Cost-Effectiveness of Flash CGM Compared with SMBG – a Canadian Private Payer Perspective

1051-P

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Introduction

- Diabetes mellitus is one of the most common chronic health conditions in Canada, affecting 3.7 million people in Canada (9.4% of the population) and leading to annual treatment costs of $30 billion[1]
  - In addition to healthcare costs, diabetes has a substantial impact on employers as a result of absenteeism[1] – accordingly, diabetes is of major concern to Canadian private payers, which make up around 50% of the healthcare market
- For people living with diabetes, effective glucose monitoring is recognized as a key component in diabetes care to reduce disease burden, complications, and healthcare utilization
  - Sensor-based glucose monitoring can provide more comprehensive information about glucose levels than capillary-based self-monitoring of blood glucose (SMBG), while reducing the need for finger sticks[2]
- FreeStyle Libre Systems are advanced, factory-calibrated, sensor-based glucose monitoring devices that enable patients to monitor minute-by-minute glucose fluctuations and future trends, as well as their responses to insulin[2]
  - Use of FreeStyle Libre has been found to improve glycated hemoglobin (HbA1c) levels, reduce hypoglycemia, and increase patients' time in the recommended glycemic range[3–8]

Objectives

- This study aimed to assess the cost-effectiveness of FreeStyle Libre, compared with SMBG, from the perspective of Canadian private payers using a recently validated model, DEDUCE (Determination of Diabetes Utilities, Costs, and Effects)[9]

Materials and methods

Modeling approach

- This analysis used the patient-level microsimulation model, DEDUCE, with 10,000 patients per analysis[9]
  - The published DEDUCE model assigns costs and utilities according to the complications and acute events (diabetic ketoacidosis [DKA], severe hypoglycemic events [SHE] and non-severe hypoglycemic events [NSHE]) experienced by each simulated patient, with the incidence and history of complications updated each 1-year cycle[9]
  - Complications are modeled with risk equations that use patient characteristics, including HbA1c, to predict the likelihood of a patient developing each complication (e.g., congestive heart failure or stroke) in each cycle[9]
  - Analyses were conducted separately for populations of patients with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM)
- Costs and disutilities were applied per event for acute diabetic events and annually for complications

Model inputs and assumptions

Target population (Tables 1 and 2)	• Patients ≥ 18 years of age with T1DM or T2DM
Effect of FreeStyle Libre (Table 3)	• Immediate absolute reduction in HbA1c that persisted over the model time horizon • Reductions in DKA, SHEs and NSHEs • Work absenteeism, including long-term absence when patients did not return to work due to diabetes complications
Costs (Table 4)	• All costs were in 2023 Canadian dollars • FreeStyle Libre and SMBG acquisition costs and costs of treating diabetes complications • Absenteeism costs
Health utilities (Table 5)	• An additional disutility was included for the fingersticks associated with SMBG use • Fear of hypoglycemia was included for patients with T1DM
Risk of complications	• T1DM risks were based on the Sheffield type 1 Diabetes Model equations • T2DM risks were based on the RECODe risk engine
Time horizon	• 40- (T1DM) and 25-year (T2DM) horizons were used to reflect the period of typical private payer coverage
Discounting	• Costs and utilities were discounted at 1.5%, as per current CADTH guidelines[10]

The Sheffield type 1 Diabetes Model equations were primarily derived from the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study and the Wisconsin Epidemiological Study of Diabetic Retinopathy[11–13]
The RECODe risk engine was developed using data from the ACCORD RCT[14]
CADTH, Canadian Agency for Drugs and Technologies in Health; DKA, diabetic ketoacidosis; HbA1c, glycated hemoglobin; NSHE, non-severe hypoglycemic event; RCT, randomized controlled trial; RECODe, Risk Equations for Complications Of type 2 Diabetes; SHE, severe hypoglycemic event; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Modeling inputs

Table 1: Patient characteristics – T1DM

Characteristic	Value (SD)	Source
Demographics		
Age at model entry (years)	23	IMPACT RCT; Bolinder 2016[8]
Female sex	35.0%	
Baseline risk factors		
HbA1c level	6.7% (0.5%)	IMPACT RCT; Bolinder 2016[8]
SBP (mmHg)	130.0 (27.0)	FinnDiane RCT; Ahola 2010[15]
BMI (kg/m^2)	25.2 (3.6)	IMPACT RCT; Bolinder 2016[8]
Total cholesterol (mg/dL)	186.4 (0.8)	FinnDiane RCT; Ahola 2010[15]
HDL cholesterol (mg/dL)	55.3 (0.4)	
% current smokers	22.0%	
History of complications		
Neuropathy	10.7%	FinnDiane RCT; Ahola 2010[15]
Peripheral arterial disease with amputation	1.0%	
Micro-albuminuria	0.0%	
Macro-albuminuria	7.0%	
End-stage renal disease	4.0%	
Background Retinopathy	0.0%	
Proliferative Retinopathy	38.0%	
Macular edema	0.0%	
Blindness	0.0%	
Myocardial infarction	2.0%	
Stroke	2.0%	
Angina	0.0%	
Heart failure	0.0%	

Note: Data are mean (SD) or percentage of patients.
BMI, body mass index; FinnDiane, Finnish Diabetic Nephropathy Study; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; RCT, randomized controlled trial; SBP, systolic blood pressure; SD, standard deviation; T1DM, type 1 diabetes mellitus.

Table 2: Patient characteristics – T2DM

Characteristic	Value (SD)	Source
Demographics		
Age at model entry (years)	40	Assumption
Female sex	Non-insulin, 36.2% Basal insulin, 39.8% MDI, 38.0%	IMMEDIATE RCT; Aronson 2023[16] US and Canada real-world data; Carlson 2022[4] ACCORD RCT; Basu 2017[14]
Ethnicity		
Black	19.0%	ACCORD RCT; Basu 2017[14]
Hispanic	7.0%	
Baseline risk factors		
HbA1c level	Non-insulin, 8.6% (1.1%) Basal insulin, 9.2% (1.0%) MDI, 9.2% (1.0%)	IMMEDIATE RCT; Aronson 2023[16] US and Canada real-world data; Carlson 2022[4]
SBP (mmHg)	136.5 (17.1)	ACCORD RCT; Basu 2017[14]
Total cholesterol (mg/dL)	183.2 (41.7)	
HDL cholesterol (mg/dL)	41.8 (11.6)	
Serum creatinine (mg/dL)	0.9 (0.2)	
Urine albumin:creatinine ratio	99.2 (359.4)	
% current smokers	12.0%	
% with CVD	35.7%	
Medication use		
Insulin	MDI, 6%; basal insulin, 10%; non insulin, 84%	US real-world data; Brixner 2019[17]
Blood pressure	84.2%	ACCORD RCT; Basu 2017[14]
Statins	64.0%	
Anticoagulants	3.0%	
Oral antidiabetics	83.0%	Assumption

Note: Data are mean (SD) or percentage of patients.
ACCORD, Action to Control Cardiovascular Risk in Diabetes; CVD, cardiovascular disease; HbA1c, glycated hemoglobin; HDL, high-density lipoprotein; IMMEDIATE, IMpact of flash glucose Monitoring in pEople with type 2 Diabetes Inadequately controlled with non-insulin Antihyperglycaemic ThErapy; MDI, multiple daily injections of insulin; RCT, randomized controlled trial; SBP, systolic blood pressure; SD, standard deviation; T2DM, type 2 diabetes mellitus.

Table 3: Treatment effectiveness

Input	Cohort	FreeStyle Libre	SMBG	Source
HbA1c benefit				
One-time absolute reduction in HbA1c	T1DM	0.42%	0%	Meta-analysis; Evans 2022[18]
	T2DM MDI/basal insulin	0.59%	0%	
	T2DM non-insulin	0.90%	0.60%	IMMEDIATE RCT; Aronson 2023[16]
Hypoglycemic events				
SHE (annual probability)	T1DM	0.65%	0.65%	French real-world study; Roussel 2021;[19] Guerci 2023[20]
	T2DM MDI	0.62%	0.70%	
	T2DM basal insulin	0.41%	1.73%	
	T2DM non-insulin	0.03%	0.05%	
SHE mortality (probability per event)	T1DM	0.30%		Assumed to be the same with FreeStyle Libre and SMBG; rate based on US real-world study; Pettus 2019[21]
	T2DM	0%		UK Prospective Diabetes Study; Wright 2006[22]
NSHE (events per year)	T1DM	48.97	67.60	Previous economic model; Bilir 2018[23]
	T2DM MDI/basal insulin	16.85	23.31	US real-world data and meta-analysis; Bergenstal 2021,[24] Edridge 2015[25]
	T2DM non-insulin	1.92		Conservative assumption
DKA				
DKA (annual probability)	T1DM	2.30%	4.50%	French and Danish real-world data; Guerci 2023,[20] Jensen 2017,[26] Roussel 2021[19]
	T2DM MDI	0.82%	1.70%	
	T2DM basal insulin	0.34%	1.37%	
	T2DM non-insulin	0.03%	0.13%	
DKA mortality (probability per event)	All groups	4.7%		Assumed to be the same with FreeStyle Libre and SMBG. Rate based on Israeli real-world data; Sagy 2021[27]
Absenteeism				
Days absent (per year)	T1DM	3.68	12.88	Dutch real-world data (FLARE NL4); Fokkert 2019[28]
	T2DM	2.03	10.72	US real-world data; Gibson 2010[29]

DKA, diabetic ketoacidosis; FLARE-NL, FLAsh monitor Registry in The Netherlands; HbA1c, glycated hemoglobin; IMMEDIATE, IMpact of flash glucose Monitoring in pEople with type 2 Diabetes Inadequately controlled with non-insulin Antihyperglycaemic ThErapy; NSHE, non-severe hypoglycemic event; SHE, severe hypoglycemic event; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Table 4: Costs

Input	FreeStyle Libre	SMBG	Source
Glucose monitoring costs			
FreeStyle Libre annual costs	$2,330	$0	Abbott
SMBG annual costs[a]	$42	T1DM and T2DM MDI, $1,211 T2DM basal insulin/ non-insulin, $388	Diabetes Canada;[1] Diabetes Depot[30]
Costs for complications, year 1 (proportion of people not returning to work after event)[b]			
Blindness	$856 (34%)		Canadian studies; Benoit 2012,[31] Deloitte 2021[32]
Congestive heart failure	$906 (24%)		Canadian and German real-world data; Levy 2021,[33] Reibis 2017[34]
Myocardial infarction	$2,781(13%)		Canadian and international real-world data; Tran 2018,[35] Dreyer 2016[36]
Peripheral arterial disease with amputation (T1DM only)	$2,796 (34%)		Canadian real-world data and literature review; Hopkins 2015,[37] Burger 2007[38]
Renal failure	$5,000 (80%)		Canadian real-world data; Manns 2017,[39] 2019[40]
Stroke	$10,222 (56%)		Canadian real-world data and meta-analysis; Yu 2021,[41] Duong 2019[42]
Absenteeism costs			
Hourly wage	$31.90		Statistics Canada average wage

[a]FreeStyle Libre users are assumed to use one SMBG test per week; people with T1DM and T2DM using MDI are assumed to use four tests per day; people with T2DM using basal insulin or non-insulin therapies are assumed to use one test per day.
[b]Complications not listed are assumed to have no associated costs.
MDI, multiple daily injections of insulin; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Table 5: Utilities

Input	Value	Source
General utilities		
Baseline health utility	T1DM, 0.839; T2DM, 0.785	UK prospective studies; Peasgood 2016;[43] Clarke 2002[44]
Fingerstick disutility	0.03	UK time trade-off study; Matza 2017[45]
Fear of hypoglycemia (T1DM only)	0.0254	UK survey data; Currie 2006[46]
Acute diabetic event disutilities, per event		
SHE	0.0183	Previous economic model; Bilir 2018[23]
NSHE	0.0016	
DKA	0.0091	Previous economic model; Jorissen 2022[47]
Disutilities for complications, year 1 (subsequent years)		
Blindness	0.0498 (0.0498)	CADTH report, 2017[48]
Congestive heart failure	0.0635 (0.0180)	
Myocardial infarction	0.0409 (0.0120)	
Renal failure	0.2630 (0.2630)	
Stroke	0.0524 (0.0400)	ACCORD RCT; Shao 2019[49]
Neuropathy (T1DM only)	0.2361 (0)	UK prospective study; Peasgood 2016[43]
Peripheral arterial disease with amputation (T1DM only)	0.2800 (0)	Previous economic model; Brown 2014[50]
Microalbuminuria (T1DM only)	0.0120 (0)	
Macroalbuminuria (T1DM only)	0.0360 (0)	FinnDiane RCT; Ahola 2010[15]
Background retinopathy (T1DM only)	0.0265 (0)	UK prospective study and previous economic model; Peasgood 2016;[43] Pollard 2018[51]
Peripheral retinopathy (T1DM only)	0.0288 (0)	Previous economic model; Pollard 2018[51]
Macular edema (T1DM only)	0.0171 (0)	Previous economic model; Brown 2014[50]

ACCORD, Action to Control Cardiovascular Risk in Diabetes; CADTH, Canadian Agency for Drugs and Technologies in Health; DKA, diabetic ketoacidosis; NSHE, non-severe hypoglycemic event; RCT, randomized controlled trial; SHE, severe hypoglycemic event; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Table 6: Scenario analyses

Parameter	Base-case input		Scenario analysis input
	T1DM	T2DM	
Time horizon	40 years	25 years	20 years
Discounting	1.5%	1.5%	0%, 3%
Cost of SMBG	$1,211	$388	−50%, +50%
FreeStyle Libre HbA1c treatment effect	0.42%	0.90% (non-insulin) 0.59% (basal insulin/MDI)	−30%, +30%
Rate of severe hypoglycemia	0.65%	Non-insulin: 0.03% (FreeStyle Libre); 0.05% (SMBG) Basal insulin: 0.41% (FreeStyle Libre); 0.73% (SMBG) MDI: 0.62% (FreeStyle Libre), 0.70% (SMBG)	−50%, +50%
Baseline utility	0.839	0.785	T1DM, 0.910; T2DM, 0.881 (from alternative sources[10,51])
FreeStyle Libre Utility Benefit	0.05536	0.030	No utility benefit (conservative assumption)
Disutility for severe hypoglycemia	0.0183	0.0183	0.0475 (from CADTH 2017[48])
T2DM subpopulation proportions	–	Non-insulin: 84% Basal insulin: 10% MDI: 6%	100% MDI, 100% basal insulin, 100% non-insulin

HbA1c, glycated hemoglobin; MDI, multiple daily injections of insulin; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Table 7: Cost-effectiveness results

	FreeStyle Libre	SMBG	Incremental
T1DM			
Total costs	$213,673	$245,960	−$32,287
QALYs	18.6874	17.4330	1.25438
ICER (Cost/QALY)	Dominant		
T2DM			
Total costs	$120,978	$129,069	−$8,091
QALYs	14.0642	13.5838	0.48036
ICER (Cost/QALY)	Dominant		

Costs are in 2023 Canadian Dollars. Complication costs comprised blindness, end-stage renal disease, heart failure, myocardial infarction, peripheral arterial disease with amputation, and stroke.
ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life year; SMBG, self-monitoring of blood glucose; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Results

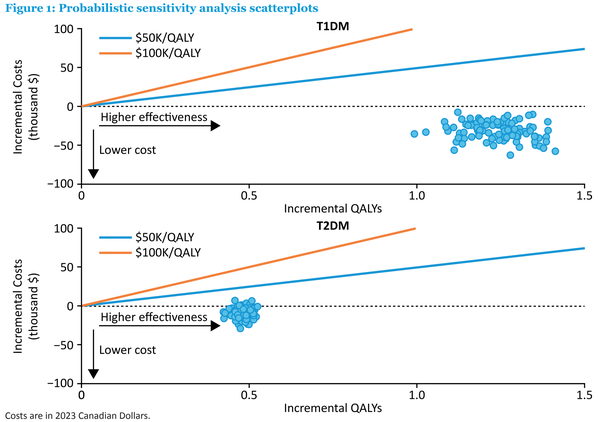
Base-case cost-effectiveness results

- In both the T1DM and T2DM analyses, FreeStyle Libre provided more quality-adjusted life years than SMBG, at a lower cost, and was therefore the dominant intervention (**Table 7**)

Sensitivity analysis results

- For both T1DM and T2DM, FreeStyle Libre was dominant to SMBG in all scenarios tested
- Probabilistic sensitivity analysis (**Figure 1**) showed that FreeStyle Libre has a 100% probability of being dominant to SMBG for T1DM, and a 91% probability of being dominant for T2DM

Figure 1: Probabilistic sensitivity analysis scatterplots



Costs are in 2023 Canadian Dollars.
QALY, quality-adjusted life year; T1DM, type 1 diabetes mellitus; T2DM type 2 diabetes mellitus.

Discussion

- This is the first analysis to evaluate the cost effectiveness of FreeStyle Libre for all people living with diabetes, including those not using insulin
- The DEDUCE microsimulation model improves on previous diabetes models, such as the IQVIA CORE Diabetes Model, by providing increased transparency and using updated risk equations for T2DM, based on the ACCORD randomized controlled trial rather than the older UK Prospective Diabetes Study[9]
- This economic evaluation has found that from a Canadian private payer perspective, FreeStyle Libre is dominant to SMBG for the monitoring of glucose levels by people with T1DM or T2DM
- A limitation of this economic analysis is that patients were assumed to use the same glucose monitoring method indefinitely, with no increase in SMBG frequency
  - Productivity losses were based on overall absenteeism, and it was not possible to include reduced productivity while at work in the model

Conclusion

- From a Canadian private payer perspective, FreeStyle Libre is cost effective compared with SMBG for all people living with diabetes

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SC [TBC]
YN is a clinical pharmacist and the president of Synergyx Consulting, which has received an honorarium from Abbott to participate in an advisory board for this study
YP is an employee and shareholder of Abbott
KS is an employee of Eversana, which has received project funding from Abbott

References

1. Diabetes Canada. **2.** Rodbard D. *Diabetes Technol Ther* 2016;18 Suppl 2:S3–S13. **3.** Evans M *et al. Diabetes Ther* 2020;11:83–95. **4.** Carlson AL *et al. BMJ Open Diabetes Res Care* 2022;10:e002590. **5.** Deshmukh H *et al. Diabetes Care* 2020;43:2153–2160. **6.** Haak T *et al. Diabetes Ther* 2017;8:55–73. **7.** Wada E *et al. BMJ Open Diabetes Res Care* 2020;8:e001115. **8.** Bolinder J *et al. Lancet* 2016;388:2254–2263. **9.** Szafranski K *et al. Value in Health* 2024;10.1016/j.jval.2024.01.010. **10.** CADTH. **11.** Thokala P *et al. Diabet Med* 2014;31:477–86. **12.** EDIC Research Group. *Diabetes Care* 1999;22:99–111. **13.** Klein R *et al. Ophthalmology* 2008;115:1859–68. **14.** Basu S *et al. Lancet Diabetes Endocrinol* 2017;5:788–798. **15.** Ahola AJ *et al. Nephrol Dial Transplant* 2010;25:1903–8. **16.** Aronson R *et al. Diabetes Obes Metab* 2023;25:1024–1031. **17.** Brixner D *et al. Clin Ther* 2019;41:303–313.e1. **18.** Evans M *et al. Diabetes Ther* 2022;13:1175–1185. **19.** Roussel R *et al. Diabetes Care* 2021;44:1368–1376. **20.** Guerci B *et al. Diabetes Technol Ther* 2023;25:20–30. **21.** Pettus JH *et al. Diabetes Care* 2019;42:2220–2227. **22.** Wright AD *et al. J Diabetes Complications* 2006;20:395–401. **23.** Bilir SP *et al. Eur Endocrinol* 2018;14:73–79. **24.** Bergenstal RM *et al. J Endocr Soc* 2021;5:bvab013. **25.** Edridge CL *et al. PLoS One* 2015;10:e0126427. **26.** Jensen ML *et al. Diabetes Care* 2017;40:e57–e58. **27.** Sagy I *et al. Intern Med J* 2021;51:948–954. **28.** Fokkert M *et al. BMJ Open Diabetes Res Care* 2019;7:e000809. **29.** Gibson TB *et al. Am J Manag Care* 2010;16:589–600. **30.** Diabetes Depot. 2021. **31.** Benoit C *et al. Disability and Society* 2012;28. **32.** Deloitte. 2021. **33.** Levy AR *et al. CMAJ Open* 2021;9:E826–E833. **34.** Reibis R *et al. SAGE Open Med* 2017;5:2050312117744978. **35.** Tran DT *et al. Pharmacoecon Open* 2018;2:433–442. **36.** Dreyer RP *et al. Circ Cardiovasc Qual Outcomes* 2016;9:545–52. **37.** Hopkins RB *et al. BMC Health Serv Res* 2015;15:13. **38.** Burger H, Marinček C. *Disabil Rehabil* 2007;29:1323–9. **39.** Manns B *et al. Can J Kidney Health Dis* 2017;4:2054358117703986. **40.** Manns B *et al. Can J Kidney Health Dis* 2019;6:2054358119835521. **41.** Yu AYX *et al. BMC Health Serv Res* 2021;21:619. **42.** Duong P *et al. Arch Phys Med Rehabil* 2019;100:1140–1152. **43.** Peasgood T *et al. Med Decis Making* 2016;36:1020–33. **44.** Clarke P *et al. Med Decis Making* 2002;22:340–9. **45.** Matza LS *et al. Value Health* 2017;20:507–511. **46.** Currie CJ *et al. Curr Med Res Opin* 2006;22:1523–34. **47.** Jorissen W *et al. Acta Clin Belg* 2022;77:945–954. **48.** CADTH. 2017. **49.** Shao H *et al. Pharmacoeconomics* 2019;37:921–929. **50.** Brown ST *et al. Clin Ther* 2014;36:1578–87. **51.** Pollard DJ *et al. BMJ Open* 2018;8:e016766. **52.** McQueen RB *et al. Patient* 2014;7:197–205. **53.** Mok CH *et al. Value Health* 2021;24:1059–1067.

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