Transcatheter aortic valve implantation for severe aortic stenosis: the cost-effectiveness case for inoperable patients in the United Kingdom

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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.

CRD summary
This study evaluated the cost-effectiveness of transcatheter aortic valve implantation (TAVI) for patients with severe aortic stenosis who were deemed ineligible for aortic valve replacement. The authors concluded that TAVI was not cost-effective in their original evaluation, but the long-term evidence indicated that TAVI was cost-effective. The model and data were adequately reported. Some of the evidence was not described, but references were given. The authors’ conclusions appear to be reasonable.

Type of economic evaluation
Cost-utility analysis

Study objective
This study evaluated the cost-effectiveness of transcatheter aortic valve implantation (TAVI) for patients with severe aortic stenosis, who were deemed inappropriate for aortic valve replacement.

Interventions
The TAVI procedure involved a prosthetic valve mounted on a catheter, which was inserted into an artery, and passed to the diseased aortic valve, where the prosthetic valve was implanted. This was compared against medical management, without valve implantation.

Location/setting
UK/hospital.

Methods
Analytical approach:
A two-part stochastic decision model was used to simulate the outcomes of TAVI or medical management for aortic stenosis. The first part of the model was a short-term decision tree for the first month after the start of treatment. This decision tree fed into a three-state long-term Markov model, with 12-month cycles, from one month after the start of treatment to death. The authors stated that they adopted a UK NHS perspective.

Effectiveness data:
Where possible, the effectiveness data were from the multicentre, multinational, Placement of Aortic Transcatheter Valves (PARTNER) trial (see Other Publications of Related Interest). The main source was cohort B, as this most closely represented the patient population. Effectiveness was measured by the transition probabilities between model states, and the probabilities of procedure-related events. These events were classified as major or minor, occurring in the 30 days following the procedure, or late major or minor, occurring during long-term follow-up. Patients who experienced major events or disabling stroke transitioned to the aortic stenosis or failed valve replacement state. Those who had successful procedures or only minor events transitioned to the functioning valve replacement state. All transition probabilities were derived from the PARTNER trial cohort B, except the probabilities of cardiac tamponade and access-site events, which were from the literature. The probability of cardiac tamponade, a major event, was calculated by averaging the rates from several published studies of TAVI and aortic valve replacement, with corrections applied for zero events in aortic valve replacement, based on expert opinion.

Monetary benefit and utility valuations:
Disutilities were applied to each procedure-related event, and weighted by the proportion of total events. The utility values for a functioning valve after the procedure and for long-term arterial stenosis were mapped to EQ-5D scores by New York Heart Association (NYHA) functional class, using a published algorithm. NYHA class data were from the PARTNER trial cohort B. Patients who suffered a disabling stroke were assigned a utility of zero (identical to death).

Measure of benefit:
The summary measure of benefit was quality-adjusted life-years (QALYs).

Cost data:
The cost analysis included devices, procedures, hospitalisations, medications, and procedure-related events. Hospitalisation rates, by NYHA class, from a published study, were applied to the PARTNER trial cohort B. The unit costs were from published studies, NHS reference costs, or the Personal Social Services Research Unit. All costs were in UK £.

Analysis of uncertainty:
Probabilistic sensitivity analysis was undertaken, with a Bayesian value of information analysis. Normal distributions were used for the costs, beta distributions were used for the probabilities, and Dirichlet distributions were used for the proportion of patients in different NYHA states. A scenario analysis was conducted with 25% fewer events associated with the TAVI procedure. As further data from the PARTNER trial became available, an analysis with updated long-term probabilities was conducted.

Results
The model indicated that TAVI reduced all-cause mortality by 14%. TAVI was more costly and more effective producing an average incremental cost-effectiveness ratio (ICER) of £35,956 per QALY gained (95% CI 24,768 to 65,103). In 10,000 Monte Carlo simulations, 18% resulted in TAVI being cost-effective at a willingness-to-pay threshold of £30,000 per QALY gained.

In the scenario analysis with 25% fewer events with TAVI, the ICER fell to £23,642 per QALY gained, and it was cost-effective in 83% of simulations.

The value of information analysis indicated that the most important area of parameter uncertainty was the transition probabilities for TAVI, including mortality. The value of eliminating this uncertainty was £682,083 for the UK population, over one year, at a willingness-to-pay for a QALY of £30,000.

With long-term information from the PARTNER trial, most changes reduced the probability of an event, and reduced the uncertainty in the data, which lowered the ICER to about £19,000 per QALY gained. This was considered cost-effective in the UK. The value of information analysis showed no value in conducting additional research.

Authors' conclusions
The authors concluded that TAVI was not cost-effective in the original evaluation, but the long-term evidence indicated that TAVI was cost-effective, with no value in further research.

CRD commentary
Interventions:
The interventions were sufficiently described and appear to have been appropriate.

Effectiveness/benefits:
Most transition probabilities were derived from the PARTNER trial; those probabilities that were not available from the trial were from other literature. The methods used to identify this other literature, and the references were not reported. The trial methods were not well reported, but a reference was given. The derivation and use of the transition probabilities in the appendix could have been clearer. The health outcomes appear to have been adequately captured by the QALYs, based on the trial data. The source for the utility data was given, but its methods were not.

Costs:
The resource use and cost data were from the trial that supplied the effectiveness data. The trial was based in centres in
the USA, Canada, and Germany. The references for the unit costs were given, but each source was not defined in the paper. With the information given, it was not clear if some of the cost data were applicable to the UK. The cost data were assigned normal distributions, which may have been appropriate as the standard errors were sufficiently small. The price year was not reported; it was unclear if costs were adjusted for inflation.

**Analysis and results:**
The model structure, parameters and results were adequately reported. Probabilistic sensitivity analyses appear to have been correctly conducted, and the results were displayed in cost-effectiveness acceptability curves. The value of information analyses appear to have been correctly undertaken, and the assumptions were clearly reported. While many parameters were clearly reported, it was not clear how the parameters interacted, and some parameter values were not reported, which adds uncertainty to the results of the probabilistic analysis.

**Concluding remarks:**
The model and data were adequately reported. Some of the evidence was not described, but references were given. The authors' conclusions appear to be reasonable.

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