Effect on the duration of mechanical ventilation of identifying patients capable of breathing spontaneously


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Daily objective screening and two-hour trials of spontaneous breathing, with messages to the physician in the case of successful results, in order to facilitate the timely extubation of the patient receiving mechanical ventilation.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
Adult patients with respiratory failure receiving mechanical ventilation and without dependence on mechanical ventilation for 2 or more weeks before enrolment and without an extubation order at the time of the evaluation.

Setting
Hospital. The economic study was carried out in North Carolina, USA.

Dates to which data relate
The effectiveness and resource use data were obtained from patients admitted to the institution between June 1995 and February 1996. The price date corresponded to the fiscal year 1996.

Source of effectiveness data
Effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was prospectively undertaken on the same patient sample as that used in the effectiveness analysis.

Study sample
No power calculations were reported. A total of 300 patients was included in the study. 149 patients with an average (SD) age of 61.7 (15.8) years were randomly assigned to the intervention group, and 151 patients with an average (SD) age of 60.5 (15.5) years were randomly allocated to the control group. A respiratory therapist performed the screening tests every morning. A respiratory therapist and the nurse caring for the patients initiated and monitored the trial of spontaneous breathing. A physician took all the decisions regarding the course of patient care. The patients not enrolled in the study accounted for 7% of the total of eligible patients (323 patients).
Study design
Randomised controlled trial carried out in a single centre. The duration of follow-up was until successful extubation or death. The randomisation was carried out using a computer and the sealed-envelope method being used. No loss to follow-up was reported.

Analysis of effectiveness
The analysis was carried out based on the 'intention to treat' principle. The overall duration of mechanical ventilation, the length of time from a successful screening test to the discontinuation of mechanical ventilation (weaning time), and the length of stay in the intensive care unit were the primary health outcomes used. The frequency of complications (reintubation, removal of the breathing tube by the patient, tracheostomy, and mechanical ventilation for more than 21 days) was reported as a secondary outcome. 'Successful screening test (in order to identify candidates for the trial of spontaneous breathing to be performed later the same morning) was determined by meeting all of the following criteria: the ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen had to exceed 200; the positive end-expiratory pressure could not exceed 5 cm of water; an adequate cough during suctioning (airway reflexes had to be intact); the ratio of respiratory frequency to the tidal volume should be at most 105 breaths per minute per litre; and no infusions of vasopressor agents or sedatives could be used.

The groups were comparable in terms of causes of respiratory failure, modes of mechanical ventilation, age, gender mix, and proportion of patients treated in the coronary care unit. The severity-of-illness scores (APACHE II and the acute-lung-injury scores) were not comparable across groups. A Cox proportional hazard model was used to adjust for the differences between groups in prognostic and demographic characteristics at baseline. Variables included in the model were Acute Physiology and Chronic Health Evaluation II (APACHE II) score, the Murray acute-lung-injury score, age, sex, race, the duration of intubation before enrolment, and the type of intensive care unit.

Effectiveness results
Mechanical ventilation was successfully discontinued earlier in the intervention group than in the control group (relative risk (RR) of successful extubation, 2.13, 95% CI: 1.55 - 2.92). The number of patients successfully removed from mechanical ventilation forty-eight hours after having had successful screening tests was 65 for the intervention group, and 24 for the comparator. The median weaning time was 1 day in the intervention group, and 3 days in the comparator group, (p<0.001). The figures for the median duration of mechanical ventilation were 4.5 (intervention) and 6 days (comparator), (p=0.003). The figures for median number of days of intensive care were 8 and 9, for the intervention and comparator, respectively, (p=0.17). The median number of days of hospital care for the intervention group was 14, and for the comparator was 15.5, (p=0.93). The complication rate was 20% in the intervention group versus 41% in the control group, (p=0.001).

Clinical conclusions
The authors found that notifying physicians about their patients’ successful completion of simple trials of spontaneous breathing shortened, by about two days, the time between the recovery from respiratory failure and the successful discontinuation of mechanical ventilation. This reduced the median overall duration of mechanical ventilation as compared to patients who had more gradual weaning with standard care.

Measure of benefits used in the economic analysis
No summary benefit measure was identified in the economic analysis, and only separate clinical and health-related outcomes were reported.

Direct costs
Costs were not required to be discounted due to the short time frame of the study. The quantities of resource use were not reported separately from the prices. The costs measured were operating costs, overhead, and complication costs. The hospital was the boundary adopted. The cost estimation was based on actual data from the institution's financial data for each department. The price date was the fiscal year 1996.
Statistical analysis of costs
The medians and interquartile ranges were reported. Two-tailed t-tests were performed to compare the groups in terms of costs.

Indirect Costs
Not included.

Currency
US dollars ($).

Sensitivity analysis
Not conducted.

Estimated benefits used in the economic analysis
Not applicable.

Cost results
The median costs in the intensive care unit associated with the intervention were $15,740 (range: 7,873 - 33,035). The corresponding figure for the comparator was $20,890 (range: 11,501 - 37,570), (p=0.03). The mean cost for the entire hospitalisation was $26,229 (range: 13,744 - 51,786) for the intervention, and $29,048 (range: 17,264 - 57,117) for the comparator, (p=0.3).

Synthesis of costs and benefits
The costs and effects associated with each strategy were not combined since the intervention turned out to be the dominant strategy.

Authors' conclusions
The daily screening of the respiratory function of adult patients receiving mechanical ventilation, followed by trials of spontaneous breathing in appropriate patients and notification of their physicians when those trials are successful, can reduce the duration of mechanical ventilation and the cost of intensive care and is associated with fewer complications than usual care.

CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparator is clear.

Validity of estimate of measure of benefit
The clinical study results are likely to be internally valid given the randomised study design adopted.

Validity of estimate of costs
The resource quantities were not reported separately from the prices. However, adequate details of methods of cost estimation were given.

Other issues
The issue of generalisability to other settings or countries was not addressed.

Source of funding