A cost-effectiveness analysis of implant overdentures
Zitzmann N U, Marinello C P, Sendi P

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 authors compared three technologies. These were implant-supported overdenture prostheses (4 implants), implant-retained overdentures (2 implants), and complete dentures.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised edentulous patients. Patients were included if they required treatment in the lower jaw with removable prostheses, with or without implants.

Setting
The setting was outpatient care. The economic study was carried out in Switzerland.

Dates to which data relate
The effectiveness, price and cost data were collected between January 1999 and December 2001. The price year was 2000.

Link between effectiveness and cost data
The costing was carried out prospectively on the same sample of patients as that used in the effectiveness study.

Study sample
The study sample comprised the 60 patients who visited the study setting during the dates of the study and who met the eligibility criteria. There was no evidence that power calculations were carried out to estimate the impact of chance on the results and to inform the optimal number of patients in the trial. Instead, the authors noted that the number of patients was guided by the number requiring the most expensive treatment, although numbers were increased by offering treatment in the undergraduate programme for a reduced fee. The mean age of the patients was 71.4 (+/- 8.8) years, and the group comprised 39 women and 21 men. Each of the three groups comprised 20 patients.

Study design
This was a prospective cohort analysis with groups defined by each patient self-selecting into a group following recommendations from the specialist. The analysis was based at a single centre, the Clinic for Reconstructive Dentistry at the University of Basel, Switzerland. The patients were followed for 3 years and only one patient (who died 34
months after the treatment) was lost to follow-up. The authors did not note the cause of death or comment on whether this could have been related to the treatment.

**Analysis of effectiveness**
There were two primary outcomes, the perceived chewing ability and the associated number of quality-adjusted prosthesis-years (QAPYs). Perceived chewing ability was measured on a visual analogue scale, with 0 representing the worst possible state and 1 representing the best possible state. QAPYs were measured as the duration of a given dental health state multiplied by the patients' preference for that health state. The outcomes were assessed at baseline, 6 months and 3 years following treatment. There was no report that any patients received any treatment other than that originally selected. The authors did not report a comparison of the demographical or clinical variables of the patients in the three groups.

**Effectiveness results**
For those with complete dentures, their health state preference was 0.52 (standard deviation, SD=0.35) at baseline, 0.80 (SD=0.26) after 6 months and 0.81 (SD=0.17) after 3 years.

For those with implant-retained overdentures, their health state preference was 0.35 (SD=0.33) at baseline, 0.84 (SD=0.25) after 6 months and 0.83 (SD=0.20) after 3 years.

For those with implant-supported overdentures, their health state preference was 0.37 (SD=0.28) at baseline, 0.88 (SD=0.16) after 6 months and 0.91 (SD=0.15) after 3 years.

The differences between groups in terms of the dental health state preference at baseline and post treatment did not reach statistical significance.

The total gain in QAPYs was 0.86 or 0.68 (there was a discrepancy between the tabulated information and the main body of the text) (SD=0.89) for complete dentures, 1.46 (SD=1.06) for implant-retained overdentures and 1.57 (SD=0.89) for implant-supported overdentures.

There was a significant difference between complete dentures and implant-supported dentures, (p=0.0193), but no significant differences between the other technologies.

**Clinical conclusions**
The authors did not draw conclusions relating to the clinical study alone.

**Modelling**
The authors used mathematical modelling to extrapolate clinical outcomes and costs over a longer time horizon. Three-year outcomes from the clinical trial were projected up to 10 years by assuming that the patient's dental health state preferences observed over the 3-year period would remain stable beyond that. The authors used a long time horizon because of the structure of the study question, where costs were predominantly incurred early on in the technologies life-cycle (1st year) but the technology itself was expected to provide benefits much beyond this time horizon (10 years).

**Measure of benefits used in the economic analysis**
The authors used QAPYs as their summary measure of health benefit, as measured during the clinical study.

**Direct costs**
The economic analysis was carried out from the perspective of the individual patient, as in the authors' setting the patient is responsible for payment of their dental care. The analysis focused on implant material, surgical and prosthodontic treatment and laboratory fees for the initial treatment, as well as treatment time and resource use for
maintenance dental care over the 3-year period. The authors also took patient travel time into consideration. The source of the unit prices was not explicitly stated, although the authors reported that the costs were expressed in 2000 prices. There was no report of reflation to adjust for inflation, although the authors did appropriately use discounting (3%) to take account of time preference. The authors assumed that no further costs were incurred between the end of the clinical study (3 years) and the end of the time horizon for comparison (10 years).

**Statistical analysis of costs**
Differences between the patient groups were assessed using the Kruskal-Wallis rank sum test. A p-value of less than 0.05 was considered statistically significant.

**Indirect Costs**
Productivity costs were not relevant given the average age of the participants.

**Currency**
Swiss francs (CHF). These were converted to US dollars ($) at a rate of CHF 100 = $61.

**Sensitivity analysis**
The authors estimated bivariate distributions of the cost and effect variables using 5,000 bootstrap samples. They presented their results as cost-effectiveness acceptability curves.

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

**Cost results**
The initial dental care costs were CHF 2,525 (SD=534) for complete dentures, CHF 6,935 (SD=1,600) for implant-retained overdentures and CHF 15,805 (SD=3,063) for implant-supported overdentures.

The total costs over the 3-year horizon were CHF 3,675 (SD=417) for complete dentures, CHF 8,874 (SD=1,496) for implant-retained overdentures and CHF 17,837 (SD=2,723) for implant-supported overdentures.

The authors reported that the average total costs in the three groups were statistically significantly different.

**Synthesis of costs and benefits**
Over a 3-year horizon, the incremental cost-effectiveness ratio (ICER) of implant-retained overdentures compared with complete dentures was CHF 9,100 per QAPY. For implant-supported overdentures compared with implant-retained overdentures, the ICER was CHF 81,482 per QAPY.

Over a 5-year horizon, the ICER of implant-retained overdentures compared with complete dentures was CHF 6,136 per QAPY. For implant-supported overdentures compared with implant-retained overdentures, the ICER was CHF 42,662 per QAPY.

Over a 10-year horizon, the ICER of implant-retained overdentures compared to complete denture was CHF 3,810 per QAPY. For implant-supported overdentures compared with implant-retained overdentures, the ICER was CHF 22,375 per QAPY.

**Authors' conclusions**
The time horizon of the analysis "may substantially influence cost-effectiveness". Implant-retained overdentures were
the most cost-effective option for a willingness-to-pay between CHF 9,100 and 19,800 per quality-adjusted prosthesis-year (QAPY) over 3 years and between CHF 3,800 and 7,100 per QAPY over 10 years. Complete dentures and implant-supported overdentures become cost-effective for a willingness-to-pay below and above these limits.

CRD COMMENTARY - Selection of comparators
The authors chose to compare conventional dentures with two implant options available in their own setting. They justified the choice of the comparators with a discussion of the available technologies and the relative treatment merits of each. You should decide if the comparators are representative in your own setting.

Validity of estimate of measure of effectiveness
The authors designed a prospective cohort trial, a randomised trial being impossible due to the expensive nature of the treatments available. Patients self-selected and, although usually this would be criticised for the inability to control for confounding factors, this sample selection would seem appropriate in this analysis due to the individual perspective that was adopted. Despite this, the authors should have reported some comparisons between patients in the three groups in terms of both the clinical and demographic variables. Such comparisons would have served to reassure the reader that there were no systematic differences between the groups that might have influenced the results.

Validity of estimate of measure of benefit
The authors used QAPYs as their summary measure of health benefit. Although quality-adjusted life-years are a well-established measure of well-being, it was unclear how extensively QAPYs have been used and validated. Readers of this abstract should therefore use their own judgement to assess the relevance of QAPYs to their own clinical setting.

Validity of estimate of costs
The authors carried out the costing analysis from the individual patient’s perspective reflecting the nature of their health care setting. They included both initial and maintenance costs, although maintenance costs were assumed to continue for 3 years only. Some further analysis might consider whether maintenance costs begin to rise again as the implant ages, or whether costs do, as assumed, remain negligible after 3 years. Although bootstrap analysis was used to explore uncertainty in the final cost and outcome variables, the authors could have used distributions in the input parameters, such as unit costs, to better understand and reflect the impact of parameter uncertainty. The analysis that was carried out was well explained and reported, and appropriate discounting was used.

Other issues
The authors were able to make comparisons with other published results and noted some contrasting elements. Reasons such as differing expert opinions on cost, different outcome measures, and lengths of follow-up were discussed as potential explanations for the contrasting results. The issue of generalisability was not explicitly discussed but was improved by the use of bootstrapping to explore the impact of uncertainty on the results. Readers should consider their own setting carefully and the perspective from which they might wish to approach the clinical question before attempting to generalise any of the results. Several limitations to the study were acknowledged. These included the relatively small sample size, and the projection of costs over the longer time horizon.

Implications of the study
The authors did not make any recommendations for policy or practice as a result of their study, but did note that further work should be carried out to explore the responsiveness of using health-year equivalents to measure dental outcomes.

Source of funding
No external funding was received.

Bibliographic details

PubMedID
16861288

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.


Indexing Status
Subject indexing assigned by NLM

MeSH
Adult; Aged; Aged, 80 and over; Cost-Benefit Analysis; Dental Prosthesis, Implant-Supported /economics; Denture, Complete, Lower /economics; Denture, Overlay /economics; Female; Health Care Costs; Humans; Male; Middle Aged; Patient Satisfaction; Quality-Adjusted Life Years; Statistics, Nonparametric; Switzerland

AccessionNumber
22006006699

Date bibliographic record published
31/07/2007

Date abstract record published
31/07/2007