Cost-effectiveness of unicompartmental and total knee arthroplasty in elderly low-demand patients: a Markov decision analysis
Slover J, Espenhaug B, Havelin L I, Engesaeter L B, Furnes O, Tomek I, Tosteson A

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 study examined unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) in elderly patients with arthritis involving only one compartment of the knee.

Type of intervention
Treatment.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 78-year-old patients with arthritis involving only one compartment of the knee and for whom medical treatment had failed.

Setting
The setting was a hospital. The economic study was carried out in the USA.

Dates to which data relate
The clinical data were derived from studies published between 1986 and 2005. No dates for resource use were reported. The price year was 2005.

Source of effectiveness data
The clinical and epidemiological data used in the decision model were the survival rates after UKA or TKA, the postoperative infection rates, and the mortality rates (perioperative and death from other causes).

Modelling
A Markov model was constructed to simulate the clinical and economic impact of the two surgical procedures in a theoretical cohort of patients eligible for the interventions. The structure of the decision model was represented graphically. Time horizon (lifetime) and cycle length (annual cycles) were reported. Health states were depicted in the graphic. The model started with patients choosing a surgical procedure. Patients surviving the operation were assumed to stay well until they died from other causes or needed a revision. Postoperative complications and subsequent infections (septic) were also modelled. All patients having an infection were assumed to have a revision arthroplasty procedure.

Sources searched to identify primary studies
The survival rates after UKA and TKA were derived from the Norwegian Arthroplasty Register, which involved data from 9,286 TKAs and 770 UKAs. The sources of the infection rates were not described. The age-specific mortality rates came from 2001 US Life Tables. The rates of perioperative mortality for patients undergoing TKA came from a study of the Medicare population. Some assumptions were also made and used in the model.

**Methods used to judge relevance and validity, and for extracting data**

No systematic search for data was reported, thus the primary studies might have been identified selectively. The approaches used to select, extract and combine the primary estimates were not described. Assumptions were based on authors' opinions.

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

The summary benefit measure used was the expected number of quality-adjusted life-years (QALYs). This was estimated using the decision model. The utility weights were derived from a published study that used the quality well-being index scores. The study involved a longitudinal cohort of 1,356 patients aged 75 to 84 years with and without arthritis. Disutility scores were assigned for patients undergoing the surgical procedures, mainly on the basis of assumptions. An annual discount rate of 3% was used for benefits incurred in the future.

**Direct costs**

The analysis of the costs was performed from the perspective of the third-party payer. It included the costs of the two surgical procedures, as well as professional charges (surgeons and anaesthetists). A breakdown of the cost items was not reported, and the unit costs and resource quantities were not presented separately. Details of resource use were not given. The costs were estimated using Medicare reimbursement rates for the diagnosis-related group. Professional fees were based on specific Current Procedural Terminology codes for each surgical procedure. Discounting was relevant, as the long-term costs were evaluated, and an annual rate of 3% was used. The price year was 2005.

**Statistical analysis of costs**

The costs were treated deterministically.

**Indirect Costs**

Productivity costs were not considered.

**Currency**

US dollars ($).

**Sensitivity analysis**

A univariate sensitivity analysis was performed on all model inputs. Threshold values were used to identify the key values for model inputs at which the cost-utility ratio of UKA exceeded the threshold of $50,000 per QALY gained.

**Estimated benefits used in the economic analysis**

The expected QALYs were 5.66 with UKA and 5.61 with TKA (difference 0.05). Higher QALYs were found for UKA even when survival rates were higher for TKA. This was due to the higher quality of life scores associated with the UKA procedure.

**Cost results**

The expected costs were $13,100 with UKA and $13,300 with TKA (difference $200).
Synthesis of costs and benefits
Incremental cost-utility ratios were calculated in order to combine the costs and benefits of the alternative surgical procedures.

Under base-case assumptions, UKA dominated TKA, which was both more expensive and less effective. However, the differences in both costs and benefits were small.

The sensitivity analysis showed that the cost-utility ratios were highly sensitive to several parameters, including revision rates, procedure costs, perioperative mortality, infection rates and, above all, utility values. For example, for a utility value associated with TKA higher than 0.688 (it was 0.68 in the base-case), TKA would become more cost-effective than UKA. However, the cost per QALY gained with UKA remained below the threshold of $50,000 unless the revision rate following UKA reached 4% (it was 1.5% in the base-case). Higher variations in other clinical inputs were required before UKA ceased to be cost-effective.

Authors’ conclusions
Under base-case assumptions, unicompartmental knee arthroplasty (UKA) and total knee arthroplasty (TKA) were similarly cost-effective in a population of elderly low-demand patients. The slight advantage of UKA relied on some key data such as revision rates, utility scores and costs of the procedures.

CRD COMMENTARY - Selection of comparators
The authors provided an appropriate justification for the choice of the comparators. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness estimates were obtained from published studies. The authors did not report the methods or conduct of a systematic review of the literature, thus the primary studies might have been identified selectively. A clear description of some primary sources was given, which enhances the possibility of judging the validity of the primary studies. The use of a database to derive revision rates (the key clinical input) was appropriate since a large cohort of patients was involved. This represents a positive feature of the analysis, although Norwegian patients may differ from US patients in some respects. The mortality rates came from US life tables, which are a valid source of all-cause mortality. There was limited information on the other sources of data. The issue of uncertainty in the clinical estimates was extensively investigated in the sensitivity analysis.

Validity of estimate of measure of benefit
The benefits (i.e. QALYs) were modelled. The sources of the utility weights used to calculate QALYs were described in detail. Discounting was appropriately performed.

Validity of estimate of costs
The authors explicitly stated which perspective they adopted in the study. It appears that all the relevant categories of costs have been included in the analysis. However, the costs were presented as macro-categories, which limits the possibility of replicating the analysis in other settings. The sources of the costs were provided for all categories, and were consistent with the viewpoint of the analysis. Statistical analyses were not performed, but plausible variations in the cost estimates were considered in the sensitivity analysis. The price year was reported, which has relevant implications for the transferability of the study results to other time periods.

Other issues
The authors did not make extensive comparisons of their findings with those from other studies. However, the issue of the generalisability of the study results to other settings was clearly addressed in the sensitivity analysis, in which alternative values for key model inputs were considered. The results of this analysis were extensively reported, which should help decision-makers identify the critical threshold at which decisions are optimal within their own setting. The authors noted that a strength of their analysis was that the decision model considered all relevant aspects related to the two surgical procedures, in terms of both advantages and disadvantages.
Implications of the study
The study results suggested that UKA is a valid alternative to TKA. The model results highlighted the key variables that are likely to affect the cost-effectiveness of the two surgical procedures in different settings. The authors stated that additional studies should be performed to determine more accurately the cost-effectiveness of the two strategies.

Source of funding
Supported by a grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases.

Bibliographic details

PubMedID
17079390

DOI
10.2106/JBJS.E.01033

Other publications of related interest
Because readers are likely to encounter and assess individual publications, NHS EED abstracts reflect the original publication as it is written, as a stand-alone paper. Where NHS EED abstractors are able to identify positively that a publication is significantly linked to or informed by other publications, these will be referenced in the text of the abstract and their bibliographic details recorded here for information.

Robertsson O, Borgquist L, Knutson K, et al. Use of unicompartmental instead of tricompartmental prostheses for unicompartmental arthrosis in the knee is a cost-effective alternative. 15,437 primary tricompartmental prostheses were compared with 10,624 primary medial or lateral unicompartmental prostheses. Acta Orthop Scand 1999;70:170-5.


Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Arthroplasty /economics; Arthroplasty, Replacement, Hip /economics; Cost-Benefit Analysis; Humans; Knee Joint /surgery; Markov Chains; Models, Theoretical; Reoperation; United States

AccessionNumber
22006002391

Date bibliographic record published
31/12/2007

Date abstract record published
31/12/2007