CRD summary
This review found that the evidence base on suctioning in adult patient varied in strength and was lacking in some areas of suctioning practice. The small number of included studies with methodological limitations and the possibility of publication bias mean that the results of this review should be interpreted with caution.

Authors' objectives
To evaluate the efficacy and safety of suctioning in intubated, non-intubated or tracheotomised adult patients. This was an update of a previous clinical practice guideline (see Other Publications of Related Interest).

Searching
MEDLINE (from 1998), CINAHL, EMBASE and The Cochrane Library (from 1996) were searched to November 2007. Start dates were end dates of the searches for the previous review. Search terms were reported. Reference lists of retrieved articles were screened. The review was restricted to studies published in English.

Study selection
Randomised controlled trials (RCTs), both parallel group and cross-over trials, that assessed suctioning in adult patients were eligible for inclusion. Studies of other designs were eligible for inclusion for topics on which no RCTs were available.

Most studies assessed intubated patients on mechanical ventilation. Some studies used a lung model. Most studies were conducted in intensive care unit patients.

Two reviewers independently assessed studies for inclusion.

Assessment of study quality
Two reviewers independently assessed study quality using the five-point Jadad scale of randomisation, blinding, drop-outs and withdrawals. Study quality was also assessed using the PEDro tool to assign studies a score from zero to 10. Higher scores indicated higher quality. Disagreements were resolved through consensus.

Data extraction
Two reviewers independently extracted data to calculate odds ratios (ORs) together with 95% confidence intervals (CIs) for dichotomous data and mean differences (MD) and 95% CIs for continuous data. Authors were contacted for additional information where necessary. Disagreements were resolved through consensus.

Methods of synthesis
Data on the difference between open suction and closed suction were pooled using random effects meta-analysis. Heterogeneity was assessed using the I² statistic. Heterogeneity between studies precluded pooling of data for other outcomes and a narrative synthesis was presented instead.

Results of the review
Twenty-eight RCTs (number of participants unclear, range one to 457) were included: 15 parallel group trials and 13 crossover trials. Eleven low level studies were included for gaps in the evidence for which there were no RCTs. Jadad scores ranged from 1 to 5 (average 2) and PEDro scores ranged from 4 to 9 (average 6). Criteria most commonly not fulfilled by the included studies were appropriate randomisation, adequate concealment of treatment allocation and blinding.

Hyperinflation (three RCTs): One RCT (n=17 participants) reported no effects of hyperinflation on oxygenation, heart rate, blood pressure, mixed venous oxygen saturation and dynamic compliance following oxygen saturation. One RCT (n=15) found that hyperinflation improved lung compliance and decreased airway resistance for up to 30 minutes.
following suction. A second RCT (n=20) compared manual with ventilator hyperinflation and found no significant difference in sputum weight, but both methods improved static compliance following suction. One RCT (n=16) found that suctioning through an adaptor resulted in significantly higher pressure of arterial oxygen values for up to one hour post-section compared with off-ventilator suction.

Open suction versus close suction (12 RCTs): Two randomised cross over studies (n=19) reported no significant difference between open and closed suction on arterial oxygen saturation, but a beneficial effect in favour of closed suction on end-expiratory lung volume (WMD 12.69dL, 95% CI 9.30 to 16.09). Five RCTs showed no difference between open and closed suctioning on ventilator associated pneumonia; three of these trials also reported no difference in terms of incidence of ventilator associated pneumonia per 1,000 patient days. There was no difference between open suction and closed suction for oxygenation (two RCTs), length of hospital stay (two RCTs) and duration of mechanical ventilation (two RCTs).

Frequency of changing closed suction systems (two RCTs): There was no difference between 24 hour and 48 hour changes of closed suction systems for incidence of ventilator associated pneumonia, mortality, length of stay in intensive care unit, duration of mechanical ventilation and colonisation of catheter tips.

Subglottic suctioning (two RCTs, one observational study, one case report): There was evidence to support the use of subglottic suction for the prevention of pneumonia in patients expected to require greater than 72 hours of mechanical ventilation.

Minimally invasive suctioning (two RCTs): The two studies had methodological limitations that made it impossible to draw conclusions.

Saline instillation (three RCTs): Use of saline with suctioning may cause a decrease in oxygen saturation although this change may not be clinically significant.

Medications administered during suctioning (three RCTs, one observational study): One RCT found that remifentanil (15ng/mL) was associated with less coughing with suctioning and greater decreases in mean arterial pressure and heart rate compared to lower doses (5ng/mL or 10ng/mL). This was confirmed in an observational study. One RCT found that a homeopathic remedy reduced secretions, facilitated earlier intubation and decreased intensive care unit stay in patients with chronic obstructive pulmonary disease who had failed extubation due to profuse tenacious stringy secretions.

Outcomes assessed only in single studies or observational studies were clinical indication for suctioning patients (one observational study), hyperoxygenation (one observational study), infection control issues (two case series), airway pressures (one RCT, one bench study), size of suction systems (one RCT, one bench study) and continuous versus intermittent suctioning (one observational study).

Cost information
Two RCTs investigated costs of open suction and closed suction systems. One reported a higher cost for closed suction (US$11.11±2.25 per patient per day versus US$2.50±1.12 per patient per day). The other study supported this finding, but only in patients who were mechanically ventilated for less than four days. When patients were ventilated for longer periods, closed suction systems were less expensive (€1.6±2.8 per patient per day versus €2.5±0.5 per patient per day).

Authors’ conclusions
The evidence base varied in strength and was lacking in some areas of suctioning practice.

CRD commentary
The review addressed a very broad question. Inclusion criteria were clearly defined for RCTs, but studies of other designs were included for some questions without explicit criteria of when such studies were included or what criteria these had to fulfil. The literature search was adequate, but restriction of the review to studies published in English risked language and publication biases. Study quality was assessed using relevant criteria and results were presented, but were not considered in the synthesis. The mainly narrative synthesis was appropriate given the differences between
studies.

The authors’ conclusions lacked focus, but relevant summaries were provided for each specific intervention. The small number of included studies with methodological limitations and the possibility of publication bias mean that the results of this review should be interpreted with caution.

Implications of the review for practice and research

Practice: The authors stated that the information they provided in their review was important to guide health care team provision of best practice for patients.

Research: The authors highlighted suctioning in non-intubated patients, indications for suctioning, optimal suction pressures, clean versus sterile technique and duration of the suction pass as being in need of further research.

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