The economic benefit of organizational restructuring of the cardiothoracic intensive care unit
Cannon M A, Beattie C, Speroff T, France D, Mistak B, Drinkwater D

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
The organisational restructuring of a specialised cardiac intensive care unit (CICU) was examined. The CICU was reconstructed from a level III intensive care unit (ICU) to a level I ICU with the initiation of a consultant CICU service. The CICU service provided an attending physician dedicated to ICU care daily, such that medical care was delivered by this designated specialist with primary responsibility for the CICU. All the cardiac patients admitted to the CICU received consultation with the CICU service.

Type of intervention
Other: Management care.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised cardiac surgery patients. The inclusion criteria were ejection fraction above 35%, haemodynamic stability without intravenous inotropic support, no symptoms of congestive heart failure or cardiogenic shock, and no invasive haemodynamic support. Patients who had no immediate history of acute myocardial infarction, and those without mechanical oxygenation or ventilation support, were also included. Several criteria had to be met for early extubation. For example, a temperature above 36 degrees C, orally haemodynamic stability without significant vasoactive drugs, and blood loss of less than 100 mL/hour. Other criteria were lactate less than 2.0 mg %, pH between 7.35 and 7.45, PaO2 greater than 65 mmHg, HCO2 greater than 20 mEq/L and PCO2 35 to 45 mmHg.

Setting
The setting was secondary care. The economic analysis was conducted in Nashville, USA.

Dates to which data relate
The effectiveness and resource data were gathered between 1999 and 2000. The baseline period was between June and September 1999 and the intervention period after September 1999. The price year was not reported.

Source of effectiveness data
The effectiveness data were derived from both a single prospective study (intervention period) and a retrospective study (baseline period).

Link between effectiveness and cost data
The costing was undertaken on the same group of patients as that used in the effectiveness study.
Study sample
The use of power calculations was reported. An initial statistical analysis showed the ability to detect a change of 10 to 30% with a power of 0.80 and an alpha of 0.05 in standardised units. Between December 1999 and April 2000, 123 cardiac surgery patients were preoperatively entered into the study. Seventy-two patients were enrolled during the baseline period and 90 during the intervention period. Of these patients, 79.2% (57 out of 72) were eligible for early extubation postoperatively during the baseline period and 73.3% (66 out of 90) during the intervention period.

Study design
This was a prospective comparative study with historical controls. The study was conducted in a single centre. The patients were followed every day until discharge from the ICU to a regular hospital ward.

Analysis of effectiveness
All of the patients entered into the study were included in the analysis. The primary health outcomes used were:

the average ventilation time,

the proportion of patients extubated within 6 hours,

the LOS in the ICU,

the post-surgery LOS, and

the rate of readmission to the CICU.

No differences in demographic or clinical characteristics were found between the postoperative baseline patients and the postoperative intervention patients. There were 47% males in the baseline group versus 53% in the intervention group. The mean age was 58.7 years (baseline) versus 59.7 years (intervention) and the admission temperatures were 35.5 degrees C and 35.3 degrees C, respectively).

Effectiveness results
The average ventilation time post-surgery was significantly less during the intervention period (7.44 hours) than during the baseline period (9.96 hours), (p=0.01).

The proportion of patients extubated within 6 hours was 60.6% during the intervention period and 12.3% during the baseline period, (p<0.001).

The LOS in the ICU was shorter during the intervention period (1.27 days) than the baseline period (1.53 days). However, the difference (0.26 days) was not statistically significant, (p=0.11).

The post-surgery LOS was shorter during the intervention period (4.35 days) than the baseline period (4.82 days). However, the difference (0.47 days) was not statistically significant, (p=0.10).

The return rate to the ICU was 2.3% during the baseline period and 0% during the intervention period, (p=0.21).

Clinical conclusions
The authors did not report any clinical conclusions. All the patient outcomes (morbidity) were improved during the intervention period, compared with the baseline period.

Measure of benefits used in the economic analysis
No summary benefit measure was used in the economic evaluation. The evaluation was, in effect, a cost-consequences analysis.
Direct costs
The cost boundary adopted was that of the hospital. The cost analysis was limited to the direct costs, including anaesthesia, ICU, laboratory, pharmacy, respiratory and radiology costs. The hospital costs were calculated from cost-to-charge ratios. The resource data were obtained by reviewing medical records for every eligible patient. The price year was not stated. The costs and the quantities were not reported separately. Discounting was not carried out since the costs were incurred during less than one year.

Statistical analysis of costs
Standard statistical tests (Student's t-test) were carried out to test the statistical significance of differences in the cost estimates across the two groups. A multivariate logistic regression was performed to compare the baseline and intervention groups after adjusting for patient age, gender, race, weight, admission temperature, admission through the emergency department, all patient refined severity score, and Diagnostic-Related Group weight.

Indirect Costs
The indirect costs were not included.

Currency
US dollars ($).

Sensitivity analysis
No sensitivity analyses were performed.

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

Cost results
The cost-saving of the CICU service was reflected by a reduction of $2,285 in the average total costs per patient between the baseline and intervention periods, ($20,709 versus $18,424; p=0.04).

The savings were primarily related to $196 less in radiology costs, ($510 versus $314; p=0.003), and $311 less in pharmacy costs, ($1,633 versus $1,322; p=0.004).

There were no differences in anaesthesiology costs, ($754 versus 738; p=0.62), and respiratory therapy costs, ($315 versus $333; p=0.50).

The adjusted results were the same as those for the univariate analyses.

Synthesis of costs and benefits
Not applicable.

Authors' conclusions
The results indicated that organisational restructuring of the cardiac intensive care unit (CICU) to newer models can reduce the costs associated with cardiac surgery.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparator (a level III ICU) was clear since it represented the standard care in the authors’ setting. You should decide whether it represents a valid option in your own setting.

**Validity of estimate of measure of effectiveness**

The basis of the analysis of effectiveness was a prospective comparative study with historical controls, which was appropriate for the study question. The authors noted that ethical restraints prevented the staging of a randomised double-arm study. The study groups were shown to be comparable in terms of demographic and clinical characteristics. Power calculations were not carried out to determine the size of the sample, but they were carried out retrospectively to ensure that the sample size was appropriate for the study question. The study sample was identified from a single centre. Therefore, it may not be representative of the wider study population of cardiac surgery patients. Caution is required when transferring the results of the analysis to other centres, owing to variability in standard patterns. The main limitation of the analysis of effectiveness was that the authors used intermediate outcomes rather than the mortality rate or quality of life. Hence, it is not possible to compare their results with those of other published studies.

**Validity of estimate of measure of benefit**

No summary measure of health benefit was used in the economic analysis. The analysis was, in effect, a cost-consequences analysis.

**Validity of estimate of costs**

The perspective adopted in the study was not explicitly stated, but appears to have been that of the health service. If this was the case, all the relevant categories of costs were included in the analysis. The source of the cost data was reported, but few details of the cost analysis were provided. The resource quantities and the costs were not reported separately. In addition, the price year was not stated, which hinders reflation exercises in other settings. The costs were treated stochastically. Although the authors reported that a cost-to-charge conversion was applied to reflect the true costs of the services, the value of this ratio was not reported. It would appear that the estimates were specific to the study setting and sensitivity analyses were not performed. This fact limits the transferability of the results to other settings. No discounting was performed since the follow-up period was less than one year.

**Other issues**

The issue of the generalisability of the study results to other settings was not addressed and sensitivity analyses were not performed. These facts limit the external validity of the analysis. The authors did not highlight any limitations of their study. The reader should be aware that this study was primarily a cost analysis rather than a cost-effectiveness study. The authors acknowledged that they focused on the positive effects of organisational changes on the economic model relating to the CICU. Consequently, the study suffers from weaknesses in the analysis of effectiveness.

**Implications of the study**

The authors strongly recommended that a larger study be performed to further evaluate the significance of the organisational models of the CICU.

**Source of funding**

None stated.

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