CRD summary
This well-conducted review assessed the effect of respiratory physiotherapy on preventing pulmonary complications following cardiac surgery. The authors concluded that the usefulness of respiratory physiotherapy following cardiac surgery remained unproven, that the quality of existing trials was low, and that large-scale trials with a no-intervention control group were needed. The authors’ conclusions follow from the results presented.

Authors' objectives
To determine the effect of respiratory physiotherapy on preventing pulmonary complications following cardiac surgery.

Searching
MEDLINE, EMBASE, CINAHL and the Cochrane Controlled Trials Register were searched. The last search was performed on 19 February 2003. The keywords used were reported in the unabridged version of this review, which is available on the BMJ web site. No language restrictions were applied. The bibliographies of retrieved reports and reviews were checked for further studies and the main authors of all included studies were contacted. Data from abstracts or letters were not considered eligible for inclusion.

Study selection
Study designs of evaluations included in the review
Only randomised controlled trials were eligible for inclusion.

Specific interventions included in the review
Studies comparing any type of prophylactic respiratory physiotherapy with another method of respiratory physiotherapy, or no intervention, following cardiac surgery were eligible for inclusion. Studies where the comparison group was no intervention were considered to be of primary importance. The interventions in the included studies were physical therapy (including deep breathing, deep breathing and cough, deep breathing and costal expansion exercises), incentive spirometry, continuous positive airway pressure (CPAP) and intermittent positive pressure breathing. Cointerventions included analgesia, additional physical therapy and mobilisation.

Participants included in the review
Studies of adults or children who had undergone cardiac surgery were eligible for inclusion. One study was conducted in children only, another was conducted in both children and adults, and the remaining studies were conducted in adults only. No further details about the participants were provided.

Outcomes assessed in the review
To be eligible for inclusion, the primary studies had to report one of the following end points: atelectasis, pneumonia, oxygenation (partial pressure of arterial oxygen with the corresponding fractional inspired oxygen), or pulmonary function (vital capacity or forced expiratory volume in one second). The period of observation following the intervention had to be at least 2 days. In the included studies, evaluations were carried out between 2 and 6 days post-operatively. The reported outcomes also included adverse effects.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for review, or how many reviewers performed the selection.

Assessment of study quality
The authors looked at several aspects of the studies to describe quality; in particular, method of randomisation, allocation concealment, blinding of the outcome assessors, losses to follow-up, and use of intention-to-treat analysis. Three investigators independently assessed the methodological quality of the included studies.

Data extraction
One investigator abstracted the data, which were independently checked by the others. Data abstracted from individual studies included the incidence (and percentage) for dichotomous outcome data and the means (and standard deviations) for continuous outcome data. If outcomes were reported at more than one time point after surgery, the latest was used.

Methods of synthesis
How were the studies combined?
The data were tabulated and the studies were combined in a narrative, grouped by active or no-intervention control and within this by outcomes.

How were differences between studies investigated?
Heterogeneity between the studies was not assessed formally, but differences between the studies were discussed in the narrative.

Results of the review
Eighteen trials (1,457 patients) were included.

On average, the quality of the studies was low and only 2 studies included groups of more than 50 participants; both of these were active control trials.

Respiratory physiotherapy intervention versus no intervention (4 studies).
All 4 trials assessed physical therapy, while two also assessed incentive spirometry. There was no evidence that there was any beneficial effect from these interventions when compared with the control.

Respiratory physiotherapy intervention versus another respiratory physiotherapy intervention (14 studies).
Atelectasis (14 studies) and pneumonia (9 trials, n=292): one trial conducted in children found a lower incidence of atelectasis with less intensive physical therapy than with more intensive physical therapy. No statistically significant differences were found within any other trials reporting on these outcomes.

Oxygenation (10 trials): only one study showed any statistically significant difference between the interventions. This study compared CPAP with physical therapy and showed an increase in oxygenation in the CPAP-treated group.

Pulmonary function (11 trials): only one study showed a significant difference between the interventions. CPAP and noninvasive ventilation both showed an increase in pulmonary function in comparison with incentive spirometry.

Adverse effects (7 studies): 2 studies reported no adverse effects. The adverse events reported in the other studies included gastric distension (2 to 10% of the participants), nausea (0 to 12%), inconvenience of the mask with CPAP (43%) and, with physical therapy treatment, percutaneous capillary oxygen saturation of less than 90% (4%) and tachycardia (1%).

Cost information
Making the assumption that one physiotherapist was treating one patient at a time, and the average salary of a physiotherapist in Europe was 13 Euros per hour, the average daily labour cost for each patient was 6 Euros for incentive spirometry, 10 Euros for physical therapy, 20 Euros for intermittent positive pressure breathing, and 27 Euros for CPAP. The cost for purchase or maintenance of equipment was not considered.

Authors' conclusions
The usefulness of respiratory physiotherapy for the prevention of pulmonary complications following cardiac surgery remains unproven. Large-scale trials with a no-intervention control group are required to rectify this.

CRD commentary
The aims of the review were clearly stated. An extensive search of suitable databases was carried out to identify potentially relevant studies. Details of the methods used to abstract the data and assess validity were provided.
There were few details on how the studies were selected, which raised the possibility that subjective decisions at this stage may have introduced bias. There were also few details on the characteristics of the patients included in the primary studies and the results of the individual studies. A narrative synthesis was appropriate given the variety of interventions and comparison groups in the included studies.

The authors’ conclusions follow from the results presented.

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

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that there was a need for large-scale randomised studies with a no-intervention comparison group, clinically relevant end points and reasonable follow-up time.

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