0.032

FEV_1 = forced expiratory volume in 1 second; R^2 = R-squared.

Discussion

Overall this evaluation of service shows that the failure rate for inhaled medication trials was very low in a well powered cohort of patients. The regression analysis demonstrated that FEV_1 predicted <55% is the best point of statistical fit at which risk increases for participants undertaking a nebulised therapy trial. This aligns with the limited but available recent literature on the topic (Dennis et al. 2018). This work further increases the overall diversity of the current published dataset and includes participants from a further specialist tertiary centre.

A proposed new cut-off of FEV_1 predicted <55% would be safe based on the data analysed: patients who were non-symptomatic but had a FEV_1 drop >15% all started with a baseline FEV_1 predicted <55%. If the guidance of a FEV_1 predicted <55% cut off is used, this group of patients would have still been identified for trials. The six patients who were symptomatic did not drop their FEV_1 below 15% after a trial and refused to continue with the nebulised medication based on the symptoms experienced. These patients would have been identified as not tolerating the medication, irrespective as to whether a trial was completed or not.

Reasons why a lower lung function might result in a patient being more likely to fail the trial are that firstly, less of a reduction in millilitres (ml) is required to meet the 15% drop in spirometry cut off for failure, for example for a patient with 1ℓ as a baseline FEV_1 would need to drop 15ml after a trial in contrast with an individual with a 3ℓ baseline FEV_1 would need to drop 45ml. This means a lower ml drop is required for a greater % change. Secondly, doing repeated forced expiratory manoeuvres can cause fatigue (European Lung Foundation 2020). This may be more likely to affect those with a lower baseline FEV_1 due to increased disease severity causing fatigue, potentially predisposing these patients to a significant FEV_1 drop. Patients with a low baseline FEV_1 who during a trial are asymptomatic with no physiological changes but have a signification FEV_1 drop may be denied an inhaled medication that would benefit them long term.

Whilst a medication trial itself is important to ascertain whether an individual can tolerate a new inhaled medication, the spirometry measurements do not always show useful

information relating to a person's tolerability; the test does not replicate a real-life nebuliser routine. Airway clearance techniques are advocated after mucoactive agents and prior to nebulising an antibiotic to ensure maximum deposition. A more useful assessment of tolerability than spirometry could be the reaction of the individual during a realistic, combined physiotherapy and nebuliser session, with symptomatic and physiological measurements such as auscultation, respiratory rate and heart rate being recorded.

The results identify potential patient groups that are 'low risk' for inhaled therapy trial failures; if inhalation trials were only carried out on those patients with FEV_1 predicted <55% and not on rhDNase there would have been a 45.6% reduction in the number of trials completed over a two year period. Dennis et al. (2018) also showed no fails for rhDNase trials with patients with an FEV_1 predicted >55%. This suggests this is a very low risk of bronchoconstriction from inhaled therapy that does not require a full inhalation trial. As previously mentioned, a change to clinical practice to exclude rhDNase trials would reduce the burden of hospital appointments and streamline physiotherapy. Outpatient appointments are known to consume time and money for patients, and for those individuals with chronic respiratory disease it has been reported to have reduced adherence and attendance due to treatment burden (Sabaté 2003).

Whilst age initially presented as a statistically significant factor for trial failure, further multi-variate analysis showed non-significance. The positive correlation between the two negated age as a significant factor. There was also no statistical significance between failure rates for the different inhaled medications. Six patients failed due to medication intolerance but had an acceptable change in FEV_1; four of these had an FEV_1 predicted <55% with the other two trials being for bronchiectasis patients for 6% hypertonic saline. From the data from Dennis et al. (2018), inhaled therapy trials for patients with bronchiectasis with hypertonic saline were both associated with a higher risk for failing. This may be because hypertonic saline works through increased sputum mobilisation and ion content of the lung airway surface liquid to replenish the sol layer and accelerate mucus clearance (Robinson et al. 1997). The rate of change of osmolarity is thought to cause airway hyper responsiveness (Taube et al. 2001) and can cause airway narrowing (Elkins & Bye 2011). Hypertonic saline is generally administered prior to or during airway clearance (O'Neill et al. 2017), and so the inhaled test dose is not a veritable representation of physiotherapy treatment. Further work could consider the different groups of non-CF bronchiectasis and effect on nebuliser trial outcomes.

As this evaluation was completed to support service delivery at a local level, the limitation is that these results are also from a single centre. The findings however are supportive and reflective of the current body of evidence reviewing inhaled medication trials. Another limitation of the data is that the antibiotic group was not sub-divided meaning no resolution is available on which antibiotic inhaled therapy medications are better tolerated compared to others.

Conclusions

The findings of the evaluation suggest a low failure rate (4.9%) overall to inhalation therapy trials, with a risk factor for failure being identified as FEV_1 predicted <55%, which correlates with the current evidence base. Appropriate patient selection, using FEV_1 predicted <55% as the risk point, could significantly reduce the number of inhaled therapy trials being performed. The growing evidence base reporting a low failure rate and highlighting lower risk patient groups could help to support a review of national guidelines of inhalation trials.

Appendix 1

Appendix 1

Standard Operating Procedure (SOP)
Inhalation Therapy Response Assessment

Effective from	**2017**
Distribution	• Pharmacy. • Cardio-Respiratory Physiotherapy Team. • Respiratory Physiotherapy Team. • Cystic Fibrosis/Respiratory Medicines Consultants.
Related documents	• Medicines Management Policy. • Patient Group Direction for Specialist Healthcare Professionals. • NHS England National Service Specification. • Standards of Care and Good Clinical Practice for the Physiotherapy Management of Cystic Fibrosis.
Owner	Clinical Lead Respiratory Physiotherapist.
Author/further information	• Paul Wilson, Highly Specialist Cystic Fibrosis Physiotherapist. • Catherine Olie, Highly Specialist Pharmacist. • Tanya Usher, Clinical Lead Respiratory Physiotherapist. • Mark Butler, Senior Clinical Nurse Specialist for Cystic Fibrosis.
Superceded documents	None
Review due	2020
Keywords	Inhaled medications, respiratory, physiotherapy

Test dose of inhaled antibiotic, anti-fungal or mucolytic drug

1 Introduction

1.1 This SOP outlines the procedure for assessing the reponse to an intial dose of inhaled medication by a chartered physiotherapist, ensuring patient care and safety.

1.2 Inhaled medications are used frequently in the management of patients with cystic fibrosis (CF) and non-CF Bronchiectasis with benefits including, targeted delivery with a lower doses of antibiotics in comparison to oral or intraveneous antibiotics; as well as some medications only being available as inhaled medications, such as mucoactive medications (RhDNase, hypertonic saline, or Mannitol).

2 Rationale

2.1 Physiotherapists are often involved in inhalation therapy education with patients, regarding medications, devices and routines. This is often due to inhalation therapies being associated with airway clerance techniques (ACT) and breathing pattern training.

2.2 A bronchoconstriction trial is required for the commonly used inhaled antibiotics and bronchitol in respiratory patients, as outlined in the summary of product characteristics (SPC).

2.3 RhDNase (Pulmozyme) may cause bronchoconstriction after inhaltion, and it is therefore recommended that a Inhalation Therapy Response Assessment (ITRA) is completed prior to long term use in people with CF.

2.4 Hypertonic saline is not classfied as a medication but a medical device. There is evidence of potential bronchoconstriction with use in people with CF and non-CF bronchiectasis, and it is therefore recommended that a ITRA is completed prior to long term use in respiratory patients.

3 Indications

3.1 Identification of the need for inhaled antibiotics, for a respiratory patient, based on relevant assessment and microbiology results. That is to say, a new growth of bacterium, mycobacterium, fungus or resistance requiring a change to a current regime.

3.2 Identification of the need for mucoactive agents, for a respiratory patient, based on assessment. That includes, a change to sputum rheology, persistant symptoms, or declining lung function.

4 Precautions

4.1 Previously failed ITRA for a specific medication.

4.2 Any contradictions to performing spirometry, for example, chest pain, sinus surgery, recent pneumothorax, or hameopytsis.

5 Competencies

5.1 All physiotherapists should complete the *Inhaled Therapy Competencies* document.

5.2 All physiotherapists band 6 and above working with respiratory patients are eligible to complete the *Inhaled Therapy Compentencies*, but will be responsible for the completion of the document and to seek supervision.

5.3 Physiotherapists at band 5 level working with respiratory patients, must have completed at least 6 months post qualification working, including a core respiratory rotation to be eligible to complete the *Inhaled Therapy Competencies*.

5.4 Competencies will be discussed as part of the physiotherapists annual/rotational appraisal, with further education, supervision or support provided as required.

6 Outcome Measures

6.1 A full respiratory assessment should be completed for each patient, inclusing oxygen saturations, heart rate (HR), respiratory rate (RR) auscultation, patient reported symptoms and force expiratory technique spirometry.

6.2 Forced expiratory volume in 1 second (FEV_1) will be the primary outcome for those patients able to perform spirometry testing reliably.

$$\frac{Pre\ FEV_1 - Post\ FEV_1}{Pre\ FEV_1} \times 100 = percentage\ (\%)\ constriction$$

Equation 1.

6.3 In patients unable to perform reliable spirometry all other parameters are to guide assessment of suitability for further use. (This will include patients identified in the *Precautions* section of this document, or children under the age of 5 that are unable to perform spirometry.)

7 Procedure

ITRA form
Form to be completed by the prescriber, including patient details, prior to the assessment.

If an outpatient prescription is required this is to be attached to the form.

All patients should be prescribed a short-acting bronchodilator in the event of a symptomatic decline in FEV_1 (>15%).

Collection of medications
Inpatient: Pharmacy should be made aware to facilitate supply of medication (24-hours notice).

Outpatient: An outpatient prescription should be taken to outpatient pharmacy at least 2 hours' prior – ideally a day in advance to avoid delay.

Medication preparation
Confirmation of correct administration including diluents.

Counter signature required by a clinician regularly administering medicines (for example, nursing staff).

Ensure the correct device for delivery is working (nebuliser or DPI).

Patient preparation
Confirm patient is aware of trial indications and gain consent.

Check patient's current clinical status, if any changes to discuss with medical team.

Undertake full respiratory assessment – including auscultation, respiratory rate and signs of respiratory distress to be documented.

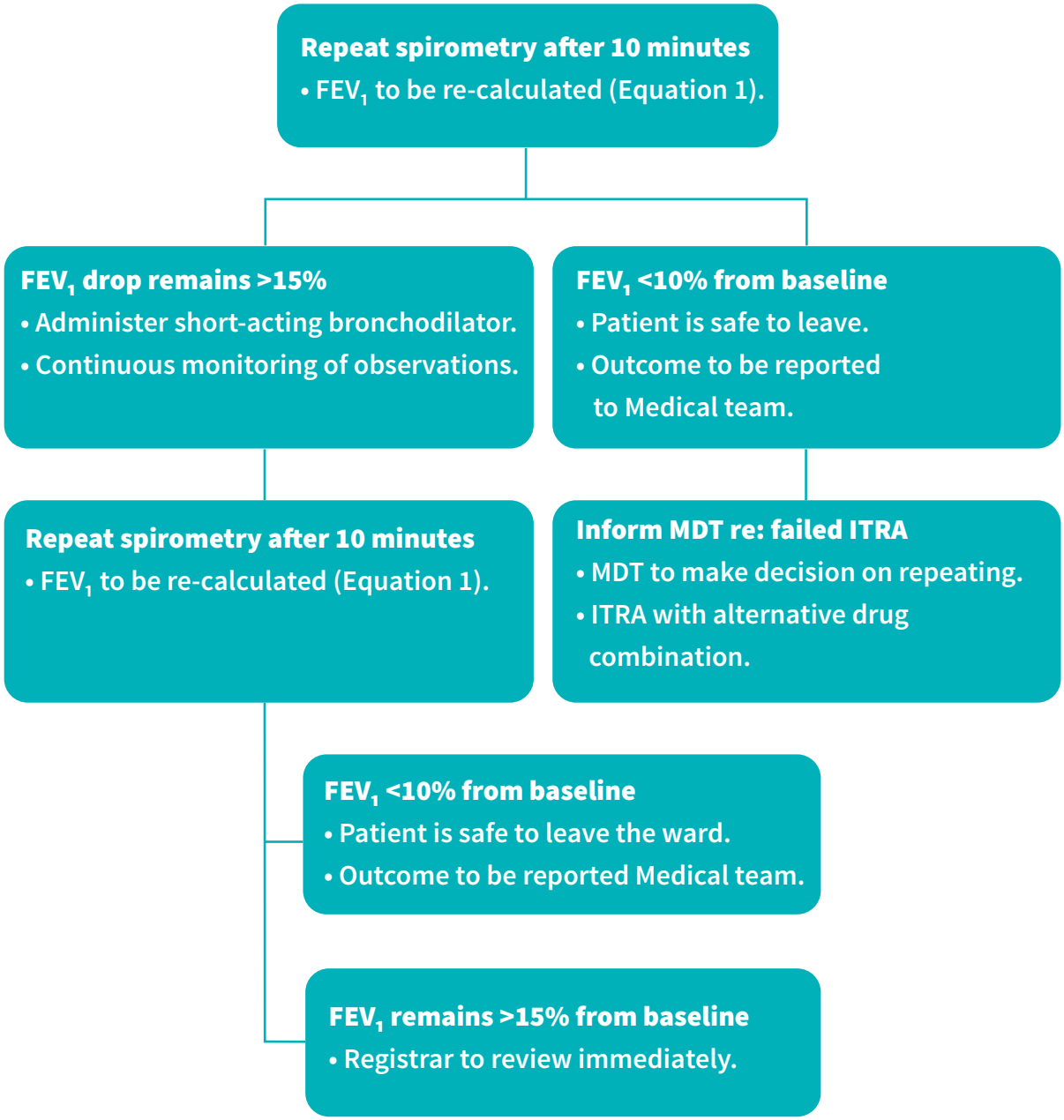
Procedure
Complete spirometry – FEV_1/FVC (best of 3 to be noted).

Monitor pulse oximetry and heart rate throughout.

Give medication as prescribed.

Repeat spirometry – FEV_1/FVC (best of 3 to be noted).

Immediate fail	Fail	Pass
If saturation falls below normal limit (>3%) for a prolonged period of time (>10 seconds) *Indication: disorder breathing pattern or bronchoconstriction*	If the post FEV_1 has reduced by more than 15% (see Equation 1) Patient should be monitored closely	If the post FEV_1 has reduced by less than 10% (see Equation 1)
If the patient reports nausea, light headedness, or chest tightness *Indication: disorder breathing pattern or bronchoconstriction*	If the post FEV_1 has dropped between 10–15% and is experiencing adverse symptoms (including, wheeze, increased respiratory rate, or excessive coughing)	If the post FEV_1 has dropped between 10–15% and is *not* experiencing adverse symptoms
If the patient reports chest tightness, breathlessness or wheeziness, of tingling of the lips, mouth or throat *Indiciation: anaphylaxis*		
	If the post ITRA respiratory assessment shows a drop of >3% SpO_2, increase in HR >10bpm, or RR >5bpm and changes to ausculation, such as wheeze or reduced air entry	If the post ITRA respiratory assessment shows no significant change to SpO_2, HR, RR or ausculation



9 Documentation and education

9.1 After the ITRA is the information is to be recorded on CRS using the pre-configured template form entitled *Inhalation Therapy Response Assessment Form*. An email of the outcome to be sent to the requesting consultants and the specialised pharmacist.

9.2 All patients to be given leaflet on the drug being prescribed, to include information on storage, preparation and/or reconstitution after completing the ITRA. Including details on side effects and what to do in the event of experiencing such side effects.

9.3 Relevant equipment including instructions for cleaning and maintaining to be provided to the patients after completing the ITRA. Education regarding the safe disposal of all sharps should be detailed with patients.

Outcome	Method of review	Responsibility	Frequency
Physiotherarpy competencies	Competency documents	Senior physiotherapists	Annually
Inhaled medications trial form completion	Inhaled medications trial form review	Physiotherapy Team	Initially 6 months, then 2 yearly
Incidents and events	Datix Inhaled medications trial form review	Physiotherapy Team	Initially 6 months, then 2 yearly

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Differences in maximal inspiratory pressure when using a standard yoga mat versus a standard yoga block in healthy individuals

Mair Davies[1], Sue Annetts[2]

Abstract

Background

Yoga, which incorporates posture optimisation and specific breathing techniques, is recognised for its health benefits including musculoskeletal strengthening, stress relief and respiratory enhancement. It is therefore becoming an increasingly utilised practice within the medical environment, specifically for those with respiratory dysfunctions such as chronic obstructive pulmonary disease (COPD). The relationship between posture and yoga and the potential impact upon breathing is an important topic to study for its potential health benefits. This study compares the impact of two different yoga seating positions on respiratory muscle strength.

Methodology

Eighteen students from Cardiff University between the ages of 19–34 years were recruited via convenience sampling. Each was in good health, with body mass index (BMI) in the normal category and possessed no respiratory infection or significant spinal deformities. Participants were required to sit comfortably, cross-legged for 2 minutes in each sitting position, before three measurements of maximal inspiratory pressure (MIP) were taken. Analysis was performed on the highest result in each position using Statistical Package for the Social Sciences (SPSS) version 25. Comments on comfort levels were given spontaneously and, despite not being a primary aim of the study, provided an interesting discussion point.

Authors

[1]Band 5 Physiotherapist, Cardiff and Vale University Health Board, Cardiff, CF14 4XW, UK.

[2]Senior Lecturer, School of Healthcare Sciences, Cardiff University, Cardiff. CF14 4XN, UK.

Keywords

Yoga, position, maximal inspiratory pressure, healthy participants.

Correspondence author

Mair Davies. Email: DaviesMB2@outlook.com.

Results and conclusions

Sitting on a yoga mat produced higher mean MIP figures (104cm H_2O) than the yoga block (100.39cm H_2O), $p = 0.015$. Despite statistical significance, the mean difference of 3.61cm H_2O is unlikely to have clinical significance as it is small compared to the observed MIP range (>90 cm H_2O). There does not appear to be a recognised minimum clinically important difference in the literature, making interpretation difficult.

Introduction

Poor posture has become increasingly prevalent in all demographics, particularly in the sedentary population (Owen 2012). Although extensive research recommends frequent physical activity, people with chronic obstructive pulmonary disease (COPD) remain one of the most inactive populations and spend a significant amount of their time sitting or lying down (Furlanetto et al. 2017). Physiological changes related to COPD, including hyperinflation and thoracic kyphosis, compromise posture causing shoulder protraction, head protrusion and slouching (Goncalves et al. 2017). The slouching posture frequently observed in the COPD population compromises diaphragmatic function (Morrow et al. 2016; Albarrati et al. 2018). Habitual maintenance of this posture is also detrimental to spinal health (Castanharo et al. 2014) and is heavily associated with poor outcomes (Furlanetto et al. 2017). It is therefore important that people with COPD optimise their posture as far as possible.

Physiotherapy guidelines encourage the provision of patient education on appropriate postures as a self-management tool to combat the symptoms of dyspnoea and to reduce exertion (Bott et al. 2009). Certain postures can modify the ability of muscles to contract more forcibly in relation to the length tension theory (Kirsch & Stein 2000) thus improving their ability to utilise inspiratory muscles and inhale optimally. Good posture and specialised breathing techniques present in yoga practice have been associated with improved respiratory function and health outcomes, especially amongst people with COPD (Donesky-Cuenco et al. 2009; Fulambarker et al. 2012). Yoga can therefore be recommended as an adjunct to other therapies, particularly if the patient's breathlessness interferes with moderate exercise.

Seating aids such as yoga mats and blocks are commonly used to optimise posture and facilitate comfort during yoga practice. Significant changes to body alignment can be observed whilst using certain yoga apparatus (Sheeran et al. 2018). Even slight changes in pelvic tilt of only 10 degrees away from neutral impacts on respiratory function (Hwang & Kim 2018). It is therefore important to consider the impact of seating apparatus on body

alignment when choosing the most beneficial seating position for people with COPD in relation to pulmonary function during yoga practice. One way of measuring inspiratory muscle strength and thus general pulmonary function is by calculating MIP.

This study aimed to explore whether there is a statistically significant difference (p <0.05) in MIP in healthy individuals when sitting upon a standard yoga mat compared to a standard yoga block. We hypothesised there to be no significant difference between these two groups.

Methodology

Ethical considerations

Ethical approval was gained from the Cardiff University School of Healthcare Sciences Ethics Committee in August 2018.

Participants

Students from Cardiff University were invited to volunteer following a personal presentation by M.D. during two physiotherapy lectures. Inclusion criteria were: adults aged 18–35 years with a healthy BMI (18.5–24.9) to avoid compromising lung function due to excess adipose tissue compressing lungs (Banerjee et al. 2014) or malnutrition reducing respiratory function (Liu et al. 2015). Participants also needed to be capable of sitting crossed-legged (for uniformity) on the floor for up to 20 minutes without discomfort. Participants were excluded if they possessed any significant spinal deformities, acute or chronic respiratory conditions, had a history of smoking or were pregnant, due to the likelihood that their lung function would be compromised (Barroso et al. 2018).

Participants were provided with an information sheet detailing the purpose and nature of the research at least 24 hours before study commencement. If volunteers were eligible and happy to continue, a consent form was signed.

Data collection

A standiometer and weighing scale were used to measure the height and weight of each participant so that their BMI could be calculated on arrival. Each participant was then asked to sit crossed-legged on a yoga mat and yoga block (Figure 1).

Figure 1a: Position for sitting on a standard yoga block.

Figure 1b: Position for sitting on a standard yoga mat.

The order of seating positions was randomised to eliminate any bias due to practice effect. This was attained through having the participants select one of the two seating positions from an opaque container. Participants sat for two minutes in each position to regulate their breathing before their MIP was measured using a Micro Respiratory Pressure Meter. Data were collected by a single examiner to avoid potential problems arising from inter-rater measurements. As MIP is an effort-dependent measurement the researcher provided standardised verbal encouragement using a specified script.

Adhering to ATS and ERS (2002) standardised guidelines, 3 correctly performed manoeuvres lasting for over 1.5 seconds were attained. A two-minute break in between each measurement was also given in order to regain participant baseline breathing pattern and reduce associated fatigue. Once 3 acceptable measurements in each sitting position, exhibiting less than 20% variance of each other, were collected (ATS & ERS 2002), the highest figure for each participant's sitting position underwent further analysis using SPSS version 25.

Following spontaneous feedback regarding perceived comfort level using the apparatus, comments were recorded thereafter to identify any relationships. However, as this was not a part of the original study design, the recording of comfort was limited to stating which apparatus was more comfortable. No attempt was made to attribute a value to the degree of comfort for each sitting position.

Results

It is particularly important to consider the demographics as lung function can be influenced by age, gender and participant size (Bellemare et al. 2003). Of the 18 participants successfully recruited (Figure 2), 55% (n = 10) were female. Weight was normally distributed, and BMI fell within normal parameters (Table 1).

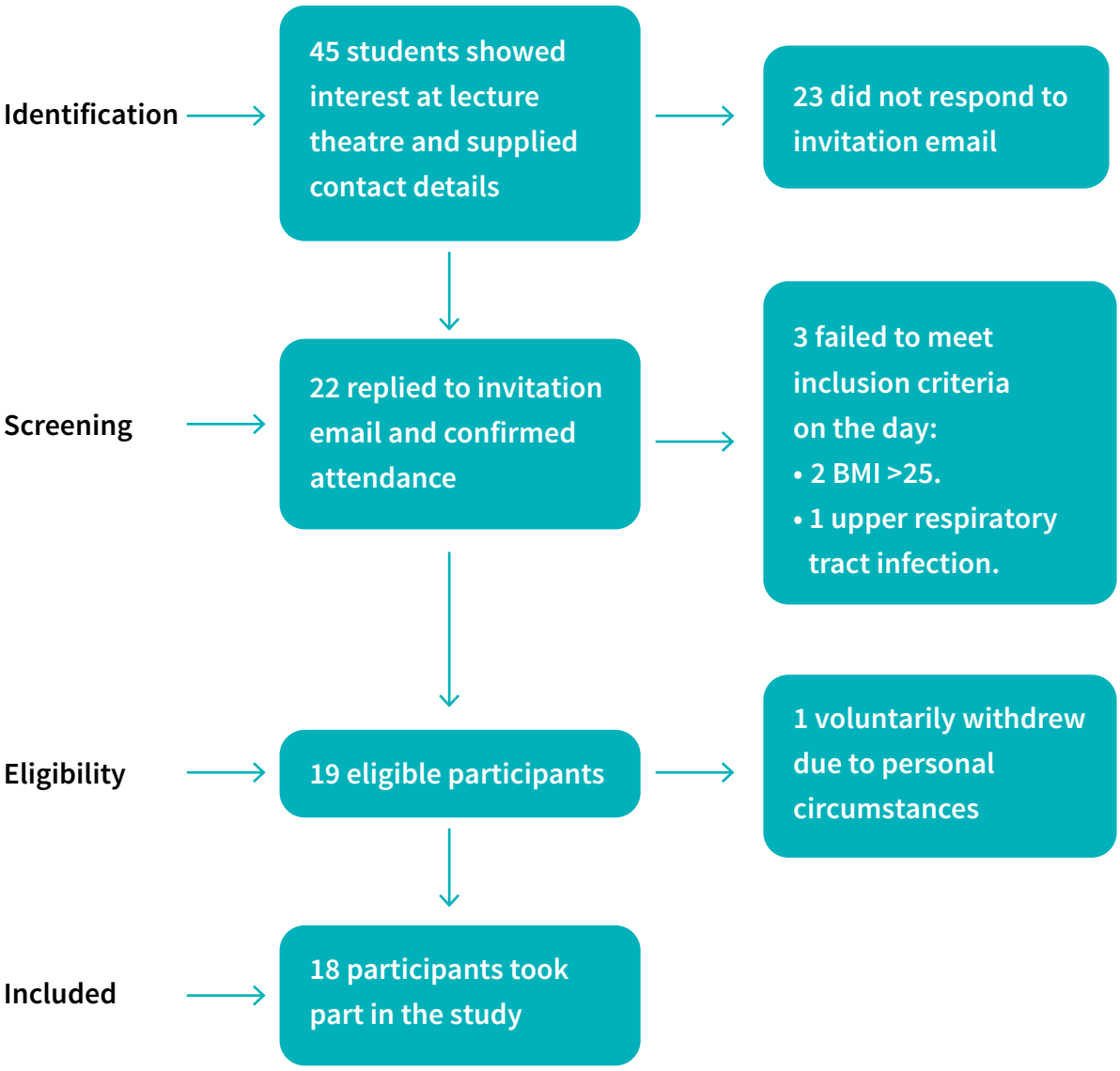

Figure 2: Flow chart for participant selection.

Table 1: Mean, standard deviation (SD) and range of demographic data.

	Mean	SD	Range	(Max)	(Min)
Age (years)	23.72	4.41	15	34	19
Height (cm)	167.83	10.09	35	188	153
Weight (kg)	64	8.63	32	80	48
BMI (kg/m^2)	22.67	1.76	5.6	24.8	19.2

Normal distribution was assessed and met parametric assumptions. A paired *t* test was therefore appropriate and showed that MIP was statistically significantly higher on the yoga mat compared to the yoga block with a mean difference of 3.61cm H_2O ($t = 2.703$, $p = 0.015$) (Table 2). In addition, all participants reported that sitting on a yoga block compared to a yoga mat was considerably more comfortable. However, this was not quantified.

Table 2: Mean, standard deviation (SD) and range of MIP values in sitting on yoga mat and sitting on yoga block.

	Mean	SD	Range	Max	Min
Sitting on standardised yoga mat (cm H_20)	104.00	27.82	94	166	72
Sitting on standardised yoga block (cm H_20)	100.39	28.58	96	157	61

Gender subsets largely also followed the same trend of mat MIP values being greater than those produced on the block however, male values generally exceeded female values. *T* tests confirmed that the order of seating positions did not affect results. This further suggests data consistency overall and within subgroups. There were no significant correlations between MIP and age, height, weight or BMI (suggesting that any differences were coincidental).

Discussion

This study showed that MIP was significantly greater when measured during sitting on a yoga mat, compared with a yoga block. Sheeran et al. (2018) reported that yoga block seating aids induced significant changes to posture and reduced overall flexion in lumbar spine and pelvic region. This encourages more upright sitting with a slight lumbar lordosis and anterior pelvic tilt, which is considered the optimal seating position for respiratory function (Castanharo et al. 2014; Sheeran et al. 2018). It is therefore surprising that MIP was universally lower on the yoga block compared to the yoga mat which encourages a posterior pelvic tilt. Additionally, a positive correlation between comfort and inspiratory muscle strength has previously been identified (Naitoh et al. 2014) which also contradicts the incidental results of this study where anecdotally, participants were more comfortable on the yoga block.

Considering the above factors, it might be expected that the block would produce higher MIP values than the mat. However, this study contradicted this expectation. There is no obvious physiological explanation for the above findings, but this difference may be explained by factors which this study had not been designed to formally address. These may include pelvic tilt, spinal angles, comfort or any other unknown influences. It is also important to consider whether the difference between positions is of any clinical importance. The small difference in MIP (only 3.61cm H_2O) makes it unlikely to have a significant clinical impact on the participant.

Maximal inspiratory pressure is one of the most commonly used measures for respiratory muscle strength and is recommended by ATS & ERS (2002) as a diagnostic tool. Yet, MIP devices are less commonly used in clinical practice and are not currently considered suitable as protocol tools in respiratory function testing (Culver et al. 2017). Although MIP is not as reliable as other, invasive, non-volitional methods, data collected in this study shows a stable variation across the range of MIP values. This suggests that the machine performed as expected and that the examiner technique was consistent thus supporting the reliability of the results.

There is a wide range of normal MIP figures amongst the general population (Pessoa et al. 2014) and no distinct pattern has been identified by previous studies. However, no minimum clinically important difference (MCID) has been reported in the literature and it is difficult to estimate whether differences are significant. This study revealed no evident correlations in relation to MIP and age, height, weight or BMI in the sample used. It could therefore be assumed that MIP is not dependant on these variables. Hence these results may be considered applicable to the young, healthy population. However, there may still be a limited applicability of these results to the unwell population such as those with respiratory, musculoskeletal or neurological disorders for which this study was not intended.

Conclusion

This study revealed that sitting on a yoga mat yielded greater MIP values (104cm H_2O) than sitting on a standard 5cm yoga block (100.39cm H_2O). Due to the statistically significant difference ($p = 0.015$) the null hypothesis was rejected. However, as the range of normal MIP values in the studied population is so great (>90cm H_2O), without a reported MCID in existing literature, it is difficult to say whether the difference of 3.61cm H_2O between both seating positions has any significance in clinical practice. Furthermore, it is currently unknown whether this information would be transferrable to those with long term respiratory conditions such as COPD where a 3.61cm H_2O difference would represent a greater proportional change compared to those with healthy respiratory systems and higher MIP values.

The strengths of the study include having a single data collector to avoid inter-rater differences. However, the small size of the study and convenience sampling method of young and healthy participants is not representative of the general population.

Further research incorporating measurements of spinal angles, pelvic tilt and perceived comfort might contribute to a fuller understanding of these results. As the clinical applicability of this study is unknown, it would also be particularly helpful to repeat this study in people with COPD.

Key points

- Sitting position influences inspiratory muscle performance and therefore should be considered during yoga practice.

- In healthy individuals, sitting on a yoga mat produced higher results compared to sitting on a yoga block, despite being no apparent physiological explanation.
- The applicability of MIP measurements to the general population may be hindered by the apparent lack of recognised MCID values.

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A service evaluation on the use of digital chest drains following thoracic surgery on postoperative mobilisation and time on physiotherapy caseload

Chloe Tait[1], Leanne McCarthy[1], Simon Hayward[1]

Abstract

Introduction

Chest drains are required following thoracic surgery but their presence can cause people pain, limit postoperative mobility and increase hospital length of stay (LOS). The use of portable digital chest drains can promote early postoperative mobilisation, reduce drain duration and hospital LOS. In our hospital, digital chest drains were introduced in February 2017 for use with patients following thoracic surgery performed by one thoracic surgeon. Other surgeons continued to use under water seal (UWS) drains.

Aims

To explore whether the use of digital chest drains allowed earlier postoperative mobilisation, compared with UWS drains. To explore whether the use of digital chest drains reduced time on physiotherapy caseload, chest drain duration and hospital LOS.

Method

A retrospective service evaluation was conducted in a UK teaching hospital. Data were collected for a six month period for all patients following thoracic surgery referred to physiotherapy. Data were analysed using descriptive statistics and statistical tests.

Results

Median day first mobilised postoperatively was statistically significantly shorter for the digital drain group (day 1) compared to the UWS drain group (day 3) (observed median difference 1, 95% CI 1 to 2 $p = 0.0001$).

Authors

[1]Physiotherapy Department, Blackpool Teaching Hospitals NHS Foundation Trust, Blackpool, UK.

Keywords

Digital chest drains, physiotherapy, thoracic surgery.

Correspondence author

Chloe Tait. Email: chloe.tait1@nhs.net. Telephone: 01253 953812.

Time on physiotherapy caseload was statistically significantly shorter for the digital drain group (4 days) compared to the UWS drain group (5 days) (Observed median difference 1, 95% CI 1 to 2 $p = 0.02$). There was no statistically significant difference in median chest drain duration between the digital drain group (2 days) and the UWS group (3 days) (observed median difference 1, 95% CI 0 to 0 $p = 0.91$). Median hospital LOS was shorter for the digital drain group (5 days) compared to the UWS group (6 days) however this difference did not reach statistical significance (observed median difference 1, 95% CI 0 to 1 $p = 0.06$).

Conclusion

The use of digital chest drains with inbuilt suction enabled individuals to mobilise on the first day following thoracic surgery, thereby facilitating earlier liberation from the bed space and reducing the potential for known effects of immobilisation. The use of digital chest drains also facilitated earlier discharge from physiotherapy. In this service evaluation there was no significant difference in chest drain duration or hospital LOS between individuals with digital drains and those with UWS drains.

Introduction

Patients require chest drains following thoracic surgery to remove air and fluid that collects in the chest (Lijkendijk et al. 2015; Shoji et al. 2016). Chest drains limit the patient's ability to move away from their bed space, cause patient's pain, reduce their independence and pose a potential infection risk (Bertholet et al. 2011). Chest drains are traditionally non-digital and require attachment to wall suction. This causes subjective measurement of air and fluid drainage (Lijkendijk et al. 2015) and often delays postoperative mobilisation (Rathinam et al. 2011; Lijkendijk et al. 2015), lengthening drain duration and hospital length of stay (LOS) (Agostini et al. 2014; Lijkendijk et al. 2015). The use of digital drains allows more accurate measurement of air leak/fluid drainage allowing drains to be removed when they meet protocol or when no air leak was reported shortening drain duration (George & Papagiannopoulos 2015; Lijkendijk et al. 2015; NICE 2018). Portable digital drains also enable patients to mobilise earlier postoperatively as they do not need to wait to be detached from wall suction (Rathinam et al. 2011; Lijkendijk et al. 2015; NICE 2018). This facilitates earlier re-expansion of the operated lung reducing the risk of postoperative

pulmonary complications (PPCs) and aiding earlier drain removal (NICE 2018). Early chest drain removal helps reduce patients' pain levels and reduces infection risk (Bertholet et al. 2011). It also allows patients earlier liberation from the bed space and encourages early patient independence (Bertholet et al. 2011; Agostini et al. 2014; Lijkendijk et al. 2015; Yeung 2016; NICE 2018). Better lung expansion, reduced risk of PPCs and early postoperative mobilisation can reduce time spend on the physiotherapy caseload. Earlier discharge from physiotherapy can also encourage earlier independence. Early chest drain removal, postoperative mobilisation, discharge from physiotherapy and patient independence can all contribute to a reduction in hospital LOS (Bertholet et al. 2011; Agostini et al. 2014; Lijkendijk et al. 2015; NICE 2018). Whether the use of digital chest drains reduces the time taken to mobilise postoperatively, and the time spent on physiotherapy caseload following thoracic surgery, has not been explored or measured within existing research.

The primary aims were to explore whether the use of digital drains allowed earlier postoperative mobilisation and reduced time on physiotherapy caseload compared to under water seal (UWS) drains. Secondary aims were to explore whether the use of digital drains reduced chest drain duration and hospital LOS compared to UWS drains and reduced hospital LOS.

Method

A service evaluation was conducted exploring retrospective data collected from the 1st February 2017 to 31st July 2017. This service evaluation was registered with, and approved by, the Blackpool Teaching Hospitals NHS Foundation Trust's Research and Development team. Ethical approval was not required in-line with the trust policy on undertaking service evaluations.

The use of digital drains commenced in February 2017 at the Lancashire Cardiac Centre on the cardiac intensive care unit and the cardiothoracic surgical wards. Prior to February 2017 only UWS drains were used following thoracic surgery. From February 2017 all patients undergoing thoracic surgery performed by one of the thoracic surgeons had a digital drain and patients undergoing thoracic surgery performed by the other surgeons continued with UWS drains. The protocol for UWS drains removal was:

- Lobectomy/pneumonectomy: drain to be removed following at least 48 hours with no air leak for 24 hours.
- Wedge resection: removal after 24 hours if there is no air leak for 12 hours.
- Bullectomy/Pleurodesis: removal after 72 hours if no air leak for 24 hours.
- Biopsy: removal day 1 if no air leak for 12 hours.
- For all other surgeries drains were removed following surgeon approval.

The protocol for digital drain removal was less than 30ml air leak within 12 hours with no pneumothorax/air airspace and no surgical emphysema on chest radiograph (CXR) and less than 200mls of fluid drainage within 12 hours. Drain removal was subject to surgeon approval.

All patients who received inpatient physiotherapy following thoracic surgery with a chest drain in situ postoperatively on cardiac intensive care or one of the cardiothoracic wards at the Lancashire cardiac centre were included in this service evaluation. Patients were identified from the electronic patient referral system and physiotherapy patient contact sheets.

The following data were retrieved:

- Date of surgery.
- Gender of patient.
- Age of patient.
- Type of surgical incision and surgical procedure.
- Type of chest drain.
- Day first mobilised postoperatively.
- Time spent on physiotherapy caseload (measured in days from day 1 postoperatively until day discharged from physiotherapy).
- Chest drain duration (number of days chest drain(s) remained in situ postoperatively measured from day 1 postoperatively until day chest drain removed.
- Hospital LOS (measured in days from day 1 postoperatively until day discharged from hospital).

Date of surgery, gender and age of the patient, type of surgical incision and surgical procedure, type of chest drain, day first mobilised and time spent on physiotherapy caseload were collected from physiotherapy patient contact sheets and the hospital electronic patient database. Date of chest drain removal was collected from the patient's routine post-drain removal CXRs. Hospital discharge date was obtained from the hospital's electronic patient database. The time spent on physiotherapists' caseload was defined as the number of days patients received treatment from the cardiothoracic physiotherapy team from the day first assessed by the physiotherapist postoperatively (usually day 1 postoperatively) until the day the patient was discharged from physiotherapy.

Data were analysed using descriptive statistics and statistical tests. Data were plotted using histograms to check the normality of the data. Median values were used for all outcomes due to their skewed distribution. Upper and lower quartiles were used to explore the spread of the data. The non-parametric Mann Whitney U Test was used to test for statistically significant differences between data from the digital drain group and the UWS drain group.

Results

Over the six-month period, from 1st February 2017 to 31st July 2017, 195 patients received in-patient physiotherapy following thoracic surgery. Two patients died and were excluded due to incomplete data. A third patient was excluded as they did not have a chest drain inserted. Of the remaining 192 patients, 110 had a digital drain and 82 had an UWS drain(s) postoperatively. Table 1 shows the characteristics of patients in the two different drain

groups. Both groups were comparable in ratio of male to female patients and the mean age of both groups of patients was the same.

Table 1: The characteristics of patients in the digital chest drain group and the UWS chest drain group.

Characteristics	Digital chest drain group (*n* = 110)	UWS chest drain group (*n* = 82)
Gender (male/female)	63/47	54/28
Mean age in years (standard deviation)	65 (14.14)	65 (13.73)
Surgical incision (thoracotomy/VATS)	17/94	14/70

N = number, UWS = underwater seal, VATS = video-assisted thoracoscopic surgery.

Table 2: Thoracic surgical procedures patients in the digital chest drain group and the UWS chest drain group underwent.

Type of thoracic surgery	Number of patients in digital chest drain group	Number of patients in UWS chest drain
Lobectomy	53	22
Wedge resection	23	16
Talc pleurodesis and bullectomy	5	4
Pleural biopsy	5	5
Decortication	5	3
Talc pleurodesis	3	6
Bullectomy	3	4
Thoracotomy only	2	1
Talc pleurodesis and biopsy	2	1
Removal of pleural cyst and mediastinal mass	2	3
Rib fixation	1	0
Evacuation of hamothorax	1	2
Debulking of upper lobe tumour	1	2
Bullectomy and pleurectomy	1	0
Bullectomy and pleural abrasion	1	2
Pneumonectomy	0	4
VATS only	0	2
Drainage of pleural and pericardial effusion	0	3
Pleurectomy	0	1

UWS = under water seal, VATS = video-assisted thoracoscopic surgery.

Table 2 shows the types of thoracic surgery that patients underwent in the two different drain groups. Lobectomy and wedge resection were the most common surgical procedures that patients underwent in both groups.

Table 3 shows the clinical outcomes for the digital drain group and UWS drain group.

Table 3: Clinical outcomes for the digital chest drain group and UWS chest drain group.

Clinical outcomes	Digital chest drain	Non-digital chest drain	Median Difference (95% CI)	*p* value
Day first mobilised postoperatively median (LQ – UQ)	1 (1–2)	3 (2–4)	1 (CI: 1 to 2)	0.0001
Time on physiotherapy caseload (days) (LQ – UQ)	4 (3–7)	5 (4–8)	1(CI: 1 to 2)	0.02
Chest drain duration (days) median (LQ – UQ)	2 (1–4)	3 (1–4)	0 (CI: 0 to 0)	0.91
Hospital LOS (days) median (LQ – UQ)	5 (4–7)	6 (4–8)	1 (CI: 0 to 1)	0.06

LQ = lower quartile, UQ = upper quartile, UWS = under water seal, CI = confidence interval.

The median day that patients first mobilised postoperatively was statistically significantly shorter for the digital drain group compared to the UWS drain group (observed median difference 2 days, 95% CI 1 to 2 $p = 0.0001$).

Time on physiotherapy caseload was statistically significantly shorter for the digital drain group compared to the UWS drain group (observed difference 1 day, 95% CI 1 to 2, $p = 0.02$). There was no statistically significant difference in chest drain duration between the digital group and the UWS group (observed median difference 1 day, 95% CI 0 to 0 $p = 0.91$). Median hospital LOS was shorter for the digital drain group than the UWS drain group however this difference did not reach statistical significance (observed median difference 1 day, 95% CI 0 to 1 $p = 0.06$).

Discussion and conclusion

In this service evaluation patients receiving a digital chest drain were mobilised significantly sooner than those with a non-digital UWS drain. The use of portable digital drains with inbuilt suction allows patients to mobilise with drains in and on suction. In contrast, patients with UWS drains need to wait until suction is no longer required, or for suction to be removed prior to mobilisation (Rathinam et al. 2011; Lijkendijk et al. 2015; NICE 2018). Benefits of early postoperative mobilisation for patients following thoracic surgery include reduced risk of deep vein thrombus and pulmonary embolism, reduced risk of PPCs, earlier

liberation from the bed space (allowing mobilisation to the bathroom and away from the ward) and earlier independence with mobility (Yeung 2016).

Time on physiotherapy caseload was also significantly shorter for patients within the digital drain group. This could be attributed to patients mobilising earlier postoperatively with digital drains enabling them to achieve their mobility goals earlier and allowing patients to be discharged from physiotherapy even with drains in-situ. Time on physiotherapy caseload following the use of digital drains after thoracic surgery has not been previously explored. Benefits of reduced time on physiotherapy caseload for patients include earlier patient independence. By reducing the length of time patients spend on the physiotherapy caseload post-thoracic surgery provides the physiotherapy service with the opportunity to allocate more staff and resources to patients who require more intensive physiotherapy interventions, which may have a secondary benefit in facilitating a reduction in hospital LOS for these patients.

Chest drain duration was shorter for the digital drain group than the UWS drain group following thoracic surgery, however this difference did not reach statistical significance. There was also no statistically significant difference reported in median hospital LOS between groups. It was anticipated that the use of digital drains would shorten drain duration by allowing more accurate measurement of air leak/drainage than UWS drains leading to digital drains being more likely to be removed once drains met protocol and no air leak was reported (George & Papagiannopoulos 2015; Lijkendijk et al. 2015; NICE 2018). As this service evaluation took place during the first six months following the implementation of digital drains, it is possible that staff were initially cautious regarding digital drain removal, lacking the confidence and experience regarding the use of the drains. Previous studies have also all reported no significant difference in drain duration or hospital LOS between digital drains and UWS drains (Bertolaccini et al. 2011; Gilbert et al. 2015, Lijkendijk et al. 2015; De Waele et al. 2017). In contrast others have reported significantly shorter drain duration and in hospital LOS with digital drains compared to UWS drains (Cerfolio & Bryant 2008; Brunelli et al. 2010; Filosso et al. 2010; Mier et al. 2010; Pompili et al. 2014; Shoji et al. 2016; Wang et al. 2019).

The introduction of digital chest drains has changed practice enabling the physiotherapy team to mobilise patients further one day after thoracic surgery and allowing patients to mobilise away from the bed space. Traditionally individuals following thoracic surgery would have UWS drain(s) in situ and would be limited to bedside mobility, for example marching on the spot one day after thoracic surgery with physiotherapy staff, often not mobilising away from the bed space until three days or later after thoracic surgery.

There were several strengths to this service evaluation. Firstly the influence of drain type on physiotherapy practice has not previously been extensively explored. It is an important area given that chest drains can limit physiotherapists' ability to mobilise patients away from the bed space. Since both types of drains were used over the same time period, it can

be assumed that all other medical and surgical care remained similar. This adds weight to the suggestion that it is drain type that influences time to first mobilisation and time on physiotherapy caseload, rather than other unknown factors.

A few limitations can be noted. One of these is that digital drains were newly introduced and staff may not yet have been confident in their usage. Moreover only patients who received in-patient physiotherapy were included in this service evaluation therefore not all data for patients with a digital drain following thoracic surgery were captured. Also the retrospective collection of data from the physiotherapy ward sheets potentially affects the accuracy of the data collected as this relies on staff accurately completing data. The majority of operations in the digital drain group were performed by the lead thoracic surgeon whilst all operations in the UWS group were performed by other thoracic surgeons. Differences in surgeon drain removal preferences between the groups could have influenced differences in outcomes.

Future studies could obtain feedback from patients on the type of drain they had and their levels of satisfaction. It may also be advantageous to explore whether there are any factors/reasons that prevent patients with digital chest drains mobilising one day postoperatively to identify further ways of encouraging earlier postoperative mobilisation. The use of digital chest drains with inbuilt suction has enabled individuals to mobilise earlier following thoracic surgery facilitating earlier liberation from the bed space. The use of digital chest drains has also facilitated earlier discharge from physiotherapy. In this service evaluation there was no significant difference in chest drain duration or hospital LOS between those with a digital chest drains and those with a UWS drain.

Key points

- The use of digital drains allowed significantly earlier postoperative mobilisation facilitating earlier liberation away from the bed space.
- The use of digital chest drains enabled significantly earlier discharge from physiotherapy caseload.
- The use of digital chest drains did not significantly reduce chest drain duration or hospital LOS.

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How culture may influence adherence to ventilatory support systems. A case report of a Sikh with amyotrophic lateral sclerosis

Euan Ratcliffe[1], Robyn Stiger[2]

Abstract

Previous literature has developed an evidence base for the use of ventilatory support systems for promoting quality of life, managing respiratory complications and reducing risk of mortality for patients with amyotrophic lateral sclerosis. The adherence literature in this population has predominantly focused on barriers and facilitators to ventilatory support systems, but not the potential influence of culture. This case report explores how Sikh culture may influence and impact upon adherence to ventilatory support systems for patients with amyotrophic lateral sclerosis. It concludes that the patient's Sikh and the clinician's western culture may have influenced adherence and that culturally congruent information may help bridge the gap between the two.

Authors

[1]Band 5 Physiotherapist, Maidstone General Hospital, Maidstone and Tunbridge Wells NHS Trust, Hermitage Lane, Maidstone, ME16 9QQ, UK.

[1]Senior Lecturer, Oxford Brookes University, Department of Sport and Health Sciences, Faculty of Health and Life Sciences, UK.

Keywords

Culture, amyotrophic lateral sclerosis, adherence, decision making.

Correspondence author

Euan Ratcliffe. Email: euan.ratcliffe2@nhs.net. Telephone: 01622 729000 (extension 27293).

Introduction

Amyotrophic lateral sclerosis (ALS) are degenerative neuromuscular diseases characterised by progressive neurodegeneration and death of upper and or lower motor neurons (Kiernan et al. 2011). It clinically presents as global progressive muscle atrophy and weakness, bulbar dysfunction, early presence of respiratory failure and premature death (Kiernan et al. 2011). There is currently no cure, so disease management focuses on symptoms and enhancing Quality of Life (QoL) (NICE 2016). Mortality in this population is commonly due to respiratory weakness and subsequent respiratory failure with or without pneumonia (Zarei et al. 2015).

Patients with ALS spend the majority of their time at home due to the high level of disability seen in this population (Kim et al. 2018). In this environment domiciliary ventilatory support systems, such as non-invasive ventilation (NIV) and mechanical insufflation and exsufflation, are used to reduce the effects of hypopnea and facilitate sputum clearance (Sancho et al. 2004; Kiernan et al. 2011). A study (n = 41) has shown NIV to benefit QoL (p = <0.0001) and survival (p = 0.0059) for patients with ALS and good bulbar function (Bourke et al. 2006).

Patients with predicted premature death are managed by palliative care teams. In this population, management of the patient centres on building a 'good death' by considering how best to manage the dying process and death. Three themes were highlighted within a study group including patient control, autonomy, and independence (Debate of the Age Health & Care Study Group 1999). Patient-centred shared decision making promotes these themes and facilitates informed decisions by bringing together clinician expertise with the patient's preferences, circumstances, goals, values and beliefs (NHS England 2020). Despite research on how to best facilitate decision making and overcome the barriers to ventilatory support systems (Bélanger et al. 2011) there is still a disparity between patients' choices and clinicians' perception of evidence, knowledge and experience (Hogden et al. 2012). This may be because patients with ALS adopt a 'wait and see' coping strategy (Hogden et al. 2015), perceiving non-adherence as maintaining control, autonomy and independence. Additionally, patient preferences have been difficult to identify and explain (Bélanger et al. 2011), potentially due to the underrepresentation of the potential influence of culture in the literature. Most recently Murphy et al. (2000) explored the influence of culture on decision making and behaviours in 46 patients with ALS and concluded that spirituality had an effect on attitudes towards the dying process and adherence to invasive procedures. The aim of this article is to further explore how Sikh culture may influence adherence.

The Case presentation

A female aged 45 was admitted to hospital with shortness of breath and was later diagnosed with community acquired pneumonia (CAP). Two years prior to this admission she was diagnosed with ALS; she had no known other comorbidities. She was prescribed

domiciliary ventilatory support systems at diagnosis of ALS for nocturnal use and to facilitate sputum clearance. The patient had recurrent admissions to hospital with CAP and was treated both on general medical and respiratory wards using ventilatory support systems. During this time the patient was observed adhering to ventilatory support systems as prescribed, however, collateral history from her family described poor adherence to domiciliary ventilatory support systems. This was noted by the team, who used shared decision making to explore alternative treatment options and common barriers such as ventilator pressures, dry mouth, discomfort and understanding of application. No common barriers were identified and despite issues with adherence the patient chose to continue with domiciliary ventilatory support systems. Figure 1 outlines an overview of her presenting disability and functioning using the International Classification of Functioning, Disability and Health (WHO 2002).

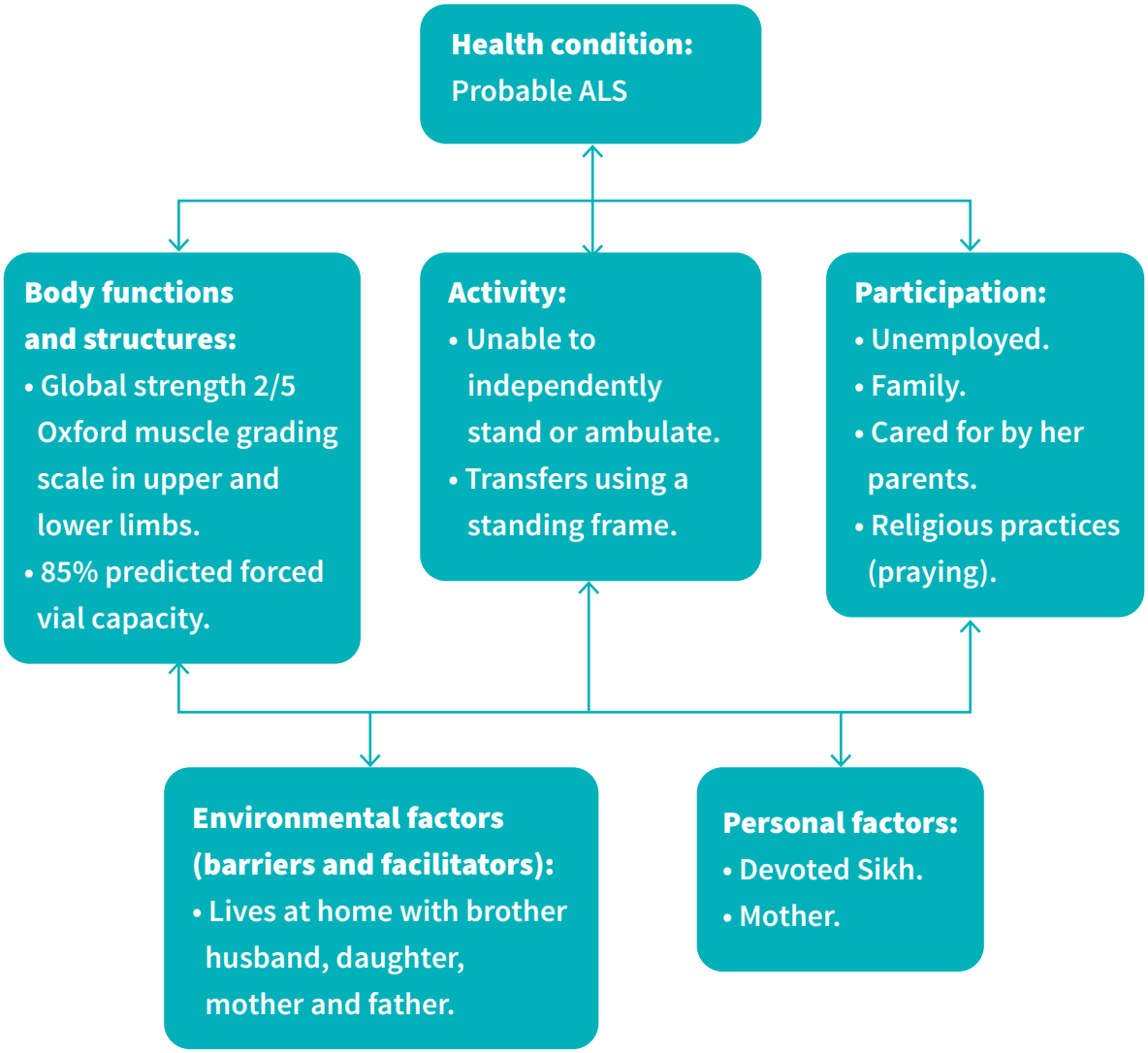

Figure 1: Patient information presented using the International Classification of Functioning, Disability and Health (WHO 2002) framework.

Discussion

The patients' culture

Palliative care is focused around promoting QoL (Stewart et al. 1999) and one's self-identity plays a role in patients' perception of QoL. Self-identity can be defined as the perception or recognition of one's characteristics as a particular individual, in relation to a social context (James 2015). Prior to diagnosis and progression of disability, she perceived herself as a devoted Sikh through believing and behaving in line with the teachings of Sikhism. As disability progressed, she could no longer participate in these self-defining activities, prayer rituals, and explained that she had lost this sense of self. In terms of NIV, patients describe a fear, or belief, of becoming dependent on NIV as a means for survival (Ando et al. 2015). This challenges Sikh's beliefs that death and illness should be that of God's will and not external influence (Singh 2009). The belief of dependency could have further challenged the teachings of Sikhism and thus her self-identity, potentially contributing to her poor adherence. The clinicians involved in her care may have been unaware of how these cultural beliefs may have influenced adherence.

The clinicians' culture

Patients diagnosed with ALS receive news of a 3.9 years mean life expectancy (Kim et al. 2018), which could be perceived as bad news. Bad news being any information which adversely or seriously affects an individual's view of one's future (Buckman 1992). Sikhs generally accept illness and death are that of God's will (Singh 2009; FHDS 2013) which differs from western culture whereby there is a belief that medical intervention prevails over death (Young et al. 1996). This may mean that Sikhs are not inclined to fight illness as western clinicians may expect. This difference between a patients and clinician's worldview may have led to the clinicians being unable to understand the reasons for poor adherence as the patient's actions potentially did not coincide with a westerner's world view. This may have led to ineffective communication and delivery of pertinent information that the patient desired.

Culture and decision making

Previous literature has defined the decision-making process in ALS as a framework through which patients and clinicians interact with consciously (Hogden et al. 2015). Despite this the patient continued to have poor adherence. Traindis (2007 as cited in Alden et al. 2014) highlighted culturally congruent situations tend to feel right and make sense to an individual, while those that are culturally incompatible may feel wrong and uncomfortable. This 'feeling' towards using the ventilatory support systems could explain reasons behind poor adherence that the patient was unaware of herself and thus unable to discuss with the team, as earlier highlighted. Even if the patient was to recognise the potential deeper cultural influence, it may be unwise to explore or challenge her worldview with styles like motivational interviewing or shared decision making as they are what define her as an individual, and to do so may feel like a personal attack. And so, professionals should be

understanding and sensitive to other cultural worldviews whilst remaining vigilant to factual incorrectness.

Bridging the gap

If a patient's culture does influence decision making, be it conscious or unconscious, there is no guidance on how clinicians bridge the gap between their worldview and the people for which they provide care. Psychological theories have developed decision aids that focus on targeting and tailoring decisions based on the individual's culture (Miscel 2004; Higgins 2006; Kitayama et al. 2009; Oyeserman et al. 2009). These predict that when information is culturally congruent with the individual it could result in deeper thinking and thus improve important decision outcomes. These include knowledge gained, improved accuracy regarding possible benefits and harms, choices that are more consistent with informed values, and increased participation in decision making (Stacey at al. 2017). Although the majority of the research to date pertains to Hispanic American and African American populations, Alden et al. (2014) developed a framework which may be a starting point for other populations. This is not within the scope of this article, however, may be relevant for future research.

Conclusion

Although guidelines advocate for patient-centred care there is little high-quality research pertaining Sikh culture's influence to adherence; therefore, the robustness of the discussion, conclusion and key points are limited. However, this study outlines the potential influence of the patient's and clinician's culture when dialoguing to promote adherence to ventilatory support systems in order to build a 'good death'. Ultimately the clinician's role is to inform patients with information about ventilatory support systems in a way that can be understood and is meaningful to that individual so they can make informed decisions, culturally congruent messages may bridge the gap.

Key points

- A difference between the clinician's culture and the patient's culture may lead to poor understanding of adherence and thus ineffective communication of pertinent information.
- Sikh culture may influence decision-making subconsciously, for a clinician to attempt to challenge this rooted cultural worldview for adherence to interventions may be unwise.
- The use of targeted and tailored decision aids may have the potential to bridge the gap for culturally diverse populations more effectively than current decision-making frameworks.

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The use of high-flow oxygen therapy delivered via Airvo™ in the acute setting over a six-month period: A clinical perspective

Elaine Weatherston[1]

Abstract

Since 2010 the benefits of high-flow oxygen therapy (HFOT) have been realised both in the acute clinical setting and for chronic long-term conditions. Independent control of flow, inspired oxygen and humidification, and reports of good patient tolerance, makes it a favourable treatment option.

A service review looking at the use of HFOT delivered via Airvo™ (Fisher and Paykel) was completed over a six-month period in the acute clinical environment in a small tertiary hospital in New Zealand. It was used on the critical care unit, but its use focused primarily at ward level to determine which patients could benefit from it and to indicate where it could be safely delivered. Data was collected on patient diagnosis, clinical indications, respiratory rate, oxygen percentage and mode of delivery prior to using high-flow, initial HFOT settings and highest settings throughout treatment, number of HFOT treatment days and clinical outcome.

In this report, clinical observations showed that for those patients who have secretion retention, atelectasis, increased work of breathing, and increasing oxygen requirements, HFOT is an appropriate treatment option especially in those patients who are not reliant on high levels of positive end expiratory pressure (PEEP). It also demonstrated that HFOT via Airvo™ can be safely implemented in ward settings for a variety of clinical conditions.

Authors

[1]Senior Cardio-respiratory Physiotherapist, Acute In-patient team, Dunedin Hospital, Southern DHB, New Zealand.

Keywords

High flow, oxygenation, humidification, positive end expiratory pressure (PEEP).

Correspondence author

Elaine Weatherston.
Email: eweatherston@yahoo.co.uk.

Recommendations for future work includes the collection of qualitative data on patient comfort and compliance with HFOT in addition to information on clinician confidence in setting up and weaning patients from the device.

Introduction

Oxygen delivery via nasal cannula was first implemented in the early 1940s in order to direct flow into the nose. The advantages of this were soon recognised, enabling the patient to eat, drink and speak, as well as limiting the feelings of claustrophobia often felt with a tight-fitting face mask. However, limitations were also recognised in terms of nasal discomfort, dryness and the provision of only lower levels of inspired oxygen to the patient's minute ventilation (Ward 2016).

It is widely accepted that caution should be exercised when using nasal cannula with oxygen flow rates over 5–6ℓ/minute due to the risk of mucosal dryness and damage. Additionally, in current clinical practice when using nasal cannula with low flow rates, this is not used in conjunction with humidification (Nishimura 2015).

In adults, HFOT was initially recognised using flows of up to 40ℓ/minute, showing that a higher fraction of inspired oxygen (FiO_2) could be achieved with higher flows compared to the same flows with other interfaces due to the nasopharynx and oropharynx acting as internal anatomic reservoirs that increase the volume of inhaled oxygen as well as a wash out of dead space in the nasal passage. With higher flow rates there appears to be even greater washout of anatomical dead space (Ward 2016).

Over ten years ago HFOT devices were introduced with heated humidification systems allowing higher flow rates and oxygen concentrations, whilst minimising the effects of mucosal dryness and damage, enhancing patient comfort and tolerance (Ward 2016).

Landmark studies also report the ability for higher flows to generate distending pressures similar to those achieved with continuous positive airway pressure (CPAP) (Groves 2007; Park et al. 2009). In clinical practice CPAP has the effect of 'splinting open' alveoli, improving ventilation/perfusion matching and subsequent oxygenation whilst also decreasing work of breathing and can stabilise the chest wall in the presence of chest wall trauma. However, traditional CPAP is administered using either a tight-fitting face, nasal mask or the CPAP hood, and positive end expiratory pressure (PEEP) is achieved by placing a PEEP valve within the circuit. These interfaces can be uncomfortable for the patient and can impact on patient tolerance of the device and subsequent compliance. Care is needed to maintain skin integrity, particularly at the bridge of the nose, and often the patient can only tolerate wearing the mask for short periods of time, decreasing its overall benefit.

HFOT devices may generate clinically significant positive pressure depending on flow rate. Both Groves (2007) and Park et al. (2009, 2011a) found a positive correlation between high-flow rates and generation of PEEP. Groves (2007) report a significant positive end expiratory pressure of 3.2–5.2cm H_2O with flows of 40ℓ/minute. This is also strongly influenced by whether the patient's mouth is open or closed. Park et al. (2009b) found that with flows of 35ℓ/minute, a PEEP of 2.7cm H_2O could be generated. It is accepted that an increased flow rate subsequently increases generated PEEP, with PEEP being further increased during HFOT when the patient's mouth is closed. A possible explanation of this could be due to the higher resistance to expiration as the air is forced out through the nose. However, anecdotal evidence from clinical practice indicates that most patients find it difficult to nose breathe in times of respiratory distress, therefore the benefits of PEEP are reduced or negated.

Patient selection is varied ranging from application post-extubation, to supporting those patients with postoperative pulmonary complications (PPC) and for acute respiratory failure, to more long-term conditions such as exacerbations of chronic obstructive pulmonary disease and idiopathic pulmonary fibrosis (Braunlich et al. 2012; Maggiore et al. 2014). It also has demonstratable benefit with those patients that are not appropriate for invasive mechanical ventilation, including those in respiratory distress receiving active treatment and also in palliation (Peters et al. 2012).

Prior to commencing this work, in the author's place of work, only three Airvo™ HFOT devices were in current use, one being in paediatrics. Within the department CPAP was the overriding modality of choice. Patients that required higher levels of oxygen were also managed with cold water humidification systems, the evidence for these being negligible (Ward 2016). In recognition of the growing body of literature to support the use of HFOT in a range of clinical areas, and as part of a service improvement initiative, the use of HFOT in the acute setting in a small tertiary hospital in New Zealand was implemented.

The intended aim was to have the option to use HFOT in patients who developed pulmonary complications such as atelectasis, retained secretions and subsequent increase in work of breathing and to report on the observed clinical outcomes in using it with particular emphasis on the clinical indications, patient suitability, machine settings and clinical outcomes. These findings could then inform the delivery of care for subsequent patients within the author's place of work.

Method

Over a six-month period from October 2015 to April 2016, where clinical reasoning indicated HFOT was appropriate it was delivered using the Airvo™ 2 device manufactured by Fisher and Paykell Healthcare. This was used with patients on critical care and in the ward setting and delivery interface was by either nasal cannula, face mask or tracheostomy mask. In addition to the HFOT devices already available in the department, four Airvo™ 2 HFOT machines (plus consumables) were donated to the physiotherapy department by

Fisher and Paykel Healthcare for the duration of the six months. Training was provided to physiotherapists by experienced staff working in the hospital to develop competence with clinical reasoning in use and set-up of HFOT machines.

A document on clinical application was made available for reference on the hospital intranet (Appendix 1). The service initiative had a prospective design and included referrals within the six-month period who presented with:

1 Oxygen saturation <94% on 4ℓ nasal prongs and/or.
2 Had signs of pulmonary complications (atelectasis, retained secretions, infection and chest x-ray changes).

Where clinical reasoning indicated that HFOT was required, initiation of HFOT via Airvo™ took place regardless of where the patient was situated in the hospital.

When HFOT was initiated, a proforma was completed by the clinician to ascertain the date it was commenced, patient diagnosis, clinical indications, respiratory rate, oxygen percentage and mode of delivery prior to the commencement of HFOT, initial settings and highest settings throughout treatment, oxygen saturations and respiratory rate whilst on HFOT, number of days the patient received HFOT and clinical outcomes (Appendix 2). HFOT was discontinued when either target saturations were reached on Airvo™ settings of 30ℓ flow rate, FiO_2 0.3; and/or the original clinical pathology was resolved, or active treatment was ceased, and end-of-life care was established.

Verbal informed consent was obtained from each patient in order to be assessed and treated by a physiotherapist which covered all aspects of treatment including HFOT. Where this was not possible the patient was treated in their best interests.

Consultants, charge nurses and the wider multi-disciplinary team were made fully aware of the nature and purpose of the initiative. Consultant agreement for the device to be used on patients under their care was obtained on an individual basis at the time of clinical assessment. Oxygen therapy was medically prescribed and charted along with target saturations for each patient. As this was a service improvement initiative, ethical approval was not required.

The six-month pilot was supported by Fisher and Paykel, where the equipment and consumables were donated for use. There was no payment to the author or department for this work to be completed and the author had no potential competing interest to disclose.

Results

Anonymised prospective data from 74 patients was obtained in the six-month period from October 2015 to April 2016. Another 13 patients fitted the criteria but were unable to receive HFOT due to availability of machines. These patients received alternative intervention.

Results indicate that HFOT was used extensively throughout the hospital with most wards utilising the device at some point, the majority of machines used on the surgical wards including the high dependency unit. (Figure 1).

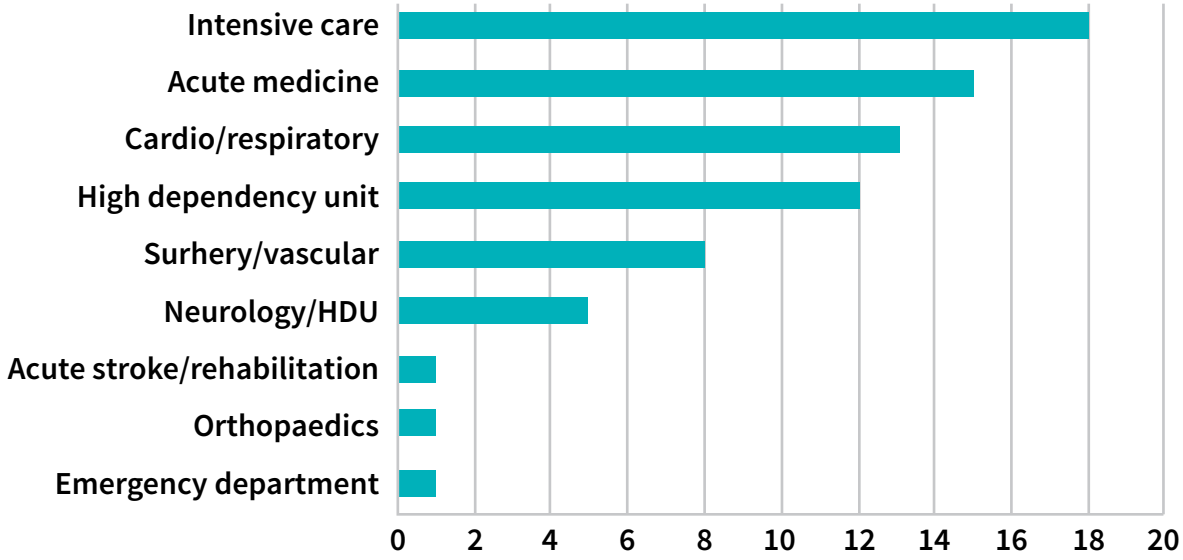

Figure 1: Frequency of clinical location of high flow oxygen therapy use.

Pneumonia was the most common diagnosis. This was recorded as either their primary diagnosis or secondary to their reason for admission (Figure 2).

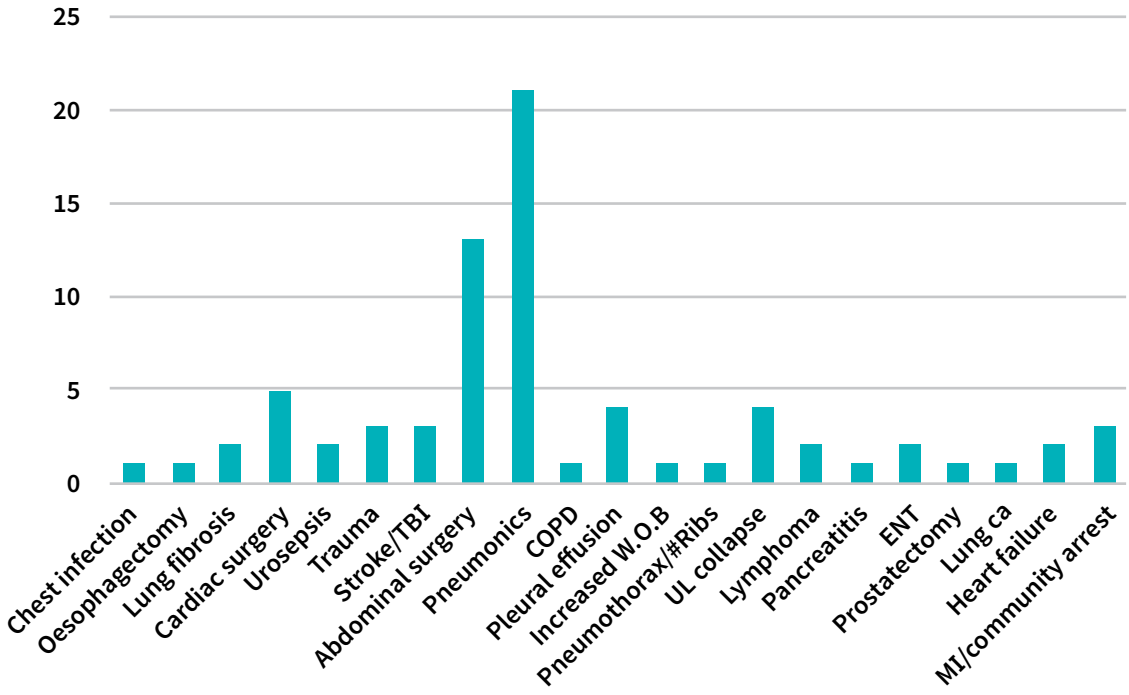

Figure 2: Diagnosis of patients placed on high flow oxygen therapy.

Clinical indicators for HFOT demonstrates that most patients were placed on the device for either consolidation, tenacious secretions, increasing oxygen requirements, increased work of breathing or a combination of the four (Figure 3).

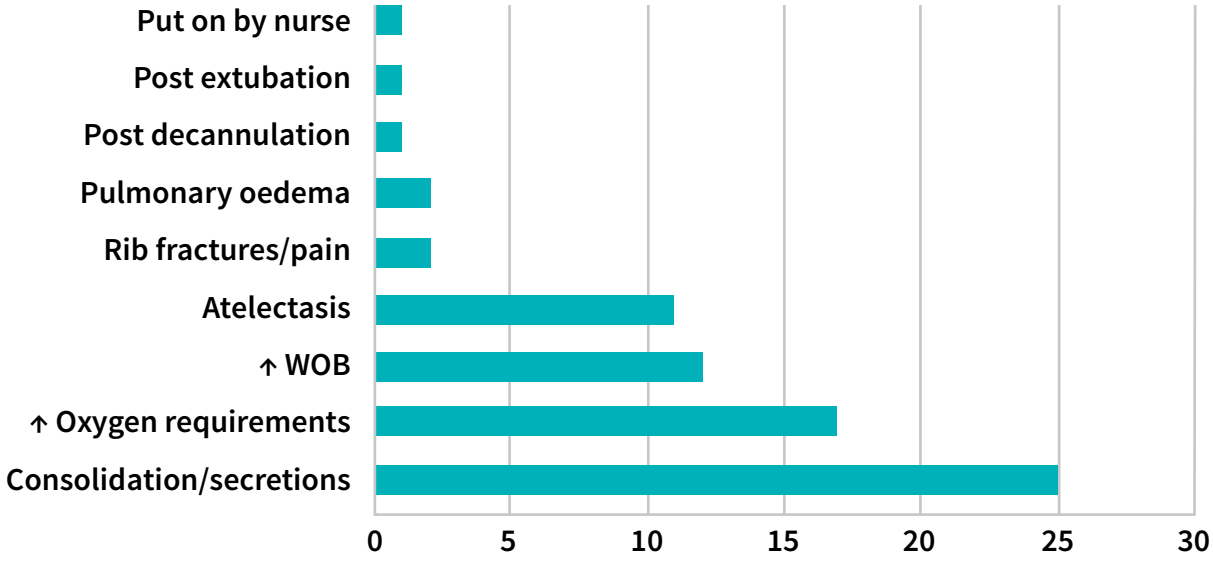

Figure 3: Frequency of clinical indications for commencing high flow oxygen therapy.

Figure 4 highlights those patients that transitioned between CPAP and HFOT. Of the patients receiving CPAP prior to Airvo™, seven were non-compliant with the tighter fitting mask and were swapped to HFOT via nasal prongs. Three patients fluctuated between CPAP and HFOT, whilst two patients were weaned from CPAP to HFOT as a treatment progression.

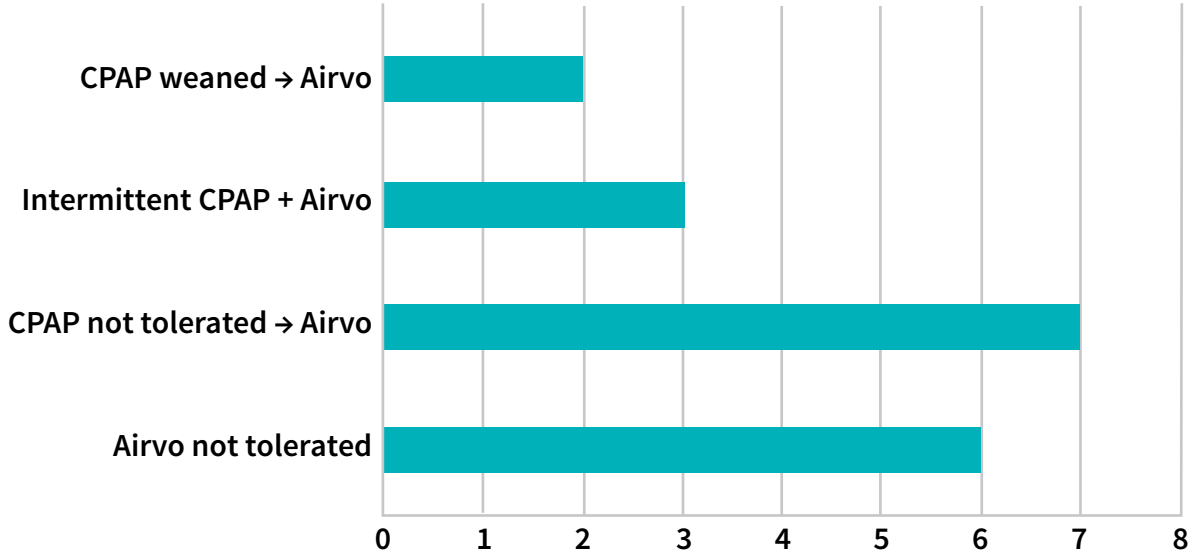

Figure 4: Frequency of patients who transitioned between CPAP and high flow oxygen therapy.

The average fraction of inspired oxygen that patients received whilst on HFOT to achieve target saturations was FiO_2 0.35. Mean starting flow rates were 41ℓ/minute. There was a mean percentage improvement in patient's saturations of 2.7% whilst receiving high flow.

Outcomes included that 75% of patients were successfully weaned from HFOT. There was 14% of patients that died either on HFOT or following escalation to CPAP or invasive ventilation (Figure 5). The patients in this group were all receiving flows of at least 45ℓ/minute,

with four patients receiving 50ℓ of flow, FiO_2 0.5 at the point of which a respiratory review by a physiotherapist was called for. Mean length of time spent on high flow was 4.37 days, however data was skewed by three patients who received it for 13, 18, and 24 days.

Clinical outcomes

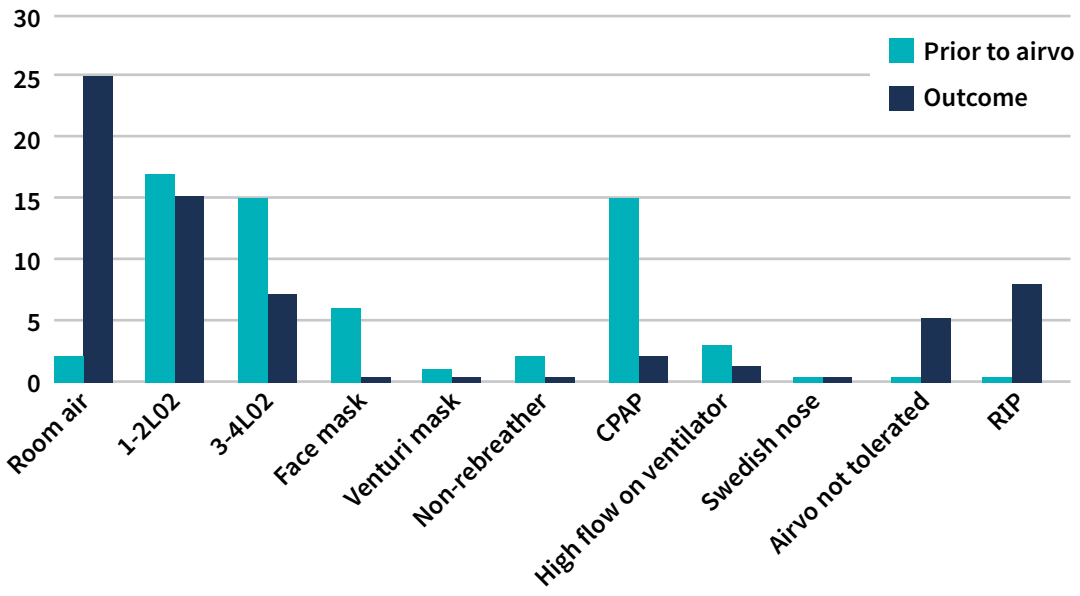

Figure 5: Frequency of level of respiratory support prior to and following high flow oxygen therapy.

Not enough data was collected to compare alterations in work of breathing or respiratory rate before and during the use of HFOT. This was due to poor completion of the proforma. It was not planned for any qualitative data to be collected on patient comfort and compliance whilst on high-flow, although six patients were unable to tolerate high-flow via Airvo™ and were taken off.

As this work was carried out from October 2015 to April 2016, in a tertiary hospital in New Zealand, this was predominantly the summer months. However, apart from the month of October there was an overall steady use of HFOT. Patient numbers dipped slightly in February but peaked again in March with a sudden decline in the last month. The reasons for this were not recorded as part of the work.

Discussion

HFOT devices can be used in a range of clinical settings including post cardiac surgery, (Corley et al. 2011), in the emergency department (Lenglet et al. 2012), immediately post extubation (Maggiore et al. 2014), in the prevention of recurrent hospital admissions in patients with chronic obstructive pulmonary disease (Rae et al. 2010), and for palliation in the community setting, to name but a few. In this service initiative, clinical practice reflected the evidence base and it showed that HFOT use was widespread through clinical locations in the hospital, with all specialties utilising the device at some point within the six-month period. On Intensive Care, only 20% of patients used the Airvo™. This could be

due to the fact that high flow can also be delivered through a ventilator. As this work only recorded information on high flow with the Airvo™ data for these patients was not available for analysis.

In the authors place of work, patients whose SpO_2 was ≤92% on 4ℓ via nasal prongs and were starting to display other signs of pulmonary complications could be initiated onto HFOT. The author is aware that in many centres in the United Kingdom, patients may be initially escalated from nasal prongs to either a venturi system or higher levels of inspired oxygen via heated humidification in order to support increasing respiratory demands. Only after this stage is it commonplace for the patient to progress to HFOT. This may be partly protocol driven but may also be due to the availability of HFOT devices.

In this initiative, patients could be established onto HFOT on any ward within the hospital providing there had been the necessary training. In many UK centres protocols dictate that HFOT only be initiated and continued on designated wards that are able to support the acutely unwell respiratory patient on this level of support such as an Intensive Care Unit, High Dependency Unit, coronary care or the emergency department. The author argues that this New Zealand centre adopted a more proactive approach by initiating patients onto HFOT much earlier in their acute illness, and on any ward.

Patients required HFOT to help with either consolidation/tenacious secretions, increased work of breathing, increasing oxygen requirements, atelectasis or a combination of the four (Figure 3). This is supported by current research advocating HFOT in acute respiratory failure and for postoperative pulmonary complications due to the ability to heat and humidify gases, the option of higher flow rates to reduce dead space, and promote slower deeper breathing, improve dyspnoea, and the effect of PEEP enabling improvements in lung volumes and subsequent oxygenation (Roca et al. 2010; Ward 2010; Corley et al. 2011). It is also of interest that patients appeared to fit into one of two categories: those initially on lower levels of inspired oxygen, for instance those on one to 4ℓ required HFOT primarily for humidification purposes, where in contrast those on higher levels of oxygen either through a face mask, venturi or non rebreathe mask required minimum flow rates of 45ℓ/minute to match their inspiratory demand in the acutely unwell stage and to improve oxygenation and ventilation/perfusion matching.

Sztrymf et al. (2011) identified significant reductions in respiratory rates and increases in partial pressure of oxygen after 15 minutes. Dyspnoea scores decreased after 30 minutes in patients with acute respiratory failure who were switched from conventional oxygen therapy to HFOT. This work also demonstrated a mean improvement in patient oxygen saturations by 2.7% whilst receiving HFOT. In the author's own clinical experience, respiratory variables in the first hour can often indicate if HFOT will be of any benefit. Unfortunately, due to poor completion of the proforma reductions in WOB and respiratory rate were not captured. This would have been valuable information to gather and the author recommends this for future studies. Patients at ward level did not have arterial lines in situ

therefore the taking of arterial blood gases was not performed frequently enough to obtain suitable comparable data on improvements in PaO_2 post application of HFOT.

In this initiative seven patients (almost half) receiving facial CPAP were non-compliant and were switched to HFOT. Three patients alternated between CPAP and high flow (Figure 4). Although no current literature could be found on why patients would prefer to alternate between CPAP and HFOT, the author suggests this was to give the patient a break from the tight-fitting mask without compromising respiratory status. Two patients were transitioned from CPAP to high flow as a 'step down' as part of the weaning process. It is surmised that these patients required much higher and more accurate levels of PEEP than could be generated with high flow in the initial stages of their illness.

Studies indicate generation of PEEP with HFOT especially with higher flow rates and with the mouth closed. Stephan et al. (2015) in comparing HFOT with conventional non-invasive ventilation (NIV) via face mask noted that with 50ℓ of flow and FiO_2 0.5, HFOT was not inferior to NIV in patients with respiratory failure following cardiac surgery. Fratt et al. (2015) found that patients with PaO_2/FiO_2 ≤200mmHg receiving HFOT had a significantly lower 28 day intubation rate, as well as a significantly lower 90 day mortality rate compared to the those receiving NIV. Parke et al. (2011a) demonstrates that with 50ℓ of flow, 3cm PEEP can be generated with the mouth closed. Current literature suggests higher flow rates to achieve successful outcomes. However, in clinical practice, some patients are unable to tolerate such pressures through the nasal passages and find it difficult to keep the mouth closed continuously therefore allowing some loss of PEEP. Patients who are in respiratory distress or asleep will tend to mouth breathe. Maggiore et al. (2014) demonstrated a decrease in respiratory rate and number of desaturation episodes as well as a reduced need for NIV or reintubation in people post extubation using starting flows of 50ℓ/minute. Stephan et al. (2015) also advocates the use of HFOT to prevent intubation and to support the patient's respiratory system in the critical phase post extubation. In this study starting flow rates of 50ℓ/minute were used. In contrast, in this work patients were able to tolerate mean starting flow rates of 41ℓ/minute, with the average fraction of inspired oxygen required to obtain target saturations 0.35. In clinical practice higher flow rates may be needed to achieve favourable outcomes.

In the author's own clinical experience, devices are often set up at ward level in anticipation of pulmonary complications and to prevent escalation to a higher dependency unit. Patients may also be established on high flow devices at high dependency level in preparation for transition to ward-based care and to prevent readmission. High flow is also used in conjunction with CPAP in order to give the patient a break from the tighter mask. However, further research is needed to determine whether high-flow devices at ward level can prevent admissions to critical care.

Over this six-month period, anecdotally, patients preferred the comfort of HFOT over the CPAP mask, but a common complaint was that it was 'too hot'. Unfortunately, subjective data

on patient comfort whilst on HFOT was not included in the proforma. The author suggests that this was a limitation and inclusion of this information would be beneficial for future studies. Hasani et al. (2008) suggests that providing high-flow oxygen therapy at 37°C (optimum humidity) at flows of 20–25ℓ/minute for a minimum of three hours a day significantly improves mucociliary clearance. Whilst this study was carried out in patients with bronchiectasis these findings may also apply for patients over this six-month period that had difficulty with retained secretions. Patients who were unable to tolerate the higher temperatures were reduced to 31°C as the author felt it more clinically beneficial to keep them on high-flow therapy at lower temperatures than not on at all.

It is apparent from both the available research and this clinical perspective that HFOT can be regarded as a viable treatment option for those patients who demonstrate signs of respiratory distress and who have pulmonary complications. This work has also shown that patients receiving HFOT via Airvo™ can be managed safely in a number of ward settings without the need to transfer to a high dependency unit for initiation of high flow treatment. However, the maximum amount of PEEP that can be generated with high-flow oxygen is approximately three cm H_2O. Those patients who require higher levels or need more accurate measurement of PEEP, demonstrate signs of cardiogenic pulmonary oedema or have stable chest wall trauma may still warrant conventional CPAP. HFOT should not be seen as a replacement but an alternative treatment option.

The study was carried out in a New Zealand hospital from October 2015 to April 2016, predominantly over summer months. However, apart from the month of October there was a steady use of high flow. The number of patients initiated on HFOT dipped in March with a sudden decline in April. It would be interesting to repeat or extend the study into the winter months to include seasonal variation. The author surmises that the same trends would be noticed but the demand would be greater. Thirteen patients were unable to use HFOT via Airvo™ due to lack of machines. This is interesting in itself as it demonstrates a high demand for high-flow and a clinical need for the device.

The author noted no adverse effects from the application of HFOT during the six-month period. It was safely set up and utilised by ward staff and the study has highlighted that it can be safely applied on the ward providing there is adequate staff training and regular assessment of competencies. This has implications on a service when deciding where the clinically unwell patient could be safely managed and cared for. This study provides interesting debate and food for thought as only 30 patients were cared for in a critical care setting. The remaining group (44 patients) were safely cared for on the ward (Figure 1).

Whilst the policy of a large number of hospitals is to provide CPAP under close observation for instance in a high dependency unit or coronary care facility, from this initiative it appears safe to administer HFOT via an Airvo™ in the ward setting which in turn may enable more flexible care planning and place of delivery for the acutely unwell respiratory compromised patient.

Limitations

It is acknowledged that this pilot study was carried out over a short period of time with a small sample size ($n = 74$). It was also carried out over the summer months with a decline in the use of HFOT in some months. Continuing into winter would potentially allow for more patients to be included. An increase in the use of such devices may be demonstrated particularly when there may be spikes in data for those patients diagnosed with pneumonias or exacerbations of chronic lung conditions in the colder months.

Data to compare alterations in work of breathing and respiratory rate before and during the use of HFOT was not collected due to poor completion of the proforma. Arterial blood gas analysis was not carried out routinely to obtain significant data on changes in PaO_2. The author recommends that this be included in future work. Subjective data regarding patient comfort whilst receiving high flow was also not recorded. This was a limitation of the proforma and is recommended for future work.

Recommendations

This pilot may enable clinicians still solely using CPAP via face, nasal mask or hood in this patient group to consider use of HFOT via Airvo™ as another treatment option in their area of practice. This may be of particular benefit for those patients who are unable to tolerate a tighter fitting mask/hood and therefore may become non-compliant with treatment. Over the six-month period, HFOT was delivered safely in the ward setting with no adverse effects. The author suggests the successful delivery of HFOT at ward level may have clinical implications with regards to intensive care admissions and discharges if these patients can be safely managed on the ward.

For future work, it would be beneficial to collect some qualitative data on patient comfort and compliance with the machine as well as some information on how confident clinicians feel in setting up and weaning patients from the device.

Conclusion

Over a six-month period in a small tertiary hospital in New Zealand, the availability of HFOT devices was increased. Within this timeframe, 74 patients used HFOT. Results indicate that for those patients who have secretion retention, atelectasis, increased work of breathing and increasing oxygen requirements regardless of initial diagnosis, HFOT via the Airvo™ is a viable treatment option. It can be particularly beneficial for those patients who are unable to tolerate a tighter fitting mask and who do not depend on high levels of accurately measured PEEP. With suitable staff training for HFOT in place, this work has shown that it can be used safely in the ward setting and has utilisation across the hospital on a variety of wards in the acute setting.

Key points

- Airvo™ HFOT is a viable treatment option as part of ward-based care which has positive clinical implications in terms of managing the patient at ward level.

- HFOT has been found to be clinically beneficial to patients demonstrating signs of pulmonary complications such as atelectasis, sputum retention, increased work of breathing and increased oxygen requirements.
- HFOT may be more easily tolerated than a tighter fitting mask and should be viewed as an alternative to CPAP not a replacement.

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Disclosure statement

No potential competing interest was reported by the author.

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Appendix 1

How to use the AIRVO™ – physiotherapy

Introduction

- High-flow oxygen therapy must be charted and oxygen prescribed.
- The AIRVO units and tubing kits are stored:
    - In the 4th floor Allied Health Gym store room (AIRVO 2) (trial from October 2015–April 2016).
    - On 8MED floor (AIRVO 2).
    - In ward 5B (AIRVO).
    - In the children's unit (AIRVO 2).
- (*Refer to:* Storage and cleaning of the AIRVO – physiotherapy [Bleep xxxx].

Indications for AIRVO

- Patients whose SpO_2 is <92% on 4ℓ 02 via normal nasal cannula (for eample, those patients who would require escalating to face mask oxygen).
- To decrease the work of breathing.
- Patients who would benefit from humidified O_2/air to aid secretion clearance.
- Patients who are unable to tolerate CPAP therapy but who would benefit from high-flow, humidified oxygen therapy (*please note:* high-flow oxygen creates only a very small amount of PEEP).

Contraindications to the AIRVO

- Blocked nasal passages/choanal atresia.
- Trauma/surgery to the nasopharynx.
- Suspected pneumothorax if using high flow rates.

When to see medical review

- If SpO_2 is <95% on 50% FiO_2 (for example, if oxygen requirements reach 60% or more).
- There is any other sign of acute respiratory distress or failure, for example, RR >30 or <10.
- The need for repeated ABG analysis is identified.

When to discontinue use

- SpO_2 is >95% on 30% FiO_2 on flow of 30ℓ or less unless requires heated humidified oxygen/air to aid secretion clearance.

Appendix 2

Fisher and Paykel high flow oxygen therapy audit form

Patient name: _____ Diagnosis: _____

Ward: _____

HFOT commenced on: _____

Patient's oxygen requirements prior to commencing HF:

% inspired oxygen: _____ N/C litres or FM: _____ % SaO_2 prior: _____

Starting settings: flow rate: _____ FiO_2: _____

Highest FiO_2 whist on HF: _____ Highest flow rate on HF: _____

Resp rate prior to HF: _____ Resp rate on HF: _____ SpO_2: _____

Reason for commencing HF:

- Increasing O_2 requirements ☐
- Consolidation/infection ☐
- Atelectasis ☐
- Retained secretions ☐
- Increased WOB ☐
- Other ☐

Number of days on HF: _____

Outcome:

- Weaned down to normal O_2 therapy: ☐ _____ %/flow rate
- Transferred to higher level of care: ☐
- Transferred onto CPAP/NIV: ☐
- Other: please state _____

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BREAS

ACPRC statement and considerations for the teaching of airway clearance techniques in higher education institutions during the COVID-19 pandemic

Jackie Clarke[1], Amy Bendall[2], Eleanor Douglas[3], Liz Buckman[4], Jane L Cross[5], Sheric G Ellum[6], Lucy Gardiner[7], Molly Hasmi-Greenwood[8], Robyn Stiger[9], Harriet Shannon[10]

In March 2020 the World Health Organisation (WHO) declared the outbreak and spread of SARS-CoV-2 (COVID-19), a pandemic 'that would touch every sector' (WHO 2020a). At this point, 77 countries around the world had reported cases of COVID-19 (WHO 2020b), with 419 cases in the United Kingdom (UK) (Department of Health and Social Care (DHSC) 2020a). In response to the pandemic, Matt Hancock, Secretary of State for Health, told the House of Commons on 16th March 2020 that 'unnecessary social contact' should be avoided, with the UK government announcing strict measures including a full national lockdown from 23rd March 2020 (DHSC 2020b). These measures included immediate closure of non-essential industries, while higher education institutions (HEIs) rapidly reorganised their curriculum to deliver virtual/online teaching with significant associated implications for clinical placements. Such changes were guided by Health Education England (HEE 2020) and the Council of Deans for Health, but were not uniform across the UK, with individual HEIs creating their own action plans for the remainder of the 2019–20 academic year. The Chartered Society of Physiotherapists produced guidance for HEIs, which were broader than the remit of the current commentary.

Physiotherapy teaching teams had to find new ways to deliver academic content and assess students who were now at home, whilst still preparing them for clinical placements. By the Summer of 2020, it became evident that

Authors
[1]University of Essex.
[2]Cardiff University.
[3]University of Nottingham.
[4]University of Queensland.
[5]University of East Anglia.
[6]University of Hertfordshire.
[7]University of Birmingham.
[8]Sheffield Hallam University.
[9]Oxford Brookes University.
[10]University College London.

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Correspondence authors
Jackie Clarke jeclarke@essex.ac.uk, Dr Harriet Shannon education@acprc.org.uk.

the 2020–21 academic year would need to be adjusted to reflect the ongoing challenges brought about by the pandemic. These adjustments included a marked reduction in face-to-face teaching, considerations for physical distancing and the balance between preparing students for clinical placements whilst also acknowledging the more limited scope for in-house practical sessions.

A survey was sent to academics in respiratory care to better understand the different approaches being taken by HEIs. Thirty-one responses were received, representing nearly all regions of the UK. Responders suggested that all universities were aiming to offer some face-to-face teaching, often with a blended approach involving both face-to-face and online sessions. Of the responders, 18 (58%) indicated asynchronous teaching was taking place, front loading theory with the practical application being delayed and (hopefully) taught later in the academic year. Higher risk techniques such as pulmonary function testing, positive pressure devices, respiratory adjuncts (for example, Intermittent Positive Pressure Breathing and mechanical insufflation exsufflation (MI-E)) and expiratory manoeuvres were reported to being taught online only by 19 (61%), 18 (58%), 14 (45%), and 19 (61%) respectively. In comparison, these higher risk techniques were being taught using a combination of face to face and online by 3 (10%) for pulmonary function tests, 8 (26%) for positive pressure devices, 9 (29%) for respiratory adjuncts and 7 (23%) for teaching expiratory manoeuvres.

Students in many HEIs (n = 29, 93%) were taught in allocated 'pods' and personal protective equipment (PPE) was widely used for practical sessions. 29 (93%) of HEIs were equipped with surgical masks and 25 (82%) provided goggles/visors for teaching. Eight (26%) of HEIs were utilising FFP2 or 3 masks, with similar numbers taking students' temperatures (n = 9, 29%). Six (20%) HEIs were requiring regular COVID-19 tests for asymptomatic students and staff. It was suggested by 14 (45%) HEIs that students may feel more apprehensive about performing airway clearance techniques (ACTs) and aerosol generating procedures (AGPs), knowing the increased risk that such applications could carry. Conversely, 25 (81%) of responders felt that the pandemic could offer students the opportunity to develop their clinical reasoning and problem-solving skills.

Responders described a wide variety of adaptations they had made to deliver respiratory modules, including using already available videos on YouTube (n = 27, 87%), self-made videos (n = 22, 71%) and 'practorials' (n = 19, 61%) – a combination of theory with use of videos to support practical delivery, and adaptations such as practicing skills on mannequins (n = 16, 51%).

Where face-to-face teaching was undertaken, teaching teams were tasked with preparing risk assessments to enable recognition of the importance of continued face-to-face teaching for essential practical skills with healthcare students, and to reflect government guidance on the remobilisation of services (Public Health England (PHE) 2020). This PHE guidance, along with further NHS guidance on infection control and the appropriate use of

PPE (NHS 2020) was useful in identifying safe systems of work but raised further questions in relation to the safe teaching of respiratory physiotherapy. Questions were being asked by physiotherapists in clinical practice globally around which respiratory physiotherapy techniques could be considered AGPs, and therefore what level of PPE was indicated (Thomas et al. 2020). These questions were being reflected by respiratory physiotherapy academics and how they could, or should, teach ACTs safely. The ACPRC received an unprecedented number of requests from across the UK, and further afield, for further guidance on how to teach ACTs whilst following local and national infection control guidance in relation to COVID-19 and the risk of virus transmission.

A webinar was held in June 2020 by the ACPRC, to discuss the teaching of respiratory physiotherapy within the constraints placed upon HEIs by the pandemic, and to consider ways forward in the 2020–21 academic year. Discussion topics included the use of PPE in the classroom (appropriate levels and purchasing), class sizes, practical skills bubbles, fit testing, simulation, risk assessment procedures and AGPs. There was consensus that it was essential to continue teaching as many respiratory skills as possible, including ACTs, to prepare students adequately for their clinical placements. This would help to alleviate the increased burden on clinical educators, who may otherwise need to teach such techniques to students on placement. Given the marked variation between HEIs in terms of arrangements for teaching in the 2020–21 academic year, the group were unable to provide universal recommendations, but instead wrote a set of considerations for best practice, to be used within the context of local guidance.

The resulting guidance document is entitled *ACPRC statement and considerations for the teaching of airway clearance techniques in higher education institutions during the COVID-19 pandemic* and is intended to be used for guidance only, with changes possible in response to further government and national recommendations. It should be considered within the context of inclusive curriculum, with appropriate adjustments made depending on the student cohort. The initial document is attached as an appendix, and is also available (with any necessary updates) on the ACPRC website, as a reference document for academics teaching respiratory physiotherapy in UK HEIs, and covers the following points:

- Where possible, face-to-face teaching should continue for *essential* practical skills, with others taught theoretically via case studies, 'practorials' and video-based resources, with greater emphasis on physiological justification and associated clinical reasoning.
- Techniques that could risk dispersion of aerosolised virus (by generating a cough or huff) should only be undertaken in the classroom following careful risk assessment and weighing up the risks versus benefits of the teaching. Some HEIs have local policies in place to enable this to take place.
- Techniques that HEIs are generally *not* planning to teach face-to-face for 2020–21 include: peak expiratory flow rate; spirometry/pulmonary function tests, forced expiratory technique component of ACBT; supported cough/cough augmentation; incentive spirometry; manual techniques (although could be completed on mannequins as able);

airway clearance devices (positive expiratory pressure (PEP)/flutter/MI-E and so on; non-invasive ventilatory support (IPPB, NI, for example).
- Some HEIs are planning to teach the above, following a 'green pathway' (or equivalent non-COVID-19 pathway), as per clinical practice. Those not planning to teach them will be encouraged to use video resources instead.
- Risk assessment processes might include:
  - Individual risk assessments for all staff and students.
  - Student preparation for attendance at practical sessions.
  - Specific measures for face-to-face teaching.
  - Infection control measures.
  - PPE.
- When ACTs cannot be taught practically, a 'practical pack' could be delivered to each student containing materials that they would need in order to participate in a virtual practical session (or a pack that students can make themselves out of materials easily accessible in the home); consider use of a simulation centre for a virtual sim-based practical.
- There will be occasions where students or staff are unable to attend scheduled face-to-face practical sessions due to self-isolation requirements. Lecturers will work towards ensuring alternative content is available or offer recorded/live streaming to ensure no student is disadvantaged. Institutions may consider having a 'stand by' staff member for this reason.

The statement of considerations was produced to offer a starting point for discussion for academics involved in the delivery of respiratory physiotherapy teaching. It is acknowledged that there will be some limitations on what can be taught safely within the University environment, and as such, students from the 2019–20 and 2020–21 may arrive on placement with reduced cardiorespiratory practical skills in comparison to previous years. Partner providers need to be aware of this, so that adjustments to both expectations and clinical teaching can be made, and HEIs will continue to work closely with clinical education leads to discuss which techniques may not have been taught prior to students attending placements. Due to the variety of brands of face masks being used in clinical practice, it is not expected that academics will fit test students prior to clinical placements. This testing will need to be undertaken by clinical educators on each placement, using the relevant brand of face mask to be used for that placement.

In summary, the COVID-19 pandemic has brought unprecedented challenges to physiotherapy clinicians across the world, with services being transformed to new ways of working. Challenges have also been felt within the academic community, as academic staff find new ways to teach essential physiotherapy practical skills, whilst following local HEI policy, decreased attendance on campus, and strict infection control policies. Despite these challenges, academic teams are working hard to provide innovative ways of teaching that prepare students for clinical placement and as future members of the workforce. The authors

would like to acknowledge all those who contributed constructive discussion points to the development of the document, which is a 'live' document and may be updated as our understanding of the risks associated with COVID-19 continue to change.

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Appendix

Statement and considerations for the teaching of airway clearance techniques (ACTs) in higher education institutions during the COVID-19 pandemic

Rationale

Over the Summer of 2020 the ACPRC received an unprecedented number of requests for information and guidance as to how undergraduate and postgraduate students could be taught important airway clearance techniques (ACTs) and other Aerosol Generating Procedures (AGPs), whilst adhering to local infection control guidelines and government guidance with regards to COVID-19, and minimising the risk of virus transmission. There was a perceived disconnection between students being unable to practice ACTs within the university but being expected to perform them with a degree of competence when on clinical placement.

Given the marked variation between higher education institutions (HEIs) in terms of arrangements for teaching in the 2020–21 academic year, we are unable to provide universal recommendations. Therefore, what follows are considerations for best practice, which should be used within the context of local guidance. This document is for guidance only and may change in response to further government and national recommendations.

Terms of reference

A definition of an aerosol generating procedure (AGP) can be found in the following document: *COVID-19: Guidance for the remobilisation of services within health and care settings. Infection prevention and control guidance (20 August 2020)*.

The above document also lists certain other procedures or equipment that may generate an aerosol from material other than patient secretions but are not considered to represent a significant infectious risk for COVID-19. Please refer to the document above for further details.

Although not detailed in the above document, the ACPRC recognise that there are a number of other techniques that may increase the risk of dispersion of aerosolised virus by generating a cough or huff. With regards to specific respiratory physiotherapy techniques these also include:

- Manual techniques (for example, percussion/shaking/manual assisted cough) that may lead to coughing and expectoration of sputum.
- Use of positive pressure breathing devices (for example, IPPB, mechanical insufflation/exsufflation (cough assist) devices, intra/extra pulmonary high frequency oscillation devices).
- Any mobilisation or therapy that may result in coughing and expectoration of mucus (for example, ACBT; incentive spirometry; rehabilitation).
- Any diagnostic interventions that involve the use of video laryngoscopy that can result in airway irritation and coughing.
- Techniques that involve a forced expiratory manoeuvre, such as peak flow/spirometry.

Recommendations for institutions to consider for practical skills delivery

- Physical space is likely to be at a premium in the next academic year, owing to the size of classrooms needed to accommodate appropriate physical distancing. The ACPRC strongly recommends that HEIs carefully consider which physiotherapy techniques could reasonably be taught online, versus which ones might be ‘essential’ for a physical practical session. There was a consensus at the July 2020 ACPRC academic forum that, in instances where some techniques could not be taught, they should be replaced with more in-depth physiological justification for the technique, followed by a greater emphasis on clinical reasoning and case studies so that students would have a strong basis upon which to build their practical experience on placement.

- The general consensus from those academics that have attended the academic forums is that for the academic year 2020/21 techniques that could risk dispersion of aerosolised virus by generating a cough or huff should only be undertaken as practical sessions in the classroom, with careful risk assessment and weighing up the risks versus benefits of the teaching. The ACPRC acknowledges that local risk assessments may identify that this is still possible with certain measures in place and some HEIs may be planning to do so.
- The commonly reported techniques that HEIs are NOT planning to teach practically in face-to-face teaching for 2020/21 include: peak expiratory flow rate; spirometry/pulmonary function tests, forced expiratory technique component of ACBT; supported cough/cough augmentation; incentive spirometry; manual techniques (although could be completed on a mannequins as able); airway clearance devices (PEP/flutter, for example). Pre-made video recordings could be a useful tool to familiarise students with these techniques. Local HEIs have different arrangements for the teaching (or not) of these, with some teaching the full range of ACTs following a 'green pathway' similar to NHS institutions.
- For any respiratory practical session that is feasible to be completed face-to-face on campus, the following practical steps may be useful in informing any local risk assessment:

Risk assessment/local requirements

- Geographical location of the HEI will determine the country specific/public health organisations advice that needs to be followed.
- Advisable for students to complete their own individual risk assessment and any students that fall in moderate/high risk categories may need to be referred to occupational health. There are examples of variations in the risk assessments in use in the workplace across the UK countries, one example from Wales is here. Completing a risk assessment of this nature is also likely to be useful for HEIs when considering clinical education placement.
- Number of students permissible in a teaching room will be dependent on its size and an assessment as to social distancing space that can be met between plinths. Staff: student ratios as recommended by CSP also need to be considered as part of this.
- Students should not be allowed unsupervised access in practical teaching rooms, to ensure infection control policies are always followed.

Student preparation for attendance on campus

- Students to be made aware of their responsibility in familiarising themselves with the guidance on donning/doffing of personal protective equipment (PPE) before they participate in any practical sessions. An example of a video that may be provided to the student is available here. There are also posters available which may also be useful to provide students with, ahead of the session.

- Students need to be aware of the symptoms of COVID-19 and their responsibilities in not attending class if they have any symptoms, and the need to self-isolate and get tested. In the event that a student tests positive for COVID-19, the National Track and Trace Guidelines should be followed. HEIs may also have local 'track and trace' systems in place, that should be adhered to. Students should be directed to the NHS COVID-19 page and familiarise themselves with its content.
- Some universities are putting in place universal COVID-19 testing from the start of the academic year for asymptomatic staff and students (separate to the government testing programme); others also plan to complete temperature checks on arrival to campus/ buildings/sessions. Local guidance therefore will need to be followed where these apply.

Measures in place for face-to-face teaching practical skills

- Students are taught in 'pods' and/or 'bubbles' to minimise interactions between individuals. As such, it is not recommended that students swap between groups if they are unable to attend their scheduled practical session.
- One-way systems will be in place in buildings. Movement of students in rooms to be considered and minimised to ensure social distancing can be maintained. Additional time should be allowed for students to move between spaces.
- Students to be advised *not* to congregate in corridors outside teaching rooms, before or after a session, but to leave the building immediately upon completion of a session.
- Practical spaces to be marked out to demonstrate physical distancing and ensure that students remain within their 'space' for the duration.
- Alcohol hand gel to be readily available in the practical classrooms – ideally one by each plinth.
- At the start/during/end of sessions handwashing to be completed and facilities made available for this.
- Lecturers can move between pods, bubbles or pairs to check and correct techniques, using PPE and hand hygiene if local guidance allows.
- Students are encouraged to work and remain in their designated practice pods/bubble/ pairs for the session, maintaining social distancing from others in the room.
- Consideration must be given as to whose responsibility it will be for touch points to be cleaned (for example, door handles etc) and the frequency for this. A check list may assist with this.
- The processes in place for disposing of PPE waste.

Other considerations in relation to infection control

- Face coverings to be worn by all present in the room (likely that this will be a requirement in all university buildings anyway). Some HEIs are issuing a set number of face coverings to all students required to attend campus. If the practical session involves people being less than 2m apart, it is recommended that a surgical fluid proof mask is worn, rather than a face covering.

- Students should be reminded not to touch facemasks, and advised on correct method for removal.
- Consider how teaching spaces will be cleaned between student groups.
- The cleaning of plinths in between sessions to be completed by the students. Consider whether plinths need a disposable covering on during the sessions (for example, some HEIs planning to use 'blue-roll') or not. Some HEIs will be providing each student with their own pillowcase to bring to practicals, which they will then launder at home; other HEIs are only using pillows with a plastic cover that can be wiped with disinfectant at the end of a session. Use of blankets and towels to be kept to a minimum – some HEIs are providing students with one of each for them to bring clean to each session, and advised to wash them at home between sessions.
- Infection control procedures (for example, don/doff required PPE; handwashing) can be built into lesson plans to allow sufficient time to complete.
- Staff and students informed of the need to wear a clean uniform for each day attended for practical skills on campus.
- Students may be asked to bring a clean change of clothing only to be worn for the session to limit cross contamination. Changing facilities may be necessary to identify for use if this is practice is adopted.
- Staff to consider how the laundering of their own uniform worn in practicals will be undertaken – some HEIs may provide scrubs for use in practicals which the staff member can change out of before leaving campus.
- For staff and student clothing that has been worn for a practical session and needs to be home laundered the following should be followed: washed separately from other household linens; in a load not more than half the machine capacity; at the maximum temperature the fabric can tolerate (recommended more than 60°C where possible). It should then be ironed or tumbled dried. This is also the guidance on home laundering students should follow whilst on clinical placement.
- Avoid using a paper register for student attendance – instead a staff member may need to read the names out loud for programmes where attendance monitoring is required, and electronic means are not in place.
- Students advised not to use pen/paper/laptop in the practical skills space for taking notes.
- Student to be advised to bring only the essentials required with them to a practical session; where possible students should use a bag that can easily be wiped with disinfectant wipes at the end of the session. All belongings can then be stored in the bag for the duration of the practical. Bags to be stored apart from each other so they are not touching.
- Students to not drink/eat during the practical sessions.
- Students to be made aware of the cleaning materials used in the classroom and to inform staff at the start of the session if they have any known allergies to any of these.

Personal-protective equipment

- Where social distancing cannot be maintained in order to complete a skill, PPE will be required. General consensus across HEIs, and planning that is already being undertaken, indicates that this will involve:
  - Fluid-repellent surgical masks; disposable apron and disposable gloves (refer to the CSP guidance for HEIs). Face visor to also be used. Masks, aprons and gloves are disposed of in an appropriate bin at the end of the session. Cleaning procedures to be followed for the face visor at the end of the session – it may be possible for some visors to be appropriately cleaned and to be quarantined for at least 72 hours before being able to be used again.
  - Lecturers should consider the length of time it may take for students to enter a teaching room, wash hands, and don PPE whilst remaining 2m apart. This time may need to be added onto a session at start and end, to minimise loss of available teaching time. A safety briefing may also be appropriate, particularly at the beginning of each new term.

Considerations for teaching

The ACPRC academic forum made several suggestions for the teaching of ACTs that will not be completed practically in face-to-face teaching:

- Videos created by lecturers that demonstrate correct technique with regards to ACTs.
- 'Practorials' that combine practical skills (via video) with tutorials.
- A 'practical pack' that could be delivered to each student containing materials that they would need to participate in a virtual practical session. Or a pack that students can make themselves out of materials easily accessible in the home.
- Use of a simulation centre for a virtual sim-based practical.

It is also acknowledged that it is reasonable to expect that not all students may be able to attend their scheduled face-to-face practical session. Academics are therefore advised to consider an alternative learning activity that the students can complete if they are unable to attend campus (for example, the student is required to self-isolate). Having such plans already in place would also help to mitigate against another lock-down where face-to-face teaching may not be possible.

The fact that there may be instances where staff may need to self-isolate and not be able to complete their scheduled teaching may also need to be considered. In HEIs with larger cardiorespiratory teaching teams, having a 'shadow' member of staff on stand-by to cover sessions if required may be a feasible option. More facilitators than usual may be required if students are being taught in larger rooms, to ensure that they adhere to physical distancing.

If feasible, it may be possible to use 'Zoom' or similar, with the lead session facilitator in a practical room for international students and others unable to attend in person. A laptop could be placed on a trolley so it is portable and can move around room to watch other

students and listen to clinical educators/facilitators providing feedback and discussing technique, rationale, and so on, with students in the room. Appropriate cleaning of equipment would need to be considered.

Considerations for clinical placements

It is likely that students in both the 2019/20 (depending on teaching delivery pre/post-lockdown) and 2020/21 cohorts will arrive on placement with reduced cardiorespiratory practical skills in comparison to previous years. It is essential that placement centres are aware of this, so that appropriate adjustments to clinical teaching can be made. HEIs should be encouraged to collaborate closely with clinical education leads to agree upon which techniques should be taught prior to students attending placements, and which ones clinical educators would be happy to lead on. It should be emphasised that, where students may have had less hands-on skills practice, they should instead have an increased level of theoretical knowledge that will provide a solid grounding for their placement. Expectations on clinical placement are therefore unlikely to differ from previous years.

There are some HEIs that are planning to undertake *Mask Fit Testing* to prepare the student for clinical placement. During the academic forums it became evident that across placement providers for one HEI there may be different brands of masks used – therefore before an HEI undertakes any testing it is recommended placement providers are asked which masks are used. For many HEIs it was reported the responsibility to undertake *Mask Fit Testing* will be with the clinical placement provider and not completed by the programme.

As with previous years, it may not be possible for all students to access a respiratory placement. If this is the case, students could seek respiratory experience whilst on placement in other areas, as appropriate.

Other considerations

The ACPRC recommends that academics are aware of the procedures in place locally that they are required to adhere to, should there be an emergency whilst they are on campus and their responsibilities in relation to this. The response to some of these may have changed as a consequence of COVID-19 and staff should be guided by their employer's advice and local procedures.

Examples of emergencies may include:

- Fire: there may be a reduced number of fire wardens on site; the building exits may have changed as a consequence of one-way systems being instigated.
- First aid: the location of equipment may have moved; the number of trained first aiders may not be as great as previously.
- Need to complete CPR – this is particularly relevant in the context of COVID-19 and potential risk of cross infection from both rescue breaths and chest compressions (the latter are considered AGPs). All academics should be guided by employer's advice.

Authors and contributors

Name	Role	Institution
Amy Bendall	Journal Editor for ACPRC	Cardiff University
Liz Buckman	Senior Cardiorespiratory Physiotherapist	University of Queensland
Jackie Clarke	Lecturer/Subject lead for Physiotherapy	University of Essex
Jane L Cross	Senior Lecturer	University of East Anglia
Eleanor Douglas	Chair of Respiratory Leaders group	University of Nottingham
Sheric G Ellum	Senior Lecturer	University of Hertfordshire
Lucy Gardiner	Lecturer	University of Birmingham
Molly Hashmi-Greenwood	Senior Lecturer	Sheffield Hallam University
Robyn Stiger	Senior Lecturer	Oxford Brookes University
Harriet Shannon	Education Champion for ACPRC	UCL

Version 1, 8.9.2020. Please contact Dr Harriet Shannon education@acprc.ac.uk for further support or queries related to this document.

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