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Chest physical therapy (chest PT) for adults over the age of fifty years suffering from acute exacerbations of chronic obstructive pulmonary disease (COPD)

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Chest physical therapy (chest PT) for adults over the age of fifty years suffering from acute exacerbations of chronic obstructive pulmonary disease (COPD)

Disciplines

Physical Therapy

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Critically Appraised Topic

Title: Chest physical therapy (chest PT) for adults over the age of fifty years suffering from acute exacerbations of chronic obstructive pulmonary disease (COPD).

Introduction: For the purpose of my clinical question, I want to know what the research says about the use of chest physical therapy for patients suffering from acute exacerbations of chronic obstructive pulmonary disease (COPD). COPD can produce copious amounts of mucus and impede the airway, which can escalate into respiratory distress and require hospital admission for treatment. The patients in the hospital I am working at never receive chest physical therapy (PT) as a treatment for acute exacerbations of COPD. However, chest PT has been thought to be a viable treatment for improving airway clearance by increasing the elimination of secretions. Based on theories of the mechanisms by which chest PT facilitates airway clearance and by the tradition of chest PT for many years, one would hypothesize that chest PT should continue to be used to help patients suffering from airway obstruction.

Clinical Scenario: Throughout my current acute internship, chest PT is never practiced. This hospital has a large number of patients admitted with respiratory complications and therefore, has an ICU dedicated to respiratory issues. The respiratory ICU (RICU) is known for the “care process model, focusing on best practices and improvement in care, including early mobility”⁶. Due to the large number of patients suffering from acute exacerbations of COPD in the respiratory ICU and its ability to provide advanced care, I wondered why chest physical therapy was not a treatment provided.

My Clinical Question: Does chest physical therapy consisting of postural drainage, percussion and/or vibration promote sputum production and improve oxygen saturation in patients with acute exacerbations of chronic obstructive pulmonary disease?

Clinical Question:

Population – Adults, 50 years of age and older, admitted to a hospital with acute exacerbations of COPD not receiving mechanical ventilation or tracheotomy

Intervention – Conventional medical treatment combined with chest PT consisting of postural drainage, percussion and/or vibration

Comparison – Conventional medical treatment

Outcome – Sputum production, Oxygen saturation either measured by blood gases or pulse oximetry, (PaO₂ and SpO₂)

Overall Clinical Bottom Line: Based on the articles by Anthonisen *et al.* and Buscaglia *et al.*, chest physical therapy is not effective for reducing sputum in the lungs or increasing PaO₂ and SpO₂ for patients hospitalized with acute exacerbations of COPD. However, both articles had such significant flaws in internal validity (PEDro scores of 1/10 and 4/10, respectively) that the outcomes should be looked at with extreme caution. Furthermore, due to the poor validity of these articles, the outcomes cannot be generalized to other COPD populations. Future studies should include stronger protocols, randomization, control groups and subjects with sputum production, which is the primary indication for chest PT.

Search Terms: Chest physical therapy, chronic obstructive pulmonary disease, bronchopulmonary hygiene, acute exacerbation, postural drainage, chest physiotherapy.

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Rationale for chosen articles:

Using search terms, I collected and read literature reviews and systematic reviews found through CINAHL, MEDLINE, and PEDro. These articles included:

Langer D, *et al.* A Clinical Practice Guideline for Physiotherapists treating Patients with Chronic Obstructive Pulmonary Disease Based on a Systematic Review of Available Evidence. *Clin Rehab* 2009; 23:445-462.

Van der Schans, C. Conventional Chest Physical Therapy for Obstructive Lung Disease. *Respir Care* 2007; 52(9):1198-1206.

Tang C T, Taylor N F, Blackstock F C. Chest Physiotherapy for Patients Admitted to Hospital with an Acute Exacerbation of Chronic Obstructive Pulmonary Disease (COPD): A Systematic Review. *Physiotherapy* 2010; 96:1-13.

Bach P B, *et al.* Management of Acute Exacerbations of Chronic Obstructive Pulmonary Disease: A Summary and Appraisal of Published Evidence. *Ann Intern Med* 2001; 134:600-620.

Faling L J. Pulmonary Rehabilitation - Physical Modalities. *Clinics in Chest Medicine* 1986; 7(4):599-618.

From these reviews, I found references for the original articles that looked like they would fit my clinical PICO. Of the articles I was able to receive in full text, I chose to review in depth:

(1) Anthonisen P, Riis P, and Sogaard-Anderson T. The Value of Lung Physiotherapy in the Treatment of Acute Exacerbations on Chronic Bronchitis. *Acta Med Scand* 1964; 175(6):715-9.

PEDro Score: 1/10

Article PICO:

P – 69 adults (average age of 60 years) admitted to Glostrup Hospital, Denmark with acute flare-up of chronic bronchitis, defined as having a cough for at least 6 months, having acute deterioration, raised temperature and muco-purulent expectorate. No exclusion criteria were stated.

I – Conventional medical treatment plus chest PT consisting of postural drainage, tapotement, vibrations and expansion exercises

C – Conventional medical treatment alone

O – Sputum volume, PaO₂, PaCO₂ and temperature

Similarity/Dissimilarity to my PICO:

The population, intervention and comparison were similar to my clinical PICO and the PEDro score is low.

- (2) Buscaglia A, and St Marie M S. Oxygen Saturation during Chest Physiotherapy for Acute Exacerbation of Severe Chronic Obstructive Pulmonary Disease. *Respir Care* 1983; 28(8):1009-13.

PEDro Score: 4/10

Article PICO:

P – 10 adults (57 to 83 years old) with severe chronic airway obstruction and abnormal gas exchange hospitalized for acute exacerbation of their disease but not in an ICU and not receiving mechanical ventilation. Exclusion criteria: heart failure, pneumonia and atelectasis
I – Postural drainage with percussion and vibration
C – Pre-treatment oxygen saturation SpO₂
O – Post-treatment oxygen saturation SpO₂

Similarity/Dissimilarity to my PICO:

The population and intervention were similar to my clinical PICO. Although the PEDro score is low, it is the highest of the three articles reviewed.

- (3) Campbell A H, O'Connell J M, and Wilson, F. The Effects of Chest Physiotherapy Upon the FEV₁ in Chronic Bronchitis. *Med J of Aust* 1975; 1:33-35.

PEDro Score: 3/10

Article PICO:

P – 17 adults (55 to 76 years old) admitted to the thoracic department of Repatriation General Hospital, Australia with acute exacerbations of chronic bronchitis who were willing and fit enough to perform a pulmonary function test. If acute exacerbations of chronic bronchitis was their primary issue patients with mild asthma and congestive heart failure were not excluded.
I – Conventional medical treatment and chest PT consisting of postural drainage, percussion, vibration and forced coughing
C – Conventional medical treatment with postural drainage alone
O – Forced Expiratory Volume in one minute, FEV₁

Similarity/Dissimilarity to my PICO:

The population and intervention were similar to my clinical PICO and the PEDro score is low.

Table 1 compares my personally-ranked PEDro scores for each article reviewed using the PEDro scoring criteria.⁹

Table 1. Comparison of PEDro Scores

	Anthonisen P, <i>et al.</i>	Buscaglia A J, <i>et al.</i>	Campbell A, <i>et al.</i>
Randomization	-	-	-
Concealed Allocation	-	-	-
Baseline Comparability	1	1	-
Blind Subjects	-	-	-
Blind Therapists	-	-	-
Blind Assessors	-	-	-
Adequate Follow-up	-	1	1
Intention-to-Treat	-	1	-
Between Group	-	1	1
Point Estimates and Variability	-	-	1
Total Score	1/10	4/10	3/10

Based on the above comparisons, I have chosen to write this critically appraised paper on the two articles by Anthonisen P, *et al.* and Buscaglia A J. *et al.* These two articles had the most similarities to my clinical PICO and/or the highest PEDro scores. While researching this topic, I discover that the majority of the research was done from the late 1960's to mid 1980's with several more recent literature reviews based on this older research. To complete my own literature review of this specific topic it was imperative I look at this older, original research.

Article: Anthonisen P, Riis P, and Sogaard-Anderson T. The Value of Lung Physiotherapy in the Treatment of Acute Exacerbations on Chronic Bronchitis. *Acta Med Scand* 1964; 175(6):715-9.

Clinical Bottom Line: Based on the results of this study, there is weak evidence to suggest that for patients averaging the age of 60 years, hospitalized with an acute flare-up of chronic bronchitis, an intervention of conventional medical treatment plus chest physical therapy consisting of postural drainage, tapotement, vibrations and expansion exercises results in no significant difference in sputum production and PaO₂ when compared to conventional medical treatment alone. The authors reported no statistical significant difference in sputum volume and PaO₂. However, the lack of a placebo group, randomization, analysis of subjects at baseline, power analysis and intention-to-treat show poor study internal validity. Also, no tests or statements were reported regarding outcome measure reliability. Further research is needed with a stronger study design to understand the suitability of chest PT (postural drainage, percussion and/or vibration) for subjects with acute flare-ups of chronic bronchitis.

Article PICO:

Population – 69 adults (average age of 60 years) admitted to Glostrup Hospital, Denmark with acute flare-up of chronic bronchitis

Intervention – Conventional medical treatment plus chest physical therapy consisting of postural drainage, tapotement, vibrations and expansion exercises

Comparison – Conventional medical treatment alone

Outcomes – Temperature, sputum volume, PaO₂, PaCO₂

Blinding: There was no blinding of subjects, therapists, or assessors. The lack of blinding is not a threat to validity as the outcome measures were objective measures read from machines.

Controls: There was a control group that received only conventional medical treatment (defined in Study section below). The only difference in the treatment versus the control group was the addition of chest physical therapy in the treatment group; therefore, the control group was an appropriate comparison group. There were no prognostic differences at baseline between groups. There was no placebo group to account for maturation of the condition; however, it would not be considered ethical to do nothing for patients with acute flare-ups of chronic bronchitis.

Randomization: There was no formal randomization of subjects. When patients were admitted to the hospital, they were allocated based on day of admission to either the treatment or the control group. Allocation based on odd or even days of the week is a weak form of randomization. The authors did not mention concealment to subjects, therapists, or assessors to group allocation. Subjects in the treatment and control groups were reported to be similar at baseline in regards to number of patients with severe COPD, age, sex, and other medical complications that may be expected to influence prognosis though no statistical analysis was performed.

Study: This was a quasi-experimental study. A total of 63 patients participated (two subjects were admitted multiple times and were treated in different groups). Therefore, there were 68 episodes of acute exacerbations of COPD; 35 in the treatment group and 33 in the control group. Age ranges were not stated but the average for all participants was 60 yrs. Inclusion criteria were acute chronic bronchitis flare-up, defined as having a cough for at least 6 months, having acute deterioration, raised temperature and muco-purulent expectorate. No exclusion criteria were enforced; many patients had complications such as chronic *cor pulmonale*, dependent edema, obesity, cardiac insufficiency and thorax deformity. Both groups received medical treatment consisting of antibiotics, bed-rest, and if appropriate digitalis,

theophylline, diuretics, expectorants and supplemental oxygen. The treatment group also received "lung physiotherapy" or chest PT from a trained physical therapist consisting of expansion exercises, tapotement or vibrations and postural drainage daily for 10 days. No further elaboration was given regarding the chest PT.

Outcome Measures: The outcome measures relevant to my clinical question are sputum volume and PaO₂. They were measured every day for 10 days. Expectorant volumes of each subject were measured by the same person, then the group was averaged to form daily group expectorant values for 10 days. The authors did not mention whether these measures were done at the end of day or after treatment. Sixteen patients in the treatment group and 14 patients in the control group were considered to have respiratory insufficiency (PaO₂ ≤ 80% and/or PaCO₂ ≥ 45 mm Hg), so arterial blood gasses were taken almost daily only in these patients; mean change scores were reported. The reliability, validity, inter-rater, intra-rater reliability and MCID of sputum collection and PaO₂ measurement were not reported. The type of blood gas analyzer and method of sputum volume collection were not reported.

Study Losses: 69 subjects were initially included in the study and 6 were lost: 3 due to incomplete investigations, 1 died, and 2 had malignant disease. Three of the losses were from the control group. With regards to the arterial blood gasses, it is unclear exactly how many subjects were measured. It is clear that not every patient's arterial blood gas (PaO₂) was measured with every treatment; in the treatment group, only 75%-93% of patients were evaluated and 81% - 86% of patients in the control group. With regards to the measurements of expectoration volume, it is also unclear how many subjects were included in the data. The average percentage of patient expectoration measured throughout the study was 81.4% (range 29% - 97%) for the treatment group, and 75.4% (range 36% - 88%) in the control group. There was no explanation in the article for differences in measurements. Two subjects allocated to enter the treatment group were switched to the control group as they had received chest PT on prior admissions and requested it again. No intention-to-treat analysis was performed.

Summary of Internal Validity: The internal validity of this study is poor (PEDro score 1/10). There were seven threats I identified: two major, three moderate and two minor. The major threats include: a lack of randomization and statistical analysis of similarities at baseline. A lack of randomization can lead to selection bias and a lack of control for independent differences. Though the authors commented on the similarity of subjects at baseline, no statistical analyses of similarities were performed. The moderate threats include: lack of power analysis and intention-to-treat, and no statement as to the reliability of testers or instrumentation used. Power analysis and intention-to-treat analysis would have helped with statistical validity. The minor threats include: lack of a true control group and blinding. Having a placebo group can help control for outside influences like maturation, testing effects, and other events that affect outcomes of the treatment. However, this would not have been ethically plausible as it is unethical and illegal to refuse treatment to patients with this diagnosis. Independently, each missing validity threat would not be significant, but together, they threaten the validity of the outcomes.

Evidence: The outcomes measures I am interested in are sputum volume and PaO₂ for the ten-day period. Table 2 represents the oxygen saturation data collected from patients with severe COPD using the arterial blood gas method pre-intervention and post-intervention.

Table 2. Average oxygen saturation in select patients with severe COPD, baseline to end of 10 day period

	Treatment Group, n=16	Control Group, n=14
Average Oxygen Saturation, PaO ₂ , Pre-Test	72% ^a	74% ^b
Average Oxygen Saturation, PaO ₂ , Post-Test	77% ^c	80% ^d
Mean Change	5%	6%

a: Average from 15 patients. b: Average from 12 patients. c: Average from 12 patients. d: Average from 13 patients.

Because the authors only reported means, I was unable to run further statistical analyses of the data. To do this, I would need the standard deviations of average PaO₂ percentages. The authors reported no “definite” difference between groups; this may mean that the difference of 1% in average oxygen saturation between groups was not statistically significant. However, without showing the statistical tests used to present the raw data (to run my own analysis), it is not possible to state whether there was a statistically significant difference. While I was unable to find a MCID for PaO₂ in the COPD population, a 1% difference likely does not represent a clinically significant difference between groups. However, it would depend on the absolute PaO₂ value for each subject. For example, the difference between 77% and 78% may make a difference in a subject’s ability to eat without shortness of breath; whereas we would not anticipate a clinically significant difference between 92% and 93%, due to the shape of the oxyhemoglobin dissociation curve.

In regards to average daily expectorant volumes, the authors reported no statistically significant difference between the treatment and control group; therefore, there could not be a clinically significant difference between the groups. With no reported raw data, I am unable to run my own statistical analysis.

Applicability of the Study Results:

Benefits vs. Costs: There were limited costs to the inclusion of chest PT; therapist wages, time and money to educate therapist in the chest PT technique. There was negligible cost to the patient in terms of their time; they were in the hospital recovering regardless of the treatment given. No adverse events were reported in the treatment group. Regardless of the limited costs of this treatment, there was no evidence that this treatment was effective because there was no increase in sputum volume or improvement in PaO₂ due to inclusion of chest PT. However, the major threats to the internal validity of this study have put the lack of effectiveness of chest PT into question. Therefore, I cannot say whether there is a benefit to performing this treatment for this patient population.

Feasibility of treatment: The study lacked a descriptive procedure to recreate the treatment, but the equipment, a therapist and tilt table, would be available at most hospitals. Today, most patients would not be in the hospital more than five days according to the CDC⁴, leaving the ten-day inpatient protocol unrealistic. The procedure was not reported to be painful or having adverse effects. Due to the lack of descriptive

protocol and length of treatment, this treatment is not feasible regardless of the limited cost and availability of equipment.

Summary of external validity: Though the patient population appears to be similar to most inpatient populations suffering from acute exacerbations of COPD, the compromise to internal validity is such that these study results cannot be generalized to other populations.

Article: Buscaglia A, and St Marie MS. Oxygen Saturation during Chest Physiotherapy for Acute Exacerbation of Severe Chronic Obstructive Pulmonary Disease. *Respir Care* 1983; 28(8):1009-13.

Clinical Bottom Line: Based on the results of this study, there is weak evidence to suggest that for patients 57 to 83 years of age hospitalized with acute exacerbations of chronic obstructive pulmonary disease with little to no sputum production, an intervention of chest physical therapy of postural drainage with percussion and vibration resulted in no statistically or clinically significant change in SpO₂ when compared to not receiving chest physical therapy. This quasi-experimental pre- to posttreatment designed study lacked a control group, randomization, and an analysis of subjects at baseline. The authors chose to only include subjects with little to no sputum production, which is the primary indication for chest physical therapy. This study would need to be repeated with a large number of sputum-producing subjects, randomized into two groups, and included more thorough data analyses of subjects at baseline to determine whether chest PT is effective at increasing SpO₂ for patients suffering from acute exacerbations of COPD.

Article PICO:

Population – 10 adults (average age 57 to 83 years old) hospitalized for acute exacerbation of severe chronic airway obstruction and abnormal gas exchange

Intervention – Postural drainage with percussion and vibration

Comparison – With-in-group post-treatment oxygen saturation, (SpO₂)

Outcome – Oxygen saturation as measured by pulse oximetry, (SpO₂)

Blinding: There was no blinding of subjects, therapist or assessors. A lack of blinding is not a threat to validity as the outcome measure was an objective measures read from a machine.

Controls: There was no control group. This quasi-experimental study was a pretreatment-posttreatment design with one group of subjects. Without a control group there is a lack of understanding of external effects, such as similarity of subjects to each other at baseline and maturation. This can affect research outcomes.

Randomization: There was no randomization of subjects. Subjects were consecutively selected upon admission to Mercy Hospital, New York for inclusion into the study. There was no statistical analysis to determine the similarity of patients at baseline. Therefore, the best way to analyze the data is as a within-subject pre-treatment to post-treatment analysis. By reviewing the data provided by the authors, it does not appear that these subjects were similar at baseline. Though the authors classified them as having severe airway obstruction, there was a wide range in their baseline data: subjects' use of nasal cannula varied from none to 2 L, chest-radiograph findings varied from hyperinflation and fibrosis to cardiomegaly, SpO₂ varied from 60 mmHg to 82 mmHg, and FEV1 and FEV1/FVC have extremes with varied forces expiratory volumes.

Study: This was a quasi-experimental study pretreatment-posttreatment design. Seven men and three women, with an age range of 57 to 83 years were recruited over a period of several months. Inclusion criteria was the presence of severe chronic airway obstruction and hospitalization for acute exacerbations of this disease. Exclusion criteria were subjects in an ICU, receiving mechanical ventilation, complications such as left-sided heart failure, pneumonia and atelectasis as determined by a chest radiograph. All subjects' COPD severity was reported to be similar at baseline in terms of resting arterial blood gas oxygen (PaO₂) and carbon dioxide saturation (PaCO₂) as measured by ABG, as well as FEV1 and FEV/FVC. However, further analysis of the baseline data shows extremes in the subjects FEV1 and FEV/FVC data. There was

no statistical analysis of patients at baseline in terms of prognostic variables. The treatment intervention included six positions; sitting, supine Trendelenburg, supine Trendelenburg with chest PT, prone Trendelenburg, prone Trendelenburg with chest PT and ending in sitting. Chest PT consisted of ten minutes of clapping on specific areas of the chest focusing on certain lung lobes after lying in each position for ten minutes. This was followed by one to two minutes of vibration and compression in the same region. Each position was maintained for ten minutes and a pulse oximetry (SpO₂) reading was taken after ten minutes in each position and after each chest PT administration.

Outcome measures: The outcome measure relevant to my clinical question is oxygen saturation after each chest PT position. Oxygen saturation (SpO₂) measured by an ear oximeter was used before treatment and after every position. Authors reported the validity of the pulse oximeter (Model 47201 A, Hewlett-Packard Co, Waltham MA) by referencing previous studies. In those studies, there was good correlation between measurements taken by pulse oximetry to arterial oxygen saturation measurements (SaO₂) collected by arterial blood gas sampling, which is the gold standard. The reliability of ear oximetry was not reported in this or referenced in previous studies. Validity and reliability tests of pulse oximetry were not performed in this study: the authors showed no correlation of the pulse oximeter to arterial blood gases (the gold standard) from the subjects and no test-re-test reliability. An MCID of change in SpO₂ was not discussed by the authors and I was unable to find a stated MCID for this patient population in the literature. However, with an understanding of the oxyhemoglobin dissociation curve, a slight change in SpO₂ may be significant to the subject, depending on the subject's baseline percentage of oxygen saturation. For example, the difference between 77% and 78% may make a difference in a subject's ability to eat without shortness of breath. In contrast, we would not anticipate a clinically significant difference between 92% and 93%, due to the shape of the oxyhemoglobin dissociation curve.

Study Losses: All ten subjects completed every stage of the study. There were no study losses so an intention-to-treat analysis did not need to be performed.

Summary of internal validity: The internal validity of this study is fair (PEDro score 4/10). There were two major threats I identified. These threats were a lack of randomization and no control group. Lack of randomization can lead to selection bias and a lack of control of subject differences. The lack of a control group can impede researchers' understanding of outside influences on outcomes such as maturation. The authors addressed validity of the outcome measurement tool and had a strict protocol that would help with reliability of measurements. When comparing the threats to validity to the positive factors of this study's internal validity, outcomes of this study should be considered cautiously.

Evidence: The outcome measure I am interested in is oxygen saturation. I would like to know if there is a change in SpO₂ post-treatment as compared to pre-treatment. Due to the lack of statistical analysis showing subject similarity at baseline, the evidence is best analyzed within-subject rather than between-subject. All chest PT positions SpO₂ measurements were reported by the authors. There was a total of 44 minutes of treatment: including 20 minutes of postural drainage only (supine Trendelenburg and prone Trendelenburg) plus 24 minutes of percussion/vibration with postural drainage. Table 3 shows within-subject pre- to post-treatment change in SpO₂ as well as mean change within-subject.

Table 3. Within-subject pre and post CPT change in SpO₂ in sitting position for each of ten subjects

Subject	1	2	3	4	5	6	7	8	9	10
Initial Sitting	91.5	95	93	93	94	90	92	92	93	95
Ending Sitting	93.5	94.5	92	95	94	91	92.5	92	93	95
Mean Change	2	-0.5	-1	2	0	1	0.5	0	0	0

Overall, the authors reported that there were no statistically significant changes after chest physical therapy. However, the authors analyzed pre-treatment to post-treatment between-subjects (mean change score). With no baseline similarity between subjects reliably presented, this would not be an appropriate analysis. It is also worth noting that a pulse oximeter does not report oxygen saturation with decimals (*e.g.*, 0.5) and I do not know where the authors may have gotten these numbers.

In Table 3, I evaluated the data within-subject and found that after chest physical therapy, four subjects had a positive change, three had no change and two had a negative change in SpO₂.

Though no MCID was reported for SpO₂, I would strongly suggest that if one were found, a positive change of two or a negative change of one would likely not be clinically significant for two reasons. First, most patients would not notice a difference in their oxygen saturation, depending of where they were on the oxyhemoglobin dissociation curve. Second, the accuracy of the oximeter is variable. In 1999, Amal Jubran stated the average accuracy of pulse oximeters is <2% (SD: <3%) when actual arterial blood gas oxygen saturation is above 90%. The accuracy can vary widely when SaO₂ is below 80% or other factors such as anemia and poor perfusion of extremities is involved. None of the ten subjects experienced a clinically significant change: none of the subjects' oxygen saturation was below 90% and none had more than a 2% change in SpO₂.

Applicability of study results:

Benefits vs. Costs: There were limited costs to this chest PT treatment: therapist wages and time and money to educate therapist in the chest PT technique (which is an entry-level PT skill). There was negligible cost to the patient in terms of their time; they were in the hospital recovering regardless of the treatment given. No adverse events were reported. Regardless of the limited costs of this treatment, there was no evidence that this treatment was effective because there was no statistically or clinically significant increase in SpO₂ due to the chest PT treatment. However, the major threats to the internal validity of this study have put the outcomes into question. Furthermore, chest PT was designed as a treatment to reduce lung secretions; this study's subjects did not suffer from copious amounts of secretions. The study design was such that patients with secretions were excluded. Therefore, I question why the authors chose these subjects and am not surprised there was no benefit of chest PT for these subjects. There is no benefit of this treatment for a patient population without copious lung secretions.

Feasibility of treatment: Though the cost is low, the treatment procedure was stated in detail, and most hospitals have access to equipment and therapists, there was no change in SpO₂ from the beginning to the end of treatment. Chest PT should likely not be a treatment of choice for acute exacerbations of COPD for patients with limited to no sputum production.

Summary of external validity: The patient population does not appear to be similar to most inpatient populations suffering from acute exacerbations of COPD and the compromise to internal validity is such that these study results cannot be generalized to other populations. Also, the exclusion criteria would also make it difficult to generalize the outcomes of this study to other populations who often have co-morbidities and sputum production.

Discussion/Synthesis: The purpose of the articles by Anthonisen *et al.* and Buscaglia *et al.* was to assess the appropriateness of chest physical therapy as a treatment for acute exacerbations of COPD. Anthonisen *et al.* assessed sputum volume and PaO₂, while Buscaglia *et al.* assessed SpO₂. Both articles had significant threats to internal validity. Anthonisen *et al.* had seven threats ranging from major to minor: lack of randomization and statistical analysis of similarities at baseline, lack of power analysis and intention-to-treat, and lack of a true control group and blinding. Independently, each missing validity threat would not have been significant, but together, they threaten the validity of the outcomes and the study was given a PEDro score 1/10. Buscaglia *et al.* had two major threats: lack of randomization and no control group. The authors addressed validity of the outcome measurement tool and a strict protocol was reported. Though this study was given a PEDro score of 4/10, the study population was not appropriate for the intervention. The exclusion criteria included that all subjects with sputum production were eliminated. However, sputum production is the main indication for chest PT. With both studies lacking strong internal validity and one article lacking appropriate subjects, neither can be used to answer my clinical question. At this time, more research needs to be completed with stronger protocols and study designs to answer the question of whether chest physical therapy is an appropriate treatment for patients suffering from acute exacerbations of COPD.

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