An economic assessment of analogue basal-bolus insulin versus human basal-bolus insulin in subjects with type 1 diabetes in the UK


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 compared analogue basal-bolus insulin with human basal-bolus for glycaemic control in patients with Type 1 diabetes.

Type of intervention
Treatment.

Economic study type
Cost-effectiveness analysis and cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of 1,000 patients with Type 1 diabetes. Baseline demographics, incidence of complications and use of concomitant medications, as reported by Hermansen et al. (2004, see ‘Other Publications of Related Interest’ below for bibliographic details), were used to create this cohort.

Setting
The setting was outpatient, secondary care. The economic study was carried out in the UK.

Dates to which data relate
The effectiveness data used to populate the model came from studies published between 1994 and 2005. The price year was 2004. The dates to which the resource use referred were not reported.

Source of effectiveness data
The CORE model has been described in detail elsewhere and most of the clinical parameters were not reported in this paper. The specific data obtained for the model in this paper were the effect on glycosylated haemoglobin (HbA1c) and the risk of hypoglycaemic events. Patient characteristics were used in the model to determine other probabilities.

Modelling
The model used was the published and validated CORE Diabetes Model (Palmer et al. 2004). This comprises 15 sub-models, which are state-transition models. Functions relate probabilities in the model to patient characteristics and a patient-level simulation is conducted. The time horizon was the patient's lifetime. However, 5-, 10- and 25-year time horizons were also mentioned. The health states, cycle length and transitions probabilities were not presented in the paper.

Sources searched to identify primary studies

NHS Economic Evaluation Database (NHS EED)
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The clinical data obtained in this paper were derived from a multinational randomised study (Hermansen et al. 2004).

Methods used to judge relevance and validity, and for extracting data
No systematic review was reported to have been conducted.

Measure of benefits used in the economic analysis
The measures of benefit used were the life expectancy and quality-adjusted life-years (QALYs). Utility weights were derived from two published studies. The benefits were discounted at a rate of 3.5%.

Direct costs
The study reported the direct costs to the health service and, therefore, only included the costs of medications and complications. The costs of diabetes complications were taken from UK published sources, whilst acquisition costs for insulin were obtained from the Monthly Index of Marketed Medicines. The annual costs of each treatment regimen were calculated by applying the mean daily dosage of each insulin type multiplied by 365 days per year plus the cost of the delivery devices used to administer the insulin. The costs of glucose monitoring devices, test strips and needles were not included. The costs were reported as the average cost per patient. The costs were discounted at an annual rate of 3.5%. The price year was 2004 and, when necessary, the costs were inflated to 2004 using the composite National Health Service price inflation index.

Statistical analysis of costs
The costs were treated stochastically in the model.

Indirect Costs
No productivity losses were included, which was appropriate given the perspective adopted.

Currency
UK pounds sterling (£).

Sensitivity analysis
The authors investigated uncertainty arising from variability in the data. One thousand trials were conducted to obtain mean costs and health outcomes, and a distribution of means was obtained by replicating this 1,000 times. Sensitivity analyses were performed to investigate the effects of changes in model parameters. The parameters used in this analysis included the HbA1c levels, body mass index, rate of major hypoglycaemic events, hypoglycaemic events disutility, cost of treating a major hypoglycaemic event, and discount rates for costs and clinical outcomes.

Estimated benefits used in the economic analysis
The mean life expectancy was 14.16 years with analogue insulin therapy and 14.01 years with human insulin therapy.

The mean QALYs were 7.65 with analogue insulin therapy and 6.99 with human insulin therapy.

Cost results
The average total lifetime cost was 40,876 for the analogue insulin group and 39,222 for the human insulin group.

Treatment costs were one of the main cost-drivers, and were higher in the analogue insulin group than in the human insulin group (8,095 versus 5,576).
The increase in treatment costs was partially offset by reductions in the costs of cardiovascular disease, renal disease, and foot ulcer, amputation or neuropathy. Most notably, the costs of major hypoglycaemic events were reduced by 420 per patient.

**Synthesis of costs and benefits**

The incremental cost-effectiveness ratios (ICERs) per life-year gained and per QALY gained were computed. For analogue insulin compared with human insulin therapy, the ICER was 10,719 per life-year gained and 2,500 per QALY gained.

The use of the acceptability curve approach showed that the probability that analogue insulin was cost-effective for diabetes Type 1 patients was 0.95 given a willingness-to-pay of 25,000 per QALY.

When only the differences in effects in HbA1c were considered, the ICER increased from 2,500 to 12,598 per QALY gained for analogue insulin versus human insulin.

When the cost of a hypoglycaemic event was varied from 0 to 382, the ICER varied from 3,135 to 2,037 per QALY gained for analogue insulin versus human insulin.

When using annual discount rates of 1.5% for QALYs and 6.0% for costs, the cost per QALY gained for analogue insulin versus human insulin was improved to 1,464.

With time horizons of 5, 10 and 25 years, the costs per QALY for analogue insulin versus human insulin were 2,937, 2,555 and 2,024, respectively.

**Authors' conclusions**

Treatment with analogue insulin in patients with Type 1 diabetes was associated with a decreased incidence of long-term complications and improved quality-adjusted life expectancy, but slightly higher treatment costs in comparison with human insulin therapy.

**CRD COMMENTARY - Selection of comparators**

The authors did not justify their choice of the health technologies and it was unclear if one of them was current practice. You should decide whether these represent current practice in your own setting.

**Validity of estimate of measure of effectiveness**

The authors mainly used data from a published study. They did not report any search methods or inclusion criteria, nor did they provide any justification for their selection of the estimates. It was also unclear from the paper whether all the ranges for the sensitivity analysis were derived from published studies.

**Validity of estimate of measure of benefit**

Life expectancy and QALYs are good measures of benefit, especially QALYs given that a major benefit is a gain in quality of life. The estimation of health benefits was modelled using a Markov model. The methods used to estimate the utility weights were not described as they were taken from published papers (Clarke et al. 2002 and Currie et al. 2005 see ‘Other Publications of Related Interest’ below for bibliographic details). The use of QALYs permits comparisons with the benefits of other health care interventions.

**Validity of estimate of costs**

The analysis of the costs was consistent with the perspective adopted, but a more detailed breakdown of the costs would have been more informative. The unit costs and the resource quantities were not reported separately, and the cost estimates are likely to have been specific to a UK National Health Service setting, although this might have been overcome to some degree by the sensitivity analysis performed. Discounting was performed appropriately given the
time horizon considered.

**Other issues**
The authors made comparisons of their findings with those of other studies. They stated that this piece of research conforms to the previous trend of analogue basal bolus being cost-effective in comparison with the respective basal or bolus human insulin. A more detailed costing exercise would have been more informative to the decision-maker, whilst a detailed description of resource use would have enhanced the generalisability to other settings. The authors acknowledged that the model was based on the result of only a single clinical trial and that new evidence had become available since then. They also pointed out that the maximum length of follow-up of the clinical study was 18 weeks, thus it was assumed in the study that differences between treatments in the short term would be maintained in the longer term. All in all, the results of the study do not appear to have been presented selectively and the authors’ conclusions appear to be an adequate reflection of the scope of the analysis.

**Implications of the study**
The authors’ findings suggest that analogue basal-bolus therapy in Type 1 diabetes patients appears to have an ICER within the range generally considered to represent good value for money in the UK.

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**Bibliographic details**

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**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.


Hermansen K, Fontaine P, Kukojla KK, et al. Insulin analogues (insulin detemir and insulin aspart) versus traditional

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Adult; Computer Simulation; Cost-Benefit Analysis; Diabetes Mellitus, Type 1 /drug therapy /economics; Drug Therapy, Combination; Female; Great Britain; Humans; Insulin /administration & dosage /analogs & derivatives /economics; Male; Middle Aged; Models, Economic; Patient Acceptance of Health Care; Randomized Controlled Trials as Topic /economics

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