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Article: Chest physiotherapy for pneumonia in adults

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ABSTRACT

Background
Despite conflicting evidence, chest physiotherapy has been widely used as an adjunctive treatment for adults with pneumonia.

Objectives
To assess the effectiveness and safety of chest physiotherapy for pneumonia in adults.

Search methods

Selection criteria
Randomised controlled trials (RCTs) assessing the efficacy of chest physiotherapy for treating pneumonia in adults.

Data collection and analysis
Two authors independently assessed trial eligibility, extracted data and appraised trial quality. Primary outcomes were mortality and cure rate. We used risk ratios (RR) and mean difference (MD) for individual trial results in the data analysis. We performed meta-analysis and measured all outcomes with 95% confidence intervals (CI).

Main results
Six RCTs (434 participants) appraised four types of chest physiotherapy (conventional chest physiotherapy; osteopathic manipulative treatment (which includes paraspinal inhibition, rib raising and myofascial release); active cycle of breathing techniques (which include active breathing control, thoracic expansion exercises and forced expiration techniques); and positive expiratory pressure).

None of the physiotherapies (versus no physiotherapy or placebo) improved mortality rates of adults with pneumonia.
Conventional chest physiotherapy (versus no physiotherapy), active cycle of breathing techniques (versus no physiotherapy) and osteopathic manipulative treatment (versus placebo) did not increase the cure rate or chest X-ray improvement rate.

Osteopathic manipulative treatment (versus placebo) and positive expiratory pressure (versus no physiotherapy) reduced the mean duration of hospital stay by 2.0 days (mean difference (MD) -2.0 days, 95% CI -3.5 to -0.6) and 1.4 days (MD -1.4 days, 95% CI -2.8 to -0.0), respectively. Conventional chest physiotherapy and active cycle of breathing techniques did not.

Positive expiratory pressure (versus no physiotherapy) reduced fever duration (MD -0.7 day, 95% CI -1.4 to -0.0). Osteopathic manipulative treatment did not.

Osteopathic manipulative treatment (versus placebo) reduced the duration of intravenous (MD -2.1 days, 95% CI -3.4 to -0.9) and total antibiotic treatment (MD -1.9 days, 95% CI -3.1 to -0.7).

Limitations of this review are that the studies addressing osteopathic manipulative treatment were small, and that six published studies which appear to meet the inclusion criteria are awaiting classification.

Authors' conclusions

Based on current limited evidence, chest physiotherapy might not be recommended as routine additional treatment for pneumonia in adults.

PLAIN LANGUAGE SUMMARY

**Chest physiotherapy for pneumonia in adults**

Pneumonia is one of the most common health problems affecting all age groups around the world. Antibiotics represent the mainstay of pneumonia treatment, while other therapies are mostly supportive. Chest physiotherapy has been widely used as an adjunctive therapy for pneumonia in adults without any reliable evidence.

Six randomised controlled trials assessing 434 participants were included. The studies appraised four types of chest physiotherapy, namely conventional chest physiotherapy, osteopathic manipulative treatment (including paraspinal inhibition, rib raising, and diaphragmatic or soft myofascial release), active cycle of breathing techniques (including active breathing control, thoracic expansion exercises and forced expiration technique) and positive expiratory pressure. None of these techniques (versus no physiotherapy or placebo therapy) reduce mortality. Among three of the techniques (conventional chest physiotherapy, active cycle of breathing techniques and osteopathic manipulative treatment) there is no evidence to support a better cure rate in comparison with no physiotherapy or placebo therapy. Limited evidence indicates that positive expiratory pressure (versus no physiotherapy) and osteopathic manipulative treatment (versus placebo therapy) can slightly reduce the duration of hospital stay (by 2.02 and 1.4 days, respectively). In addition, positive expiratory pressure (versus no physiotherapy) can slightly reduce the duration of fever by 0.7 day, and osteopathic manipulative treatment (versus placebo therapy) might reduce the duration of antibiotic use by 1.93 days. No severe adverse events were found.

In summary, chest physiotherapy should not be recommended as routine additional treatment for pneumonia in adults. The limitation of our review is that six published studies which appear to meet the inclusion criteria are awaiting classification (five of which are published in Russian).

**BACKGROUND**

**Description of the condition**

Pneumonia is caused most commonly by bacteria but occasionally by viruses, fungi, parasites and other infectious agents. It is the leading cause of death from infectious disease (Niederman 2001). Pneumonias are typically classified as community-acquired pneumonia, hospital-acquired pneumonia (nosocomial pneumonia) and ventilator-associated pneumonia (the most serious form of nosocomial pneumonia, infecting patients who are mechani-
cally ventilated for other reasons). It is estimated that community-
acquired pneumonia costs the United States USD 12.2 billion in
treatment per year (Colice 2004), with an average mortality rate
of 14% (Fine 1990). Nosocomial pneumonia is the second most
common nosocomial infection and the leading cause of death from
hospital-acquired infection (Bowton 1999).

**Description of the intervention**
Antibiotics represent the mainstay of pneumonia treatment, while
other therapies are mostly supportive. These adjunctive therapies
include supplementary oxygen, intravenous hydration and chest
physiotherapy (George 1995). Chest physiotherapy is an airway
clearance technique that combines manual percussion of the chest
wall by a caregiver, strategic positioning of the patient for mucous
drainage, and teaching cough and breathing techniques.

Conventional chest physiotherapy includes postural drainage, per-
cussion, chest shaking, huffing and coughing. Recently, several
new physiotherapy techniques have been developed, including the
active cycle of breathing techniques, positive expiratory pressure
and osteopathic manipulative treatment. Active cycle of breathing
techniques include active breathing control, thoracic expansion
exercises and forced expiration technique, and sometimes postural
drainage and chest clapping. Positive expiratory pressure uses de-
vice to provide a positive expiratory pressure of 10 to 25 cmH_2O
during expiration. It may stabilise airways by keeping them open
during expiration, which may facilitate airway clearance. Osteo-
pathic manipulative treatment includes bilateral paraspinal inhibi-
tion, bilateral rib raising, diaphragmatic myofascial release and
soft myofascial release to the anterior thoracic inlet. It may im-
prove chest wall mobility and enhance exercise tolerance.

**How the intervention might work**
Chest physiotherapy assists in treating some of the symptoms of
respiratory disorders, such as airflow obstruction, alterations in
ventilatory pump functions and impaired exercise performance.
The aim is to improve the patient’s respiratory status and expedite
recovery by enhancing airway clearance in lung diseases associ-
ated with hypersecretion and reduced airway resistance. Increased
airway clearance enhances gas exchange and reduces the work of
breathing (Wallis 1999). Chest physiotherapy is best used for pa-
ients with copious secretions (more than 30 ml/day) and reduced
ability to cough (Cochrane 1977; Graham 1978).

**Why it is important to do this review**
Chest physiotherapies for cystic fibrosis, acute bronchiolitis and
patients undergoing mechanical ventilation have been reviewed
(Flenady 2010; Roqué i Figuls 2012; Van der Schans 2009). How-
ever, the clinical effectiveness of chest physiotherapy for pneu-
omia is controversial. Some clinical studies have concluded that
chest physiotherapy did not hasten the resolution of pneu-
omia (Graham 1978) or was not useful (Britton 1983; Britton
1985). Two studies suggested that larger or multi-centre trials
were needed to confirm the findings (Ntoumenopoulos 2002;
Tydeman 1989). Others concluded that chest physiotherapy had
beneficial effects in patients with pulmonary infection (Hanying
2005). However, chest physiotherapy may be ineffective and even
harmful. It may cause an increase in oxygen consump-
tion (Horiuchi 1997; Weissman 1991; Weissman 1993), bron-
chospasm (Campbell 1975), induce hypertension, increase oxy-
gen demand (Horiuchi 1997; Weissman 1993), cause hypoxaemia
(Connors 1980; Poelaert 1991) and even lead to rib fractures
(Chalumeau 2002).

To our knowledge, no systematic review or meta-analysis of chest
physiotherapy for pneumonia has been published. This review
aims to systematically review all randomised controlled trials
(RCTs) which examine the effectiveness of chest physiotherapy for
pneumonia in adults.

**OBJECTIVES**
To assess the effectiveness and safety of chest physiotherapy for
pneumonia in adults.

**METHODS**

**Criteria for considering studies for this review**

**Types of studies**
We considered all randomised controlled trials (RCTs) assessing
the efficacy of chest physiotherapy for adult participants with any
type of pneumonia. We included trials which also included other
basic respiratory diseases, once pneumonia was diagnosed; we anal-
ysed such trials separately. We excluded trials in which physiother-
apy was administered for the prevention of pneumonia, as pneu-
omia could occur in many conditions, such as trauma, cerebral
vessels disease and postoperative conditions. We included both
published and unpublished trials.

**Types of participants**
Adult participants (older than 18 years of age) of either gender,
with any type of pneumonia. Pneumonia was defined by each original
trial author. We included intubated or non-intubated participants.
Types of interventions
Chest physiotherapy of any type was compared with no chest physiotherapy. We included trials using traditional chest physiotherapy. We included trials using mechanical devices which have the same effect as traditional chest physiotherapy. We considered the following methods: postural drainage, chest percussion, vibration, thoracic oscillation, chest shaking, huffing, directed coughing, thoracic expansion, forced exhalation or expiration techniques and manual hyperinflation.

Types of outcome measures

Primary outcomes
1. Mortality.
2. Cure rate (the definitions of 'cure' and the 'time to cure' were determined by original trial authors).

Secondary outcomes
1. Duration of hospital stay (days).
2. Healing time (days) (subjective or objective assessment of time to complete recovery).
3. Duration of fever (days) (fever defined as more than 37.5 degrees).
4. Rate of improvement of chest X-ray (chest X-ray improvement was defined as any improvement on chest X-ray after treatment compared with before treatment. The assessment could be made by radiologists or clinicians).
5. Duration of antibiotic therapy (days).
6. Duration of sputum production (days).
7. Duration of leukocytosis (days).
8. Change in leukocyte count.
9. Mean leukocyte count.

Adverse events
We defined serious adverse events according to the International Conference on Harmonisation (ICH) Guidelines (ICH 1997) as any event that: leads to death, is life-threatening, requires in-patient hospitalisation or prolongation of existing hospitalisation, results in persistent or significant disability, and any important medical event which may harm the patient or requires intervention to prevent it. All other adverse events were considered non-serious.

Search methods for identification of studies

Electronic searches

We used the following search strategy to search CENTRAL and MEDLINE. We combined the MEDLINE search with the Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE; sensitivity- and precision-maximising version (2008 revision), Ovid format (Lefebvre 2011). We adapted these search terms to search EMBASE (see Appendix 2), PEDro (see Appendix 3) and CINAHL (see Appendix 4).
**Searching other resources**

We handsearched related journals. We did not impose any language or publication restrictions.

**Data collection and analysis**

**Selection of studies**

Two review authors (XLY, BYW) independently searched the databases. Two review authors (BYW, YPY) independently assessed the titles and abstracts to identify potentially relevant articles. We excluded the trials which failed to meet the inclusion criteria. Differences were resolved by the arbitrator (BRD).

**Data extraction and management**

Two review authors (XLY, BYW) independently extracted data using a standardised form. A third review author (MY) checked the extracted data. Extracted data included, where possible:

- description of participants (including age, gender, type of pneumonia);
- severity of pneumonia;
- basic conditions and setting;
- description of intervention (details of chest physiotherapy, including type, frequency, intensity and time);
- description of control therapy;
- methodological details (including design and recruitment);
- method of randomisation;
- sample size;
- trial inclusion and exclusion criteria;
- withdrawals;
- description of outcomes (including mortality, duration of hospital stay, adverse events, cure, healing time, rate of clearing of X-ray film and duration of fever); and
- source of funding.

**Assessment of risk of bias in included studies**

Two review authors (XLY, BYW) independently assessed trial quality based on the generation of the allocation sequence, allocation concealment, blinding and follow-up. Finally, we assessed the risks of bias as follows: A = low risk of bias (all of the criteria met); B = moderate risk of bias (one or more criteria partly met); C = high risk of bias (one or more criteria not met). Differences were resolved by the arbitrator (BRD).

The detailed quality components were as follows.

**Generation of the allocation sequence**

Adequate: computer-generated random numbers, table of random numbers, or similar.
Unclear: the trial was described as randomised, but the generation of the allocation sequence was not described. Inadequate: the allocation sequence was generated by some rules based on date of admission, record number, date of birth, and so on.

**Allocation concealment**

Adequate: concealed up to the point of treatment by central randomisation, sealed envelopes or similar.
Unclear: the allocation concealment procedure was not described. Inadequate: open table of random numbers or similar.

**Blinding**

Adequate: since the intervention of chest physiotherapy was extremely difficult to mask completely, it was rare to have double-blinding. Hence, we considered single-blinding as adequate.
Unclear: if the method of blinding was not described.
Not performed: if the trial was not blinded.

**Follow-up**

Adequate: if the numbers and reasons for drop-outs and withdrawals in all intervention groups were described or if it was specified that there were no drop-outs or withdrawals.
Unclear: if the report gave the impression that there had been no drop-outs or withdrawals, but this was not specifically stated.
Inadequate: if the number or reasons for drop-outs and withdrawals were not described.

**Measures of treatment effect**

We expressed dichotomous data, such as cure rate or mortality, as risk ratios (RR). We expressed continuous data, such as duration of fever, as mean differences (MD). We reported all outcomes with 95% confidence intervals (CIs).

**Unit of analysis issues**

The unit of analysis was the individual, because all RCTs included in this review were simple parallel-group trials in which participants were randomly allocated to several groups and a single result for each outcome from each individual was collected and analysed. There were no complicated designs, such as cross-over or cluster-randomisation, used in the included RCTs.
Dealing with missing data
We contacted trial authors (by e-mail, letter or fax) to search for additional papers, and to confirm data extraction and obtain missing data.

Assessment of heterogeneity
We assessed heterogeneity in trial results by inspecting the forest plots to detect non-overlapping CIs, applying the Chi² test with a P value of 0.10 indicating statistical significance, and implementing the I² statistic (with a value of 50% to denote moderate levels of heterogeneity). In the case of heterogeneity between studies, we made efforts to explore sources of heterogeneity due to various factors, such as type of pneumonia and type of physiotherapy.

Assessment of reporting biases
We could not perform a funnel plot analysis to identify reporting biases because of the small number of included studies.

Data synthesis
We used RevMan (version 5.0) (RevMan 2011) to combine some outcomes. We used a fixed-effect model unless significant heterogeneity was noted; in which case we used a random-effects model. We calculated both the effect sizes and the summary measures with their 95% CIs.

Subgroup analysis and investigation of heterogeneity
We performed a subgroup analysis for different types of chest physiotherapies and outcomes.

Sensitivity analysis
We did not perform a sensitivity analysis in this review.

RESULTS

Description of studies
See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of studies awaiting classification; Characteristics of ongoing studies.
See the ‘Characteristics of included studies’ and ‘Characteristics of excluded studies’ tables.

Results of the search
In this 2012 update we retrieved a total of 835 records from the electronic databases after duplicates had been removed. After screening the titles and abstracts we identified two publications (Dangour 2011; Noll 2008) as potentially eligible, which we retrieved in full text. However, both of them were excluded.

In the 2009 search we retrieved 1329 articles by electronic database searching (383 in MEDLINE, 452 in EMBASE, 105 in CBM, 378 in CENTRAL, six in PEDro and five in the National Research Register). After screening the titles and abstracts we identified 68 trials as potentially relevant, which we retrieved in full text. Among those, six trials (Bjorkqvist 1997; Britton 1985; Graham 1978; Noll 1999; Noll 2000; Tydeman 1989) met the inclusion criteria (see 'Characteristics of included studies' table). Seven trials which appeared to meet the inclusion criteria have not yet been included or excluded in this review, as five of them (Kuznetsov 1976; Kuznetsov 1980a; Kuznetsov 1980b; Sedov 1975; Vorob’ev 1984) are published in Russian, one (Facto 1947) was published in 1947 and we have not yet managed to retrieve the full text, and the seventh trial (Noll) is as yet unpublished.

Included studies
Six trials (Bjorkqvist 1997; Britton 1985; Graham 1978; Noll 1999; Noll 2000; Tydeman 1989) were included in this review, of which three (Graham 1978; Noll 1999; Noll 2000) were conducted in the United States, two (Bjorkqvist 1997; Britton 1985) in Sweden, and one (Tydeman 1989) in the United Kingdom. All of them were randomised, parallel-group controlled trials.

Participants
In total, 434 participants (215 males, 219 females) were involved in the six trials, with 211 participants in the treatment group and 223 participants in the control group. The participants' ages ranged from 15 to 94 years. The included trials involved participants with acute pneumonia. Two trials (Bjorkqvist 1997; Tydeman 1989) included community-acquired pneumonia only, two trials (Noll 1999; Noll 2000) included community-acquired pneumonia, nosocomial pneumonia and nursing home-acquired pneumonia. The remaining two trials (Britton 1985; Graham 1978) did not describe the type of pneumonia. The severity of pneumonia was mild to moderate in two trials (Graham 1978; Tydeman 1989), and not stated in the other four trials (Bjorkqvist 1997; Britton 1985; Noll 1999; Noll 2000). The baseline characteristics of the experiment and control groups of each included trial were comparable.

Interventions
Two trials (Noll 1999; Noll 2000) compared chest physiotherapy and routine treatment to placebo and routine treatment. In the
other four trials (Bjorkqvist 1997; Britton 1985; Graham 1978; Tydeman 1989) chest physiotherapy and routine treatment was compared with routine treatment alone. Among these trials, the types of chest physiotherapies were significantly different to each another, including conventional chest physiotherapy, osteopathic manipulative treatment, active cycle of breathing techniques and positive expiratory pressure. Both treatment groups and control groups were given routine treatments such as antibiotics, oxygen therapy and other drug therapies, if necessary.

Outcome measures
The primary outcomes were mortality and cure rate. Mortality could be calculated from data from all included trials. However, cure rate was calculated from five included trials (Britton 1985; Graham 1978; Noll 1999; Noll 2000; Tydeman 1989). The following secondary outcomes were reported in some of the included trials:

- duration of hospital stay (Bjorkqvist 1997; Britton 1985; Graham 1978; Noll 1999; Noll 2000; Tydeman 1989);
- healing time (Britton 1985);
- duration of fever (Bjorkqvist 1997; Britton 1985; Graham 1978);
- rate of improvement of chest X-ray (Graham 1978; Noll 1999; Noll 2000; Tydeman 1989);
- duration of antibiotic therapy (Noll 1999; Noll 2000; Tydeman 1989);
- duration of sputum production (Tydeman 1989);
- in-patient sputum weight (Tydeman 1989);
- duration of leukocytosis (Noll 1999);
- change in leukocyte count (Noll 2000);
- mean leukocyte count (Noll 2000); and
- adverse effects: one trial (Noll 2000) reported adverse effects, another trial (Bjorkqvist 1997) stated no side effects were reported during the period of study, and the remaining trials did not discuss this outcome.

Excluded studies
For reasons for excluding studies please see the 'Characteristics of excluded studies' table.

Risk of bias in included studies
The detailed risk of biases and quality of each study are explained in the Characteristics of included studies table. We identified none of the included trials as 'low risk of bias', we assessed three trials (Graham 1978; Noll 1999; Noll 2000) as 'moderate risk of bias', and we assessed three trials (Bjorkqvist 1997; Britton 1985; Tydeman 1989) as 'high risk of bias' (Figure 1; Figure 2). None of the studies were supported by pharmaceutical company funding.

Figure 1. 'Risk of bias' graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.
Figure 2. 'Risk of bias' summary: review authors' judgements about each risk of bias item for each included study.

<table>
<thead>
<tr>
<th></th>
<th>Random sequence generation (selection bias)</th>
<th>Allocation concealment (selection bias)</th>
<th>Blinding (performance bias and detection bias)</th>
<th>Incomplete outcome data (attrition bias)</th>
<th>Selective reporting (reporting bias)</th>
<th>Other bias</th>
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<td>Bjorkqvist 1997</td>
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</table>
Allocation

All six trials explicitly stated that randomisation was used in their studies. However, none mentioned the method of randomisation. Only three studies clearly described the method of allocation concealment (Bjorkqvist 1997; Britton 1985; Graham 1978).

Blinding

Participants and outcome assessors were blinded in two studies (Noll 1999; Noll 2000). In one trial (Britton 1985) only participants were blinded. Two studies (Bjorkqvist 1997; Tydeman 1989) clearly stated that blinding was not conducted. One study (Graham 1978) did not describe whether blinding was used or not.

Incomplete outcome data

Each of the included studies had a statement on drop-outs or withdrawals. Two studies (Noll 1999; Noll 2000) had no drop-outs, and four studies (Bjorkqvist 1997; Britton 1985; Graham 1978; Tydeman 1989) had more than 10% drop-outs. An intention-to-treat (ITT) analysis was not used in these four studies (Bjorkqvist 1997; Britton 1985; Graham 1978; Tydeman 1989).

Selective reporting

There was no evidence of selective outcome reporting.

Other potential sources of bias

One trial (Britton 1985) did not report the standard deviation of duration of hospital stay and fever.

Effects of interventions

Because of the obvious clinical heterogeneity between different chest physiotherapies, we presented the results as comparisons between:

1. conventional chest physiotherapy plus routine treatment versus routine treatment alone;
2. active cycle of breathing techniques plus routine treatment versus routine treatment alone;
3. osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment; and
4. positive expiratory pressure plus routine treatment versus routine treatment alone.

We only used a placebo with the osteopathic manipulative treatment because in the two trials (Noll 1999; Noll 2000) using this therapy, participants in the control group received standardised light touch treatment as placebo, in addition to the routine treatment. In the remaining trials, participants in the control group received routine treatment alone.

1. Conventional chest physiotherapy plus routine treatment versus routine treatment alone

Two trials (Britton 1985; Graham 1978) including 225 participants, with 110 participants in the treatment group and 115 participants in the control group, appraised the effect of conventional chest physiotherapy.

1.1 Primary outcomes

1.1.1 Mortality

The meta-analysis of the two trials (Britton 1985; Graham 1978) using a fixed-effect model indicated that there was no significant difference between conventional chest physiotherapy plus routine treatment and routine treatment alone (risk ratio (RR) 1.03, 95% confidence interval (CI) 0.15 to 7.13) (Figure 3).

![Figure 3. Forest plot of comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone, outcome: 1.1 Mortality.](image-url)
1.1.2. Cure rate

Among the two included trials (Britton 1985; Graham 1978), all participants were cured in both treatment group and control group in one trial (Britton 1985); the other trial (Graham 1978) reported that cure rates in the treatment group and control group were 59.26% and 70.37%, respectively. However, there was no significant difference between the two groups (RR 0.84, 95% CI 0.57 to 1.25) (Figure 4).

![Figure 4. Forest plot of comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone, outcome: 1.2 Cure rate.](image)

1.2 Secondary outcomes

1.2.1 Duration of hospital stay

Meta-analysis could not be performed, as one of the included trials (Britton 1985) did not report the standard deviation of duration of hospital stay. This study (Britton 1985) found that “there was no significant difference between the treatment and control groups” (P value was not available). The other trial (Graham 1978) reached a similar result (mean difference (MD) 0.7 day, 95% CI -1.39 to 2.79).

1.2.2 Duration of fever

One of the included trials (Britton 1985) did not report the standard deviation of duration of fever, therefore meta-analysis could not be carried out. Britton (Britton 1985) found the mean duration of fever in the treatment group and control group was 6.8 and 4.9 days, respectively (P < 0.01). The other trial (Graham 1978) reported the mean duration of fever in treatment group and control group was 2.9 and 2.5 days, respectively. However, there was no statistical significance between the groups (P = 0.64).

1.2.3 Rate of improvement of chest X-ray

Only one trial (Graham 1978) reported this outcome, which indicated that conventional chest physiotherapy had no benefit on improvement of chest X-ray (RR 0.85, 95% CI 0.59 to 1.22).

1.2.4 Healing time

One trial (Britton 1985) reported healing time as a secondary outcome. The mean healing time was 30.6 days in the treatment group, and 31.3 days in the control group. However, it reported “there was no significant difference between groups” (P value was unavailable).

2. Active cycle of breathing techniques plus routine treatment versus routine treatment alone

Only one trial (Tydeman 1989) including 32 participants (12 in the treatment group and 20 in the control group) was included in this review.

2.1 Primary outcomes

2.1.1 Mortality

No participants died during the study period.
2.1.2 Cure rate

The cure rates in the treatment group and the control group were 41.67% and 70.00% respectively, with no statistical significance between groups (RR 0.60, 95% CI 0.29 to 1.23).

2.2 Secondary outcomes

2.2.1 Duration of hospital stay

The duration of hospital stay (mean ± SD) was 6.67 ± 3.26 days in the treatment group, and 5.27 ± 2.26 days in the control group. However, there was no significant difference between groups (MD 1.40 days, 95% CI -0.69 to 3.49).

2.2.2 Rate of improvement of chest X-ray

Active cycle of breathing techniques had no benefit for rate of improvement of chest X-ray (RR 0.60, 95% CI 0.29 to 1.23).

2.2.3 Duration of antibiotic therapy

The duration of antibiotic therapy (mean ± SD) was 15.17 ± 6.70 days in the treatment group, and 15.02 ± 5.53 days in the control group. No significant difference was identified between groups (MD 0.15 day, 95% CI -4.39 to 4.69).

2.2.4 Duration of sputum production

The mean duration of sputum production seemed to be 0.37 days longer in the treatment group than in the control group, but there was no significant difference between groups (MD -0.37, 95% CI -3.74 to 3.00). The subgroup analysis indicated that there were no significant differences in both in-patient and out-patient populations in terms of duration of sputum production (MD 0.83 day, 95% CI -1.57 to 3.23; MD -1.20 days, 95% CI -3.28 to 0.88, respectively).

2.2.5 In-patient sputum weight

Active cycle of breathing techniques did not improve the in-patient sputum weight either (MD 4.9 g, 95% CI -1.82 to 11.62).

3. Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

We identified two trials (Noll 1999; Noll 2000), involving 79 participants in total, with 39 in the treatment group and 40 in the control group.

3.1 Primary outcomes

3.1.1 Mortality

Compared with placebo, osteopathic manipulative treatment did not improve mortality (RR 0.27, 95% CI 0.05 to 1.57) (Figure 5).

3.1.2 Cure rate

Osteopathic manipulative treatment did not increase cure rate in comparison with placebo (RR 1.54, 95% CI 0.97 to 2.46) (Figure 6).
3.2 Secondary outcomes

3.2.1 Duration of hospital stay
Osteopathic manipulative treatment, compared with placebo, significantly reduced the mean duration of hospital stay by 2.0 days (weighted mean difference (WMD) -2.0, 95% CI -3.46 to -0.58).

3.2.2 Duration of fever
Only one trial (Noll 1999) with 21 participants assessed this outcome, which suggested that osteopathic manipulative treatment could not decrease the duration of fever in comparison with placebo (MD 0.6 day, 95% CI -1.60 to 2.80).

3.2.3 Rate of improvement of chest X-ray
Two trials (Noll 1999; Noll 2000) appraised this outcome. Pooled data showed that osteopathic manipulative treatment, compared with placebo, had no benefit on improvement of chest X-ray (RR 1.16, 95% CI 0.77 to 1.73).

3.2.4 Duration of antibiotic therapy
Compared with placebo, osteopathic manipulative treatment decreased the mean duration of antibiotic therapy by 1.9 days (MD -1.9, 95% CI -3.12 to -0.74). In addition, the subgroup analysis found that osteopathic manipulative treatment could decrease the mean duration of intravenous antibiotic therapy by 2.1 days (MD -2.1, 95% CI -3.36 to -0.87), but it had no benefit for decreasing the mean duration of oral antibiotic therapy (MD 0.9 day, 95% CI -1.25 to 3.20).

3.2.5 Duration of leukocytosis
Only one trial (Noll 1999) with 21 participants assessed this outcome, and found that osteopathic manipulative treatment did not decrease the mean duration of leukocytosis in comparison with placebo (MD -0.90 day, 95% CI -7.02 to 5.22).

3.2.6 Change in leukocyte count
One trial (Noll 2000) with 58 participants assessed the change in leukocyte count. There was a significant difference in leukocyte count changes between days one and three (MD 2271.5, 95% CI -1287.07 to 5830.07).

3.2.7 Mean leukocyte count
One trial (Noll 2000) also assessed the mean leukocyte count on day three and five after admission, and it identified no significant differences between groups for mean white blood cell count on days three and five (day three: MD 1383, 95% CI -1072 to 3838; day five: MD 1210, 95% CI -1052 to 3472, respectively).

3.2.8 Adverse effects
Only one trial (Noll 2000) reported adverse effects, as transient muscle tenderness emerged after treatment in two individuals during the period of study.

4. Positive expiratory pressure plus routine treatment versus routine treatment alone
One trial (Bjorkqvist 1997) including 98 participants, with 50 in the treatment group and 48 in the control group, focused on this technique.

4.1 Primary outcomes

4.1.1 Mortality
No participants died during the period of study.

4.1.2 Cure rate
Not reported.
4.2 Secondary outcomes

4.2.1 Duration of hospital stay

Compared with the routine treatment alone, positive expiratory pressure plus routine treatment reduced the mean duration of hospital stay by 1.4 days and there was a significant difference between groups (MD -1.4, 95% CI -2.77 to -0.03).

4.2.2 Duration of fever

Positive expiratory pressure could reduce the mean duration of fever by 0.7 day with a significant difference between groups (MD -0.7, 95% CI -1.36 to -0.04).

4.2.3 Adverse effects

No side effects were found during the study period.

DISCUSSION

Summary of main results

Six randomised controlled trials (RCTs) with 434 participants were included in this review, which appraised four types of chest physiotherapies (i.e. conventional chest physiotherapy, active cycle of breathing techniques, osteopathic manipulative treatment and positive expiratory pressure). None of the techniques were found to improve mortality of pneumonia in adults. Conventional chest physiotherapy, active cycle of breathing techniques and osteopathic manipulative treatment did not increase the cure rate of pneumonia nor the rate of chest X-ray improvement. Osteopathic manipulative treatment and positive expiratory pressure did reduce the mean duration of hospital stay by 2.02 and 1.4 days, respectively, whereas conventional chest physiotherapy and active cycle of breathing techniques did not. Positive expiratory pressure might reduce the duration of fever, while osteopathic manipulative treatment might not. In addition, osteopathic manipulative treatment might have an effect on reducing the duration of intravenous and total antibiotic treatments.

Overall completeness and applicability of evidence

Most of the included RCTs were conducted around 10 to 30 years ago. The main positive conclusions (a decrease in duration of hospital stay, fever and antibiotic treatment) were based on two trials with small sample sizes, conducted more than 10 years ago. There have been advances in chest physiotherapies which have not yet been appraised in randomised controlled trials. The authors of Noll 2008 are conducting a RCT which evaluates the effect of osteopathic manipulative treatment for elderly patients with pneumonia. The results are supposed to offer valuable information for this special population. Moreover, to a large extent, the effects of physiotherapy depend upon the skills of the practitioners. It has been reported that the duration, sessions and quality of chest physiotherapies vary from case to case (Guessous 2008). Misleading results may occur if the treatments are administered by unskilled practitioners. However, information on the experience and training of the physiotherapists who implemented the treatments was not available in most of the included trials. The techniques, the number and duration of sessions and the duration of the intervention period also varied across trials. We therefore recommend that caution is required when interpreting the results of this review and applying them to current practice.

Quality of the evidence

All included studies were of poor to moderate methodological quality. Firstly, although all studies stated that randomisation was used, none mentioned the method of randomisation. Secondly, only two of the six studies (Noll 1999; Noll 2000) were double-blinded trials (in which participants and outcome assessors were blinded), and one (Britton 1985) was a single-blinded trial. Lack of blinding might cause overestimation of the effects. It should be noted that chest physiotherapy was performed by a physiotherapist, so it might be difficult to blind the practitioners. Thirdly, four of the six studies (Bjorkqvist 1997; Britton 1985; Graham 1978; Tydeman 1989) had more than 10% drop-outs, but none used an intention-to-treat (ITT) analysis, which aims to maintain the unbiased group comparison afforded by randomisation and to resolve the problem of non-compliance. Absence of an ITT analysis might lead to potential biases. Finally, the sample sizes of the six trials were too small to permit adequate assessment of this intervention. Moreover, there were challenges in obtaining high-quality evidence for physiotherapy interventions because of the difficulties in blinding the intervention, standardising the method of chest physiotherapy and defining clinically meaningful outcomes.

Potential biases in the review process

Six published studies appeared to meet the inclusion criteria but have not yet been included or excluded. Five papers are published in Russian and one was published in 1947 and we have not yet managed to retrieve a copy of the trial. This is the major limitation in our review and may lead to selective reporting bias. It was impossible to perform a funnel plot analysis to assess potential publication bias because of the limited number of trials for each outcome. Another limitation of our review is that none of the included studies were recent publications; most trials reported on participants treated in the 1980s and 1990s. Moreover, the pub-
lication date of the included studies varied from 1978 to 2000, which leads us to consider that definitions of care and cure in the different studies, plus medical management (including the methods of chest physiotherapy) may have differed. For these reasons, clinical heterogeneity was inevitable, although we had performed subgroup analyses on different types of chest physiotherapies and outcomes to minimise the effect of heterogeneity. Clinical heterogeneity might lead to bias if we combined the results of different studies by meta-analysis.

**Agreements and disagreements with other studies or reviews**

Although chest physiotherapy has been widely used in pneumonia, there is little evidence of any benefit (Guessous 2008). To our knowledge, this is the first systematic review to examine chest physiotherapy for pneumonia in adults. According to our results, chest physiotherapy has no benefit for mortality and cure rate. It can be costly as it requires equipment and experienced respiratory therapists, physiotherapists or clinicians to perform (Guessous 2008). Therefore, we recommend caution when prescribing chest physiotherapy for pneumonia in adults.

**AUTHORS’ CONCLUSIONS**

**Implications for practice**

There is limited evidence indicating that osteopathic manipulative treatment and positive expiratory pressure may reduce the mean duration of hospital stay. Osteopathic manipulative treatment could also reduce the duration of antibiotic treatment, while positive expiratory pressure could reduce the duration of fever. However, based on current evidence, chest physiotherapy should not be recommended as a conventional adjunctive treatment for pneumonia in adults.

**Implications for research**

Further well-designed randomised controlled trials addressing the role of chest physiotherapy for pneumonia in adults may be warranted. The following key points should be considered in the future studies: appropriate sample size with power to detect expected difference, rigorous standardisation of the method of chest physiotherapy, an appropriate comparator therapy, appropriate outcomes (the following categories might be included: mortality, cure rate, improvements in symptoms, improvements in laboratory results, duration of hospital stay, duration of antibiotic or other therapies, and quality of life), and the cost-effectiveness of the therapy.

**ACKNOWLEDGEMENTS**

We thank Elizabeth Dooley, the Managing Editor of the ARI Group, for her help with drafting the review; and Sarah Thorn, ARI Group Trials Search Co-ordinator, for her useful comments on the search strategy. We also wish to thank the following people for commenting on the draft review: Sai Janani Sivashankar, George Ntoumenopoulos, Jan Poelaert, Teresa Neeman, and Johannes van der Wouden.

For this 2012 update, we deeply appreciate Sarah Thorn, ARI Group Trials Search Co-ordinator, for her hard work updating database searches.

**REFERENCES**

References to studies included in this review

Bjorkqvist 1997 *(published data only)*


Britton 1985 *(published data only)*


Graham 1978 *(published data only)*


Noll 1999 *(published data only)*


Noll 2000 *(published data only)*


Tydeman 1989 *(published data only)*

References to studies excluded from this review

Barkov 1987 [published data only]

Britton 1983a [published data only]

Britton 1983b [published data only]

Burioka 1998 [published data only]

Cheng 2004 [published data only]

Choi 2005 [published data only]

Confalonieri 1998a [published data only]

Confalonieri 1998b [published data only]

Dangour 2011 [published data only]

Fu 2005 [published data only]

Holody 1981 [published data only]

Jolliet 2001 [published data only]

Li 2005 [published data only]

Mo 2004 [published data only]

Noll 2008 [published data only]

Patman 2009 [published data only]

Schultz 2006 [published data only]

Wan 2004 [published data only]

Wang 1997 [published data only]

Wu 2005a [published data only]

Wu 2005b [published data only]
Wu 2005c  [published data only]

Xia 2005  [published data only]

Xu 2004  [published data only]

Zha 2004  [published data only]

References to studies awaiting assessment

Facto 1947  [published data only]

Kuznetsov 1976  [published data only]

Kuznetsov 1980a  [published data only]

Kuznetsov 1980b  [published data only]

Sedov 1975  [published data only]

Vorob’ev 1984  [published data only]

References to ongoing studies

Noll 2006  [published data only]

Additional references

Bowton 1999

Britton 1983

Campbell 1975

Chalumeau 2002

Cochrane 1977

Connors 2004

Cochrane Database of Systematic Reviews

Colice 1984

Connors 1980

Fine 1990

Flenady 2010

George 1995
Guessous 2008

Hanying 2005

Horiuchi 1997

ICH 1997

Lefebvre 2011

Niederman 2001

Ntoumenopoulos 2002

Poelaert 1991

RevMan 2011

Roqué i Figuls 2012

Van der Schans 2009
Van der Schans C, Prasad A, Main E. Chest physiotherapy compared to no chest physiotherapy for cystic fibrosis. *Cochrane Database of Systematic Reviews* 2009, Issue 2. [DOI: 10.1002/14651858.CD001401]

Wallis 1999

Weissman 1991

Weissman 1993

* Indicates the major publication for the study
CHARACTERISTICS OF STUDIES

Characteristics of included studies  [ordered by study ID]

Bjorkqvist 1997

<table>
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<tr>
<th></th>
<th>Randomised, parallel-group trial</th>
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<tbody>
<tr>
<td>Methods</td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td>In-patient setting; relevant details of health status of participants; age; sex; country</td>
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<tr>
<td></td>
<td>50 treatment, 48 control</td>
</tr>
<tr>
<td></td>
<td>16 to 95 years old (mean 65)</td>
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<tr>
<td></td>
<td>Male/female: 84 /61</td>
</tr>
<tr>
<td></td>
<td>Conducted in Sweden</td>
</tr>
<tr>
<td>Interventions</td>
<td>The physiotherapy was positive expiratory pressure (PEP). In this study a bottle containing 10 cm of tap water was used. Patients were asked to sit up with their feet on the floor and blow bubbles at a calm speed into the bottle through a plastic tube (10 mm in diameter) with an air pressure just sufficient to overcome the resistance of the water. This method was used 20 times per hour from 9 am to 8 pm and continued after discharge. This study consisted of three group (A, B, C). Group A was control which underwent early mobilisation and &quot;huffing&quot;. Group B members were given the same as A and deep breaths. Group C members were given the same as A and the method of bottle-blowing.</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Primary outcomes: death</td>
</tr>
<tr>
<td></td>
<td>Secondary outcomes: duration of hospital stay (days); fever clearance time; CRP; VC; FEV1; PEF</td>
</tr>
<tr>
<td>Notes</td>
<td>The study was supported financially by the Orebro County Council Research Committee and the Orebro Medical Center Research Foundation</td>
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Risk of bias

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<th>Bias</th>
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<td>The randomised method was not clearly reported</td>
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<tr>
<td>Blinding (performance bias and detection bias)</td>
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<td>No blinding</td>
</tr>
<tr>
<td>All outcomes</td>
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<td></td>
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<tr>
<td>Incomplete outcome data (attrition bias)</td>
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<td>19 (13%) patients were drop-outs. However, ITT analysis was performed</td>
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<tr>
<td>All outcomes</td>
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<td>Insufficient information</td>
</tr>
<tr>
<td>Other bias</td>
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</table>
Britton 1985

Methods | Randomised, parallel-group, single-blind trial
---|---
Participants | In-patient setting; relevant details of health status of participants; age; sex; country 83 treatment, 88 control 15 to 75 years old (control: 47.2, treatment: 47.4) Male/female: 74/97 Conducted in Sweden
Interventions | The chest physiotherapy consisted of postural drainage, external help with breathing, percussion and vibration. The placebo was to receive advice on expectoration, deep breathing and how to exercise to avoid thrombosis
Outcomes | Primary outcomes: death; cure rate Secondary outcomes: duration of hospital stay (days); healing time (days); fever clearance time; FEV1
Notes | The study was approved by the ethical committee of the Karolinska Hospital, Stockholm Sources of funding were not stated

Risk of bias

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<tr>
<td>Other bias</td>
<td>High risk</td>
<td>The standard deviations of duration of hospital stay and fever were not reported</td>
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</table>

Graham 1978

Methods | Randomised, parallel-group trial
---|---
Participants | In-patient setting; relevant details of health status of participants; age; sex; country 27 treatment, 27 control Age (mean ± SD): control: 63 ± 3 years old, treatment: 61 ± 4 years old Male/female: control 13/14, treatment 14/13
### Graham 1978 (Continued)

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Conducted in Sweden</th>
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<tr>
<td>The chest physiotherapy consisted of postural drainage, chest percussion and vibration, with encouragement of deep breathing and coughing. This therapy was used concomitantly with intermittent positive pressure breathing every 4 hours during the first 24 hours. Therapy was given for at least 3 days to all the treated participants, with an average duration of 5 days.</td>
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<tr>
<th>Outcomes</th>
<th>Primary outcomes: death; cure rate</th>
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<tbody>
<tr>
<td>Secondary outcomes: duration of hospital stay (days); rate of clearing of X-ray film; fever clearance time</td>
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| Notes | The study was supported by a grant (PHS 17292) to the Vermont Lung Center from the National Heart, Lung, and Blood Institute, National Institutes of Health Sources of funding not stated |

### Risk of bias

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### Noll 1999

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<tr>
<td>Participants</td>
<td>In-patient setting; relevant details of health status of participants; age; sex; country 11 in treatment group, 10 in control group The mean age was 78.7 in the control group, 82.5 in the treatment group Male/female: control 3/7, treatment 3/8 The trial was conducted in the United States</td>
</tr>
<tr>
<td>Interventions</td>
<td>Patients in the treatment group received a standardised osteopathic manipulative treatment protocol treatment consisting of 7 osteopathic manipulative techniques and non-standardised osteopathic manipulative treatments from an osteopathic manipulative approach</td>
</tr>
</tbody>
</table>

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*Chest physiotherapy for pneumonia in adults (Review)*  
Copyright © 2013 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.
Noll 1999  (Continued)

| Outcomes | Primary outcomes: death; cure rate  
|          | Secondary outcomes: duration of hospital stay (days); rate of clearing of X-ray film; duration of antibiotic therapy; duration of leukocytosis |

Notes

Risk of bias

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<td>Incomplete outcome data (attrition bias) All outcomes</td>
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</table>

Noll 2000

Methods

Randomised, double-blind, parallel trial

Participants

In-patient setting; relevant details of health status of participants; age; sex; country  
28 in treatment group; 30 in control group  
Age (mean ± SD): control group: 77.0 ± 17.2 years old; treatment group: 77.7 ± 17.1 years old  
Male/female: control group: 16/14; treatment group: 14/14  
The trial was conducted in the United States

Interventions

Patients in the treatment group received a standardised osteopathic manipulative treatment protocol treatment consisting of 7 osteopathic manipulative techniques and non-standardised osteopathic manipulative treatments from an osteopathic manipulative treatment specialist, while participants in the control group received a standardised light touch protocol treatment (sham treatment), with care taken not to move myofascial structures or to articulate joints. The session was 10 to 15 minutes, and the frequency of treatment was 2 sessions per day
Outcomes

| Primary outcomes: death; cure rate |
| Secondary outcomes: duration of hospital stay (days); rate of clearing of X-ray film; duration of antibiotic therapy; change in leukocyte count; mean leukocyte count |

Notes

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Risk of bias

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Tydeman 1989

Methods

Randomised, parallel-group trial

Participants

In-patient setting; relevant details of health status of participants; age; sex; country 12 treatment, 20 control Age (mean ± SD): control: 36.80 ± 16.91 years old, treatment: 42.08 ± 15.59 years old Male/female: control 10/10, treatment 9/3 Conducted in UK

Interventions

The physiotherapy was active cycle of breathing techniques, which consisted of breathing control using the diaphragm; localised expansion exercises; postural drainage; thoracic expansion exercises with vibrations on expiration; percussion. The first 2 methods were continued to discharge and the other methods were used when participants became productive of sputum. The dose of the therapy was dependent on the patient's tolerance and the sputum production

Outcomes

Primary outcomes: death; cure rate Secondary outcomes: duration of hospital stay (days); rate of clearing of X-ray film; duration of all antibiotic therapy; duration of production of sputum; in-patient sputum weight
**Tydeman 1989** (Continued)

<table>
<thead>
<tr>
<th>Notes</th>
<th>This study was under the funding of Norwich Health Authority and the East Anglian Regional Health Authority Research Committee</th>
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**Risk of bias**

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<tr>
<td>Blinding (performance bias and detection bias) All outcomes</td>
<td>High risk</td>
<td>Blinding was not performed</td>
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<tr>
<td>Incomplete outcome data (attrition bias) All outcomes</td>
<td>Low risk</td>
<td>Only 4 (11%) patients did not complete the study. Among them, 1 patient died, 2 patients were re-diagnosed as having other disease and 1 patient could not attend sufficient assessments</td>
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<td>Selective reporting (reporting bias)</td>
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</tr>
<tr>
<td>Other bias</td>
<td>Unclear risk</td>
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</tr>
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</table>

CRP: C-reactive protein  
VC: vital capacity  
FEV1: forced expiratory volume in the first second  
ITT: intention-to-treat  
PEF: peak expiratory flow  
OMT: osteopathic manipulative treatment

**Characteristics of excluded studies** [ordered by study ID]

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
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<tbody>
<tr>
<td>Barkov 1987</td>
<td>Physical agent; no control</td>
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<tr>
<td>Britton 1983a</td>
<td>Secondary publications under Britton 1985</td>
</tr>
<tr>
<td>Britton 1983b</td>
<td>Secondary publications under Britton 1985</td>
</tr>
<tr>
<td>Burioka 1998</td>
<td>The participants had diffuse panbronchiolitis</td>
</tr>
<tr>
<td>Study</td>
<td>Description</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>Cheng 2004</td>
<td>This study was not a RCT or quasi-RCT. It covered mechanical ventilation for patients with acute respiratory failure caused by pneumonia.</td>
</tr>
<tr>
<td>Choi 2005</td>
<td>Study was about mechanical ventilation for patients with pneumonia.</td>
</tr>
<tr>
<td>Confalonieri 1998a</td>
<td>Study was about respiratory failure caused by pneumonia.</td>
</tr>
<tr>
<td>Confalonieri 1998b</td>
<td>Study was about respiratory failure caused by pneumonia.</td>
</tr>
<tr>
<td>Dangour 2011</td>
<td>It was a prevention study.</td>
</tr>
<tr>
<td>Fu 2005</td>
<td>In addition to pneumonia, the participants also had asthma, chronic bronchitis or bronchiectasis. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Holody 1981</td>
<td>In addition to pneumonia, the participants had atelectasis. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Jolliet 2001</td>
<td>Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Li 2005</td>
<td>Some participants with pneumonia also had congestive heart failure or diabetes mellitus. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Mo 2004</td>
<td>Some participants with pneumonia also had COPD or asthma. A before-and-after study in the same participants.</td>
</tr>
<tr>
<td>Noll 2008</td>
<td>It was a study protocol.</td>
</tr>
<tr>
<td>Patman 2009</td>
<td>Some participants in the study were less than 18 years old. There was no subgroup analysis for adults provided in the study.</td>
</tr>
<tr>
<td>Schultz 2006</td>
<td>The participants also had asthma, lung cancer, COPD or pulmonary embolism.</td>
</tr>
<tr>
<td>Wan 2004</td>
<td>Participants had lower respiratory tract infections, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Wang 1997</td>
<td>The participants also had chronic bronchitis or acute bronchitis, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Wu 2005a</td>
<td>Participants had a pulmonary infection, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Wu 2005b</td>
<td>Participants had a pulmonary infection, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Wu 2005c</td>
<td>Participants had pneumonia caused by chronic bronchitis. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Xia 2005</td>
<td>Participants had a pulmonary infection, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Xu 2004</td>
<td>Participants had lower respiratory tract infections, not only pneumonia. Not a RCT or quasi-RCT.</td>
</tr>
<tr>
<td>Zha 2004</td>
<td>The participants had acute lung abscesses. Not a RCT or quasi-RCT.</td>
</tr>
</tbody>
</table>
Participants had pneumonia caused by COPD, not only pneumonia. Not a RCT or quasi-RCT.

### Characteristics of studies awaiting assessment [ordered by study ID]

#### Facto 1947

<table>
<thead>
<tr>
<th>Methods</th>
<th>Unclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Unclear</td>
</tr>
<tr>
<td>Interventions</td>
<td>Unclear</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Unclear</td>
</tr>
<tr>
<td>Notes</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Kuznetsov 1976

<table>
<thead>
<tr>
<th>Methods</th>
<th>Unclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Unclear</td>
</tr>
<tr>
<td>Interventions</td>
<td>Unclear</td>
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<tr>
<td>Outcomes</td>
<td>Unclear</td>
</tr>
<tr>
<td>Notes</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Kuznetsov 1980a

<table>
<thead>
<tr>
<th>Methods</th>
<th>Unclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Unclear</td>
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<tr>
<td>Interventions</td>
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<tr>
<td>Outcomes</td>
<td>Unclear</td>
</tr>
<tr>
<td>Notes</td>
<td>-</td>
</tr>
</tbody>
</table>

COPD: chronic obstructive pulmonary disease  
RCT: randomised controlled trial
Kuznetsov 1980b

Methods | Unclear
Participants | Unclear
Interventions | Unclear
Outcomes | Unclear
Notes | -

Sedov 1975

Methods | Unclear
Participants | Unclear
Interventions | Unclear
Outcomes | Unclear
Notes | -

Vorob'ev 1984

Methods | Unclear
Participants | Unclear
Interventions | Unclear
Outcomes | Unclear
Notes | -

Characteristics of ongoing studies  [ordered by study ID]

Noll

<table>
<thead>
<tr>
<th>Trial name or title</th>
<th>Multi-Center Osteopathic Pneumonia Study in the Elderly (MOPSE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods</td>
<td>Randomised, double-blind, placebo-controlled trial</td>
</tr>
<tr>
<td>Participants</td>
<td>Inclusion criteria:</td>
</tr>
<tr>
<td></td>
<td>• 50 years old or older</td>
</tr>
<tr>
<td></td>
<td>• Patient is hospitalised in an acute care facility</td>
</tr>
<tr>
<td></td>
<td>• Patient must exhibit at least 2 of the classic symptoms of pneumonia, to include:</td>
</tr>
<tr>
<td></td>
<td>o respiration rate greater than or equal to 25 respirations per minute</td>
</tr>
<tr>
<td></td>
<td>o new or increased cough</td>
</tr>
</tbody>
</table>
Noll  
(Continued)

- fever greater than or equal to 100.4 degrees F (38 degrees C)
- pleuritic chest pain
- worsening of mental or functional status
- leukocytosis (WBC greater than 12,000 cells per cubic millimetre)
- new or increased physical findings (rales, wheezing, bronchial breath sounds)

Exclusion criteria:
- Lung abscess
- Advancing pulmonary fibrosis
- Bronchiectasis
- Pulmonary tuberculosis
- Lung cancer
- Metastatic malignancy
- Uncontrolled metabolic bone disease that places subject at risk of pathologic bone fracture (i.e. Paget's disease or hypoparathyroidism)
- Acute or unhealed rib or vertebral fracture
- History of pathologic bone fracture
- Previous participation in the study
- Respiratory failure (intubation)

| Interventions                  | The first group: osteopathic manipulative treatment (OMT)  
The second group: light touch control  
The third group: conventional care only |
|-------------------------------|----------------------------------------------------------|
| Outcomes                      | Primary outcome measures: length of hospital stay, time to clinical stability, rate of symptomatic and functional recovery  
Secondary outcome measures: duration of IV and oral antibiotic usage in the hospital, number of complications and deaths secondary to pneumonia, duration and severity of fever, duration and severity of leukocytosis, patient satisfaction |
| Starting date                 | March 2004                                                |
| Contact information           | Not available                                             |
| Notes                         | The trial had been completed when we were drafting this review, however it has not yet been published |

IV: intravenous
WBC: white blood cell
## Data and analyses

Comparison 1. Chest physiotherapy plus routine treatment versus routine treatment alone

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mortality</td>
<td>2</td>
<td>225</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>1.03 [0.15, 7.13]</td>
</tr>
<tr>
<td>2 Cure rate</td>
<td>2</td>
<td>225</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>0.97 [0.91, 1.04]</td>
</tr>
<tr>
<td>3 Duration of hospital stay</td>
<td>1</td>
<td>225</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>4 Duration of fever</td>
<td>1</td>
<td>225</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>5 Rate of improvement of chest X-ray</td>
<td>1</td>
<td>225</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

Comparison 2. Active cycle of breathing techniques plus routine treatment versus routine treatment alone

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Cure rate</td>
<td>1</td>
<td></td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>2 Duration of hospital stay</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>3 Rate of improvement of chest X-ray</td>
<td>1</td>
<td></td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>4 Duration of antibiotic therapy</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>5 Duration of sputum production</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
<tr>
<td>5.1 In-patient</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
<tr>
<td>5.2 Out-patient</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
<tr>
<td>5.3 Total</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
<tr>
<td>6 In-patient sputum weight</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

Comparison 3. Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mortality</td>
<td>2</td>
<td>79</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>0.27 [0.05, 1.57]</td>
</tr>
<tr>
<td>2 Cure rate</td>
<td>2</td>
<td>79</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>1.54 [0.97, 2.46]</td>
</tr>
<tr>
<td>3 Duration of hospital stay</td>
<td>2</td>
<td>79</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-2.02 [-3.46, -0.58]</td>
</tr>
<tr>
<td>4 Duration of fever</td>
<td>1</td>
<td>79</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>5 Rate of improvement of chest X-ray</td>
<td>2</td>
<td>75</td>
<td>Risk Ratio (M-H, Fixed, 95% CI)</td>
<td>1.16 [0.77, 1.73]</td>
</tr>
<tr>
<td>6 Duration of oral antibiotic therapy</td>
<td>2</td>
<td>79</td>
<td>Mean Difference (IV, Random, 95% CI)</td>
<td>0.97 [-1.25, 3.20]</td>
</tr>
<tr>
<td>7 Duration of intervenous therapy</td>
<td>2</td>
<td>79</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-2.11 [-3.36, -0.87]</td>
</tr>
</tbody>
</table>

Chest physiotherapy for pneumonia in adults (Review)
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### 8 Duration of total antibiotic therapy

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>79</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>-1.93 [-3.12, -0.74]</td>
</tr>
</tbody>
</table>

### 9 Duration of leukocytosis

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

### 10 Change in leukocyte count

#### 10.1 Change between Day 3 and 1 from admission

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
</tbody>
</table>

#### 10.2 Change between Day 5 and 1 from admission

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>0.0 [0.0, 0.0]</td>
</tr>
</tbody>
</table>

### 11 Mean leukocyte count

#### 11.1 Day 3 from admission

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

#### 11.2 Day 5 from admission

<table>
<thead>
<tr>
<th>No. of studies</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

### Comparison 4. Positive expiratory pressure plus routine treatment versus routine treatment alone

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Duration of hospital stay</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
<tr>
<td>2 Duration of fever</td>
<td>1</td>
<td></td>
<td>Mean Difference (IV, Fixed, 95% CI)</td>
<td>Totals not selected</td>
</tr>
</tbody>
</table>

### Analysis 1.1. Comparison 1 Chest physiotherapy plus routine treatment versus routine treatment alone, Outcome 1 Mortality.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone

Outcome: 1 Mortality

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Chest physiotherapy</th>
<th>No physiotherapy</th>
<th>Risk Ratio</th>
<th>Weight</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Britton 1985</td>
<td>1/83</td>
<td>1/88</td>
<td>49.3 %</td>
<td>1.06 [0.07, 16.68]</td>
<td></td>
</tr>
<tr>
<td>Graham 1978</td>
<td>1/27</td>
<td>1/27</td>
<td>50.7 %</td>
<td>1.00 [0.07, 15.18]</td>
<td></td>
</tr>
</tbody>
</table>

Total (95% CI) 110 115 100.0 % 1.03 [0.15, 7.13]

Total events: 2 (Chest physiotherapy), 2 (No physiotherapy)

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.98); I² = 0.0%

Test for overall effect: Z = 0.03 (P = 0.98)

Test for subgroup differences: Not applicable
Analysis 1.2. Comparison 1 Chest physiotherapy plus routine treatment versus routine treatment alone, Outcome 2 Cure rate.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone

Outcome: 2 Cure rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Chest physiotherapy</th>
<th>No physiotherapy</th>
<th>Risk Ratio</th>
<th>Weight</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/N</td>
<td>n/N</td>
<td></td>
<td>M-H,Fixed,95% CI</td>
<td></td>
<td>M-H,Fixed,95% CI</td>
</tr>
<tr>
<td>Britton 1985</td>
<td>83/83</td>
<td>88/88</td>
<td>81.9 %</td>
<td>1.00 [ 0.98, 1.02 ]</td>
<td></td>
</tr>
<tr>
<td>Graham 1978</td>
<td>16/27</td>
<td>19/27</td>
<td>18.1 %</td>
<td>0.84 [ 0.57, 1.25 ]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>110</td>
<td>115</td>
<td>100.0 %</td>
<td>0.97 [ 0.91, 1.04 ]</td>
<td></td>
</tr>
</tbody>
</table>

Total events: 99 (Chest physiotherapy), 107 (No physiotherapy)
Heterogeneity: Chi² = 6.74, df = 1 (P = 0.01); I² =85%
Test for overall effect: Z = 0.82 (P = 0.41)
Test for subgroup differences: Not applicable

Analysis 1.3. Comparison 1 Chest physiotherapy plus routine treatment versus routine treatment alone, Outcome 3 Duration of hospital stay.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone

Outcome: 3 Duration of hospital stay

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Chest physiotherapy</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/N</td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Graham 1978</td>
<td>27 7.6 (3.64)</td>
<td>27 6.9 (4.16)</td>
<td>0.70 [-1.39, 2.79]</td>
<td></td>
</tr>
</tbody>
</table>

Favours physiotherapy  Favours no physiotherapy
### Analysis 1.4. Comparison 1 Chest physiotherapy plus routine treatment versus routine treatment alone, Outcome 4 Duration of fever.

Review: Chest physiotherapy for pneumonia in adults
Comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone
Outcome: 4 Duration of fever

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Chest physiotherapy</th>
<th>No physiotherapy</th>
<th>Mean Difference Mean Difference 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham 1978</td>
<td>27 2.9 (2.08)</td>
<td>27 2.5 (3.12)</td>
<td>0.40 [-1.01, 1.81]</td>
</tr>
</tbody>
</table>

### Analysis 1.5. Comparison 1 Chest physiotherapy plus routine treatment versus routine treatment alone, Outcome 5 Rate of improvement of chest X-ray.

Review: Chest physiotherapy for pneumonia in adults
Comparison: 1 Chest physiotherapy plus routine treatment versus routine treatment alone
Outcome: 5 Rate of improvement of chest X-ray

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Chest physiotherapy</th>
<th>No physiotherapy</th>
<th>Risk Ratio 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham 1978</td>
<td>17/27</td>
<td>20/27</td>
<td>0.85 [0.59, 1.22]</td>
</tr>
</tbody>
</table>

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**Analysis 2.1. Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 1 Cure rate.**

Review: Chest physiotherapy for pneumonia in adults

Comparison: 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone

Outcome: 1 Cure rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Risk Ratio</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>M-H,Fixed,95% CI</td>
<td>M-H,Fixed,95% CI</td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>5/12</td>
<td>14/20</td>
<td>0.60 [0.29, 1.23]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.2</th>
<th>0.5</th>
<th>1</th>
<th>2</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favours no physiotherapy</td>
<td>Favours active cycle of breathing techniques</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analysis 2.2. Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 2 Duration of hospital stay.**

Review: Chest physiotherapy for pneumonia in adults

Comparison: 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone

Outcome: 2 Duration of hospital stay

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 6.67 (3.26)</td>
<td>20 5.27 (2.26)</td>
<td>1.40 [-0.69, 3.49]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>-4</th>
<th>-2</th>
<th>0</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Favours active cycle of breathing techniques</td>
<td>Favours no physiotherapy</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Analysis 2.3.** **Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 3 Rate of improvement of chest X-ray.**

**Review:** Chest physiotherapy for pneumonia in adults

**Comparison:** 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone

**Outcome:** 3 Rate of improvement of chest X-ray

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Risk Ratio</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>M-H,Fixed,95% CI</td>
<td>M-H,Fixed,95% CI</td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>5/12</td>
<td>14/20</td>
<td>0.60 [ 0.29, 1.23 ]</td>
<td></td>
</tr>
</tbody>
</table>

Favours no physiotherapy

Favours active cycle of breathing techniques

---

**Analysis 2.4.** **Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 4 Duration of antibiotic therapy.**

**Review:** Chest physiotherapy for pneumonia in adults

**Comparison:** 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone

**Outcome:** 4 Duration of antibiotic therapy

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 15.17 (6.79)</td>
<td>20 15.02 (5.53)</td>
<td>0.15 [-4.39, 4.69 ]</td>
<td></td>
</tr>
</tbody>
</table>

Favours active cycle of breathing techniques

Favours no physiotherapy
### Analysis 2.5. Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 5 Duration of sputum production.

**Review:** Chest physiotherapy for pneumonia in adults  
**Comparison:** 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone  
**Outcome:** 5 Duration of sputum production

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>In-patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 2.83 (3.88)</td>
<td>20 2 (2.22)</td>
<td>0.83 [-1.57, 3.23]</td>
<td></td>
</tr>
<tr>
<td>Out-patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 0.75 (2.05)</td>
<td>20 1.95 (3.94)</td>
<td>-1.20 [-3.28, 0.88]</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 3.58 (4.52)</td>
<td>20 3.95 (5.02)</td>
<td>-0.37 [-3.74, 3.00]</td>
<td></td>
</tr>
</tbody>
</table>

### Analysis 2.6. Comparison 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone, Outcome 6 In-patient sputum weight.

**Review:** Chest physiotherapy for pneumonia in adults  
**Comparison:** 2 Active cycle of breathing techniques plus routine treatment versus routine treatment alone  
**Outcome:** 6 In-patient sputum weight

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>active cycle of breathing techniques</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Tydeman 1989</td>
<td>12 7.3 (11.4)</td>
<td>20 2.4 (4.3)</td>
<td>4.90 [-1.82, 11.62]</td>
<td></td>
</tr>
</tbody>
</table>
**Analysis 3.1. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 1 Mortality.**

Review: Chest physiotherapy for pneumonia in adults

Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

Outcome: 1 Mortality

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Risk Ratio</th>
<th>Weight</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>M-H,Fixed 95% CI</td>
<td></td>
<td>M-H,Fixed 95% CI</td>
</tr>
<tr>
<td>Noll 1999</td>
<td>0/11</td>
<td>2/10</td>
<td></td>
<td>47.4 %</td>
<td>0.18 [ 0.01, 3.41 ]</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>1/28</td>
<td>3/30</td>
<td></td>
<td>52.6 %</td>
<td>0.36 [ 0.04, 3.24 ]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>39</strong></td>
<td><strong>40</strong></td>
<td><strong>100.0 %</strong></td>
<td><strong>0.27 [ 0.05, 1.57 ]</strong></td>
<td></td>
</tr>
</tbody>
</table>

Total events: 1 (Osteopathic manipulative treatment), 5 (placebo)
Heterogeneity: Chi² = 0.13, df = 1 (P = 0.72); I² =0.0%
Test for overall effect: Z = 1.45 (P = 0.15)
Test for subgroup differences: Not applicable
### Analysis 3.2. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 2 Cure rate.

**Review:** Chest physiotherapy for pneumonia in adults

**Comparison:** 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

**Outcome:** 2 Cure rate

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Risk Ratio</th>
<th>Weight</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N</td>
<td>n/N</td>
<td>M-H, Fixed</td>
<td>M-H, Fixed, 95% CI</td>
<td></td>
</tr>
<tr>
<td>Noll 1999</td>
<td>10/11</td>
<td>5/10</td>
<td></td>
<td>35.2 %</td>
<td>1.82 [0.95, 3.47]</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>13/28</td>
<td>10/30</td>
<td></td>
<td>64.8 %</td>
<td>1.39 [0.73, 2.65]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>39</strong></td>
<td><strong>40</strong></td>
<td></td>
<td><strong>100.0 %</strong></td>
<td><strong>1.54 [0.97, 2.46]</strong></td>
</tr>
</tbody>
</table>

Total events: 23 (osteopathic manipulative treatment), 15 (placebo)

Heterogeneity: $\chi^2 = 0.34$, df = 1 ($P = 0.56$); $I^2 = 0.0$

Test for overall effect: $Z = 1.82$ ($P = 0.069$)

Test for subgroup differences: Not applicable
Analysis 3.3. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 3 Duration of hospital stay.

Review: Chest physiotherapy for pneumonia in adults
Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment
Outcome: 3 Duration of hospital stay

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noll 1999</td>
<td>11</td>
<td>10</td>
<td>7.0%</td>
<td>-2.30</td>
<td>[-7.74, 3.14]</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>28</td>
<td>30</td>
<td>93.0%</td>
<td>-2.00</td>
<td>[-3.49, -0.51]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>39</td>
<td>40</td>
<td>100.0%</td>
<td>-2.02</td>
<td>[-3.46, -0.58]</td>
</tr>
</tbody>
</table>

Heterogeneity: Chi^2 = 0.01, df = 1 (P = 0.92); I^2 = 0.0%
Test for overall effect: Z = 2.75 (P = 0.0060)
Test for subgroup differences: Not applicable

Analysis 3.4. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 4 Duration of fever.

Review: Chest physiotherapy for pneumonia in adults
Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment
Outcome: 4 Duration of fever

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noll 1999</td>
<td>11</td>
<td>10</td>
<td>0.60</td>
<td>[-1.60, 2.80]</td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable.
### Analysis 3.5. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 5 Rate of improvement of chest X-ray.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

Outcome: 5 Rate of improvement of chest X-ray

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Risk Ratio M-H,Fixed 95% CI</th>
<th>Weight %</th>
<th>Risk Ratio M-H,Fixed 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noll 1999</td>
<td>10/11</td>
<td>7/10</td>
<td></td>
<td>39.8 %</td>
<td>1.30 [ 0.83, 2.03 ]</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>11/25</td>
<td>12/29</td>
<td></td>
<td>60.2 %</td>
<td>1.06 [ 0.57, 1.97 ]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>36</strong></td>
<td><strong>39</strong></td>
<td></td>
<td><strong>100.0 %</strong></td>
<td><strong>1.16 [ 0.77, 1.73 ]</strong></td>
</tr>
</tbody>
</table>

Total events: 21 (osteopathic manipulative treatment), 19 (placebo)

Heterogeneity: $\chi^2 = 0.33, df = 1$ ($P = 0.57$); $I^2 =$0.0%

Test for overall effect: $Z=0.71$ ($P = 0.48$)

Test for subgroup differences: Not applicable

Favours placebo | Favours osteopathic manipulative treatment

---

Chest physiotherapy for pneumonia in adults (Review)  
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Analysis 3.6. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 6 Duration of oral antibiotic therapy.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

Outcome: 6 Duration of oral antibiotic therapy

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Random,95% CI</td>
<td>IV,Random,95% CI</td>
<td></td>
</tr>
<tr>
<td>Noll 1999</td>
<td>11 3.1 (3)</td>
<td>10 0.8 (1.3)</td>
<td>42.4 % 2.30 [ 0.35, 4.25 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noll 2000</td>
<td>28 1.4 (1.4)</td>
<td>30 1.4 (1.8)</td>
<td>57.6 % 0.0 [ -0.83, 0.83 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>39</td>
<td>40</td>
<td>100.0 % 0.97 [ -1.25, 3.20 ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 2.06; \chi^2 = 4.54, df = 1 (P = 0.03); I^2 = 78\%$

Test for overall effect: $Z = 0.86$ (P = 0.39)

Test for subgroup differences: Not applicable

---

Analysis 3.7. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 7 Duration of interavenous therapy.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

Outcome: 7 Duration of interavenous therapy

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
<td>IV,Fixed,95% CI</td>
<td></td>
</tr>
<tr>
<td>Noll 1999</td>
<td>11 8.2 (5.2)</td>
<td>10 11.8 (5.7)</td>
<td>7.1 % -3.60 [-8.28, 1.08 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noll 2000</td>
<td>28 5.3 (2.2)</td>
<td>30 7.3 (2.8)</td>
<td>92.9 % -2.00 [-3.29, -0.71 ]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>39</td>
<td>40</td>
<td>100.0 % -2.11 [-3.36, -0.87 ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 0.42, df = 1 (P = 0.52); I^2 = 0.0\%$

Test for overall effect: $Z = 3.33$ (P = 0.00088)

Test for subgroup differences: Not applicable
### Analysis 3.8. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 8 Duration of total antibiotic therapy.

**Review:** Chest physiotherapy for pneumonia in adults

**Comparison:** 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

**Outcome:** 8 Duration of total antibiotic therapy

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>osteopathic manipulative treatment</th>
<th>placebo</th>
<th>Mean Difference</th>
<th>Weight</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
<td>IV,Fixed,95% CI</td>
</tr>
<tr>
<td>Noll 1999</td>
<td>11</td>
<td>11.4 (5.4)</td>
<td>10</td>
<td>12.4 (5)</td>
<td>-1.00 [-5.45, 3.45]</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>28</td>
<td>6.1 (2.3)</td>
<td>30</td>
<td>8.1 (2.5)</td>
<td>-2.00 [-3.24, -0.76]</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>39</strong></td>
<td><strong>40</strong></td>
<td></td>
<td></td>
<td><strong>100.0 %</strong></td>
</tr>
</tbody>
</table>

Heterogeneity: \( \chi^2 = 0.18, \text{df} = 1 (P = 0.67); I^2 = 0.0\% \\
Test for overall effect: \( Z = 3.18 (P = 0.0015) \\
Test for subgroup differences: Not applicable

---

Favours osteopathic manipulative treatment  
Favours placebo
### Analysis 3.9. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 9 Duration of leukocytosis.

**Review:** Chest physiotherapy for pneumonia in adults  
**Comparison:** Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment  
**Outcome:** Duration of leukocytosis

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Osteopathic manipulative treatment</th>
<th>Placebo</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
</tr>
<tr>
<td>Noll 1999</td>
<td>11</td>
<td>5.9 (7.7)</td>
<td>10</td>
<td>6.8 (6.6)</td>
</tr>
</tbody>
</table>

Favours osteopathic manipulative treatment

### Analysis 3.10. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 10 Change in leukocyte count.

**Review:** Chest physiotherapy for pneumonia in adults  
**Comparison:** Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment  
**Outcome:** Change in leukocyte count

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Osteopathic manipulative treatment</th>
<th>Placebo</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean(SD)</td>
<td>N</td>
<td>Mean(SD)</td>
</tr>
<tr>
<td>1 Change between Day 3 and 1 from admission</td>
<td>28</td>
<td>-2341.7 (3863)</td>
<td>30</td>
<td>-5941.5 (5655.8)</td>
</tr>
<tr>
<td>Noll 2000</td>
<td>28</td>
<td>-4529.1 (7222)</td>
<td>30</td>
<td>-6800.6 (6558.4)</td>
</tr>
</tbody>
</table>

Favours osteopathic manipulative treatment
Analysis 3.11. Comparison 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment, Outcome 11 Mean leukocyte count.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 3 Osteopathic manipulative treatment plus routine treatment versus placebo plus routine treatment

Outcome: 11 Mean leukocyte count

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Osteopathic manipulative treatment</th>
<th>Placebo</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Day 3 from admission</td>
<td>28 11962 (5665)</td>
<td>30 10579 (3564)</td>
<td>1383.00 [ -1072.48, 3838.48 ]</td>
<td></td>
</tr>
<tr>
<td>2 Day 5 from admission</td>
<td>28 10487 (5143)</td>
<td>30 9277 (3410)</td>
<td>1210.00 [ -1052.26, 3472.26 ]</td>
<td></td>
</tr>
</tbody>
</table>

-100 -50 0 50 100
Favours osteopathic manipulative treatment Favours placebo

Analysis 4.1. Comparison 4 Positive expiratory pressure plus routine treatment versus routine treatment alone, Outcome 1 Duration of hospital stay.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 4 Positive expiratory pressure plus routine treatment versus routine treatment alone

Outcome: 1 Duration of hospital stay

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Positive expiratory pressure</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N Mean(SD)</td>
<td>N Mean(SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bjorkqvist 1997</td>
<td>50 3.9 (2.9)</td>
<td>48 5.3 (3.9)</td>
<td>-1.40 [-2.77, -0.03]</td>
<td></td>
</tr>
</tbody>
</table>
Analysis 4.2. Comparison 4 Positive expiratory pressure plus routine treatment versus routine treatment alone, Outcome 2 Duration of fever.

Review: Chest physiotherapy for pneumonia in adults

Comparison: 4 Positive expiratory pressure plus routine treatment versus routine treatment alone

Outcome: 2 Duration of fever

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>positive expiratory pressure</th>
<th>No physiotherapy</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bjorkqvist 1997</td>
<td>N=50 1.6 (1)</td>
<td>N=48 2.3 (2.1)</td>
<td>-0.70 [-1.36, -0.04]</td>
<td>-0.5 0.5 1</td>
</tr>
</tbody>
</table>

Favours positive expiratory pressure  Favours no physiotherapy

APPENDICES

Appendix 1. Previous search

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library 2009, Issue 3), which contains the Cochrane Acute Respiratory Infections (ARI) Group's Specialised Register; MEDLINE (1966 to August Week 1, 2009); EMBASE (1974 to August 2009); CBM (1978 to August 2009); the National Research Register (August 2009); and Physiotherapy Evidence Database (PEDro) (1929 to August 2009).

We used the following search terms in MEDLINE in conjunction with the Cochrane Highly Sensitive Search Strategy for identifying RCTs in MEDLINE (Lefebvre 2008) for identification of randomised clinical trials. We modified these terms as appropriate for other databases.

MEDLINE (OVID)

#1 exp pneumonia/
#2 exp respiratory tract infections/
#3 (pneumonia$ or lung inflammation$ or respiratory tract infection$ or respiratory infection$).mp.
#4 1 or 2 or 3
#5 exp physical therapy modalities/
#6 exp drainage, postural/
#7 exp vibration/
#8 exp positive-pressure respiration/
#9 exp breathing exercises/
#10 exp electric stimulation therapy/
#11 exp massage/
#12 exp musculoskeletal manipulations/
#13 (physical therap$ or physiotherapy$ or physical treatment$ or postural drainag$ or chest clap$ or chest percussion or chest shak$ or oscillati$ or vibration or directed cough$ or forced exhalation or forced expiration or positive pressure ventilation or positive expiratory
pressure or breathing exercise$ or diaphragmatic breathing or thoracic expansion exercise$ or breathing train$ or ventilatory muscle train$ or electrostimulation or huff$ or massag$).mp.
#14 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13
#15 4 and 14
#16 randomized controlled trial.pt.
#17 controlled clinical trial.pt.
#18 randomized.ab.
#19 placebo.ab.
#20 randomly.ab.
#21 trial.ab.
#22 groups.ab.
#23 16 or 17 or 18 or 19 or 20 or 21 or 22
#24 15 and 23
See: Appendix 2, Appendix 3 and Appendix 4 for individual search strategies for CBM, EMBASE and PEDro respectively.

**CBM search strategy (in Chinese)**

#1 pneumonia/exp
#2 "respiratory tract infections"/exp
#3 pneumonia or "respiratory tract infection"
#4 #1 or #2 or #3
#5 "physical therapy modalities"/exp
#6 "drainage, postural"/exp
#7 "positive-pressure respiration"/exp
#8 "breathing exercises"/exp
#9 "electric stimulation therapy"/exp
#10 "massage"/exp
#11 "physical therapy" or "postural drainage" or "chest clap" or "chest percussion" or vibration or "forced exhalation" or "positive pressure ventilation" or "breathing exercise" or "thoracic expansion exercise" or "ventilatory muscle train" or "electrostimulation" or "massage"  
#12 #5 or #6 or #7 or #8 or #9 or #10 or #11
#13 #4 and #12

**EMBASE search strategy (via EMBASE.COM)**

#1 'pneumonia'/exp
#2 'respiratory tract infections'/exp
#3 pneumonia* or lung inflammation* or respiratory tract infection* or respiratory infection*  
#4 #1 or #2 or #3
#5 'physical therapy modalities'/exp
#6 'drainage, postural'/exp
#7 'vibration'/exp
#8 'positive-pressure respiration'/exp
#9 'breathing exercises'/exp
#10 'electric stimulation therapy'/exp
#11 'massage'/exp
#12 'musculoskeletal manipulations'/exp
#13 physical therapy* or physiotherapy* or physical treatment* or postural drainag* or chest clap* or chest percussion or chest shak* or oscillat* or vibration or directed cough* or forced exhalation or forced expiration or positive pressure ventilation or positive expiratory pressure or breathing exercise* or diaphragmatic breathing or thoracic expansion exercise* or breathing train* or ventilatory muscle train* or electrostimulation or huff* or massag*
#14 #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13
#15 #4 and #14
#16 'randomized controlled trial':it
#17 'controlled clinical trial':it
#18 randomized:ab
#19 placebo:ab
#20 randomly:ab
#21 trial:ab
#22 groups:ab
#23 #16 or #17 or #18 or #19 or #20 or #21 or #22
#24 #15 and #23

**PEDro search strategy**
#1 pneumonia AND "physical therapy"
#2 "respiratory tract infection" AND "physical therapy"
#3 #1 OR #2

**Appendix 2. Embase.com search strategy**
#36 #32 AND #35
#35 #33 OR #34
#34 random*:ab,ti OR placebo*:ab,ti OR factorial*:ab,ti OR crossover*:ab,ti OR 'cross over':ab,ti OR 'cross-over':ab,ti OR volunteer*:ab,ti OR assign*:ab,ti OR allocate*:ab,ti OR ((singl*: OR doubl*) NEAR/1 blind*):ab,ti
#33 'randomized controlled trial'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR #25 OR #26 OR #27 OR #28 OR #29 OR #30
#30 (osteopath* NEAR/3 (manipulat* OR treatment* OR therap* OR techniq*)):ab,ti
#29 (respirat* OR ventilat*) NEAR/2 'muscle training':ab,ti
#28 massag*:ab,ti
#27 electrostimulat*:ab,ti AND [embase]/lim 1947
#26 'positive pressure ventilation':ab,ti OR 'positive expiratory pressure':ab,ti
#25 (breath* NEAR/2 (control* OR techni* OR train* OR exercis*)):ab,ti
#24 (cough* NEAR/2 (directed OR maneuver* OR manoeuvre* OR techniq*)):ab,ti
#23 (forced NEAR/2 (exhal* OR expir*)):ab,ti
#22 (chest OR thora*):NEAR/3 (clap* OR shak* OR compress)):ab,ti
#21 oscillat*:ab,ti OR vibrat*:ab,ti OR percuss*:ab,ti OR huff*:ab,ti
#20 'postural drainage':ab,ti OR (patient* NEAR/3 position*):ab,ti
#19 'manipulative medicine'/exp
#18 'electrostimulation therapy'/de
#17 'massage'/de
#16 'electrostimulation'/de
#15 'breathing exercise'/de
#14 'postural drainage'/de
#13 'positive end expiratory pressure'/de OR 'forced expiration'/de
#12 'vibration'/de OR 'high frequency oscillation'/de OR 'oscillation'/de OR 'whole body vibration'/de
#11 physiotherap*:ab,ti OR 'physio therapy':ab,ti OR (physical NEAR/1 (therap* OR treatment*)):ab,ti
#10 'physiotherapy'/exp
#9 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 8197040
#8 (pleural NEAR/2 (effusion OR empyema)):ab,ti OR pleurisy:ab,ti
#7 'pleurisy'/exp
#6 (lung NEAR/2 (inflamm* OR infect*)):ab,ti
#5 (lower NEAR/3 'respiratory tract infection'):ab,ti OR (lower NEAR/3 'respiratory tract infections'):ab,ti OR (lower NEAR/3 'respiratory infection'):ab,ti OR (lower NEAR/3 'respiratory infections'):ab,ti OR lrti:ab,ti
Appendix 3. PEDro search strategy

Abstract and title: pneumonia
Method: clinical trial
New records added since: 6 January 2009

Appendix 4. CINAHL (Ebsco) search strategy

S40 S30 AND S39
S39 S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38
S38 (MH "Quantitative Studies")
S37 TI placebo* OR AB placebo*
S36 (MH "Placebos")
S35 TI random* OR AB random*
S34 TI ((singl* or doubl* or trebl* or tripl*) W1 (blind* or mask*)) OR AB ((singl* or doubl* or trebl* or tripl*) W1 (blind* or mask*))
S33 TI clinic* W1 trial* OR AB clinic* W1 trial*
S32 PT clinical trial
S31 (MH "Clinical Trials")
S30 S10 AND S29 S
S29 S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28
S28 TI (osteopath* N3 (manipulat* or treatment* or therap* or techni*)) OR AB (osteopath* N3 (manipulat* or treatment* or therap* or techni*))
S27 TI ((respirat* or ventilat*) N2 muscle train*) OR AB ((respirat* or ventilat*) N2 muscle train*)
S26 TI massag* OR AB massag*
S25 TI electrostimulat* OR AB electrostimulat*
S24 TI (positive pressure ventilation* or positive expiratory pressure*) OR AB (positive pressure ventilation* or positive expiratory pressure*)
S23 TI (breath* N2 (control* or techni* or train* or exercis*)) OR AB (breath* N2 (control* or techni* or train* or exercis*))
S22 TI ( cough* N2 (directed or maneuver* or manoeuver* or techni*)) OR AB ( cough* N2 (directed or maneuver* or manoeuver* or techni*))
S21 TI (forced N2 (exhal* or exhil*)) OR AB (forced N2 (exhal* or exhil*))
S20 TI ((chest* or thora*) N3 (clap* or shak* or compress*)) OR AB ((chest* or thora*) N3 (clap* or shak* or compress*))
S19 TI (oscillat* or vibrat* or percuss* or huff*) OR AB (oscillat* or vibrat* or percuss* or huff*)
S18 TI patient* N3 position* OR AB patient* N3 position*
S17 TI postural drain* OR AB postural drain*
S16 (MH "Drainage. Postural")
S15 (MH "Positive Pressure Ventilation")
S14 (MH "Respiratory Therapy")
S13 (MH "Vibration")
S12 TI (physiotherap* or physical therap* or physical treatment*) OR AB (physiotherap* or physical therap* or physical treatment*)
S11 (MH "Physical Therapy")
S10 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9
S9 TI pleurisy OR AB pleurisy
S8 TI (pleural N3 (empyema or effusion*)) OR AB (pleural N3 (empyema or effusion*))
S7 (MH "Empyema") OR (MH "Pleural Effusion") OR (MH "Pleurisy")
S6 TI (lung* N3 (inflam* or infect*)) OR AB (lung* N3 (inflam* or infect*))

Chest physiotherapy for pneumonia in adults (Review)

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S5 TI (lower respiratory tract infection* or lower respiratory infection* or lrti) OR AB (lower respiratory tract infection* or lower respiratory infection* or lrti)
S4 (MH "Respiratory Tract Infections")
S3 TI (bronchopneumon* or pleuropneumon*) OR AB (bronchopneumon* or pleuropneumon*)
S2 TI pneumon* OR AB pneumon*
S1 (MH "Pneumonia+")

WHAT'S NEW

Last assessed as up-to-date: 21 November 2012.

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<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 November 2012</td>
<td>New citation required but conclusions have not changed</td>
<td>Our conclusions remain unchanged</td>
</tr>
<tr>
<td>21 November 2012</td>
<td>New search has been performed</td>
<td>Searches conducted. We excluded two new trials in this update (Dangour 2011; Noll 2008)</td>
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HISTORY

Protocol first published: Issue 1, 2007
Review first published: Issue 2, 2010

<table>
<thead>
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<td>21 November 2011</td>
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<td>Searches conducted</td>
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<tr>
<td></td>
<td>has been</td>
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</tr>
<tr>
<td>9 September 2010</td>
<td>Amended</td>
<td>Contact details updated</td>
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<tr>
<td>5 August 2010</td>
<td>Amended</td>
<td>Contact details updated</td>
</tr>
<tr>
<td>12 August 2008</td>
<td>Amended</td>
<td>Converted to new review format</td>
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CONTRIBUTIONS OF AUTHORS

All authors have contributed to this review.
XL Yin (XLY) and BY Wang (BYW) searched the databases, extracted the data and reformatted the tables.
BYW and YP Yan (YPY) screened trials.
MY Yang (MY) and YPY appraised the quality of included trials and drafted the full text.
BR Dong (BRD) and TX Wu (TXW) were responsible for editing.
BRD also acted as an arbitrator.
HGJ Liu (HGJL) was the consultant for data analysis.

DECLARATIONS OF INTEREST

None.

SOURCES OF SUPPORT

Internal sources
- Chinese Cochrane Center, Chinese Centre of Evidence-Based Medicine, West China Hospital of Sichuan University, China.

External sources
- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Some secondary outcomes (duration of antibiotic therapy, duration of sputum production, in-patient sputum weight, duration of leukocytosis, change in leukocyte count and mean leukocyte count), which were not included in the protocol, were assessed in the review.

INDEX TERMS

Medical Subject Headings (MeSH)
*Breathing Exercises; *Physical Therapy Modalities; Anti-Bacterial Agents [therapeutic use]; Manipulation, Osteopathic [methods]; Pneumonia [mortality; *therapy]; Randomized Controlled Trials as Topic
MeSH check words

Adult; Humans