POSTER EE22

Lumanity

Hybrid Closed Loops – A Cost-Effective Future for Type 1 Diabetes Standard of Care? An Update to the TA10845 Economic SLR

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INTRODUCTION

- The Type 1 diabetes treatment landscape in the UK has rapidly evolved in the last 10 years.[1] New technologies such as non-invasive glucose monitoring are now available and offered to all Type 1 diabetics as standard according to the National Institute for Health and Care Excellence (NICE) guidelines as of March 2022[2], with the aim to improve long-term health outcomes and to help patients manage their condition.[3] Studies estimate that life with Type 1 diabetes can require 180 health-related decisions per day[4]
- Hybrid closed loop systems (HCLs) are an up-and-coming management system for patients with Type 1 diabetes in the UK which has the potential to become the new standard of care, with the Omnipod® 5 becoming the latest HCL system available. An insulin pump and continuous glucose monitor are connected using a mathematical algorithm to automate more precise deliveries of insulin to keep blood glucose levels within a healthy range. This in turn aims to ease the patient's burden by allowing them to manage their condition more easily, and reduce risk of complications[5]
- The ongoing NICE GID-TA10845 appraisal for the use of HCLs is expected to conclude at the end of 2023. As part of that appraisal, in 2022 the External Assessment Group (EAG) conducted a systematic literature review (SLR) to review the existing cost-effectiveness evidence surrounding HCLs[6]

OBJECTIVES

Our study aimed to update the SLR to understand the latest evidence related to the cost-effectiveness of HCLs versus comparator technologies.

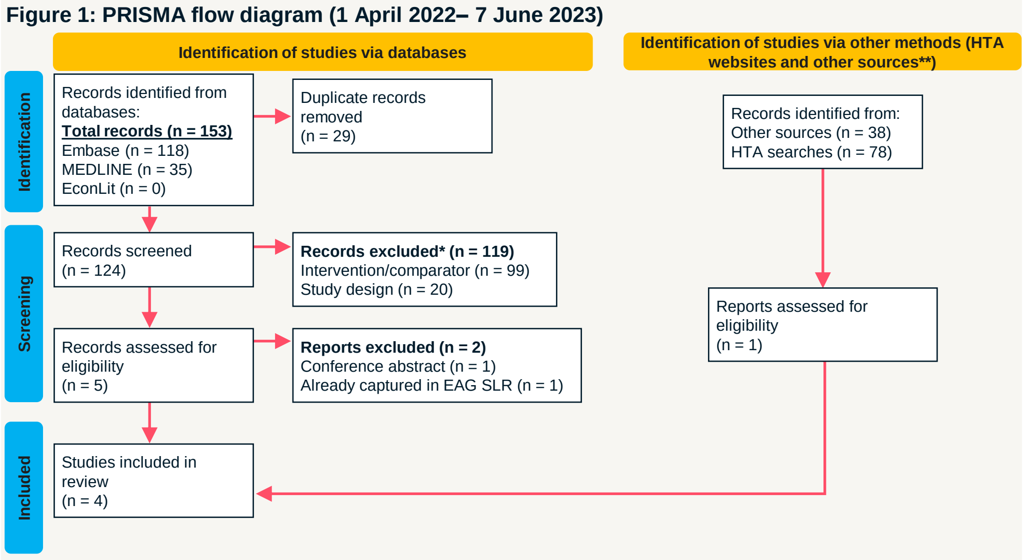
METHODS

- Using the same methodology published in NICE GID-TA10845, the economic SLR was updated. The databases searched included MEDLINE®, Embase®, EconLit® and health technology assessment (HTA) websites (search period 1 April 2022 to 7 June 2023)
- The title and abstract of each publication retrieved from the database search were initially screened by two reviewers independently. Any uncertainty regarding the inclusion was checked by a third independent reviewer. Data was extracted by one reviewer and quality-checked against the source by another independent reviewer
- Outcomes of interest were extracted, such as model structure, cost/utilities information, model results and incremental cost-effectiveness ratios (ICERs)

RESULTS

- Database searches identified 153 records in total; 29 duplicates were removed. Following the preliminary screening of abstracts, 119 records were excluded, and five records were included for secondary screening
- After secondary screening of full-text records, two were excluded, leaving three records for data extraction. In addition, 116 records were identified from HTA/other searches, out of which one record was included. This resulted in the inclusion of a total of four records, from which data were extracted (Figure 1)

Figure 1: PRISMA flow diagram (1 April 2022– 7 June 2023)



Key: CEA, cost-effectiveness analysis; EAG, External Assessment Group; HTA, health technology assessment; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; ScHARR, Sheffield Centre for Health and Related Research; SLR, systematic literature review.
Notes: *All records were screened manually; no automation tools were used. **Other methods: Canadian Agency for Drugs and Technologies in Health, International Network of Agencies for Health Technology Assessment, EconPapers, CEA Registry, SBU (Swedish HTA agency), ScHARR Health Utilities Database, and Agency for Healthcare Research and Quality (AHRQ).

SUMMARY OF EVIDENCE

- Table 1 presents the key characteristics of the four studies, which are cost-effectiveness analyses in Wales[7], the US[8], Australia[9] and Greece[10]
- Two studies used the IQVIA Core Diabetes Model (CDM)[8,10], one used the Sheffield Diabetes Model[7], and the remaining study presented a patient-level Markov model.[9]
- A payer and health system perspective was taken in three studies[7,8,9], with a societal perspective in the remaining study[10]
- The models cover a range of populations. One study considered both adults and children separately[8], another study analysed patients from 12 years to 25 years[9], and the two remaining studies analysed the adult population[7,10]
- Various willingness-to-pay thresholds were applied, ranging from GBP 20,000 to USD 100,000 per QALY gained

KEY FINDINGS

- This SLR update demonstrates the continued use of the CDM and Sheffield Diabetes Model which is common in this disease setting – with the exception of one de novo model.[9] Most of the studies found continued to show that HCLs are a cost-effective treatment option compared with current standard of care (Tables 2 and 3), which is consistent with the findings from the previous SLR[9]
- All cost-effectiveness studies included in the previous SLR supported the cost-effectiveness of HCLs. In this update, the Health Technology Wales (HTW) study found that HCLs were not cost-effective (Table 3)[7], despite predicting that HCLs would improve health outcomes against all comparators. In fact, ICER estimates of GPB 24,000 to 43,000 per QALY for HCLs vs CSII+CGM and MDI+SMBG (Table 3) could be considered cost-effective in other countries with a higher willingness-to-pay threshold, thereby having consistent conclusions with the other studies. This is a stark example of differences in willingness-to-pay thresholds swinging the cost-effectiveness conclusion for HCLs
- The estimates of incremental costs varied substantially. HTW[7] and Lambadiari[10] predicted higher incremental costs for HCLs vs their comparators relative to the remaining studies. In contrast, Biskupiak[8] estimated HCLs to be cost-saving in certain subgroups. The cost estimates varied even when methods of analysis were exceedingly similar, as in the HTW study and a 2022 Scottish Health technology group (SHTG) report (identified in the original SLR). HCLs were not cost-effective according to HTW, but they were cost-saving and even dominated CSII+CGM in the SGTH analysis
- The Biskupiak study[8] suggests HCLs may be slightly more cost-effective in children compared with adults. This study also found that when a higher threshold was used for non-severe hypoglycaemic events (NSHEs) (<70 mg/dL versus <54 mg/dL), the ICERs were improved
- The models were shown to be most sensitive to the patient's baseline haemoglobin A1c value, the base rate of non-severe hypoglycaemic events (NHSEs), the definition of severe hypoglycaemic events (SHEs), and treatment costs. This differs from the original SLR, which found that in most studies, key drivers of the results were the SHE rates and changes in the assumptions relating to the quality-of-life benefit associated with reduced fear of hypoglycaemia (FoH)

Table 1: Key characteristics of included studies

Study name & details	Intervention/ comparator	Model structure	Time horizon	Perspective	WTP threshold used	Top model sensitivities
Biskupiak 2023 (US, CEA) *Children and adults*	Tubeless AID (Omnipod 5) / SoC*	IQVIA Core Diabetes Model	60 years	US payer's perspective	USD 100,000 per QALY	▪ Cost of ketoacidosis ▪ Duration of treatment effect ▪ Threshold of NSHE ▪ Definition of severe hypoglycaemia
Pease 2022 (Australia, CEA) *Children and adults (12–25 years)*	HCL / SoC*	Markov model	13 years (patients entered at 12 years of age)	Australian healthcare system's perspective	AUD 50,000 per QALY gained	▪ Base rate and treatment effect on NSHE ▪ Cost of HCL system ▪ Time horizon ▪ Treatment effect of HCLs on HbA1c
Lambadiari 2022 (Greece, CEA) *Adults*	AHCL (MiniMed 780G) / MDI plus isCGM**	IQVIA Core Diabetes Model	Lifetime	Societal	EUR 34,000 per QALY gained	▪ Time horizon ▪ Baseline HbA1c ▪ Number of SMBG strips used
HTA Wales 2021 (UK, CUA) *Adults*	CLS / Other comparators***	Sheffield Type 1 Diabetes Model	Lifetime	UK NHS and PSS	GBP 20,000 per QALY gained	▪ Discount rates on costs and QALYs ▪ Cost of HCLs ▪ Baseline HbA1c ▪ Base rate and treatment effect on NSHE

Key: AHCL, advanced hybrid closed loop; AID, automated insulin delivery; CEA, cost-effectiveness analysis; CLS, closed loop system; CSII, continuous subcutaneous insulin infusion; CUA, cost–utility analysis; HbA1c, haemoglobin A1c; HCL, hybrid closed loop; HTW, Health Technology Wales; isCGM, intermittently scanned continuous glucose monitoring; MDI, multiple daily injections; NHS, national health service; NSHE, non-severe hypoglycaemic event; PSS, personal social services; QALY, quality-adjusted life year; SoC, standard of care; SMBG, self-monitoring blood glucose; WTP, willingness-to-pay.
Notes: *Insulin pump therapy or multiple daily injections of insulin with either capillary glucose testing or continuous glucose monitoring. ** SAP plus PLGM was also included in this study but is not a focus for this analysis due to not being a comparator of interest. ***MDI+SMBG: multiple daily injections with self-monitoring of blood glucose. MDI+CGM: multiple daily injections with continuous glucose monitoring. MDI+FGM: multiple daily injections with flash glucose monitoring. CSII+CGM: continuous subcutaneous insulin infusion with continuous glucose monitoring.

Table 2: Results of included studies

Study name (cost)	Intervention/ comparator	Incremental QALYs	Incremental LYs	Total costs	Incremental costs	ICER	Outcome
Biskupiak 2023 (USD)	Tubeless AID (Adults (NSHE < 54 mg/dL)	1.112	1.022	441,023	11,465	10,310	Cost effective
	SoC Adults (NSHE < 54 mg/dL)			429,558			
	Tubeless AID Adults (NSHE < 70 mg/dL)	1.123	-	480,200	-8,029	Dominant	Cost effective
	SoC Adults (NSHE < 70 mg/dL)			488,230			
	Tubeless AID Children (NSHE < 54 mg/dL)	1.521	1.375	499,539	15,099	9,927	Cost effective
	SoC Children (NSHE < 54 mg/dL)			484,440			
	Tubeless AID Children (NSHE < 70 mg/dL)	1.519	1.375	553,141	-2,483	Dominant	Cost effective
	SoC Children (NSHE < 70 mg/dL)			555,624			
Lambadiari 2022 (EUR)	AHCL	2.708	-	370,681	80,880	29,869	Cost effective
	MDI plus isCGM			289,800			
Pease 2022 (AUD)	HCL	1.15	NR	128,334	37,827	32,789	Cost effective
	Current care		NR	90,507			

Key: AID, automated insulin delivery; HCL, hybrid closed loop; ICER, incremental cost-effectiveness ratio; LY, life years; MDI, multiple daily injections; NR, not reported; QALY, quality-adjusted life year; SoC, standard of care.

Table 3: Results of included HTW study

Strategy	Comparator on efficiency frontier	Total costs (£)	Total QALYs	Total health benefit	Incremental costs (£)	Incremental QALYs	Net health benefit	ICER (£/QALY)	Outcome
Summary of base case pairwise analysis									
CLS	-	124,911	12.42	6.18	N/A	N/A	N/A	N/A	CLS not cost effective
MDI+SMBG	-	44,458	10.56	8.34	80,453	1.87	-2.16	43,114	
MDI+CGM	-	72,860	11.77	8.13	52,051	0.66	-1.95	79,463	
MDI+FGM	-	50,959	11.45	8.90	73,953	0.98	-2.72	75,783	
CSII+CGM	-	106,407	11.67	6.35	18,505	0.76	-0.17	24,446	
Summary of base case fully incremental analysis									
MDI+SMBG	Reference	44,458	10.56	8.34	N/A	N/A	N/A	N/A	CLS not cost effective
MDI+FGM	MDI+SMBG	50,959	11.45	8.90	6,501	0.89	0.57	7,303	
CSII+CGM	N/A	106,407	11.67	6.35	N/A	N/A	N/A	N/A	
MDI+CGM	MDI+FGM	72,860	11.77	8.13	21,901	0.32	-0.77	68,268	
CLS	MDI+CGM	124,911	12.42	6.18	52,051	0.66	-1.95	79,463	

Key: CGM, continuous glucose monitoring; CLS, closed loop system; CSII, continuous subcutaneous insulin infusion; FGM, flash glucose monitoring; HTA, health technology assessment; ICER, incremental cost-effectiveness ratio; MDI, multiple daily injections; QALY, quality-adjusted life year; SMBG, self-monitoring blood glucose.

CONCLUSIONS

- Both the previous SLR and all but one of the studies found in this update support the cost-effectiveness of HCLs versus comparator technologies for Type 1 diabetics across a wide range of geographies, whilst also showing an increase in the quality of life for these patients
- This update to the SLR highlighted different model sensitivities, which focused on the base rate and treatment effect of NHSEs, instead of previous key drivers (SHE rates and the assumptions around utility benefit for lower rates of FoH). Differences in the conclusions around cost-effectiveness are in part driven by variation in incremental costs as HCLs were predicted to both increase and save costs depending on the study, and willingness-to-pay thresholds
- Taking this evidence into account – alongside other published studies finding that patients using HCLs experienced improvement in diabetes distress, hypoglycaemic confidence, and treatment satisfaction[11] – further uptake of this technology may continue to prove to be a beneficial choice for both the payer and the patient

An electronic version of the poster can be viewed by scanning the QR code.

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Poster presented at the ISPOR Europe 2023, 12–15 November 2023, Copenhagen, Denmark