Ventilator-associated pneumonia with circuit changes every 2 days versus every week

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
A strategy of frequent ventilator circuit changes (every week) was examined in critically ill patients receiving mechanical ventilation.

Type of intervention
Primary prevention.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised critically ill patients aged over 14 years who were receiving mechanical ventilation. Patients with noninvasive ventilation or high frequency ventilation were excluded.

Setting
The setting was secondary care. The economic study was carried out in Taiwan.

Dates to which data relate
The effectiveness and resource use data were gathered from November 1991 to October 1993 for the control group (two changes) and from November 1995 to October 1997 for the intervention group (weekly changes). The price year was not reported.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that used in the effectiveness study.

Study sample
The use of power calculations to determine the sample size was not reported. All eligible patients who were identified in the two study periods were included in the analysis. There were 6,213 patients in the control group and 7,068 in the intervention group. In the control group, the mean age was 67 (+/- 15) years and the ratio of males to females were 4.3. In the intervention group, the mean age was 65 (+/- 14) years and the ratio of males to females were 3.59.

Study design
This was a prospective cohort group with historical control patients. The study was carried out in a single centre. The length of follow-up was not reported. No loss to follow-up was observed.

**Analysis of effectiveness**

All patients included in the initial study sample were considered in the analysis of the effectiveness. The primary outcome measures used in the study were the absolute number of VAP cases and the rate of VAP per 1,000 ventilator days. VAP was defined according to CDC criteria. Pneumonia occurring within 24 hours after the initiation of mechanical ventilation, or 24 hours after the termination of ventilation, was not considered ventilator-associated. The baseline comparability of the study groups was not discussed.

**Effectiveness results**

The absolute number of VAP cases was 174 in the control group and 225 in the intervention group.

The rate of VAP per 1,000 ventilator days was 2.66 in the control group and 2.58 in the intervention group.

The difference in the rate of VAP between the groups was not statistically significant, (p=0.803).

**Clinical conclusions**

The effectiveness analysis showed that the change in the frequency of ventilator circuits (weekly rather than every other day) did not result in an increase in the rate of VAP among critically ill patients.

**Measure of benefits used in the economic analysis**

The health outcomes were left disaggregated and no summary benefit measure was used in the economic evaluation. In effect, the study was a cost-consequences analysis.

**Direct costs**

Discounting was not relevant since the costs were incurred during a short time. The unit costs were reported separately from the quantities of resources used. The health services considered in the economic analysis were the time taken by a respiratory therapist to change the circuit, and the use of reusable circuits and their disinfection. The authors calculated the cost reduction due to the fewer changes of ventilator circuits. Although not explicitly reported, the cost/resource boundary of the study was likely to have been that of the hospital. Resource use was estimated on the basis of the actual number of ventilators used for the patients who participated in the effectiveness study and on the actual time required to change a circuit. The unit costs of respiratory therapists’ time and reusable circuits (and disinfection) were reported, but the source was not stated. The price year was not given.

**Statistical analysis of costs**

The costs were not treated stochastically.

**Indirect Costs**

The indirect costs were not considered.

**Currency**

New Taiwan dollars (NT$). The estimated total cost-savings were also reported in US dollars ($), but the exchange rate was not provided.

**Sensitivity analysis**
No sensitivity analyses were performed.

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

**Cost results**
The total annual cost reduction associated with weekly changes of ventilator circuit changes, relative to the standard approach of changes every 2 days, was NT$ 2.5 million ($80,000).

**Synthesis of costs and benefits**
The costs and benefits were not synthesised.

**Authors' conclusions**
The weekly frequency of changing ventilator circuits in non-paediatric critically ill patients did not increase the rate of ventilator-associated pneumonia (VAP). It did, however, reduce the hospital costs associated with the change and use of ventilators, mainly due to a reduction in manpower-related costs.

**CRD COMMENTARY - Selection of comparators**
The comparator used in the analysis was a change of ventilator circuits every 2 days, which represented the standard frequency of changes for critically ill patients. This was also the frequency recommended by the CPC. You should decide whether it represents a valid comparator in your own setting.

**Validity of estimate of measure of effectiveness**
The analysis of effectiveness used a prospective cohort group with historical control patients. However, the use of a fully prospective and randomised study would have been more appropriate for the study question. The study sample was not selected on the basis of strict inclusion criteria, hence it is likely to have been representative of the study population of patients requiring mechanical ventilation. However, it should be noted that patients were identified from a single centre. Caution is therefore required when extrapolating the effectiveness results to other samples of patients. The patients' characteristics were reported only in terms of the demographics, and the baseline comparability of the two groups of patients was not discussed. Therefore, it was unclear whether the two groups were well matched. No information on the length of follow-up was reported. The study groups were not studied concurrently and factors other than the change in frequency of ventilator circuits may have had an impact on the results of the analysis. Power calculations were not reported, but the sample was very large and the authors stated that it represented the study with the largest sample in the literature. The internal validity of the study is likely to be quite low given the study design used.

**Validity of estimate of measure of benefit**
No summary benefit measure was used in the analysis.

**Validity of estimate of costs**
The perspective adopted in the economic analysis was not explicitly stated, although it appears to have been that of the hospital. In addition, the hospital is also likely to have provided the cost data. Only those costs strictly related to the change of the ventilator circuits were included in the analysis. The authors provided all the information about the quantities of resources used and unit costs, thus simplifying the replication of the study in other settings. However, the price year was not reported and this may limit reflation exercises, which are required to generalise the results of the analysis. Further, the cost estimates were specific to the study setting and sensitivity analyses were not carried out.
Other issues
The authors made several comparisons of their findings with those from other studies, which were accurately described in order to provide a justification for differences in the results. However, the authors did not address the issue of the generalisability of their results to other settings and did not carry out sensitivity analyses. This reduces the external validity of the analysis. The study referred to critically ill patients requiring mechanical ventilation and this was reflected in the conclusions of the analysis. The authors discussed the main limitation of their analysis, namely the critical diagnosis of pneumonia in critically ill patients receiving mechanical ventilation.

Implications of the study
The study results suggested that ventilator circuits may be changed less frequently than recommended by CDC. This resulted in a reduction in cost without affecting the patients' health (in terms of incidence of VAP).

Source of funding
None stated.

Bibliographic details

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