Impact of cost reduction programs on short-term patient outcome and hospital cost of total knee arthroplasty

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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
The implementation of a clinical pathway (CP) for total knee arthroplasty (TKA) and a knee-implant standardisation programme (KISP), both intended to control the increase of hospital costs associated with knee replacement, were examined. The CP was developed by a multidisciplinary team and was designed to provide an algorithm for the management of patients requiring TKA (from hospital admission until rehabilitation and physical therapy). The KISP assisted surgeons in knee implant selection and was designed to reduce the implantation costs.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients undergoing unilateral primary TKA for the treatment of osteoarthritis.

Setting
The setting was a hospital. The economic study was conducted at the Department of Orthopaedic Surgery, Lahey Clinical Medical Center, Burlington (MA), USA.

Dates to which data relate
The effectiveness and resource use data were gathered in 1992 for the control group and in 1995 for the intervention group. The price year was 1995.

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

Link between effectiveness and cost data
The costing was conducted prospectively on the same sample of patients as that used in the study group of the effectiveness study, but retrospectively on the historical control group.

Study sample
Power calculations to determine the sample size were not reported. The comparison group comprised 56 consecutive patients who had TKA in 1992, while the intervention group comprised 103 consecutive patients who underwent TKA in 1995. Thus, a total sample of 159 patients was considered. The mean age of the patients was 70.66 years (age range:
45 - 88) in the comparison group and 69.53 years (age range: 46 - 91) in the intervention group.

**Study design**
This was a comparative study with a historical control, which was conducted in a single centre. The data were collected prospectively for the study group and retrospectively for the control group. The minimum duration of follow-up was 8 years in the control group and 5 years in the intervention group. No loss to follow-up was reported. All the outcome data were gathered using a questionnaire, which was distributed by the nursing staff during hospitalisation.

**Analysis of effectiveness**
All of the patients included in the initial study sample were taken into account in the effectiveness analysis. The health outcomes used in the analysis were:

- pain score, evaluated using a visual analogue scale ranging from 0 (no pain) to 10 (severe pain);
- Knee Society knee score and Knee Society function score;
- Hospital for Special Surgery knee score;
- the percentage of patients satisfied with TKA;
- post-operative disposition, that is, patients who went home or to post-acute-care facilities;
- the number of readmissions within 4 months after operation;
- the number of reoperations (manipulations under anaesthesia and revisions); and
- the length of stay.

The study groups were comparable at baseline in terms of their age, pain score, Knee Society function score, and Hospital for Special Surgery knee score. However, compared to the control patients, the patients in the intervention group were significantly heavier, had a high Knee Society knee score, and had less preoperative motion of the knee.

**Effectiveness results**
The pain score was 0.94 (range: 0 - 5) in the control group versus 0.86 (range: 0 - 10) in the intervention group, (p non significant);

the Knee Society knee score was 90.75 (range: 45 - 100) in the control group versus 92.11 (range: 60 - 100) in the intervention group, (p non significant);

the Knee Society function score was 74.69 (range: 0 - 100) in the control group versus 75.11 (range: 20 - 100) in the intervention group, (p non significant);

the Hospital for Special Surgery knee score was 86.92 (range: 56 - 98) in the control group versus 88.06 (range: 61 - 98) in the intervention group), (p non significant);

the arc of maximum flexion-maximum extension was 110 (range: 90 - 125) in the control group versus 113.24 (range: 75 - 130) in the intervention group, (p non significant);

98% of the control patients and 99% of the intervention patients were satisfied with TKA, (p non significant);

61% of the control patients and 1% of the intervention patients went home, while 39% (control) and 99% (intervention) went to post-acute-care facilities, respectively, (p<0.0001);
within 4 months after operation there were 3 readmissions in the control group versus 4 in the intervention group, (p non significant);

there were 2 manipulations under anaesthesia in the control group versus 4 in the intervention group, and the numbers of revisions were 2 (control) and 0 (intervention), respectively, (p non significant); and

the average length of stay was 6.79 days (range: 3 - 19) in the control group versus 4.16 days (range: 3 - 9) days in the intervention group, (p<0.0001).

Clinical conclusions
The effectiveness analysis showed that the new care protocol was effective in reducing the length of stay without affecting the clinical outcomes or the quality of care, as perceived by the patients.

Measure of benefits used in the economic analysis
The health outcomes were generally shown to be not significantly different. Therefore, in effect, a cost-minimisation analysis was conducted.

Direct costs
It was unclear whether discounting was relevant because the patients were followed for a long time, but most of the costs per patient were incurred after the main initial surgery. The unit costs were not analysed separately from the quantities of resources used. The health services included in the economic evaluation were the hospital and implantation costs, but a breakdown of the costs was not provided. Resource use was estimated using actual data referring to the patients included in the effectiveness study. The costs were evaluated from the perspective of the hospital, and the financial data were obtained from a hospital database. The 1992 cost data were estimated from charges that were then converted into costs using a cost-to-charge ratio, which was government-mandated and department-specific. The 1995 data came from a resource-based cost accounting system. The costs were compared in terms of both actual dollars and inflation-adjusted dollars. The price year was 1995.

Statistical analysis of costs
Standard statistical analyses were conducted to compare the costs estimated in the two study groups.

Indirect Costs
The indirect costs were not included in the economic evaluation.

Currency
US dollars ($).

Sensitivity analysis
Sensitivity analyses were not conducted.

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

Cost results
The mean actual hospital costs were $10,043.11 (range: 7,331 - 19,980) in the control group and $8,747.18 (range: 6,524 - 15,225) in the intervention group. This represented a 12.9% reduction per admission, (p<0.0001).
In 1995 values, the mean inflation-adjusted hospital costs were $10,804 (range: 7,961 - 21,968) in the control group and $8,747.18 (range: 6,524 - 15,225) in the intervention group. This represented a 19% reduction per admission, (p<0.0001).

This reduction in hospital costs was mainly due to the shorter hospital stay and the lower cost of knee implants.

**Synthesis of costs and benefits**
The costs and benefits were not synthesised because a cost-minimisation analysis was conducted.

**Authors’ conclusions**
The implementation of a critical pathway (CP) for total knee arthroplasty (TKA) and a knee-implant standardisation programme (KISP) significantly reduced the hospital costs, compared with the prior model of care, without affecting the quality of care.

**CRD COMMENTARY - Selection of comparators**
The rationale for the choice of the comparators was clear. The two interventions were selected because they represented the routine approaches used to manage patients requiring TKA in the two study periods. You should decide whether they are valid comparators in your own setting.

**Validity of estimate of measure of effectiveness**
The effectiveness analysis used a comparative study with a historical control. The outcome assessment was carried out prospectively from 1995 onwards, the start of the study group treatment. Power calculations were not performed and there was no evidence that the sample size was appropriate. The study groups were not balanced at baseline, as there were significant differences between the groups in terms of disease-related data. This may have had an impact on the estimated results of the analysis, although most of the clinical outcomes were similar. The use of a randomised design would have been more appropriate. The length of follow-up was reported. However, the reason for such a long follow-up when the clinical outcomes appear to have been estimated over a short time, was not stated. The groups were evaluated in two distinct periods of time, but factors other than the study intervention may have changed over time. These issues represent a limitation to the internal validity of the analysis. The study sample appears to have been representative of the study population as unselected consecutive patients were recruited.

**Validity of estimate of measure of benefit**
No summary benefit measure was used in the analysis and a cost-minimisation analysis was, in effect, conducted.

**Validity of estimate of costs**
The perspective adopted in the study was that of the hospital. However, a detailed breakdown of the costs was not provided, and thus it was unclear which categories of costs were included in the analysis. Consequently, the replication of the economic analysis in other settings could be problematic. The costs were estimated in two different time periods and inflation-adjusted estimates were reported, thus simplifying reflation exercises. Local cost estimates were used and sensitivity analyses, to take potential variability in the data into account, were not conducted. Conventional statistical tests were performed to compare the costs estimated in the two groups. The authors noted that the new care protocol may have generated some cost-shifting because the patients were more likely to be discharged to post-acute-care facilities than before. In this context, the hospital realised a profit, while the payer (health plan or insurance company) incurred extra costs. The authors also noted that the price of the knee implant decreased over time. The issue of discounting was unclear because revisions of the implants were carried out in the long term, and this was likely to have generated a cost.

**Other issues**
The authors did not make extensive comparisons of their findings with those from other studies. It was stated that the results of the present study were consistent with those of an earlier evaluation carried out by the same authors (see Other Publications of Related Interest). The issue of the generalisability of the study results to other settings was not addressed and sensitivity analyses were not conducted. Consequently, the external validity of the analysis was low and the transferability of the conclusions of the analysis to other contexts could be difficult. The study referred to patients undergoing TKA due to osteoarthritis. Extrapolations to similar patient populations should be conducted with care.

**Implications of the study**
The study results suggested that the use a treatment algorithm to treat patients and reduce hospital costs was successfully implemented at the study hospital. The quality of care was not affected and the patients' satisfaction was high.

**Source of funding**
Partially funded by Harvard Community Health Plan.

**Bibliographic details**

**Other publications of related interest**


**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Aged; Aged, 80 and over; Arthroplasty, Replacement, Knee /economics; Cost-Benefit Analysis /economics; Economics, Hospital; Female; Follow-Up Studies; Hospital Costs; Humans; Male; Middle Aged; Osteoarthritis, Knee /economics /surgery /physiopathology; Outcome Assessment (Health Care) /economics; Pain Measurement /economics; Program Evaluation /economics; Recovery of Function /physiology; Research Support, Non-U.S. Gov't; Time Factors

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