Humidification policies for mechanically ventilated intensive care patients and prevention of ventilator-associated pneumonia: a systematic review of randomized controlled trials

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CRD summary
This review of trials comparing different humidification methods concluded that there is no evidence of benefits of specific humidification techniques in reducing ventilator-associated pneumonia. The authors' conclusions reflect the limited evidence presented and appear reliable.

Authors' objectives
To assess the effectiveness of different methods of air humidification in preventing ventilator-associated pneumonia (VAP).

Searching
MEDLINE and the Cochrane Library were searched up to February 2006. The search terms were reported and no language restrictions were applied. The reference lists of all identified trials were also checked.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs), quasi-randomised trials and systematic reviews or meta-analyses of such trials were eligible for inclusion.

Specific interventions included in the review
Studies of hydrophobic and or hygroscopic heat and moisture exchangers (HMEs) with or without bacterial filters, and of heated humidifiers (HHs) with or without heated wire circuits (HWCs), were eligible for the review. The included studies compared HH with HWC versus HH without; hygroscopic versus hydrophobic HME; hydrophobic HME versus HH and HH with HWC; hygroscopic HME versus HH with HWC; and hygroscopic HME with filter versus HH and HH with HWC.

Participants included in the review
The participants in eligible studies were patients undergoing mechanical ventilation in intensive care units. No further details of the participants were reported.

Outcomes assessed in the review
The included studies were required to have occurrence of VAP as their primary outcome.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed studies for relevance. Any disagreements were resolved by discussion or referral to a third reviewer.

Assessment of study quality
Two reviewers independently assessed validity on the basis of concealment of treatment allocation, description of drop-outs and use of intention-to-treat analysis. Any disagreements were resolved through discussion with a third reviewer.

Data extraction
The data were extracted by two reviewers independently and cross-checked. Study authors were contacted for additional information if required. Data on the number of cases of VAP in each study group were used to calculate the
relative risk (RR) and its 95% confidence interval (CI).

**Methods of synthesis**

How were the studies combined?
When trials were considered methodologically, clinically and statistically homogeneous, the results were pooled by meta-analysis using a random-effects model.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the chi-squared test and I-squared statistic.

**Results of the review**

Ten RCTs with 2,014 participants were included.

In terms of study quality, allocation concealment was adequate in 2 studies, unclear in seven and inadequate in one. Seven studies had inadequate description of drop-outs and only one clearly used an intention-to-treat analysis.

Passive versus active humidification: 9 RCTs compared passive against active humidification methods. Most comparisons were represented by only 1 study and showed no significant difference. One RCT comparing hydrophobic HME with HH-HWC significantly favoured HME (RR 0.41, 95% CI: 0.20, 0.86). Three RCTs comparing hygroscopic HME with HH-HWC found no significant difference (pooled RR 0.90, 95% CI: 0.53, 1.53).

Active humidification: 1 study comparing HH-HWC with HH found no significant difference.

Passive humidification: 1 study comparing hydrophobic HME with hygroscopic HME found no significant difference.

Tests of statistical heterogeneity were not significant for any comparison.

**Authors' conclusions**

The results of this review did not show any benefits of specific humidification techniques in terms of reducing VAP.

**CRD commentary**

This review addressed a defined question and the inclusion criteria were clear. No language restrictions were applied to the search, thus minimising the risk of language bias. Unpublished studies were not sought and the risk of publication bias was not assessed. Validity was assessed using standard criteria and the results were taken into account in the review. Only limited details of the primary studies were presented, making it difficult to assess any differences between the included studies. Appropriate methods were used to minimise the risk of bias and error in the study selection, validity assessment and data extraction processes. The studies were pooled by meta-analysis and the absence of statistical heterogeneity supports the authors' decision to pool. The authors' conclusions reflect the limited evidence presented and appear reliable.

**Implications of the review for practice and research**

Practice: The authors stated that it is not possible to recommend the use of either active or passive humidifiers to prevent VAP, nor the type of passive humidifier to be used. They recommended active humidifiers with HWCs in preference to those without; this recommendation is based on theoretical considerations and not on the evidence presented in the review.

Research: The authors stated the need for large high-quality RCTs comparing different humidification policies, the most clinically relevant comparisons being between hygroscopic HME and HH-HWC and between hygroscopic HME with filter and HH-HWC.
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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.