Effect of an education program aimed at reducing the occurrence of ventilator associated pneumonia
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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
An educational programme directed toward respiratory care practitioners and intensive care unit (ICU) nurses was considered. The programme consisted of a 10 page self study module on risk factors and practice modifications involved in ventilator associated pneumonia (VAP), in-services at staff meetings, and formal didactic lectures. Each participant was required to take a pre-intervention test before the study module and an identical post-intervention test following completion of the study module. Fact sheets and posters reinforcing the information in the study module were also posted throughout the ICUs and the Department of Respiratory Care Services.

Type of intervention
Secondary prevention.

Economic study type
Cost effectiveness analysis.

Study population
The study population comprised patients admitted to Barnes Jewish Hospital care units between October 1999 and September 2001 requiring mechanical ventilation and who developed VAP.

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

Dates to which data relate
The effectiveness data were gathered between 1999 and 2001. The costs of implementing the programme at the hospital were gathered between 2000 and 2001, while resource use and price data for the disease were obtained from studies published in the 10 years prior to the study.

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

Link between effectiveness and cost data
The costs of programme implementation were obtained prospectively from the same patient sample as that used for the effectiveness study. However, the authors reported the estimated cost per episode of pneumonia from studies published between 1991 and 2001.

Study sample
No power calculations to determine the sample size were reported. During the 12 month pre intervention period, 191 episodes of VAP occurred during a total of 15,094 ventilator days among 23,664 patient admissions. Following the intervention, 81 episodes of VAP were recorded out of a total of 14,171 ventilator days among 22,823 patient admissions.

**Study design**
This was a pre and post intervention, observational study based on a single medical centre. The duration of follow-up was not stated. There was no loss to follow-up.

**Analysis of effectiveness**
The form of analysis (intention to treat or treatment completers only) was not stated, but the study design indicates that it was probably conducted on the basis of treatment completers only. The primary outcomes were the rates of VAP. In terms of the comparability of patient demographics and clinical characteristics in the pre and post intervention groups, no formal analysis was presented.

**Effectiveness results**
During the 12 month pre-intervention period, 191 episodes of VAP occurred during a total of 15,094 ventilator days among 23,664 patient admissions. This equated to an infection rate of 12.6 per 1,000 ventilator days.

Following the intervention, 81 episodes of VAP were recorded out of a total of 14,171 ventilator days among 22,823 admissions. This equated to an infection rate of 5.7 per 1,000 ventilator days. It represents a decrease of 57.6% in comparison with the pre-intervention period, (p<0.001).

**Clinical conclusions**
The study showed that an educational initiative directed at respiratory care practitioners and ICU nurses can dramatically decrease the incidence of VAP.

**Measure of benefits used in the economic analysis**
The measure of benefits used in the economic analysis was the number of VAP infections avoided because of the education programme. This was computed as the expected episodes of VAP minus the actual episodes after the intervention.

**Direct costs**
The cost/quantity boundary adopted for the costing was not clear from the paper. Broad expenditure items included the cost per episode of VAP and the cost of implementing the education programme (i.e. salaries and benefits for infection control nurses, and paper supplies). The quantities and the costs were reported separately only for the education programme. Discounting was not relevant to the education programme because of the short period of follow up. However, it was unclear whether discounting was applied to the cost of episodes obtained from prior studies. No price year was reported.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
No indirect costs were included.
Currency
US dollars ($).

Sensitivity analysis
No areas of uncertainty were identified or investigated.

Estimated benefits used in the economic analysis
The number of VAP episodes prevented by the intervention was 98 (179 expected versus 81 actual).

Cost results
Total costs from the literature were used for the costing analysis. The costs of VAP ranged from $4,947 to $5,800 when using dollars from the early 1990s, and from $37,900 to $41,294 when using more recent analyses. The costs of implementing the education programme included salaries and benefits for infection control nurses (two half equivalent positions at $29,000 each) and paper supplies (at $1,200).

Synthesis of costs and benefits
The study multiplied the episodes of VAP prevented by the range of published costs attributable to VAP, and then subtracted the intervention costs. This resulted in cost-savings in the post-intervention period of $425,006 to $4.05 million.

Authors' conclusions
The implementation of an educational initiative aimed at preventing nosocomial infections can result in cost-savings that justify the initial investment required for the development and implementation of such interventions.

CRD COMMENTARY - Selection of comparators
The comparator (clinical procedures and practices prior to the introduction of the education programme) was not explicitly described, but the rationale for the choice of the comparator was clear. It reflected prior standard practice in ICUs.

Validity of estimate of measure of effectiveness
The design of this study (pre and post observational study) was appropriate for the study question. However, as the authors acknowledged, such a design is associated with potential biases and confounding variables which may partially explain the results (see ‘Other Issues’ field below for details). Since there was no adjustment for potential confounding factors, there is the possibility of selection bias. Power calculations were not reported, thus it is unclear whether the sample size was large enough to obtain robust results. The authors adopted VAP rates as the measure of effectiveness. This appears to have been a valid measure of effectiveness, although it was not the same as that used by the Centers for Disease Control.

Validity of estimate of measure of benefit
The number of VAP infections prevented by the education programme was the measure of benefits. This appears to have been an appropriate measure of benefits.

Validity of estimate of costs
The study perspective, though not stated explicitly, appears to have been that of the hospital. It was unclear whether all the relevant cost categories for this perspective were included, as the authors limited their analysis to the total costs obtained from published studies. The resource quantities were not reported separately, and no price year was reported.
This limits the transferability of the results.

**Other issues**
The authors reported comparisons of their findings with those of other research. They stated that this piece of research conforms with a previous trend of using educational programmes as a means of avoiding risk factors associated with VAP. The authors partially addressed the issue of generalisability. A more detailed costing exercise would have been more informative to the decision-maker, while detailed resource use would have helped transferability to other settings. Overall, the results of the study should be considered with some caution.

The authors acknowledged four limitations of the study. First, it was performed in a single medical centre and the results could not be applied to other hospitals. Second, in this pre and post observational non randomised study, the ICU staff were not blinded to either the presence or the recipients of the intervention. Third, the definition of VAP differed from that employed by the Centers for Disease Control. Finally, no other outcomes with an impact on costs (e.g. antibiotic use, mortality or antibiotic resistance patterns) were evaluated.

**Implications of the study**
In terms of clinical practice, the study suggested that focusing education primarily towards respiratory care practitioners and ICU nursing staff can lead to lower rates in VAP. In terms of further research, the authors stated that future studies are needed to validate these results and to determine the impact of infection control practice on patient-specific outcomes.

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