

Choosing a Blood Glucose Monitor

Monitor		GDH-FAD					GOX			Mut Q-GDH		GDH-PQQ	GDH-NAD
Patient Group	Considerations	Finetest Lite, Neon	GlucRx Nexus Voice, GlucRx LTD	GlucRx HCT plus Ketone, GlucRx LTD	Contour XT (Contour Next Strips), Ascensia	4sure Smart Duo, Nipro	Insulinx (Freestyle Lite strips), Abbott (bolus calc)	Wavesense Jazz, AgaMatrix	Glucomen Areo 2K, Menarini	Accucheck Performa nano, Roche	Accucheck Mobile, Roche	Accucheck Aviva Expert, Roche (bolus calc)	Freestyle Optium Neo, Abbott
Test Strip Cost	Drug Tariff April 2019, based on 50 strips (yellow: first line)	£5.95	£9.95	£9.95	£15.16	£8.99	£16.23	£8.74	£9.95	£7.50	£9.99	£16.21	£16.12
Lancet Cost	Drug Tariff April 2019, based on 200 lancets	£6.00	£5.50	£5.50	£7.44	£5.80	£7.56	£5.43	£5.50	£5.90	£5.90	£5.90	£7.56
Test Strip shelf life	Cost effectiveness of the strips may be dependent on how long they last once open.	6 months after opening or expiry date (pots of 25)	6 months after opening or expiry date (pots of 25)	6 months after opening or expiry date (pots of 25)	until expiry date even once opened	until expiry date even once opened	12 months after opening or expiry date	90 days after opening or expiry date (pots of 25)	12 months after vial opening or expiry date	until expiry date even once opened	3 months after opening or expiry date	until expiry date even once opened	until expiry date (individually wrapped)
Children/young adults	Meters for these patients should be chosen in discussion with patients and their specialist team.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pregnancy	Meters for these patients should be chosen in discussion with patients and their specialist team.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Type 1 diabetes in adults	It is important to choose a meter which suits individual patient needs to ensure best diabetes management and long term outcomes. Meters should be chosen to ensure patient confidence when adjusting insulin dosage, and ketone testing facility when appropriate. The cost effective meters have been highlighted, however they may not be suitable for all T1 patients. The specialist team can advise.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
People who need to be able to test blood ketones.	These patients should have access to a meter which measures blood ketones, but they may consider using two separate meters (one for glucose and one for ketones).	Would require separate ketone meter	Would require separate ketone meter	£9.95 for 10	Would require separate ketone meter	£9.92 for 10	Would require separate ketone meter	Would require separate ketone meter	£9.95 for 10	Would require separate ketone meter	Would require separate ketone meter	Would require separate ketone meter	£21.71 for 10
Peritoneal dialysis ¹	GOX meters are required to prevent dialysis solutions from interfering with results. Some GDH-FAD meters can be used but this should be checked with the manufacturer. GDH-PQQ meters should be avoided unless manufacturer confirms suitability.	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High ascorbic acid (vitamin C) dosage ²	GDH meters are preferred. GOX meters should be avoided due to possible interference from ascorbic acid levels following high dosage administration. Specialist advice should be sought if plasma levels exceed meter limits.	Accuracy demonstrated up to 0.3mmol/l	Accuracy demonstrated up to 0.28mmol/l	Accuracy demonstrated up to 0.28mmol/l	Accuracy demonstrated up to 0.57mmol/l	Accuracy demonstrated up to 0.28mmol/l	Accuracy demonstrated up to 0.28mmol/l	Accuracy demonstrated up to 0.11mmol/l	Accuracy demonstrated up to 0.33mmol/l	Accuracy demonstrated up to 0.17mmol/l	Accuracy demonstrated up to 0.17mmol/l	Accuracy demonstrated up to 0.17mmol/l	Accuracy demonstrated up to 0.34mmol/l
Gout ²	GDH meters are preferred. GOX meters should be avoided due to possible interference from high urate levels. Specialist advice should be sought if plasma levels exceed meter limits.	Accuracy demonstrated up to 1.2mmol/l	Accuracy demonstrated up to 0.59mmol/l	Accuracy demonstrated up to 0.53mmol/l	Accuracy demonstrated up to 3.5mmol/l	Accuracy demonstrated up to 0.55mmol/l	Accuracy demonstrated up to 2.38mmol/l	Accuracy demonstrated up to 1.4mmol/l	accuracy demonstrated up to 0.89mmol/l	no interference from uric acid	Accuracy demonstrated up to 2.2mmol/l	Accuracy demonstrated up to 2.4mmol/l	Accuracy demonstrated up to 1.43mmol/l
Hypertriglyceridaemia	Very high triglyceride levels may interfere with meter readings. Specialist advice should be sought if plasma levels exceed meter limits.	Accuracy demonstrated up to 116.5mmol/L	Accuracy demonstrated up to 33.9mmol/l	Accuracy demonstrated up to 33.9mmol/l	Accuracy demonstrated up to 53.2mmol/l	Accuracy demonstrated up to 165.5mmol/l	Accuracy demonstrated up to 34mmol/l	Accuracy demonstrated up to 37mmol/l	Accuracy demonstrated up to 38mmol/l	Accuracy demonstrated up to 20.3mmol/l	Accuracy demonstrated up to 40mmol/l	Accuracy demonstrated up to 20.3mmol/l	Accuracy demonstrated up to 17mmol/l
Bolus calculation meter systems (for specialist initiation only)	A small number of type 1 diabetes patients may be commenced by their specialist on meters which offer a bolus insulin dosing adviser function. These patients will require carbohydrate counting, and will have attended 'insight' structured education.	✗	✗	✗	✗	available on app	✓	✗	✗	✗	✗	✓	✗
Drivers holding a Group 2 licence & taxi drivers ⁴	A meter which has a 90 day memory is required for medical certification. Ensure that meters have a separate quality control function for control tests, as this ensures that these results are not stored in the memory.	test memory 500	test memory 450	test memory 1000	test memory 800 (Next) / 480 (XT)	test memory 1000	memory 165 days (3 tests/day)	test memory 1865	730 glucose and 100 8-ketone	test memory 500	test memory 2000	test memory 1000	Test memory 1000
Sight impairment	A meter with an audible (speaking) result facility may be required	✗	speaking facility ✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Alternative site testing for glucose	Some patients may require capillary blood samples to be obtained from areas other than their fingertips. Meters should be accredited for this use, and specific meter instructions should be followed.	✓	✓consult HCP before you perform AST.	ketones only, limited (see manufacturers details)	✓consult HCP before you perform AST.	✓consult HCP before you perform AST.	Only during times of steady state	✓	✓consult HCP before you perform AST.	✓	✓	✗	✓
Extremes of temperature (°C)	Meters and test strips will only perform correctly within temperature ranges specified by the manufacturers. This may be important when people travel abroad or keep their meter in the car. NB storage & usage ranges differ.	Use between 10-40	Use between 10-40°C	Use between 10-40°C	Use between 5-45°C	Use between 8 to 45°C	Use between 4-40°C	Use between 10-40°C	use between 5-45°C for glucose testing; 10 to 40 °C for 8-ketone testing.	Use between 6-44°C	Use between 10-40°C	Use between 6-44°C	Use between 10-50°C
Oxygen therapy ³	GOX meters are more susceptible to interference from high blood oxygen concentrations. GDH meters are therefore preferred.	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Ability to Download and share		Download via USB cable or Bluetooth. Diasend compatible.	Download via USB cable. Diasend compatible.	Download via USB cable. Diasend compatible.	Download via USB cable. Diasend compatible.	Download via USB cable or bluetooth. Diasend compatible.	Download via USB cable. Diasend compatible.	Downloadable via an AgaMatrix Cable. Diasend compatible.	Via dedicated USB cable, NFC, or a Bluetooth device. Diasend compatible.	Download via infrared cable (infrared window data port).	Download via USB cable. Diasend compatible.	Download via Infrared cable. Diasend compatible.	Download via USB cable. Diasend compatible.

The meter information in the table has been sourced from manufacturers' product literature or direct from the manufacturer in July 2016 or April 2019. All meters conform to ISO Standard 15197:2013.

SI unit conversion carried out with: <http://www.ammanualofstyle.com/page/si-conversion-calculator>

GDH-FAD = glucose dehydrogenase-flavin adenine dinucleotide GOX = glucose oxidase

GDH-PQQ = glucose dehydrogenase-pyrroloquinoline quinone

Mut Q-GDH = glucose dehydrogenase with pyrroloquinolinequinone modified to eliminate maltose interference

¹<http://www.glucosafety.com/uk/index.html>, Baxter Healthcare Corporation, last updated 18/10/2012

²Ginsberg B.H., Factors Affecting Blood Glucose Monitoring: Sources of Errors in Measurement. Journal of Diabetes Science and Technology, Volume 3, Issue 4, July 2009 © Diabetes Technology Society

³Tonyushkina K, Nichols JH. Glucose Meters: A Review of Technical Challenges to Obtaining Accurate Results. Journal of Diabetes Science & Technology, 07 2009, vol./is. 3/4(971-80), 1932-2968;1932-2968 (2009 Jul).

⁴Medical Examination Report D4 (INF4D). DVLA. http://www.dft.gov.uk/dvla/medical/aag/-/media/pdf/leaflets/INF4D_ashx

Clinical Considerations and Cost Effective Prescribing

There is now a range of meters which use low cost blood glucose test strips, offering cost-effective choices for clinicians and patients - see Blood Glucose Monitoring Guidelines (link below). The table lists the commonly used blood glucose testing meters and the limitations to their use. Prices are listed and clinicians are encouraged to use meters with lower cost strips (<£6 per 50 strips) unless there is a clear need to use other meters. A review of whether or not patients require self-monitoring of blood glucose (SMBG) should be carried out regularly and the discussion should be supported by the Blood Glucose Monitoring Guidelines and patient information leaflets as well as information from the meter companies. Other specific considerations include haematocrit, altitude, and humidity etc., where specialist or manufacturers advice may need to be sought. Note that, in addition to group 2 driver requirements, there are DVLA requirements for group 1 drivers on insulin and certain oral hypoglycaemic medication (sulfonylureas or glinides).

Accuracy of Blood Glucose Meters

Please note that all meters made for home use demonstrate a degree of inaccuracy and imprecision. The 2013 ISO standards require that 95% of blood glucose results should reach the following standard: Within ± 0.83 mmol/L of laboratory results at concentrations of under 5.6 mmol/L (Within ± 15 mg/dl of laboratory results at concentrations of under 100 mg/dl), Within ± 20% of laboratory results at concentrations of 5.6 mmol/L (100 mg/dl) or more

It should be noted that more than 90% of meter inaccuracies are caused by operator error (1). Patient education around correct testing and monitoring technique is therefore paramount. The limitations/interferences outlined in the table should therefore always be considered in this context and their relevance evaluated. The information overleaf is important but will apply to small numbers of patients only. Interference/limitation data is obtained from system tests which may have inherent practical limitations of their own. Different meters have different thresholds for displaying 'Lo' and 'Hi' glucose readings, so be careful when switching meters.

Downloadable Results and Diasend

Many meters now have the function to download results to compatible computer software. It may be helpful for some patients to reflect on downloaded results, as this may inform management and treatment decisions. iPhone and Android applications are available to use independently with any meter. Choosing meters on the basis of additional technology, however, should only be considered when a clear clinical benefit is anticipated. Diasend[®] offers health care providers an online solution that collects and stores all their diabetes patients' data centrally. All data from multiple devices will be consolidated and presented in one report in a secure diasend.com account. This is used locally by OCDEM to help support their patients.

1. Tonyushkina K, Nichols JH. Glucose Meters: A Review of Technical Challenges to Obtaining Accurate Results. Journal of Diabetes Science & Technology, 07 2009, vol./is. 3/4(971-80), 1932-2968;1932-2968 (2009 Jul)

[Blood Glucose Monitoring Guidelines](#)

[Patient Information Leaflets](#)