Continuous subcutaneous insulin infusion versus multiple daily injections of insulin: economic comparison in adult and adolescent Type 1 diabetes mellitus in Australia

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
The objective of the study was to assess the cost-effectiveness of continuous subcutaneous insulin infusion (CSII) in comparison with multiple daily injections (MDIs) in adult and adolescent patients with Type 1 diabetes mellitus in Australia. The authors concluded that CSII is likely to represent a cost-effective therapy, but there was high uncertainty around the model results. The quality of the study methodology was good, with sufficient reporting of the methods and findings.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
The objective of the study was to assess the cost-effectiveness of continuous subcutaneous insulin infusion (CSII), compared with multiple daily injections (MDIs), in adult and adolescent patients with Type 1 diabetes mellitus in Australia.

Interventions
The health interventions under examination were CSII (Novorapid or Humalog) versus MDIs (NPH insulin plus Novorapid or Humalog).

Location/setting
Australia/secondary care.

Methods
Analytical approach:
The economic evaluation used a modelling analysis, the validated CORE diabetes model, to simulate disease progression and the subsequent clinical and economic impact of the two strategies. A lifetime horizon (i.e. 60 years) was adopted. The authors stated that the perspective of the Australian single-payer health care system was adopted.

Effectiveness data:
The baseline characteristics of the patient population were mainly taken from the Australian National Diabetes Information Audit and Benchmarking. Treatment effectiveness (decrease in mean glycosylated haemoglobin, HbA1c) was based on a published meta-analysis of 52 studies with more than 1,500 patients. Transition probabilities among model health states had already been estimated in the published CORE diabetes model, thus few details of these data were reported. Additional clinical evidence required in the current study appears to have been based on selectively identified studies, including observational cohort studies.

Monetary benefit and utility valuations:
The utility valuations were based on published studies. When published evidence was not available, conservative assumptions were made. No details of the methods used to elicit preferences were provided, although utility weights were reported for each health state.

Measure of benefit:
The summary benefit measures were the life-years (LYs) and quality-adjusted life-years (QALYs). The benefits were
discounted at an annual rate of 5%.

Cost data:
The analysis of the costs included insulin administration, concomitant medications and the treatment of diabetes-related complications (e.g. myocardial infarction, angina, stroke, neuropathy). The costs of insulin administration covered the pump, insulin, consumable supplies, self-monitoring of blood glucose, medical assistance with pump initiation, maintenance and operation. The costs and quantities of resources used were derived from published sources, including Australian diagnosis-related groups for all diabetes complications. An annual discount rate of 5% was applied to future costs. The price year was 2006 and the costs were in Australian dollars (AUD).

Analysis of uncertainty:
A number of univariate sensitivity analyses were undertaken to consider the effect of alternative scenarios on treatment effectiveness, hypoglycaemia event rates, change in body mass index, the inclusion of insulin glargine instead of standard insulin for MDI, variations in the discount rates for both costs and benefits, and a different rate of replacement of the insulin pump. A probabilistic sensitivity analysis was also carried out using first-order Monte Carlo simulation. This generated cost-effectiveness acceptability curves.

Results
In the adult population, CSII led to an improvement of 0.393 LYs and 0.467 QALYs in comparison with MDI.

The additional costs associated with CSII were AUD 34,642.

The incremental cost per LY gained was AUD 88,220, while the incremental cost per QALY gained was AUD 74,147.

Using an informal threshold for cost-effectiveness in Australia (AUD 76,000 per LY gained), the analysis demonstrated that the probability that CSII is cost-effective was 35.74% using LYs as the benefit measure.

In the adolescent population, CSII led to an improvement of 0.537 LYs and 0.560 QALYs in comparison with MDI.

The additional costs associated with CSII were AUD 41,779.

The incremental cost per LY gained was AUD 77,851, while the incremental cost per QALY gained was AUD 74,661.

CSII had a 47.96% probability of being cost-effective at a threshold of AUD 76,000 per LY gained.

In both patient populations, the sensitivity analysis suggested high variation in cost-effectiveness ratios, in particular for changes in haemoglobin (HbA\text{1c}) levels. Replacing standard insulin with insulin glargine for MDI generally led to increased cost-effectiveness ratios for CSII compared with MDI. These ranged from AUD 74,147 to AUD 229,760.

Authors’ conclusions
The authors concluded that, under most plausible scenarios considered in the modelling framework, CSII was a cost-effective alternative to MDI in adult and adolescent patients with Type 1 diabetes mellitus in Australia.

CRD commentary
Interventions:
The selection of the comparators appears to have been appropriate in that all relevant strategies were considered. An alternative comparison with insulin glargine instead of standard insulin for MDI was also considered. The comparators are also likely to be relevant in other settings.

Effectiveness/benefits:
The bulk of the evidence for transition probabilities had already been incorporated in the decision model, thus details of the derivation of the clinical estimates were not provided. Key information on treatment effect and patient characteristics was reported; this had been derived from a meta-analysis and a national database, respectively. Both sources were appropriate and valid. The derivation of benefit measures was clear. LYs and QALYs are validated
measures and have the further advantage of being comparable with the benefits of other health care interventions.

Costs:
The analysis of the costs covered all relevant items for the health care perspective adopted. The unit costs were not reported separately from the resources quantities for all items, most of the costs being presented as macro-categories (especially the costs of diabetes complications). Statistical analyses of costs were performed in the probabilistic analysis. The price year was reported, which enhances the possibility of replicating the analysis in other time periods.

Analysis and results:
The synthesis of the costs and benefits was appropriate. The results of both the base-case and sensitivity analyses were extensively presented and discussed. The issue of uncertainty was well addressed and described. The authors pointed out that key assumptions used in the model were rigorously tested.

Concluding remarks:
Overall, the study methodology was good, with satisfactory reporting and discussion of the methods. The authors’ conclusions are appropriate, although it appears that there was high uncertainty around the model results.

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Other publications of related interest


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