Effects of a multifaceted, multidisciplinary, hospital-wide quality improvement program on weaning from mechanical ventilation


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
Patients on mechanical ventilation in diagnosis-related groups (DRGs) 475 and 483 were subjected to a hospital-wide weaning management protocol, which aimed to reduce their time on mechanical ventilation and to improve their health outcomes. Under this protocol, each patient underwent a daily trial of spontaneous breathing using a continuous positive airway pressure (CPAP) of 5 cm H2O on Puritan-Bennett 7200a ventilators modified with the flow-by system. When patients successfully managed 5 minutes of breathing, they remained on CPAP until extubation; tracheotomised patients were changed to trach masks. Whenever there was a sign of failure the patient was returned to the ventilator. A standardised approach to common obstacles to weaning, such as infection, was taken. The comparator treatment was a situation in which each doctor in the hospital decided the weaning policy that they thought best and there was no standardisation of care.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients admitted to the adult medical, surgical and cardiac intensive care units (ICU). The patients had to be aged at least 18 years and be in DRGs 475 (respiratory system diagnosis with mechanical ventilation) and/or 483 (tracheotomy except for mouth, laryngeal, or pharyngeal disorder).

Setting
The setting was secondary care. The economic study was carried out in Massachusetts, USA.

Dates to which data relate
No dates for the effectiveness or resource evidence were given. The decision to adopt the weaning protocol was taken in 1995. The price year was not reported.

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

Link between effectiveness and cost data
The costing was carried out prospectively on the same group of patients as that used in the effectiveness analysis.
Study sample
No power calculations were reported. There was no sample selection; all patients who met the inclusion criteria were included. There were 220 patients in the year before the protocol was introduced, 247 patients in the first year of the protocol, and 271 in the second year of the protocol.

Study design
This was a single-centre, non-randomised trial with historical controls. The patients were followed up until hospital discharge.

Analysis of effectiveness
The analysis was conducted on an intention to treat basis. The health outcomes used were:

- ICU mortality,
- hospital mortality,
- the percentage discharged home,
- the percentage discharged to acute rehabilitation,
- the percentage discharged against medical advice,
- the percentage discharged to an acute care hospital,
- the percentage discharged to long-term care,
- the percentage having tracheotomy,
- the percentage having reintubation, and
- the number of days before weaning began.

The patient groups in the 3 years were not comparable, with the percentage in the nontracheal group increasing in the 2 years after the protocol was introduced, (p<0.0005). The APACHE II measure of severity of illness was higher in year 1 than year 0, (p=0.006), and increased still further in year 2, (p<0.0005). The patient groups in the 3 years were not statistically significant different in terms of the gender ratio or age.

Effectiveness results
There was a statistically significant reduction in the percentage of patients requiring tracheotomy, 61% in year 0, 50% in year 1 and 42% in year 2, (p<0.0005).

The percentage of cases involving reintubation also declined, from 33% in year 0 and 36% in year 1 to 26% in year 2, (p=0.039).

The declines in ICU and hospital mortality were not statistically significant.

There were no significant differences in the destinations at discharge.

The number of days before weaning began for years 0, 1 and 2 were not statistically significant.

Clinical conclusions
The mechanical ventilation weaning programme adopted by the hospital was effective in improving health outcomes,
despite the fact that the patients admitted were in a worse condition.

**Measure of benefits used in the economic analysis**
No summary measure of benefit was produced. Therefore, the study was, in effect, a cost-consequences analysis.

**Direct costs**
This study considered only the hospital costs. No discounting was carried out as the costs were incurred during less than one year. The quantities and the costs were not analysed separately. The costs to the hospital were derived from actual data provided by the hospital. The unit costs were taken from the authors' setting. The date of the resource evidence and the price year were not given.

**Statistical analysis of costs**
Simple descriptive statistics for the costs were given.

**Indirect Costs**
No indirect costs were measured.

**Currency**
US dollars ($).

**Sensitivity analysis**
No sensitivity analysis was carried out.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness Results' section.

**Cost results**
The mean cost per patient was $92,933 (standard deviation, SD=5,380.75) in year 0, $78,624 (SD=4,828.12) in year 1, and $63,687 (SD=3,838.50) in year 2, (p<0.005 for the trend from year 0 to year 2).

The costs of adverse effects were dealt with in the costing.

**Synthesis of costs and benefits**
The costs and benefits were not combined as the study was, in effect, a cost-consequences analysis.

**Authors’ conclusions**
The new protocol introduced in the hospital to wean patients from mechanical ventilation as soon as their condition permitted was effective in improving patient health, and it reduced the costs. This was particularly noticeable as the health status of the patients on mechanical ventilators had become worse during the 3 years.

**CRD COMMENTARY - Selection of comparators**
The choice of the comparator (no standardised protocol for weaning) was used because it had been current practice in the authors' setting. You should decide if the comparator represents current practice in your own setting.
Validity of estimate of measure of effectiveness
The source of the effectiveness data was a single study. The analysis was based on a non-randomised trial with historical controls, which was not ideal as the patients studied in the 3 years were not shown to be comparable in terms of the DRG and severity of illness. In addition, confounding factors were not adjusted for. The authors argued that, as illness severity was worse after the protocol was introduced, this would make the improvement in patient outcomes all the more impressive, but they did acknowledge that the improvement in results might be partly due to the improved effort and motivation resulting from the adoption of a new procedure, rather than the procedure itself. The study sample was representative of the study population as all patients meeting the inclusion criteria were included in the study.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The health benefits were, therefore, those associated with the effectiveness outcomes.

Validity of estimate of costs
The cost perspective adopted was that of the acute care hospital. The study assessed resource use in terms of ventilator days, and the length of stay in the hospital and ICU. However, it was not entirely clear what items the unit costs included. It is therefore possible that some costs, such as physician and nurse costs, might not have been included. The mean lengths of stay and their unit costs were not reported separately, which means that for decision-makers in other settings, the usefulness of the results will be limited. The resource use quantities were obtained from a single study, while the prices were taken from the authors' setting. No sensitivity or other analysis of the quantities and prices was performed. Information was not given as to whether charges were used to proxy prices. No years were reported for any of the cost data and no price year was given. Discounting was unnecessary since all the costs were incurred during less than 2 years.

Other issues
The authors compared their results with the findings from other studies. Although the authors did not address the issue of generalisability to other settings, they drew attention to many of the details in the new protocol which would have to be followed in order to replicate the effectiveness results. The cost analysis was incomplete and did not give sufficient information to allow the results to be generalised to other settings, particularly when only the acute hospital costs were included. The authors did not present their results selectively and their conclusions reflected the scope of the analysis. The authors did not discuss any further limitations to their study.

Implications of the study
The authors recommended a weaning protocol, as carried out in their acute care hospital, to improve health outcomes for patients in DRGs 475 and 483 and as a way of reducing the hospital's costs.

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