















✓✓ An Advantage ✓ Neutral ✗ ✗ A Disadvantage

Meter	Accuracy (esp. ability to detect ↓BG)	Blood (µL) Required	Re-Apply Blood?	Comments / Extra Features	App Available	Cost /100 strip
Medisure Empower 	✓ typically ± 0.6 mmol/L	0.5 µL	Cannot re-apply blood	• Illuminated. • Strip ejector. • Option for AST (forearm, upper arm, hand).	no app	\$89
Accu-Chek Guide 	✓✓ typically ± 0.3 mmol/L	0.6 µL	Cannot re-apply blood	• Strip ejector. • Option for AST (palm, forearm, upper arm).	mySugr	\$84
One Touch Ultra 2 	✓ typically ± 0.6 mmol/L	1.0 µL	Cannot re-apply blood	• Requires coding. • Option for AST (forearm or palm, but requires a special lancing device).	no app	\$85
One Touch Verio Flex 	✓✓ typically ± 0.3 mmol/L	0.4 µL	Cannot re-apply blood	• Colour bar classifies glucose level.	OneTouch Reveal	\$85
One Touch Verio Reflect 	✓ typically ± 0.6 mmol/L	0.4 µL	Cannot re-apply blood	• Colour bar / emoji classifies glucose level.	OneTouch Reveal	\$85
Contour Next 	✓✓ typically ± 0.3 mmol/L	0.6 µL	Can re-apply blood	• Option for AST (palm).	no app	\$84
Contour Next EZ 	✓✓ typically ± 0.3 mmol/L	0.6 µL	Can re-apply blood		no app	\$84
Contour Next One 	✓✓ typically ± 0.3 mmol/L	0.6 µL	Can re-apply blood	• Small size. • Option for AST (palm). uses colour light to classify glucose level	Contour Diabetes	\$84
Contour Next Gen 	✓✓ typically ± 0.3 mmol/L	0.6 µL	Can re-apply blood	• Option for AST (palm).	Contour Diabetes	\$84
Freestyle Lite 	✓ typically ± 0.6 mmol/L	0.3 µL	Can re-apply blood	• Option for AST (upper arm, forearm, hand, fingers, thigh, or calf).	no app	\$84
GE200 	✓✓ typically ± 0.3 mmol/L	0.75 µL	Cannot re-apply blood	• Option for AST (palm or forearm).	no app	\$65
Oracle EZ 	✓ typically ± 0.8 mmol/L	0.7 µL	Cannot re-apply blood	• Talking audio (French & English). • Option for AST (palm, forearm, upper arm, calf, or thigh).	no app	\$85
Spirit 	✓ typically ± 0.6 mmol/L	0.5 µL	Cannot re-apply blood	• Option for AST (palm or forearm).	no app	\$62





Clinical Pearls

- There is no need to choose a meter with numerous features if the patient does not plan to use those features.
- If capillary testing >6 times per day, a continuous system can be more affordable than capillary testing.
- Testing has limited purpose if results are not used to adjust treatment.
- Continuous systems are preferred in **Type 1** diabetes (↑ safety, ↓ A1c).

Table 1. Who should test?^{1-5,7,75-79}

T2DM	Diet-controlled	On meds other than insulin	On insulin
	No routine testing if targets met.		
	May recommend testing if: <ul style="list-style-type: none"> • will result in a change in therapy (e.g. drugs, diet) • will ↑ adherence to therapy • managing or preventing hypoglycemia (e.g. before driving or exercise) / in acute illness If testing, capillary meters (finger prick) usually ↓ cost.		
	May capillary test at least as often as taking insulin (for safety & to help dose). Continuous systems provide minimal extra A1c benefit. ⁴ Consider a continuous system if unable to capillary test, or if recurrent/severe/unaware of hypoglycemia. ^{NICE'22}		
T1DM	Continuous systems preferred in T1DM on basal-bolus therapy. If capillary testing, target ≥ QID.		
Diabetes in Pregnancy	Usually requires regular or continuous testing to guide management. See also page 10. Adjust "time in range" for continuous systems (see online  Table 4).		

Capillary Meters

Meter	General Notes	Sensor	Alerts (app must be open to transmit)	Reader	Cost /30 days
Libre 2  intermittent scan; age ≥4yrs	Can falsely detect hypoglycemia. ⁸⁴ Readings lag behind capillary measurements by 5-15 mins. Apps available.	14 day duration; on back of arm; about toonie-sized.	✓ Range 20ft. To interpret alert, must scan sensor.	\$65 reader; can also use cellphone. Must scan q8hrs.	\$194
Libre 3  real-time; age ≥4yrs		14 day duration; on back of arm; about nickel-sized.	✓✓ Sends real-time info to phone; range 20 ft.	No reader; must be near cellphone at all times to transmit.	Not yet available in Canada
Dexcom G6  real-time; age ≥2yrs 		⚠: Falsely ↑ readings if on Vitamin C >500mg/d with Libre or if on hydroxyurea with Dexcom G6. ⁷⁹	10 day duration; on abdomen (≥2yrs) or back of arm (≥18yrs).	✓✓ Sends real-time info to phone/reader; range 20 ft.	Must be near reader (\$500) or cellphone q3hr.

Libre 1: a continuous system requiring intermittent scan q8hr; age ≥18yrs; 14 day duration sensor; NOT able to send alerts; same cost as Libre 2; reader available or can use cellphone to scan; finger poke required to make treatment decisions.

AST=alternate site testing. AST is available for many meters, but results lag behind capillary testing, and so AST is less useful if hypoglycemia concerns.

Capillary meter coverage in Saskatchewan: Typically available for free with purchase of 100 strips. Strips are covered by Sask Health at 200 strips per year; 400 per year if at high hypoglycemia risk; 3,650 per year if on insulin (800 strips per 100 days if NIHB).




Continuous meter coverage in Saskatchewan:  Sask Health: 4-17yrs & diabetes managed with insulin.  NIHB: age ≤19yrs on short-acting insulin ≥T1D, or patients with type 1 diabetes.

Table 2. Which meter is best for my patient?


For many patients, any meter will do. However, each meter has its pros and cons; see our colour comparison chart (left). Some meters with unique or desirable features include:


Low tech & low cost

GE200 


~25% lower cost than most other meters; strips very easy to insert.

Highest rated apps in the App Store

Accu-Chek Guide  mySugr

One Touch Verio Flex or Verio Reflect  OneTouch Reveal

Tiny blood sample

Freestyle Lite 

Useful if e.g. calluses make drawing blood difficult.

Visually impaired patient

Oracle EZ 

English & French talking feature.

Blood Glucose Meters

Acknowledgements: Written by Alex Crawley and Brooke Robertson in 2022. Updates provided by Alex Crawley. Previous versions of this chart were written by Taisa Trischuk, Loren Regier, and Christine Lee. Thanks to our reviewers: Henry Halapay, Monica Lawrence, Kerry Mansell, Lisa Rutherford, Loren Regier, Tahiri McAleer, Stephanie Zimmer, Margaret Jin, Donna Herbert, Debbie Bunka, Jessica Visentin.

Disclosures: No conflicts of interest are reported the authors.

Disclaimer: RxFiles Academic Detailing is part of the College of Pharmacy and Nutrition at the University of Saskatchewan. The content of this work represents the research, experience and opinions of the authors and not those of the University of Saskatchewan. Neither the authors nor the University of Saskatchewan nor any other party who has been involved in the preparation or publication of this work warrants or represents that the information contained herein is accurate or complete, and they are not responsible for any errors or omissions or for the result obtained from the use of such information. Any use of the materials will imply acknowledgment of this disclaimer and release any responsibility of the University of Saskatchewan, its employees, servants or agents. Readers are encouraged to confirm the information contained herein with other sources.

Online Extras:

Table 3: Blood Glucose Meter Additional Pearls

- When cleaning the skin prior to a capillary test, soap and water is adequate.
- If using continuous systems, occasional capillary testing may still be required – for example, if results are rapidly changing or do not match how the patient is feeling.
- Continuous systems are useful to detect nighttime hypoglycemia and/or the Somogi effect (hypoglycemia at night leading to rebound high blood glucose levels in the morning).
- Continuous systems have value in the peri-operative and post-operative environment (e.g. when deciding when to restart held medications).
- Watch for 'alert fatigue' and 'monitoring anxiety' with continuous systems. In patients who have well managed diabetes, a continuous system can sometimes create unnecessary stress and a hyper-awareness of blood glucose values. Alert settings may also need to be changed (e.g. in older adults) to reflect new time-in-range goals.
- For patients on an insulin pump, continuous systems allow improved monitoring. Automated insulin delivery systems are also being studied which can communicate with continuous monitoring in order to automatically adjust insulin doses. For a review of these new technologies, see [Marks et al.](#)⁸⁵ For Sask Health insulin pump criteria (2021), see [this link](#).
- Rarely, the sensor of a continuous system will detach. Typically contacting the company will result in them sending a new sensor to the patient under warranty.
- For patients concerned with privacy, the Dexcom G6 sensor can attach to the abdomen and feel more discreet than attaching to the back of the arm.

Table 4. Diabetes Monitoring Targets for Continuous Systems.^{AACE 2021}

	T1DM or T2DM	Older Adults / Frailty	T1DM in Pregnancy
Time in Range	>70% between 4-10 mmol/L	>50% between 4-10 mmol/L	>70% between 3.5-7.8 mmol/L
Time Below Range	<4% below 4 mmol/L <1% below 3 mmol/L	<1% below 4 mmol/L 0% below 3 mmol/L	<4% below 3.5 mmol/L <1% below 3 mmol/L
Time Above Range	<25% above 10 mmol/L <5% above 14 mmol/L	<10% above 14 mmol/L	<25% above 10 mmol/L

Table 5. How accurate are capillary blood glucose meters?

Below is collected accuracy data for common capillary blood glucose meters. Data collected from manufacturer instruction manuals. All blood glucose meters on the Canadian market meet ISO 15 international standards. Results are for measurements below 5.5 mmol/L;* in general meters are **more** accurate when measuring **higher** blood glucose readings. For our colour comparison chart, we gave two checks for accuracy if a meter consistently (i.e. >80% of the time) measured results within ± 0.28 mmol/L. (Note: 0.28 mmol/L was rounded to 0.3 mmol/L, and 0.56 mmol/L was rounded to 0.6 mmol/L, for the colour comparison chart).

	Accu-Chek	OneTouch			Contour				FreeStyle	General Electric	Oracle	Spirit	MediSure
	Guide	Ultra 2	Verio Flex	Verio Reflect	Next	Next Gen	Next EZ	Next One	Lite	GE200	Oracle	Spirit	Empower
Within +/- 0.28 mmol/L	94.1%	48.8%	82%	73.7%	92.8%	83.3%	91%	90.3%	70.1%	92.2%	-	55.4%	68.7%
Within +/- 0.56 mmol/L	100%	84.5%	98%	96.8%	99.4%	99%	100%	100%	95.5%	100%	-	88.2%	96.9%
Within +/- 0.83 mmol/L	100%	100%	100%	100%	100%	100%	100%	100%	99.5%	100%	100%	98.9%	100%

*One Touch Ultra 2 was tested for accuracy below 4.2 mmol/L (rather than 5.5 mmol/L).

Search Terms

Glucose Meters	54
Glucose Testing	54
Self-Monitoring of Blood Glucose	54
SMBG	54
ACCU-CHEK	54
ASCENSIA	54
FREESTYLE	54
ONE-TOUCH	54
DEXCOM	54
Type 2 Diabetes Mellitus	54
Type 1 Diabetes Mellitus	54
Hypoglycemia	54
Glucose	54
Diabetes	54

References

- Berard L, Siemens R, Woo V et al. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada: Monitoring Glycemic Control*. Can J Diabetes. 2018;42(Suppl1):S47-S53.
- CADTH Clinical Analysis- COMPUS Optimal Therapy Report: Systematic Review of Use of Blood Glucose Test Strips for the Management of Diabetes Mellitus. May 2009. https://www.cadth.ca/media/pdf/BGTS_SR_Report_of_Clinical_Outcomes.pdf
- CADTH Optimal Therapy Newsletter: Self-Monitoring of Blood Glucose. Feb 2016. https://www.cadth.ca/sites/default/files/pdf/Tools/SMBG/OT_Newsletter_en.pdf
- Tools for Practice #333. Come Spy with Me: Continuous glucose monitoring in diabetes. Available from https://gomainpro.ca/wp-content/uploads/tools-for-practice/1675379665_tfp333_glucosemonitoring.pdf
- Diabetes Canada Clinical Practice Guidelines Expert Committee. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*. Can J Diabetes. 2018;42(Suppl 1):S1-S325.
- Malanda UL, Welschen LM, Riphagen II, et al. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. Cochrane Database Syst Rev. 2012 Jan 18;1:CD005060. {From this review, we conclude that when diabetes duration is over one year, the overall effect of self-monitoring of blood glucose on glycaemic control in patients with type 2 diabetes who are not using insulin is small up to six months after initiation and subsides after 12 months. Furthermore, based on a best-evidence synthesis, there is no evidence that SMBG affects patient satisfaction, general well-being or general health-related quality of life. More research is needed to explore the psychological impact of SMBG and its impact on diabetes specific quality of life and well-being, as well as the impact of SMBG on hypoglycaemia and diabetic complications.}
- National Institute for Health and Care Excellence. Type 2 diabetes in adults: management (NICE guideline NG28). 2022. <https://www.nice.org.uk/guidance/ng28>
- 8.
- Simon J, Gray A, Clarke P, et al; Diabetes Glycaemic Education and Monitoring Trial Group. Cost effectiveness of self-monitoring of blood glucose in patients with non-insulin treated type 2 diabetes: economic evaluation of data from the DiGEM trial. BMJ. 2008 May 24;336(7654):1177-80.
- Young LA, Buse JB, Weaver MA, et al. Glucose Self-monitoring in Non-Insulin-Treated Patients With Type 2 Diabetes in Primary Care Settings: A Randomized Trial. JAMA Intern Med. 2017 Jul 1;177(7):920-929.
- Xu Y, Tan DHY, Lee JY-C. Evaluating the impact of self-monitoring of blood glucose frequencies on glucose control in patients with type 2 diabetes who do not use insulin: a systematic review and meta-analysis. *Int J Clin Pract* 2019;73:e13357.
- Yale JF, Paty B, Senior PA. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada: Hypoglycemia*. Can J Diabetes. 2018;42(Suppl1):S104-S108.
- Feig D, Berger H, Donovan L et al. *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada: Diabetes and Pregnancy*. Can J Diabetes. 2018;42(Suppl1):S255-S282.
- Aakre KM, Watine J, Bunting PS, et al. Self-monitoring of blood glucose in patients with diabetes who do not use insulin—are guidelines evidence-based? *Diabet Med* 2012;29:1226–36.
- Battelino T et al. Effect of continuous glucose monitoring on hypoglycemia in type 1 diabetes. *Diabetes Care* 2011; 34:795.
- Bergental RM et al. Effectiveness of sensor-augmented insulinpump therapy in type 1 diabetes. *N Engl J Med* 2010; 363:311.
- Blevins TC et al. Statement by the American Association of Clinical Endocrinologists Consensus Panel on Continuous Glucose Monitoring. *Endocr Pract* 2010; 16:730.
- Butalia S, Rabi D. To test or not to test? Self-monitoring blood glucose in patients with type 2 diabetes managed without insulin. *Open Medicine, North America*, 4, may. 2010.
- CADTH Rapid Response: Blood Glucose Monitors and Test Strips: A Review of the Comparative Clinical Evidence and Cost-Effectiveness. Apr 2011. Accessed at: <http://www.cadth.ca/media/pdf/htis/april-2011/L0256%20SMBG%20Test%20Strips%20and%20Monitors%20Final.pdf>
- Choi HYJ. Flash Continuous Glucose Monitoring (**FreeStyle Libre 14-Day System**) for Self-Management of Diabetes Mellitus. *Am Fam Physician*. 2021 Jun 1;103(11):688-690.
- COMPUS Optimal Therapy Report: **Cost Effectiveness** of Blood Glucose Test Strips in the Management of Adult Patients with Diabetes Mellitus. May 2009. Accessed Feb 04, 2010 at http://www.cadth.ca/media/pdf/BGTS_Consolidated_Economic_Report.pdf
- Cornish A, Chase HP. Navigating **Airport Security** with an Insulin Pump and/or Sensor. *Diabetes Technol Ther*. 2012 Nov;14(11):984-5.
23. Dimosthenopoulos C, Liatis S, Kourpas E, et al. The beneficial short-term effects of a **high-protein/low-carbohydrate diet on glycaemic control** assessed by continuous glucose monitoring in patients with type 1 diabetes. *Diabetes Obes Metab*. 2021 Mar 26. doi: 10.1111/dom.14390.
- Falk J, et al. Patterns, Policy and Appropriateness: A 12-Year Utilization Review of **Blood Glucose Test Strip Use** in Insulin Users. *Can J Diabetes*. 2017 Apr 11.
- Farmer AJ, Perera R, Ward A, et al. **Meta-analysis** of individual patient data in randomised trials of self monitoring of blood glucose (**SMBG**) in people with non-insulin treated type 2 diabetes. *BMJ*. 2012 Feb 27;344:e486. {SMBG does not appreciably improve control in T2DM patients not on insulin. ↓A1C only marginally 8.3%⇒8.05%}
Farmer AJ, Wade AN, French DP, et al; DiGEM Trial Group. Blood glucose self-monitoring in **type 2 diabetes**: a randomised controlled trial. *Health Techno Assess*. 2009 Feb;13(15):iii-iv, ix-xi, 1-50.
- FDA Aug/10 and CDC have noted a progressive increase in the reports of bloodborne infection transmission over the past 10 to 15 years (**primarily hepatitis B virus**), resulting from shared use of fingerstick and point-of-care [POC] blood testing devices.
- Franciosi M, Lucisano G, Pellegrini F, et al. ROSES Study Group. Role of **self-monitoring of blood glucose** and intensive education in patients with Type 2 diabetes not receiving insulin. A pilot randomized clinical trial. *Diabet Med*. 2011 Jul;28(7):789-96.
French DP, Wade AN, Yudkin P, Neil HA, Kinmonth AL, Farmer AJ. Self-monitoring of blood glucose changed non-insulin-treated Type 2 diabetes patients' **beliefs about diabetes and self-monitoring** in a randomized trial. *Diabet Med*. 2008 Oct;25(10):1218-28. {No change in diabetes-related health behaviours.}

28. Gellad WF, Zhao X, Thorpe CT, et al. Dual Use of Department of Veterans Affairs and Medicare Benefits and Use of **Test Strips** in Veterans With Type 2 Diabetes Mellitus. *JAMA Intern Med.* 2014 Nov 10.
29. Gillett M., Dallosso H. M., Dixon S., et al. Delivering the diabetes education and self management for ongoing and newly diagnosed (DESMOND) programme for people with newly diagnosed type 2 diabetes: cost effectiveness analysis. *BMJ* 2010;341:c4093
30. Gomes T, Martins D, Tadrus M, et al. Association of a **Blood Glucose Test Strip Quantity-Limit Policy** With Patient Outcomes: A Population-Based Study. *JAMA Intern Med.* 2016 Nov 7
31. Health Canada Mar/14: Informing Canadians that when Abbott FreeStyle glucose test strips are used with certain devices, there is a potential for users to receive a lower-than-actual blood sugar reading.
32. JDRF CGM Study Group. Continuous glucose monitoring and intensive treatment of type 1 diabetes. *N Engl J Med* 2008; 359:1464.
33. Karter AJ, Parker MM, Moffet HH, et al. Association of Real-time Continuous Glucose **Monitoring With Glycemic Control and Acute Metabolic Events** Among Patients With Insulin-Treated Diabetes. *JAMA.* 2021 Jun 2. doi: 10.1001/jama.2021.6530.
34. Kolb H, Kempf K, Martin S, Stumvoll M, Landgraf R. On **what evidence-base do we recommend** self-monitoring of blood glucose? *Diabetes Res Clin Pract.* 2010 Feb;87(2):150-156.
35. Lau, D. The Cost of Diabetes: A Game Changer. *Canadian Journal of Diabetes*, Mar '10.
36. Majumdar SR. Self-monitoring of blood glucose was not cost-effective in non-insulin-treated type 2 diabetes. *ACP J Club.* 2008 Nov-Dec;149(4):4-5.
37. Malanda UL, Bot SD, Kostense PJ, et al. Effects of **self-monitoring of glucose** on distress and self-efficacy in people with non-insulin-treated type 2 diabetes: a randomized controlled trial. *Diabet Med.* 2015 Jul 14.
38. Malanda UL, Welschen LM, Riphagen II, et al. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. *Cochrane Database Syst Rev.* 2012 Jan 18;1:CD005060. {From this review, we conclude that when diabetes duration is over one year, the overall effect of self-monitoring of blood glucose on glycaemic control in patients with type 2 diabetes who are not using insulin is small up to six months after initiation and subsides after 12 months. Furthermore, based on a best-evidence synthesis, there is no evidence that SMBG affects patient satisfaction, general well-being or general health-related quality of life. More research is needed to explore the psychological impact of SMBG and its impact on diabetes specific quality of life and well-being, as well as the impact of SMBG on hypoglycaemia and diabetic complications.}
39. Mansell K, Blackburn D, Eurich D. Do postprandial glucose levels add important clinical information when fasting glucose levels are near normal in non-insulin-dependent patients with type 2 diabetes? *CPJ* 2010;142(6):298-302. Accessed on line Feb 11, 2010 at <http://www.cpjournal.ca/perlserv/?request=get-document&doi=10.3821%2F1913-701X-142.6.298&ct=1>
40. Martens T, Beck RW, Bailey R, et al; MOBILE Study Group. Effect of Continuous Glucose Monitoring on **Glycemic Control in Patients With Type 2 Diabetes** Treated With Basal Insulin: A Randomized Clinical Trial. *JAMA.* 2021 Jun 2. doi: 10.1001/jama.2021.7444.
41. McIntosh B., Yu C., Lal A. et al. Efficacy of self-monitoring of blood glucose in patients with type 2 diabetes mellitus managed without insulin: a systematic review and meta-analysis. *Open Medicine, North America*, 4, may. 2010. Also article in *CPJ*, Sep 2010 @ <http://www.cpjournal.ca/doi/pdf/10.3821/1913-701X-143.5.218>; Commentary by Johnson in *CPJ*, Sep 2010 @ <http://www.cpjournal.ca/doi/pdf/10.3821/1913-701X-143.5.216>.
42. Medical Letter. **Continuous Glucose Monitoring.** May 2, 2011.
43. O'Kane MJ, Bunting B, Copeland M, Coates VE; ESMON study group. **Efficacy of self monitoring** of blood glucose in patients with newly diagnosed type 2 diabetes (ESMON study): randomised controlled trial. *BMJ.* 2008;336(7654):1174-7.
44. O'Kane MJ, Pickup J. Self-monitoring of blood glucose in diabetes: **is it worth it?** *Ann Clin Biochem.* 2009 Jul;46(Pt 4):273-82.
45. Parkin CG, Hinnen D, Campbell RK, et al. Effective use of paired testing in type 2 diabetes: practical applications in clinical practice. *Diabetes Educ.* 2009 Nov-Dec;35(6):915-27.
46. Pickup John C, Freeman Suzanne C, Sutton Alex J. Glycaemic control in type 1 diabetes during real time **continuous glucose monitoring** compared with self monitoring of blood glucose: meta-analysis of randomised controlled trials using individual patient data. *BMJ* 2011;343:doi:10.1136/bmj.d3805 (7 July 2011)
47. Polonsky WH, Hessler D, Ruedy KJ, Beck RW; DIAMOND Study Group. The Impact of Continuous Glucose Monitoring on Markers of Quality of Life in Adults With Type 1 Diabetes: Further Findings From the DIAMOND Randomized Clinical Trial. *Diabetes Care.* 2017 Jun;40(6):736-741.
48. Rabi, D., Johnson, J., Edwards, J. Self-monitoring of blood glucose for individuals with type 2 diabetes not using insulin: Leaving no cornerstone unturned. *Canadian Journal of Diabetes*, March 2010.
49. Accessed June 24 2010 at: SMBG: Type 2 Diabetes and **Monitoring your Blood Sugar –Patient Pamphlet.** http://www.cadth.ca/media/pdf/smbg-nb_eng.pdf
50. Riveline JP, Schaepelynck P, et al. Assessment of patient-led or physician-driven continuous glucose monitoring in patients with poorly controlled type 1 diabetes using basal-bolus insulin regimens: a 1-year multicenter study. *Diabetes Care.* 2012 May;35(5):965-71.
52. Robson J, Smithers H, Chowdhury T, et al. **Reduction in self-monitoring of blood glucose** in type 2 diabetes: an observational controlled study in east London. *Br J Gen Pract.* 2015 Apr; 65(633):e256-63.
53. Serwylo O, Friesen K, Falk J, et al. Opportunity Cost and Policy: A Utilization Review of **Self-Monitoring of Blood Glucose** in Manitoba, Canada. *Clin Ther.* 2016 Mar 2.
54. Simon J, Gray A, Clarke P, Wade A, Neil A, Farmer A; Diabetes Glycaemic Education and Monitoring Trial Group. Cost effectiveness of self monitoring of blood glucose in patients with non-insulin treated type 2 diabetes: economic evaluation of data from the DiGEM trial. *BMJ.* 2008 May 24;336(7654):1177-80.
55. Szmuiłowicz ED, Aleppo G. **Interferent Effect of Hydroxyurea** on Continuous Glucose Monitoring. *Diabetes Care.* 2021 May;44(5):e89-e90.
56. Towfigh A, Romanova M, Weinreb JE, et al. Self-monitoring of blood glucose levels in patients with type 2 diabetes mellitus not taking insulin: a meta-analysis. *Am J Manag Care.* 2008 Jul;14(7):468-75.
57. Varanauskienė E. Can blood glucose self-monitoring improve **treatment outcomes** in type 2 diabetes? *Diabetes Res Clin Pract.* 2008 Dec 15;82 Suppl 2:S112-7.
58. Vigersky RA, Fonda SJ, et al. Short- and long-term effects of real-time continuous glucose monitoring in patients with type 2 diabetes. *Diabetes Care.* 2012 Jan;35(1):32-8.
59. Visser MM, Charleer S, Fieuws S, et al. Comparing **real-time and intermittently scanned continuous glucose monitoring** in adults with type 1 diabetes (ALERTT1): a 6-month, prospective, multicentre, randomised controlled trial. *Lancet.* 2021 Jun 12;397(10291):2275-2283.
60. Woo, V., Cheng, A., Hanna, A., et al. Self-monitoring of Blood Glucose in Individuals with Type 2 Diabetes Not Using Insulin: Commentary. *Canadian Journal of Diabetes*, March 2010. Accessed June 24 2010.
61. Young LA, Buse JB, Weaver MA, et al; Monitor Trial Group. **Glucose self-monitoring** in non-insulin-treated type 2 diabetes in primary care settings: a randomized trial [online June 10, 2017]. *JAMA Intern Med.* doi:10.1001
62. Beck, R. W., Riddlesworth, T., Ruedy, K., Ahmann, A., Bergenstal, R., Haller, S., Kollman, C., Kruger, D., McGill, J. B., Polonsky, W., Toschi, E., Wolpert, H., Price, D., & DIAMOND Study Group (2017). Effect of Continuous Glucose Monitoring on Glycemic Control in Adults With Type 1 Diabetes Using Insulin Injections: The DIAMOND Randomized Clinical Trial. *JAMA*, 317(4), 371–378. <https://doi-org.cyber.usask.ca/10.1001/jama.2016.19975>
63. Cengiz E, Tamborlane WV. A tale of two compartments: interstitial versus blood glucose monitoring. *Diabetes technology & therapeutics.* 2009 Jun 2;11(S1):S-11.
64. Castellana, M., Parisi, C., Di Molfetta, S., Di Gioia, L., Natalicchio, A., Perrini, S., Cignarelli, A., Laviola, L., & Giorgino, F. (2020). Efficacy and safety of flash glucose monitoring in patients with type 1 and type 2 diabetes: a systematic review and meta-analysis. *BMJ open diabetes research & care*, 8(1), e001092. <https://doi-org.cyber.usask.ca/10.1136/bmjdr-2019-001092>
65. Cheng, A. Y., Feig, D. S., Ho, J., & Siemens, R. (2021). *Blood Glucose Monitoring in Adults and Children with Diabetes: Update 2021*. Retrieved from Diabetes Canada: <https://guidelines.diabetes.ca/cpg/chapter-9-2021-update#sec5>
66. Haak, T., Hanaire, H., Aijan, R., Hermanns, N., Riveline, J. P., & Rayman, G. (2017). Flash Glucose-Sensing Technology as a Replacement for Blood Glucose Monitoring for the Management of Insulin-Treated Type 2 Diabetes: a Multicenter, Open-Label Randomized Controlled Trial. *Diabetes therapy : research, treatment and education of diabetes and related disorders*, 8(1), 55–73. <https://doi.org/10.1007/s13300-016-0223-6>
67. Hásková, A., Radovnícká, L., Petruželková, L., Parkin, C. G., Grunberger, G., Horová, E., Navrátilová, V., Kádě, O., Matoulek, M., Prázný, M., & Šoupal, J. (2020). Real-time CGM Is Superior to Flash Glucose Monitoring for Glucose Control in Type 1 Diabetes: The CORRIDA Randomized Controlled Trial. *Diabetes care*, 43(11), 2744–2750. <https://doi-org.cyber.usask.ca/10.2337/dc20-0112>
68. Heinemann, L., Freckmann, G., Ehrmann, D., Faber-Heinemann, G., Guerra, S., Waldenmaier, D., & Hermanns, N. (2018). Real-time continuous glucose monitoring in adults with type 1 diabetes and impaired hypoglycaemia awareness or severe hypoglycaemia treated with multiple daily insulin injections (HypoDE): a multicentre, randomised controlled trial. *Lancet (London, England)*, 391(10128), 1367–1377.
69. Ontario Health (Quality) (2019). Flash Glucose Monitoring System for People with Type 1 or Type 2 Diabetes: A Health Technology Assessment. *Ontario health technology assessment series*, 19(8), 1–108.

70. Reddy, M., Jugnee, N., Anantharaja, S., & Oliver, N. (2018). Switching from Flash Glucose Monitoring to Continuous Glucose Monitoring on Hypoglycemia in Adults with Type 1 Diabetes at High Hypoglycemia Risk: The Extension Phase of the I HART CGM Study. *Diabetes technology & therapeutics*, 20(11), 751–757. <https://doi-org.cyber.usask.ca/10.1089/dia.2018.0252>
71. eddy, M., Jugnee, N., El Laboudi, A., Spanudakis, E., Anantharaja, S., & Oliver, N. (2018). A randomized controlled pilot study of continuous glucose monitoring and flash glucose monitoring in people with Type 1 diabetes and impaired awareness of hypoglycaemia. *Diabetic medicine : a journal of the British Diabetic Association*, 35(4), 483–490. <https://doi-org.cyber.usask.ca/10.1111/dme.13561>
72. *Saskatchewan Formulary*. (2023). Retrieved from Government of Saskatchewan - Ministry of Health: <https://formulary.drugplan.ehealthsask.ca/SearchFormulary>
73. Subramonian, A., & Grobelna, A. (2022, September). *Real-Time Continuous Glucose Monitoring for People Living With Type 2 Diabetes*. Retrieved from CADTH: <https://www.cadth.ca/sites/default/files/pdf/htis/2022/RC1443%20rtCGM%20for%20T2D%20Final.pdf>
74. Vigersky, R. A., Fonda, S. J., Chellappa, M., Walker, M. S., & Ehrhardt, N. M. (2012). Short- and long-term effects of real-time continuous glucose monitoring in patients with type 2 diabetes. *Diabetes care*, 35(1), 32–38.
75. Grunberger G, Sherr J, Allende M, Blevins T, Bode B, Handelsman Y, Hellman R, Lajara R, Roberts VL, Rodbard D, Stec C. American Association of Clinical Endocrinology clinical practice guideline: the use of advanced technology in the management of persons with diabetes mellitus. *Endocrine practice*. 2021 Jun 1;27(6):505-37.
76. National Institute for Health and Care Excellence. Type 1 diabetes in adults: diagnosis and management (NICE guideline NG17). 2022. <https://www.nice.org.uk/guidance/ng17>
77. National Institute for Health and Care Excellence. Diabetes (type 1 and type 2) in children and young people: diagnosis and management (NICE guideline NG18). 2022. <https://www.nice.org.uk/guidance/ng18>
78. O'Kane MJ, Bunting B, Copeland M, et al; ESMON study group. Efficacy of self monitoring of blood glucose in patients with newly diagnosed type 2 diabetes (ESMON study): randomised controlled trial. *BMJ*. 2008;336(7654):1174-7.
79. American Diabetes Association Professional Practice Committee, American Diabetes Association Professional Practice Committee. 7. Diabetes technology: standards of medical care in diabetes—2022. *Diabetes Care*. 2022 Jan;45(Supplement_1):S97-112.
80. U.S. Food and Drug Administration. Self-Monitoring Blood Glucose Test Systems for Over-the-Counter Use. Guidance for Industry and Food and Drug Administration Staff, September 2020. Accessed 18 October 2021. Available from <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/self-monitoring-blood-glucose-test-systems-over-counter-use>
81. International Standards Organization. ISO 15197:2013 [Internet]. In vitro diagnostic test systems – requirements for blood glucose monitoring systems for self-testing in managing diabetes mellitus. Accessed 18 October 2020. Available from <https://www.iso.org/standard/54976.html>
82. Beck RW, Riddlesworth TD, Ruedy K, Ahmann A, Haller S, Kruger D, McGill JB, Polonsky W, Price D, Aronoff S, Aronson R. Continuous glucose monitoring versus usual care in patients with type 2 diabetes receiving multiple daily insulin injections: a randomized trial. *Annals of internal medicine*. 2017 Sep 19;167(6):365-74.
83. Parkin CG, Hinnen D, Campbell RK, Geil P, Tetrack DL, Polonsky WH. Effective use of paired testing in type 2 diabetes: practical applications in clinical practice. *Diabetes Educ*. 2009 Nov-Dec;35(6):915-27.
84. Marks BE, Williams KM, Sherwood JS, Putman MS. Practical aspects of diabetes technology use: Continuous glucose monitors, insulin pumps, and automated insulin delivery systems. *Journal of Clinical & Translational Endocrinology*. 2022 Mar 1;27:100282.
85. Marks BE, Williams KM, Sherwood JS, Putman MS. Practical aspects of diabetes technology use: Continuous glucose monitors, insulin pumps, and automated insulin delivery systems. *Journal of Clinical & Translational Endocrinology*. 2022 Mar 1;27:100282.

Pearls:

Monitoring will be effective only if the patient and provider use the information to make appropriate dietary or therapeutic adjustments.

CGM is a tool, not a therapeutic intervention. It provides important information with which motivated patients can modify their behavior, improve their A1C values, and increase the percent of glucose readings in the target range safely while reducing hypoglycemia risk.

Physicians who provided care for the patients and were recompensed by the sponsor (the device maker) were not masked to the treatment assignment. This potential source of bias, the relatively short duration of both studies, and the absence of any obvious explanation for the modest reduction in A1C should all temper enthusiasm for using CGM in type 2 diabetes for now.

BGM is expensive. In an economic analysis of BGM in non-insulin-treated type 2 diabetes using data from a United Kingdom trial [32], BGM was associated with diminished initial quality of life and was considered unlikely to be cost effective [33].

In an evaluation of the accuracy of 18 approved monitoring systems, only six met accuracy standards in all three studies, five met them in two studies, and three in one study (four did not meet accuracy standards in any of the three studies) [34]. While these represent findings from a single study, it is important to be aware that blood glucose meter accuracy, in particular during episodes of hypoglycemia and in patients with poor peripheral tissue perfusion, may be less than optimal [35-37].

Continuous less accurate for hypoglycemia monitoring.

Common errors include leaving the lid off for periods of time (with exposure to heat, moisture, and humidity), use of expired strips, and mixing lots of different strips in one can for convenience.

Several blood glucose meters are now available that use sites other than the finger to obtain blood samples in an effort to reduce the discomfort involved with fingersticks. A study of one device that can be used to obtain samples from the arm found that it provided accurate results and was less painful than fingerstick testing [38]. Monitoring from alternate sites, such as the skin of the forearm, may give slightly lower results than those taken at the fingertips since they may sample venous blood rather than capillary blood. While this should not be a problem if the patient uses one or the other site exclusively, the between-test variability will increase if numerous sites (such as fingertips and forearm sites) are used. In addition, during times when the blood glucose concentration is either rising rapidly (such as immediately after food ingestion) or falling rapidly (in response to rapidly acting insulin or exercise), blood glucose results from alternate sites may give significantly delayed results compared with fingerstick readings (figure 1) [39,40].

I want ...

- I am blind and need a meter that will talk to me (accu-chek mobile acoustic mode)
- I use insulin and need help deciding how much insulin to use with meals (accu-check combo?? precision neo? freestyle insulin?)
- I want really big numbers to read ...
- I want the lowest cost strips
 - Accu-chek aviva 74.64
 - Ascensia countour next 73.21
 - Freestyle lite zipwik 72.28
 - Freestyle precision 72.18
 - One touch ultra blue 72.73
 - One touch verio 72.73
 - Dario 69.14 (unavailable Mckesson; yes through London drugs)
 - BG star (discontinued)
 - Dexcom sensor3 313.21
 - GE200 BLD 53.43 https://well.ca/products/ge200-blood-glucose-monitor_158518.html
(and covered NIHB!)
 - TRUETEST 56.57 (unavailable)
 - MEDI+SURE (discontinued) MEDISURE EMPOWER (discontinued)
 - FIRST CANADIAN HEALTH SPIRIT TEST STRIPS 49.76
(and covered NIHB!)
- I want the best smartphone app
- I want a very small meter for travelling
- I want to calculate blood glucose trends over time
- I do not bleed easily and can only provide a small volume of blood
- My sugars are often very high and I want to be able to measure my ketones (are there really patients like this??)
- I want the most accurate results (avoid Ultra 2?)

Big 3-4 factors:

1. low cost
2. high tech
3. portable/small

Capillary

	MediSure Empower	Accu-Chek guide	One touch ultra 2	One touch verio flex	One touch verio reflect	Contour Next	Count Next Gen	Contour Next EZ	Contour Next One	Freestyle Lite	GE 200	Oracle EZ	Spirit
Accuracy (esp. ability to detect hypoglycemia)	✓	✓✓	✓	✓✓	✓(✓?)	✓✓	✓✓	✓✓	✓✓	✓	✓✓	✓	?
Ease of Use	✓ (X?)	✓ -small strips; requires dexterity	✓ -needs coding -small strips	✓✓ -intuitive	✓✓ -intuitive	✓✓ -intuitive	✓✓ -intuitive	✓✓ -intuitive & low tech	✓ -small sized device	only need 0.3mcl of blood	✓✓ -easy to handle strips	✓	
Small blood sample	✓	✓	X	✓	✓	✓	✓	✓	✓	✓✓	X	X	?
Re-apply blood	X	X	X	X	X	✓	✓	✓	✓	✓	X	X	
Extra Features	✓ pre- and post-meal averages	✓✓ app avail. -pre- and post-meal averages	✓ pre- and post-meal averages	✓✓ app avail. (needs app to calculate trends)	✓✓ -app avail. -colour screen -pre- and post-meal averages	✓ pre- and post-meal averages	✓✓ app avail. (needs app to calculate trends)	✓ pre- and post-meal averages	✓✓ app avail. (needs app to calculate trends)	neutral	neutral	✓ talking audio	neutral
App	X	✓	X	✓	✓	X	✓	X	✓	X	X	X	?
Cost per 100 strips	\$89.00/100 (website)	\$83.99/100 (Shoppers)	\$84.99/100 (Shoppers)	\$84.99/100 (Shoppers)	\$84.99/100 (Shoppers)	\$76.99/100 (London Drugs)	\$76.99/100 (London Drugs)	\$76.99/100 (London Drugs)	\$76.99/100 (London Drugs)	\$89.99/100 (Shoppers)	✓		✓

✓✓ A Large Advantage
✓ An Advantage
Neutral
✗ A Disadvantage
✗✗ A Large Disadvantage

Best for:

1. Cost is #1 to you: GE 200 [Low cost and easy to use]
2. High tech is #1 to you: **Accu-check guide**, or Verio Reflect [high quality apps] -note Verio loses on accuracy, maybe not our fave!
3. portable/small: Contour Next One, maybe Accu-check Guide **[does this even matter / do patients think this way]**

“Special Populations”

Visually impaired – Oracle; or choose device that links to phone / voice-over.

Difficulty getting a blood sample – Freestyle Lite

Desire to measure ketones – Precision Neo [must buy ketone strips - \$20 for 10 strips + markup]

Help deciding insulin doses – not sure if we are going to actually recommend this.

- I am blind and need a meter that will talk to me (any meter that connects to an app and the oracle)
- I use insulin and need help deciding how much insulin to use with meals: FreeStyle Precision Neo
- I want really big numbers to read ... GE200, MediSure, all meters are easy to read (- FreeStyle Lite)
- I want the lowest cost strips: Ge200, Spirit)
- I want the best smartphone app
- I want a very small meter for travelling
- I want a small blood draw/re-apply blood: Contour meters, FreeStyle Lite
- appealing to kids/fun meter: oracle, OneTouch Verio Reflect

Should we included the accuracy row?

References:

Accuracy:

80% or higher for +/- 0.3 – two checks.

80% or higher for +/- 0.5 – one check

Amount of blood:

0.7 or greater – X

0.4 – 0.69 – one check

>0.4 – two checks

Finicky strips:

Strip ejector on machine and easy strips – two checks

Easy to insert strips – one check

Small strips – X

Small strips with wide blood collection – two X

Alternate site testing – blurb about when appropriate, which devices & where ...

“Available for many meters, but less accurate, therefore not recommended, especially if concerned about hypoglycemia ...”

Insulin calculator – add comments into colour chart VS have a blurb in the main chart. The Accu-Chek app has the “bolus insulin advisor” not on the machine; so the only one with this feature is the FreeStyle Precision Neo, which is not even available in pharmacies anymore, seems to only be available on their website; so maybe we do not need to add this in?

“Fits large hands” – is this anything????

T2DM	Diet-controlled	Recommend not routinely testing.
	Non-insulin pharmacotherapy	Recommend no routine testing if targets met. [Diabetes Canada 2021] Recommend testing if: -will result in a change in therapy or to improve adherence/education or to manage/prevent hypoglycemia. Or during acute illness Capillary testing first line. Limited impact on A1c. [Machry 2018]
	Insulin	Limited evidence; may use capillary testing as often as taking insulin. [Diabetes Canada 2021] (Role of continuous = ... small drop in A1c, etc.)
T1DM		Recommend continuous glucose monitoring as first-line. [Diabetes Canada 2021] Only beneficial if patients understand the technology, how to analyze the data, how to make changes, etc. e.g. decrease A1c by 0.6%. Evidence of superiority to capillary monitoring.
Gestational diabetes		Usually requires regular testing to guide management. [Diabetes Canada 2021]

