2017

After-hours respiratory physiotherapy for intubated and mechanically ventilated patients with community-acquired pneumonia: An Australian perspective

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This article was originally published as:
van der Lee, L., Hill, A., & Patman, S. (2017). After-hours respiratory physiotherapy for intubated and mechanically ventilated patients with community-acquired pneumonia: An Australian perspective. *Australian Critical Care, Early View (Online First)*.

Original article available here:
https://doi.org/10.1016/j.aucc.2017.10.001

This is the accepted manuscript version of the article published as:

van der Lee, Lisa., Hill, Anne-Marie., and Patman, Shane. (2017). After-hours respiratory physiotherapy for intubated and mechanically ventilated patients with community-acquired pneumonia: An Australian perspective. *Australian Critical Care, Early View (Online First).* doi: 10.1016/j.aucc.2017.10.001

This article has been published in final form at https://doi.org/10.1016/j.aucc.2017.10.001

Abstract

Introduction

Community acquired pneumonia (CAP) is a common reason for admission to an intensive care unit for intubation and mechanical ventilation, and results in high morbidity and mortality. The primary aim of the study was to investigate availability and provision of respiratory physiotherapy, outside of normal business hours, for intubated and mechanically ventilated adults with CAP in Australian hospitals.

Materials and methods

A cross-sectional, mixed methods online survey was conducted. Participants were senior intensive care unit physiotherapists from 88 public and private hospitals. Main outcome measures included presence and nature of an after-hours physiotherapy service and factors perceived to influence the need for after-hours respiratory physiotherapy intervention, when the service was available, for intubated adult patients with CAP. Data were also collected regarding respiratory intervention provided after-hours by other ICU professionals.

Results

Response rate was 72% (n=75). An after-hours physiotherapy service was provided by n=31 (46%) hospitals and onsite after-hours physiotherapy presence was limited (22%), with a combination of onsite and on-call service reported by 19%. Treatment response (83%) was the most frequent factor for referring patients with CAP for after-hours physiotherapy intervention by the treating day-time physiotherapist. Nurses performing respiratory intervention (77%) was significantly associated with no available after-hours physiotherapy service (p=0.04).

Discussion

Physiotherapy after-hours service in Australia is limited, therefore it is common for intubated patients with CAP not to receive any respiratory physiotherapy intervention outside of normal

business hours. In the absence of an after-hours physiotherapist, nurses were most likely to perform after-hours respiratory intervention to intubated patients with CAP.

Conclusion

Further research is required to determine whether the frequency of respiratory physiotherapy intervention, including after-hours provision of treatment, influences outcomes for ICU patients intubated with pneumonia.

Key Words (MeSH): Critical Care, Physical Therapy Modalities, Pneumonia, Respiration Artificial.

Introduction

Severe community acquired pneumonia (CAP) is a common cause for admission to an ICU, for intubation and mechanical ventilation due to respiratory failure and septic shock, and is associated with high levels of morbidity and mortality[1,2]. Lung infection and inflammation in pneumonia result in reduced compliance and alveolar ventilation[3], and exudation of purulent sputum into the airways[4], all of which contribute to impaired gas exchange and respiratory failure[3]. Physiotherapists working in ICU commonly treat intubated and mechanically ventilated patients with respiratory illness such as CAP, with the aims of facilitating airway clearance, enhancing alveolar ventilation, improving respiratory mechanics and commencing functional rehabilitation[5,6]. Evidence from randomised, controlled trials indicates that respiratory physiotherapy intervention involving lung hyperinflation techniques is beneficial for improving lung compliance[7,8,9], airway resistance[8] and sputum clearance[7,9] in heterogeneous mechanically ventilated patients. However the proven benefits have been short lived[10], with improvements in lung compliance reported to be maintained at 20 minutes[7] and 30 minutes[8] after intervention and reduction in airway resistance maintained at 20 minutes following intervention[8]. There is minimal evidence regarding the optimal dosage of intervention duration and frequency[11] for specific patient cohorts mechanically ventilated with acute respiratory illness such as CAP, leaving little guidance for physiotherapists on how

best to contribute to optimising patient care for those admitted to ICU with CAP across Australia.

It has previously been highlighted that in Australian hospitals, limited physiotherapy services exist after-hours, including on weekends, compared with normal business hours Monday to Friday[12-14]. This is in contrast to health care systems in the UK, where 97% of ICUs reported to have 24-hour access to physiotherapy[15], and in Canada where 97% of hospitals were reported to have a weekend physiotherapy service, although weekend physiotherapy staffing levels were 88% less than on weekdays[16]. In people with acute or subacute conditions, the provision of 19 minutes of extra physiotherapy per day had small, but significant, benefits in reducing hospital length of stay in both the acute and rehabilitation settings[17]. Functional and quality of life outcomes were also improved for a variety of patient cohorts including cardiac and orthopaedic surgery, and stroke[17]. The effects of respiratory physiotherapy being provided after-hours specifically in the critical care setting have been examined in a systematic review[13] which indicates two studies that reported results for subgroups in ICU, one for patients with acute spinal cord injury (n=14)[18] and another for patients following high risk upper abdominal surgery (n=31)[19]. Both these studies reported a significant reduction in pulmonary complications and length of stay, and when after-hours respiratory physiotherapy was provided following early extubation of patients with acute spinal cord injury this translated to a significant cost saving for the hospital[18]. However, to date no research has been conducted to examine provision of respiratory physiotherapy outside of normal business hours for intubated and mechanically ventilated patients with acute respiratory illness, such as CAP. The primary aim of this study was to investigate the availability and provision of after-hours respiratory physiotherapy intervention for intubated and mechanically ventilated adults with CAP throughout Australia. The secondary aims were to explore indications for referral for after-hours physiotherapy intervention for this group of patients, and how the respiratory intervention may be managed by other ICU health professionals when an after-hours physiotherapy service is limited or unavailable.

Materials and Methods

This study was nested within a larger online survey[20] using SurveyMonkey® (Palo Alto: USA), developed and piloted to explore current physiotherapy practice and clinical reasoning for adult intubated patients with CAP. Data collection for the primary study occurred over 6 consecutive months during 2014 and 2015. Senior physiotherapists working in Level 2 or 3[21] metropolitan and rural Australian ICUs were targeted for recruitment to the study. Participant inclusion criteria and recruitment, methods and full survey details have been published elsewhere [20]. Survey participants were asked to describe their practice regarding respiratory physiotherapy intervention for intubated and mechanically ventilated patients with CAP, and the types, typical duration and frequency of intervention provided for this patient cohort based on their own clinical experience. Ten of the survey items specifically enquired about after-hours physiotherapy service delivery, providing the data for this report. These survey items used categorical scales to determine the amount and nature of an after-hours physiotherapy service available. Likert scales were used to investigate the factors which respondents felt influenced the need for after-hours respiratory physiotherapy intervention for intubated patients with CAP based on their own clinical experience. Similarly, categorical scales were used to explore respondents' perception of whether respiratory physiotherapy interventions were performed by other health professionals in the ICU outside of normal business hours, and the types of respiratory physiotherapy interventions performed by non-physiotherapy health professionals in the ICU for intubated patients with CAP after-hours, based on the opinion of respondents. Ethics approval was granted by the Human Research and Ethics Committees of The University of Notre Dame Australia (014130F), and local hospital ethics committees.

Quantitative data were summarised using descriptive statistics and associations were analysed using Chi-square with Fisher exact test, using SPSS version 22 (IBM SPSS Statistics, IBM Corp, New York: USA).

Results

The nested survey was sent to 104 senior physiotherapists at 88 hospitals, with global survey results published previously [20]. Results presented uniquely here pertain to after-hours physiotherapy only. The survey response rate was 72% (n=75) and 79% of respondents (n=54) were from public hospitals. Bed capacity of the ICU, as reported by respondents[20], was 10 beds or less in 26% of respondents (n=18), 11-20 beds in 46% (n=31) and over 20 beds in 28% (n=19). Sixty percent of respondents (n=41) reported between 1.0 and 2.0 full time equivalent (FTE) physiotherapy staffing, and 32% (n=22) reported between 3.0 and 4.0 FTE respectively. The availability of after-hours physiotherapy is outlined in Figure 1. (Insert Figure 1 here)

Of the 75 physiotherapists, there were 68 participants who responded to the survey items that related to service provision. Of these respondents 97% (n = 66) indicated that a weekend ICU physiotherapy service existed during the day-time on both Saturdays and Sundays. Respondent state of jurisdiction are presented in Figure 2. (Insert Figure 2 here)

Chi-square analysis indicated that ICU bed capacity was significantly associated with weekday physiotherapy FTE staffing, as reported by respondents, with ICUs of larger bed capacity having greater reported levels of physiotherapy staffing ($p<0.001$). Public facilities were also significantly associated with greater ICU physiotherapy staffing levels, over 2.0 FTE ($p=0.004$). Further chi-square analyses also indicated that there was a significant association between both ICU bed capacity ($p=0.002$) and physiotherapy FTE ($p=0.018$) with presence of an after-hours physiotherapy service, with ICUs of greater bed capacity or greater physiotherapy staffing being more likely to have an after-hours physiotherapy service available. Respondents reported that patients with CAP in ICU were significantly more likely

to receive more frequent respiratory physiotherapy (two or more times a day) when an after-hours physiotherapy service was available (p=0.018).

There was a significant association between jurisdiction and reported presence of an after-hours physiotherapy service (p<0.001), with after-hours physiotherapy services being more common in Queensland (QLD), New South Wales (NSW) and Western Australia (WA) compared with other Australian states.

Figure 3 illustrates the most frequent reasons reported for referral of intubated and mechanically ventilated patients with CAP by the treating day-time physiotherapist to the after-hours physiotherapist, when this service was available. (Insert Figure 3 here)

The greatest factor reported by respondents influencing the need for after-hours physiotherapy intervention was whether day time physiotherapy intervention resulted in a positive change in assessment findings. Respondents' perception of the bedside nurse's capability of managing the patient's secretions, and the volume of secretions, were also important considerations reported by the ICU physiotherapist when determining referral for after-hours physiotherapy.

There was a significant association between respiratory physiotherapy interventions being conducted by other (non-physiotherapy) health professionals in the ICU and an after-hour physiotherapy service not being available (p=0.04). It was reported by 53% of respondents (n= 30) that other health professionals within the ICU performed respiratory physiotherapy techniques after-hours, with 37% (n=21) reporting that this occurrence was occasional only. There was a significant association between respiratory physiotherapy intervention being provided by nurses (77%, n= 36/47) and no after-hours physiotherapist availability (p=0.04). Twenty-one percent of respondents (n=10/47) reported that in the absence of an after-hours physiotherapist, either doctors (2%) or nurses (98%) performed respiratory physiotherapy intervention if necessary. The most common respiratory techniques reportedly performed by nurses or doctors to intubated patients with CAP outside of normal business hours were: endotracheal suction (92% of respondents, n= 43), positioning (77% of respondents, n= 36),

deep breathing and coughing (43% of respondents, n= 20) and administration of normal saline to the airway (40% of respondents, n=19). Figure 4 illustrates other respiratory techniques which were reported to be less commonly performed after-hours by those other than physiotherapists. (Insert Figure 4 here)

Discussion

This study is the first survey of physiotherapists regarding after-hours physiotherapy service provision within the acute hospital setting in over 20 years. However findings remain consistent with those reported previously[11], in that less than half of respondents indicated an after-hours physiotherapy service was available to ICU patients and that the majority of facilities that did provide an after-hours physiotherapy service utilised an on-call system.

Physiotherapists are an integral and essential part of the ICU multidisciplinary team, possessing skills that contribute to optimisation and enhancement of respiratory function for critically ill patients receiving mechanical ventilation[5,22], such as those with CAP. Traditionally ICUs are staffed 24 hours per day, seven days a week by doctors and nurses, however physiotherapists in acute hospitals across Australia most commonly only work during day-time hours[13,11,23]. This is in contrast to the College of Intensive Care Medicine of Australia and New Zealand[21] and the British Faculty of Intensive Care Medicine[24] best practice standards which recommend access to a physiotherapist 24-hours per day to provide for the needs of patients in ICU, and furthermore that “physiotherapy staffing should be adequate to provide both the respiratory and rehabilitation components of care”[24].

The survey results indicate the profile of an Australian hospital with an after-hours physiotherapy service is most likely a public facility, with an ICU of greater than 20 beds, located within the states of QLD, NSW or WA. The after-hours service is most likely to be an

on-call service, or an onsite service for part of the evening with an on-call service available thereafter. In order to maintain anonymity of participants and facilities it was not possible to identify which ICUs were Level 3 and which were metropolitan, however the above profile does suggest that the public hospitals with large ICUs of greater than 20 beds are most likely to be tertiary or quaternary facilities, providing an after-hours physiotherapy service potentially due to a higher acuity, complexity and specialised casemix. In an Australian survey of chief physiotherapists respondents indicated that after-hours physiotherapy was provided to certain hospital specialty areas such as ICU, general medical and surgical wards, transplants and burns, as these patient groups were considered to be at high risk of deterioration as a result of respiratory complications from their medical condition with the absence of respiratory physiotherapy intervention[11].

Lim et al[25] profiled the types of patients referred for after-hours physiotherapy at a tertiary hospital in Singapore. Pneumonia was one of the most common diagnoses referred to after-hours physiotherapy, with mucociliary clearance being one of the most common reasons for referral based on the clinical reasoning of the day-time physiotherapist, and 20% of referrals by medical staff having a primary diagnosis of pneumonia. However, it was not reported if the type of pneumonia was community acquired, or whether the patients were intubated and mechanically ventilated at the time of referral. A randomised controlled trial in an Australian setting found that patients with ventilator associated pneumonia and acquired brain injury receiving respiratory intervention provided by a physiotherapist six times over a 24-hour period showed a trend towards faster recovery and less occurrence of lobar collapse[26], but this study was limited by small sample size (n=33). Furthermore, the specific nature of the population studied presented limitations to respiratory physiotherapy intervention, such as the need to treat in the head up position due to presence of an intraventricular drain and minimisation of stimulation to control intracranial and cerebral perfusion pressure by limiting endotracheal tube suction, which may have influenced effectiveness of physiotherapy and potential for impact on outcomes[26]. Therefore caution must be exercised when extrapolating these results to other ICU patient populations. Further investigation regarding the benefits

and frequency of physiotherapy intervention for intubated and mechanically ventilated patients with acute respiratory illness or dysfunction is required.

The most common reason reported by respondents for referring an intubated patient with CAP for after-hours respiratory physiotherapy was whether an objective benefit was demonstrated from day-time physiotherapy intervention. However, the capacity for a patient to receive respiratory physiotherapy more frequently over a 24-hour period depends on the availability of sufficient staffing, including an after-hours physiotherapy service. If no after-hours physiotherapy service is available, intubated patients with acute respiratory illness such as CAP with deteriorating respiratory function may have worse patient outcomes such as prolonged mechanical ventilation time, increased ICU and hospital length of stay, and greater mortality, however to date there are no published data to support this. Due to the pathophysiology of CAP resulting in increased sputum production[4] and reduced lung compliance and alveolar ventilation[3], sputum retention and atelectasis can occur at any time, not only during day-time hours when an ICU physiotherapist is most likely to be available. Furthermore, common ventilator settings may cause an inspiratory flow bias resulting in caudad movement of secretions within the airways, with secretions being embedded, rather than expelled from the lungs[27]. The absence of regular respiratory intervention to clear sputum and re-inflate underventilated alveoli may lead to increased V/Q mismatch and shunt, and worsening of hypoxaemia[3].

In the opinion of respondents, in the absence of an after-hours physiotherapist nurses were the professionals most likely to perform after-hours respiratory intervention to intubated patients with CAP. However over one third of respondents indicated that this was only occasional, implying that the majority of these patients received no respiratory intervention until the physiotherapist returned to work the following day. The respiratory intervention respondents believed to be delivered after-hours by nursing staff consisted mostly of

positioning, deep breathing and coughing (presumably once the patient was awake enough to participate), administration of normal saline to the airway, and endotracheal suctioning, all of which could be classified under the scope of standard nursing care, rather than solely the purview of physiotherapy. Very few respondents believed that nursing staff in their facilities performed treatment techniques which are traditionally considered "physiotherapy" such as percussion (5%), vibrations (7%), manual hyperinflation (8%) or ventilator hyperinflation (2%). In contrast, Chaboyer et al[12] reported a much higher use of chest percussion (55%) and vibration (56%) techniques by nursing staff but did not report any use of hyperinflation techniques. Of all the respiratory physiotherapy techniques used for intubated patients, the use of hyperinflation techniques has the highest evidence of efficacy. As discussed by Ntoumenopoulos & Greenwood[11] this brings into question the quality and efficacy of the respiratory treatment delivered by nursing staff after-hours. Due to time constraints, it is unlikely the ICU nursing staff have capacity to provide the same level of respiratory intervention as a physiotherapist, who has more time dedicated to the optimisation of the patient's respiratory function, as one of their primary roles[11]. Ntoumenopoulos and Greenwood[11] suggested that nursing staff may not be adequately trained to enable provision of respiratory intervention with the same level of quality and efficacy as an ICU physiotherapist, whose practice is based on a complex clinical reasoning process[11, 28, 29]. This process integrates continuous patient assessment, an advanced understanding of respiratory mechanics and pathophysiology, indications for and contraindications against intervention modes, and the ability to adjust and modify intervention according to the individual patient's presentation, clinical need and treatment response.

The good response rate from experienced senior clinicians from all states in this study (72%) provides confidence that data are representative of physiotherapy service provision to level 2 and 3 ICUs across Australia, thereby affording strength and robustness to the findings. The reporting of after-hours respiratory intervention provided by non-physiotherapists is based on the opinion of the respondents from a physiotherapy perspective, which may differ if ICU nursing staff were surveyed directly, and this is a limitation of the study. In addition, reported

physiotherapy staffing levels are based on the respondents' opinion and may not reflect actual staffing levels. This information could be enhanced by obtaining data directly from Human Resource or Physiotherapy Department managers.

This is the first study to provide a snapshot of respiratory physiotherapy intervention outside of normal business hours for intubated and mechanically ventilated patients with an acute, potentially curable, respiratory illness. The majority of Australian ICUs do not provide an after-hours physiotherapy service, despite recommendations from peak professional bodies in both Australia and the UK supporting provision of this service. The implication is that nurses are largely left with the responsibility of providing the patient's respiratory intervention outside of business hours. The facilities with an after-hours physiotherapy service are able to provide respiratory intervention to patients with CAP more frequently, basing this intervention on the patient's response to day-time physiotherapy intervention, the volume and nature of secretions present and the physiotherapists' perception of whether these secretions can be managed adequately by the bed-side nurse. Further research, in the form of multi-centred randomised and controlled trials, is necessary to determine whether after-hours respiratory physiotherapy adds benefit to both intubated patients with CAP through improved outcomes, and to health systems by reducing ICU bed days and hospital length of stay.

Acknowledgements

Thank you to all senior physiotherapists who participated in the survey, to those who assisted with the pilot process, and for statistical support, and for final proof reading.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or Not-for-profit sectors.

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Figure Legends

Figure 1: Types of after-hours physiotherapy service.

Figure 2: Respondent jurisdiction by state.

Figure 3: Factors influencing PT referral for after-hours respiratory PT.

Figure 4: Types of after-hours respiratory interventions which physiotherapists report to be performed by other health professionals in the ICU.

Figure 1

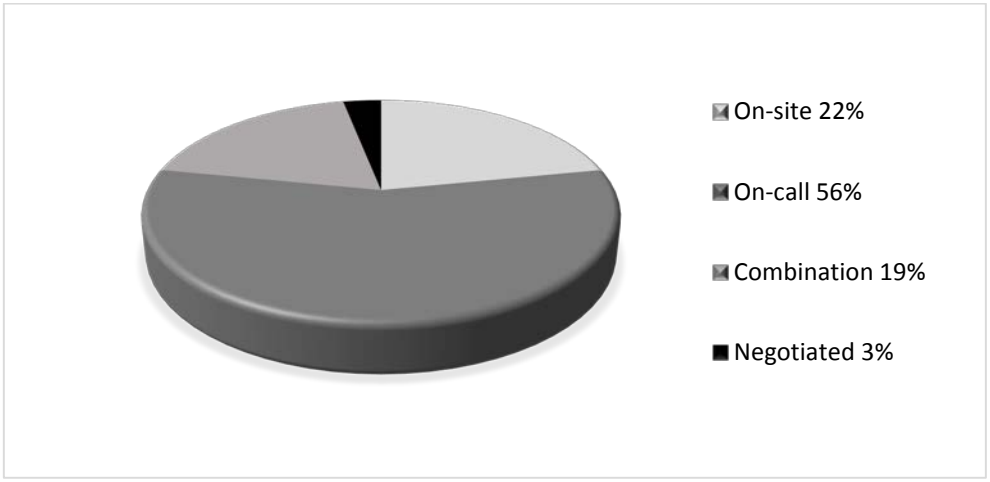


Figure 2

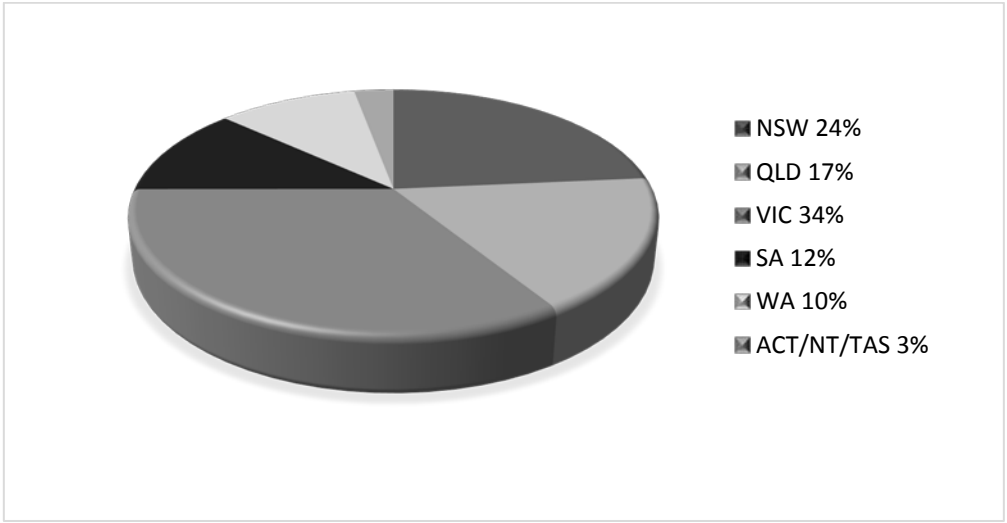


Figure 3

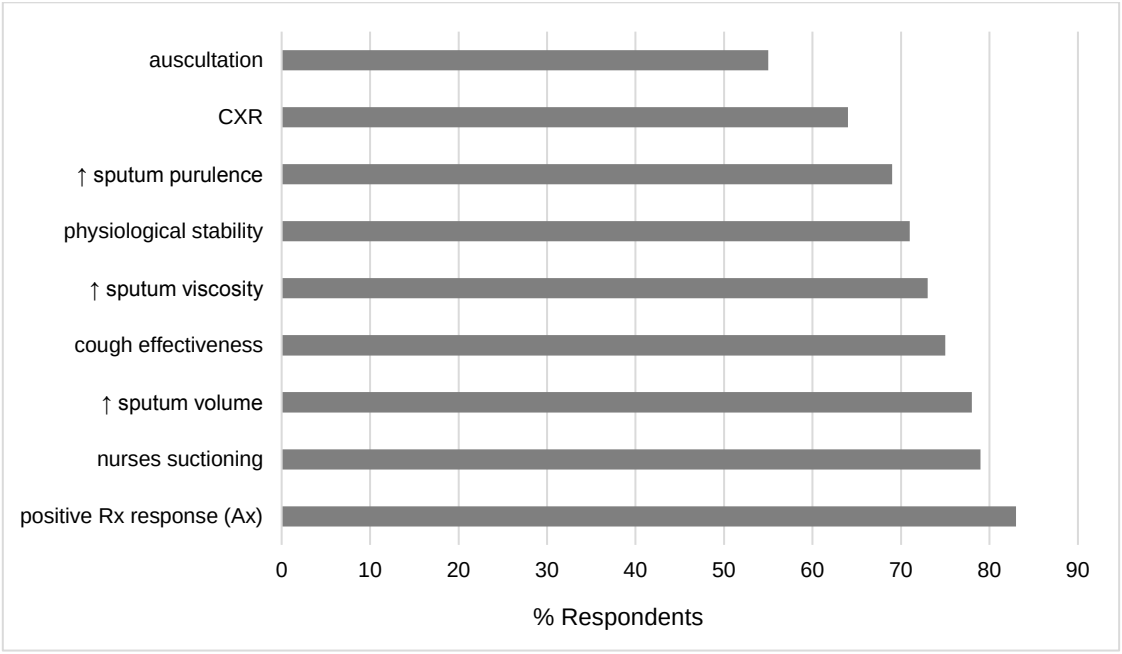
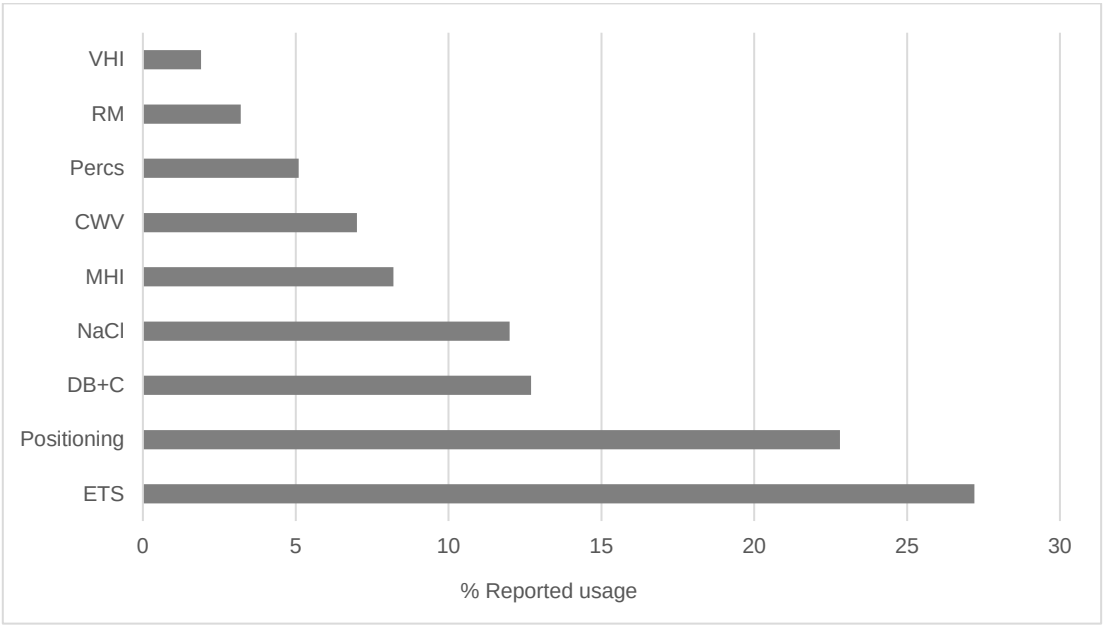


Figure 4



Abbreviations: CWV = chest wall vibrations, DB & C = deep breathing and coughing, ETS = endotracheal suction, MHI = manual hyperinflation, Percs = percussion, NaCl = normal saline administration, VHI = ventilator hyperinflation, RM = recruitment manoeuvre.