INPLASY

# Efficacy and Safety of Airway Clearance Techniques in Adult Patients with Pneumonia: A Systematic Review and Meta-Analysis

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**ADMINISTRATIVE INFORMATION**

**Support -** Not applicable.

**Review Stage at time of this submission -** Completed but not published.

**Conflicts of interest -** None declared.

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**Amendments -** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 27 May 2026 and was last updated on 27 May 2026.

## INTRODUCTION

**Review question / Objective** P (Population): Adult (≥18 years old) hospitalized patients with pneumonia (including stroke-associated pneumonia, severe viral pneumonia, and severe pneumonia requiring mechanical ventilation), of Chinese ethnicity.
I (Intervention): Adjunctive airway clearance techniques (ACTs) (e.g., evidence-based refined airway management, positioning management, chest wall vibration, fiberoptic bronchoscopy-assisted clearance) combined with conventional treatment (oxygen therapy, pharmacotherapy, routine nebulization/humidification, high-flow humidified oxygen therapy).
C (Comparator/Control): Conventional treatment alone (without adjunctive airway clearance techniques).
O (Outcomes):
Primary: Treatment effective rate, complication rate, arterial oxygen saturation ($SpO_2$).
Secondary: Modified British Medical Research Council (mMRC) Dyspnea Score.
S (Study Design): Randomized controlled trials (RCTs).
Overall Review Question:
In Chinese adult patients with pneumonia, do airway clearance techniques combined with conventional treatment improve treatment effectiveness, reduce complications, enhance oxygenation, and relieve dyspnea compared to conventional treatment alone, based on evidence from randomized controlled trials?

**Condition being studied** Pneumonia is an acute infectious disease characterized by inflammation of the lung parenchyma, typically caused by bacterial, viral, or fungal pathogens. It is associated with symptoms such as fever, cough, sputum production, dyspnea, and impaired gas exchange. Pneumonia is a major cause of hospitalization and mortality worldwide, especially in older adults and patients with underlying comorbidities. The present review focuses on adult pneumonia, including subtypes such as stroke-associated pneumonia, severe viral pneumonia, and severe pneumonia requiring mechanical

ventilation, all of which are common and clinically important conditions in Chinese adult populations.

## METHODS

**Participant or population** This review includes hospitalised adult patients (aged ≥ 18 years) in China with a clinical or radiological diagnosis of pneumonia.
The population covers the following pneumonia subtypes:
Community-acquired pneumonia (CAP)
Hospital-acquired pneumonia (HAP)
Stroke-associated pneumonia
Severe viral pneumonia
Severe pneumonia requiring mechanical ventilation
Exclusions: Paediatric/adolescent patients, non-pneumonia populations, and participants receiving interventions involving early mobilisation or general exercise training.

**Intervention** This review evaluates adjunctive airway clearance techniques (ACTs) combined with conventional treatment, compared to conventional treatment alone, in adult patients with pneumonia.
Experimental intervention (Intervention group)
One or more active airway clearance techniques plus conventional treatment:
Airway clearance techniques: Evidence-based refined airway management protocols, positioning management, chest wall vibration, specific breathing techniques, fiberoptic bronchoscopy-assisted clearance, and high-flow humidified oxygen therapy combined with clearance.
Conventional treatment: Standard care including oxygen therapy, pharmacotherapy, routine nebulization and humidification, and supportive management.
Control intervention (Control group)
Conventional treatment alone, identical to that received by the intervention group but without any adjunctive active airway clearance techniques.

**Comparator** The comparator group receives conventional treatment alone for pneumonia, without adjunctive active airway clearance techniques. Conventional treatment includes:
Oxygen therapy
Pharmacotherapy (antibiotics, supportive medications)
Routine nebulization and humidification
Standard supportive care
Study designs included
Only randomized controlled trials (RCTs) published in Chinese or English up to January 1, 2026, are included. These RCTs directly compare airway clearance techniques plus conventional treatment versus conventional treatment alone.

**Study designs to be included** Only randomized controlled trials (RCTs) are included. These are published in Chinese or English up to January 1, 2026, and directly compare airway clearance techniques plus conventional treatment versus conventional treatment alone in adult patients with pneumonia.Excluded study designsNon-randomized trials, observational studies, case reports, reviews, and conference abstracts are excluded.

**Eligibility criteria** Additional inclusion criteria
Studies published in Chinese or English, up to January 1, 2026.
Full-text articles available with extractable quantitative data for at least one predefined outcome.
Conducted in Chinese healthcare settings (to align with the review's focus on Chinese adult patients).
Additional exclusion criteria
Non-comparative studies, quasi-randomized trials, or non-randomized study designs.
Interventions including early mobilization or general exercise training (to avoid confounding effects).
Duplicate publications, conference abstracts, reviews, letters, or case reports.
Studies with incomplete or unextractable outcome data.
Studies focusing solely on pediatric/adolescent populations or non-pneumonia conditions.

**Information sources** We searched the following electronic databases from inception to January 1, 2026, with no language restrictions (Chinese/English) applied to published randomized controlled trials:
PubMed (MEDLINE)
Web of Science
Cochrane Library (including CENTRAL)
China National Knowledge Infrastructure (CNKI)
Wanfang Data
Additional sources
Reference lists: Scanned reference lists of included RCTs and relevant systematic reviews to identify additional eligible studies.
Grey literature: Checked conference abstracts and dissertations from the above Chinese databases; no additional trials were identified.
Author contact: Attempted to contact corresponding authors of included studies via email to request missing or unclear outcome data, if needed.

Trial registers: Searched PROSPERO and Chinese Clinical Trial Registry (ChiCTR) for ongoing or unpublished trials; none met the inclusion criteria.
Search details
All searches combined MeSH terms and free-text keywords, restricted to RCTs, and were independently performed by two reviewers. The final search was run on January 1, 2026.

**Main outcome(s)** We evaluated four predefined outcomes, measured post-intervention at study-defined primary endpoints, with effect measures specified for each type of data.
1. Treatment effective rate (dichotomous)
Definition: Composite clinical improvement based on symptom resolution, radiological clearance, and laboratory normalization (per trial definitions).
Effect measure: Odds ratio (OR) with 95% confidence interval (CI).
Timing: Post-intervention, at the end of treatment course.
2. Complication rate (dichotomous)
Definition: Incidence of pneumonia-related complications (e.g., respiratory failure, ventilator-associated pneumonia, secondary infection).
Effect measure: Odds ratio (OR) with 95% CI.
Timing: During treatment and follow-up period.
3. Arterial oxygen saturation ($SpO_2$) (continuous)
Definition: Peripheral oxygen saturation (%) measured via pulse oximetry.
Effect measure: Standardized mean difference (SMD) with 95% CI.
Timing: Post-intervention, at the primary assessment point.
4. Modified Medical Research Council (mMRC) Dyspnea Score (continuous, exploratory)
Definition: 0–4 scale assessing subjective breathlessness.
Effect measure: Standardized mean difference (SMD) with 95% CI.
Timing: Post-intervention, concurrent with other outcome assessments.

**Quality assessment / Risk of bias analysis** Two independent reviewers assessed the methodological quality and risk of bias of the included randomized controlled trials (RCTs).
Tools used
Joanna Briggs Institute (JBI) critical appraisal tool for RCTs: Assessed random sequence generation, allocation concealment, blinding, completeness of outcome data, selective reporting, and other biases.
Cochrane Collaboration Risk of Bias Tool: Evaluated five key domains: randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results.
Risk categorization
Low risk: No high-risk domains.
Some concerns: No high-risk domains but at least one unclear domain.
High risk: At least one high-risk domain.
Discrepancy resolution
Disagreements between reviewers were resolved through discussion or consultation with a third reviewer.

**Strategy of data synthesis** Data synthesis was performed using Stata 18.0 software, following standard meta-analytic methods.
Effect measures
Dichotomous outcomes (treatment effective rate, complication rate): Odds Ratio (OR) with 95% confidence intervals (CIs).
Continuous outcomes (arterial oxygen saturation, mMRC dyspnea score): Standardized Mean Difference (SMD) with 95% CIs.
Model selection
A random-effects model was used for all pooled analyses to account for between-study heterogeneity.
Heterogeneity assessment
Statistical heterogeneity evaluated via $I^2$ statistic and Cochrane's Q test ($p < 0.10$).
Heterogeneity interpreted as:
0–40%: may not be important
30–50%: moderate
50–75%: substantial
75–100%: considerable
Sensitivity analysis
Performed by iteratively removing each individual study to test the robustness of pooled estimates.
Publication bias
Planned for outcomes with ≥10 studies; not performed here due to insufficient number of studies per outcome.
Evidence certainty
Assessed using the GRADE approach for each main outcome.

**Subgroup analysis** Subgroup analyses were planned but not performed due to the insufficient number of studies within each predefined subgroup and heterogeneous intervention definitions across included trials.
Predefined subgroups (planned)
Pneumonia type: Stroke-associated pneumonia; severe viral pneumonia; severe pneumonia with mechanical ventilation.
Airway clearance modality: Positioning management; chest wall vibration; fiberoptic bronchoscopy-assisted clearance; combined/refined airway protocols.
Baseline severity: Mild-to-moderate vs. severe pneumonia.

Reason for non-performance
Too few studies per subgroup (e.g., only 1 study for positioning, 2 for bronchoscopy-assisted clearance).
Interventions were frequently combined, limiting clear separation of single modalities.
Insufficient data to reliably explore sources of heterogeneity for $SpO_2$ and mMRC score.
Sensitivity analysis (alternative)
Iterative removal of individual studies confirmed the robustness of pooled effects for treatment effective rate, complication rate, and $SpO_2$ improvement, despite observed heterogeneity.

**Sensitivity analysis** Sensitivity analyses were performed to assess the robustness of pooled effect estimates.
Method: Iterative leave-one-out analysis, removing one study at a time and recalculating the pooled effect size and 95% CI.
Findings:
Treatment effective rate: Pooled OR remained stable (range: 3.21–4.78); 95% CI consistently excluded 1.
Complication rate: Pooled OR remained stable (range: 0.12–0.22); 95% CI consistently excluded 1.
Arterial oxygen saturation: Pooled SMD remained positive (range: 1.42–2.05); 95% CI consistently above zero.
mMRC dyspnea score: Pooled SMD remained non-significant and highly variable.
Conclusion: Results for treatment efficacy, complications, and oxygenation were robust to single-study exclusion. The dyspnea finding remained unstable.

**Country(ies) involved** China.

**Keywords** critical care; physical therapy modalities; pneumonia; respiratory therapy; systematic review.

**Contributions of each author**
Author 1 - Hongyun Cai.
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Author 3 - Wei Yuan.
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