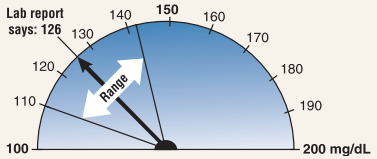
Comparing Diabetes Blood Tests‡

Test	Uses	Technical Features	PROS	CONS

FPG Test	• Screening and diagnosis of prediabetes[1] or impaired fasting glucose (IFG)
	  ◦ 100 to 125 mg/dL[2]
	• Screening and diagnosis of diabetes[1]
	  ◦ 126 mg/dL or higher[1]
	  ◦ repeat for confirmation of diagnosis
		• Diagnosis requires a lab test; meter results are not suitable
		• Sample in morning, after 8-hour fast[1]
		• Sample: sodium fluoride plasma preferred
		• Sample stability: low—requires processing within 30 minutes
		• Sensitivity: greater than the A1C test, less than the OGTT
		• Coefficient of variation: assay variability
		• Biological variability
		 
		Courtesy of David Aron, M.D., Louis Stokes Department of Veterans Affairs Medical Center
		
		With a coefficient of variation of 5.7% (typical biological variation within the same person), an FPG test result of 126 mg/dL could indicate a true FPG of anywhere from approximately 110 to 142 mg/dL.[3]
			• Low cost
			• Assay is widely available
			• Assay is automated
				• Indicates single-point blood glucose level
				• Affected by short-term lifestyle changes, such as stress or illness
				• Less tightly linked to diabetes complications than A1C
				• Not convenient for patient or health care professional; requires fasting and scheduling a morning appointment or return visit
				• Diurnal variation
				• Sample not stable after collection
				• High within-patient variability
				• Many laboratories measure serum, which is not recommended
				• Inadequate standardization of assays

OGTT	• Screening and diagnosis of prediabetes or impaired glucose tolerance (IGT)[1]
	  ◦ 140 to 199 mg/dL at 2 hours[1]
	• Screening and diagnosis of diabetes[1]
	  ◦ 200 mg/dL or higher at 2 hours[1]
	  ◦ repeat to confirm the diagnosis
		• Performed as described by the World Health Organization (WHO), using a glucose load containing the equivalent of 75 grams of anhydrous glucose dissolved in water[1]
		• Sample in morning: two samples after 8-hour fast and 2 hours after glucose load[4]
		• Sample stability: low—requires processing within 30 minutes
		• Patients should ingest at least 150 grams/day of carbohydrates for 3 days before test[3]
		• Sensitivity: greater than the A1C or the FPG tests
		• Range of variability: 16.7%[3]
			• Sensitive indicator of risk of developing diabetes
			• Early marker of impaired glucose metabolism
				• Affected by short-term lifestyle changes, such as stress, illness, and medications
				• Not convenient for patient or health care professional; requires fasting and scheduling a morning appointment or return visit
				• Extensive patient preparation
				• Sample not stable after collection
				• High within-patient variability
				• Low reproducibility
				• Higher cost than other tests

A1C Test*	• Screening and diagnosis of prediabetes[1]
	  ◦ 5.7% to 6.4%[1]
	• Screening and diagnosis of type 2 diabetes[1]
	  ◦ 6.5% or higher[1]
	  ◦ repeat for confirmation of diagnosis
	• Monitoring of diabetes
		• Diagnosis requires a laboratory test certified by the NGSP and standardized to the DCCT assay.[1] Some point-of-care A1C assays may be certified by the NGSP or approved by the U.S. Food and Drug Administration for diagnosis; however, they should only be considered in laboratories that are certified to perform moderate-to-high complexity tests to ensure testing proficiency.[1]
		• Sample at any time of day, no fasting required[2]
		• Sample: anticoagulated whole blood
		• Sample stability: superior[5]
		• Sensitivity: less than the FPG test and the OGTT[1]
		• Coefficient of variation: for between laboratory assay variability, see College of American Pathologists (CAP) survey data at www.ngsp.org/CAPdata.asp.
			• Reflects long-term blood glucose concentration[4]
			• Unaffected by acute changes in glucose levels due to stress or illness[4]
			• Highly correlated with risks for complications, such as retinopathy and cardiovascular disease
			• Convenient for patient and health care professionals
			• Most stable sample after collection[4]
			• Low within-patient variability[4]
			• Established international standardization of lab tests[1]
			• Accuracy of test is monitored[1]
				• Lower sensitivity: identifies fewer cases of diabetes than the glucose tests[1]
				• Possible interference with some assay methods, resulting in falsely increased or lowered results due to some genetic hemoglobin variants (e.g., HbC, HbS, HbE, and HbD traits**) and elevated fetal hemoglobin (HbF); this primarily affects people of African, Mediterranean, or Southeast Asian heritage[6]
				• Altered relationship between A1C and glycemia in certain conditions[1]
				  ◦ sickle cell disease[1]
				  ◦ glucose-6-phosphate dehydrogenase deficiency[1]
				  ◦ HIV[1]
				  ◦ hemodialysis[1]
				  ◦ recent blood loss or transfusion[1]
				  ◦ erythropoietin therapy[1]
				  ◦ iron deficiency anemia[1]
				  ◦ kidney disease[5]
				  ◦ liver disease[7]
				• Not recommended for rapidly progressing diabetes, such as type 1 diabetes in children[1]
				• Not recommended for screening cystic fibrosis-related diabetes[1]
				• May not be available in some laboratories/areas of the world[1]
				• Higher cost than glucose tests[1]
				
				*See www.ngsp.org for information on A1C interference and recommended testing methods.
				**See The A1C Test and Diabetes at www.niddk.nih.gov/health-information/diagnostic-tests/a1c-test

RPG Test	• Diagnosis of diabetes—used only with classic symptoms of hyperglycemia or hyperglycemic crisis
	  ◦ polyuria, polydypsia, and unexplained weight loss
	  ◦ 200 mg/dL or higher[1]
		• Sample at any time, no fasting required[2]
		• Sample stability: low—requires processing in less than 30 min
			• Convenient
			• Part of basic metabolic panel screen
				• Indicates single-point blood glucose level
				• Used only in symptomatic patients, not recommended for screening
				• Insensitive measurement
				• Greater within-patient variability
				• Affected by short-term lifestyle changes and mealtimes

References:

[1] American Diabetes Association. 2. Classification and Diagnosis of Diabetes: *Standards of Medical Care in Diabetes–2020. Diabetes Care*. 2020;43(Suppl 1):S14–S31. doi:10.2337/dc20-S002

[2] Diagnosing diabetes and learning about prediabetes. American Diabetes Association. Accessed July 8, 2019. www.diabetes.org/diabetes-basics/diagnosis

[3] Sacks DB. A1C versus glucose testing: a comparison. *Diabetes Care*. 2011;34(2):518–523. doi: 10.2337/dc10-1546

[4] Diabetes tests and diagnosis. National Institute of Diabetes and Digestive and Kidney Diseases. Updated December 2016. Accessed March 2020. www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis#diagnosediabetes

[5] The A1C test and diabetes. National Institute of Diabetes and Digestive and Kidney Diseases. Updated April 2018. Accessed July 2019. www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis/a1c-test

[6] Factors that interfere with HbA1c test results. National Glycohemoglobin Standardization Program. Updated August 21, 2019. Accessed August 2020. www.ngsp.org/factors.asp

[7] Addepally NS, George N, Martinez-Macias R, Garcia-Saenz-de-Sicilia M, Kim WR, Duarte-Rojo A. Hemoglobin A1c has suboptimal performance to diagnose and monitor diabetes mellitus in patients with cirrhosis. *Digestive Diseases and Sciences.* 2018;63(12):3498–3508. doi: 10.1007/s10620-018-5265-3

‡Adapted from Sacks DB. A1C versus glucose testing: a comparison. Diabetes Care. 2011;34(4):518–523.

National Institute of Diabetes and Digestive and Kidney Diseases