Health Economics – Camdiab

Methodology and Results

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Executive Summary

This slide deck provides information on:

- the diagnostic area that the intervention is implemented (Slide 3)
- The methodology followed for the Health Economic assessment (Slide 4)
- The parameters used (Slides 5-7)
- Analysis of the Probabilistic Sensitivity analysis (Slides 8-9)
- Analysis of the Cost effectiveness acceptability Curve (Slide 10)
- Commentary on the analysis outputs (Slide 11-14)

Executive Summary

CamDiab present significantly lower costs and improved outcomes and its adoption is encouraged (on average **£ -3,207,419.80** less cost and **133.30** more QALYs than the closest competitor)

Overall, CamDiab's intervention is more cost effective compared with the current standard of care of non–AI enabled devices, as well as compared to the closest competitor in artificial pancreas devices.

Introduction

- Type 1 diabetes is currently incurable, representing 5–10% of diabetes cases worldwide; consequently, continuous management of the condition with glycaemic control is vital.
- CamDiab is a wearable home-used medical device that seeks to allow patients to manage their glucose levels continuously: This day-and-night hybrid closed-loop insulin delivery system (the artificial pancreas) connects continuous glucose monitoring and algorithm-directed insulin pump delivery device, characterised by automated insulin delivery, apart from when the user administers insulin boosts at meal time. CamDiab offers the patients the advantage of reduced glycated haemoglobin, reduced risk of hyperglycaemia and hypoglycaemia, and importantly, improved quality of life.
- CamDiab is ISO 13485 certified and issue of CE-mark for the product is imminent: The app will be CE marked for people with type 1 diabetes aged 1 year and older. The aim to launch in the UK early 2020.
- Current competitors include Medtronic 670G pump while some of the prospective competitors include Tandem Control IQ, Insulet, Diabeloop, Beta Bionics, Eli Lilly, and Roche's Ypsomed.
- The group of Professor Hovorka at the University of Cambridge that developed the algorithm for CamDiab would like support to further explore the health economic evidence and impact of this device upon resource utilisation from an NHS perspective.
- The economic impact will be highlighted to understand the potential budget impact of the device upon current clinical pathway systems.

HE Methodology

For the purpose of the health economic assessment of the CamDiab intervention, a cost effectiveness analysis methodology was implemented aiming to compare CamDiab's cost effectiveness against the closest competitor, as well as similar interventions that do not offer AI algorithm augmented pump functions.

Cost-effectiveness analysis (CEA) is a form of economic analysis that compares the relative costs and outcomes (effects) of different courses of action.

As the closest competitor HEE used Medtronic's 670G system, currently implemented within some CCGs across England, which offers a similar technology, automatically adjusting background insulin every five minutes, based on users' sugar levels.

As a second comparison, HEE utilised data from a 12 week randomised clinical trial on 86 patients using CamDiab with, and without, the AI augmented function. This was used as a proxy of the benefits that the new artificial pancreas technology can offer to the current standard of care.

Parameters Used

All the costs related to the Medtronic and CamDiab interventions were provided by the project leads, while effectiveness data were derived from published data in well established journal studies for both Medtonic and CamDiab

- Tauschmann, M., Thabit, H., et al., 2018. Closed-loop insulin delivery in suboptimally controlled type 1 diabetes: a multicentre, 12-week randomised trial. The Lancet 392, 1321–1329. doi:10.1016/S0140-6736(18)31947-0
- Garg, S.K., Weinzimer, S.A., et al.,2017. Glucose Outcomes with the In-Home Use of a Hybrid Closed-Loop Insulin Delivery System in Adolescents and Adults with Type 1 Diabetes. Diabetes Technology and Therapeutics 19, 155–163. doi:10.1089/dia.2016.0421

Parameters Used

Neither of the studies above measured QALYs using EQ-5D, or any other tool, to translate clinical effectiveness into a quality of life measure.

The following study was used, which correlates the reduction in HbA1c with the gains in quality of life [the relationship between ΔHbA1cand incremental QALYs (ΔQALYs)] .

- Hua, X., Lung, T.W., et al.2017. How Consistent is the Relationship between Improved Glucose Control and Modelled Health Outcomes for People with Type 2 Diabetes Mellitus? a Systematic Review. PharmacoEconomics. doi:10.1007/s40273-016-0466-0

Parameters Used

All costs related to adverse outcomes and health care resources utilisation to manage them were extracted from PSSRU 2018 report:

- Curtis, L., Burns, A., 2018. Unit Costs of Health and Social Care 2018, University of Kent.

2 days of hospitalisation were used for the management of DKA events.

The same adverse events rates were used across all devices since the trials period is not enough to identify such adverse events.

Probabilistic sensitivity analysis

Probabilistic sensitivity analysis (PSA) demonstrates the parameter uncertainty in a decision problem. The technique involves sampling parameters from their respective distributions (rather than simply using mean/median parameter values). A key output of a PSA is the proportion of results that fall favourably (i.e. considered cost-effective) in relation to a given cost-effectiveness threshold. This may be represented using a cost-effectiveness acceptability curve.

- Hatswell, A.J., Bullement, A., ... Stevenson, M.D., 2018. Probabilistic Sensitivity Analysis in Cost-Effectiveness Models: Determining Model Convergence in Cohort Models. PharmacoEconomics 36, 1421–1426. doi:10.1007/s40273-018-0697-3

- https://yhec.co.uk/glossary/probabilistic-stochastic-sensitivity-analysis/

Probabilistic sensitivity analysis

Costs typically exhibit positive skewness, or, in some cases, they may even be multimodal. Distributions typically used to accommodate positively skewed data are the gamma and the log-normal. Effects expressed in terms of quality-adjusted life-years (QALYs) are subject to similar idiosyncrasies. Data is usually truncated at both ends of the distribution (ranging between 0 and 1 when the time horizon is 1 year or less). Also, QALYs exhibit negative skewness with most values lying in the upper end of the measurement scale and some extreme outliers at the lower end of the scale. The beta distribution is a candidate for modelling data in the range (0, 1), while supporting both positive and negative skewed distributions.

For the purpose of this analysis we used Gamma distribution for the costs and Beta for the QALYs and the other measurement between 0 and 1

- Mantopoulos, T., Mitchell, P.M., … Andronis, L., 2016. Choice of statistical model for cost-effectiveness analysis and covariate adjustment: empirical application of prominent models and assessment of their results. European Journal of Health Economics 17, 927–938. doi:10.1007/s10198-015-0731-8

CEAC and ICER

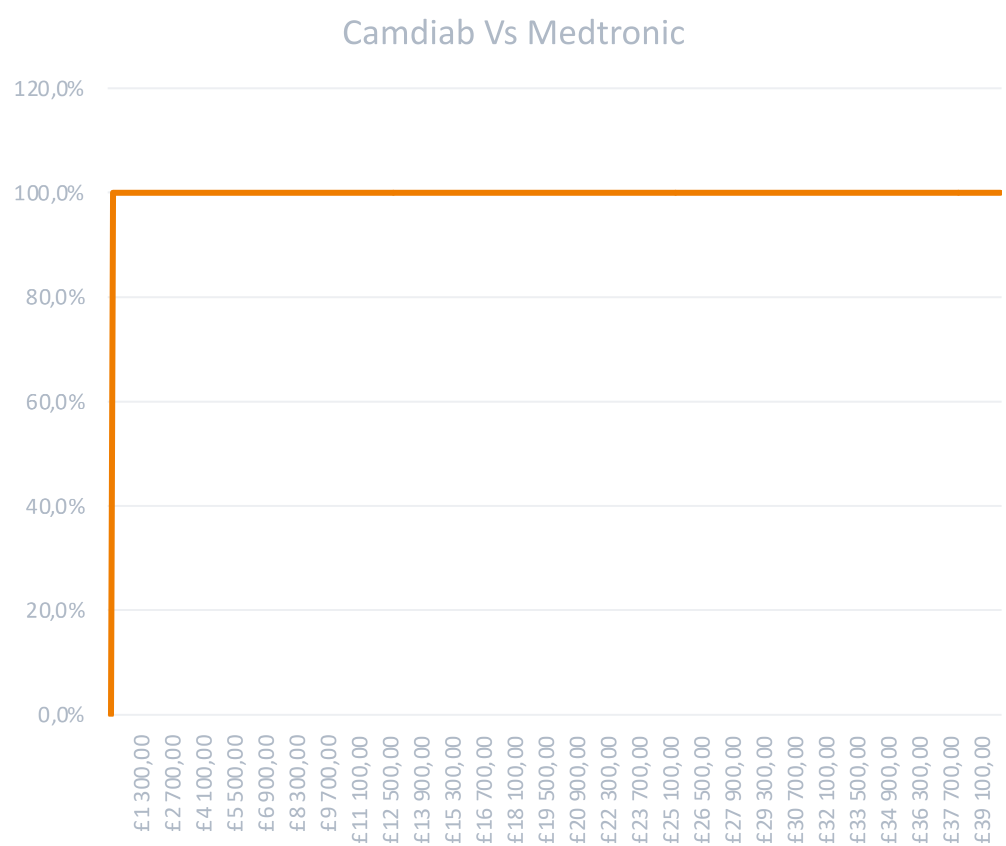
The cost-effectiveness acceptability curve (CEAC) is a graph summarising the impact of uncertainty on the result of an economic evaluation, frequently expressed as an ICER (incremental cost-effectiveness ratio) in relation to possible values of the cost-effectiveness threshold. The graph plots a range of cost-effectiveness thresholds on the horizontal axis against the probability that the intervention will be cost-effective at that threshold on the vertical axis. It can usually be drawn directly from the (stored) results of a probabilistic sensitivity analysis.

- Cost-Effectiveness Acceptability Curve (CEAC) [online]. (2016). York; York Health Economics Consortium; 2016. https://yhec.co.uk/glossary/cost-effectiveness-acceptability-curve-ceac/

Results CamDiab vs Medtronic

The base case outcomes indicated that Medtronic's's intervention was less cost-effective than Camdiab when the incremental cost-effectiveness ratio (ICER) was approximately **£ - 24,714.82** per QALYs gained. This shows that the CamDiab intervention provides less costs and better outcomes than the comparator and its adoption is encouraged (on average **£ -3,207,419.80** less cost and **133.30** more QALYs)

A probabilistic analysis, conducted with 10,000-time Monte Carlo simulations, demonstrated efficacy at the willingness to pay threshold of **£25,000** per QALY gained for approximately 100 % of the population.

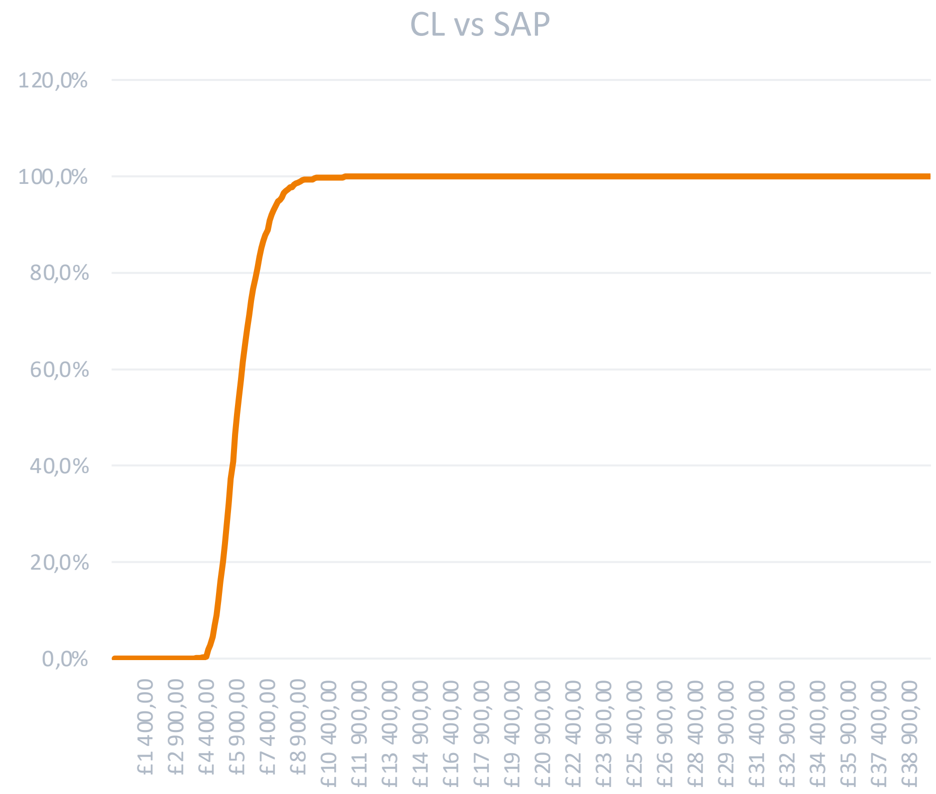


Results Closed Loop vs SAP

The base case outcomes indicated that Closed Loop intervention was more cost-effective than SAP when the incremental cost-effectiveness ratio (ICER) was approximately **£ 6,067.07** per QALYs gained. Closed loop presents higher costs but also higher QALYs gain.

The health technology was considered cost-effective from the perspective of healthcare payers since the ICER was less than the WTP threshold of **£25000** per QALY.

A probabilistic analysis conducted with 10,000-time Monte Carlo simulations demonstrated efficacy at the willingness to pay threshold of **£25,000** per QALY gained for approximately 100 % of the population.



NHS Budget Impact

Budget impact, based on 100% adoption, for the whole UK population using a deterministic Diabetes Mellitus Incident rate of 6.24%

Individual variable sensitivity				Recurrent budget impact			
	Baseline value	**Minimum value**	**Maximum value**	**Baseline budget impact (£000s)**	**Minimum budget impact (£000s)**	**Maximum budget impact (£000s)**	**Change (£000s)**
Incidence rate	6.249%	6.211%	6.290%	19,075,474	18,229,044	19,885,679	1,656,635

Thank you

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