Cost-effectiveness of Single-level Cervical Disc Arthroplasty

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Background context: Regulators and payers increasingly look at cost-effectiveness analysis, aimed at demonstrating value for money when considering the introduction of technology such as cervical disc arthroplasty (CDA).

Purpose: Formal economic evaluation of CDA with either the Bryan® or Prestige® (Medtronic, Memphis, TN) disc versus ACDF in the Australian context.

Study design: Clinical data from two IDE RCT’s were combined with cost data to produce an economic model assessing the cost-effectiveness of CDA compared to cervical discectomy and fusion (ACDF).

Patient sample: 1004 patients from US IDE randomized trials comparing either Bryan or Prestige disc with ACDF.

Methods: Outcome measures for each technique were used to estimate quality adjusted life years (QALYs), by transforming unpublished SF-36 data into preference based SF-6D utility weights. A Markov process, with a cohort expected value analysis was performed. The model used monthly cycles and a duration of five years. There were six possible health states: surgery; success; failure; index re-operation; adjacent re-operation and multilevel reoperation, with transition probabilities determined by trial outcome frequency. Billing codes for medical procedures and ancillary services were determined through expert opinion and for ACDF, after averaging across various ACDF techniques using cost weights derived from sales figures for fusion implants provided by Medtronic. The costs of each service, prosthesis, hospital stay and for lost productivity costs due to work absence were sourced from various Australian government databases. Expected per-patient costs were calculated for five years. This data was used in conjunction with the QALY estimate to calculate the incremental cost-effectiveness ratio (ICER) of CDA versus ACDF.

Results: Accounting for all downstream costs, including productivity loss by work absence, CDA was estimated to cost AU$803 less than ACDF per treated individual over a five year period. Further, the CDA group accrued 0.13 QALYs more than the ACDF group (3.43 QALYs for CDA versus 3.31 QALYs for ACDF). Removal of the impact of re-operations reduced the cost saving offered by CDA but the intervention remained cost-saving overall. Removal of the productivity losses (adopting a health care perspective only), increased the incremental cost of CDA to AU$1200, with an ICER of AU$10,395 per QALY gained. The model also demonstrated that the cost-effectiveness of CDA is sensitive to prosthesis price and overall success rate. Increasing the prosthesis price by 20% leads to an incremental cost of AU$554, with an ICER per QALY of AU$4795, while lowering the probability of overall success in the CDA arm of the model to its lower 95% confidence interval leads to an incremental cost of AU$322, with an ICER of per QALY of AU$4425. Two-way sensitivity analysis assessing the impact of reducing the overall success rate to its lower 95% confidence interval and simultaneously removing the productivity losses resulted in an ICER of AU$27,352 per QALY.

Conclusions: From the perspective of a reimbursement authority, there is a clear argument for use of CDA over ACDF in single-level surgery, with CDA being associated with a lower overall cost and improved quality of life. Worst case assumptions suggest that any incremental cost of CDA is offset by an acceptable incremental increase in quality of life.