In the name of God

CLASSIFICATION AND DIAGNOSIS OF DIABETES MELLITUS

CLASSIFICATION OF DIABETES MELLITUS :

Diabetes can be classified into the following general categories:

1. **Type 1 diabetes** (due to autoimmune B-cell destruction, usually leading to absolute insulin deficiency)

2. Type 2 diabetes (due to a progressive loss of B-cell insulin secretion frequently on the background of insulin resistance)

3. Gestational diabetes mellitus (GDM) (diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation)

4. Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes (such as neonatal diabetes and maturity-onset diabetes of the young [MODY]), diseases of the exocrine pancreas (such as cystic fibrosis and pancreatitis), and drug- or chemical-induced diabetes (such as with glucocorticoid use, in the treatment of HIV/AIDS, or after organ transplantation)

Criteria for the diagnosis of diabetes :

FPG ≥126 mg/dL Fasting is defined as no caloric intake for at least 8 h.*

OR

2-h PG ≥ 200 mg/dL during OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75-g anhydrous glucose dissolved in water.*

OR

A1C ≥ 6.5%. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*

OR

In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a **random plasma glucose ≥ 200 mg/dL**.

*In the absence of unequivocal hyperglycemia, diagnosis requires two abnormal test results from the same sample or in two separate test samples.

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Criteria for testing for diabetes or prediabetes in asymptomatic adults

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Criteria for testing for diabetes or prediabetes in asymptomatic adults :

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Criteria for testing for diabetes or prediabetes in asymptomatic adults

1. **Testing should be considered in overweight or obese (BMI ≥25 kg/m2 or ≥23 kg/m2 in Asian Americans) adults who have one or more of the following risk factors:**

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Criteria for testing for diabetes or prediabetes in asymptomatic adults

1. Testing should be considered in overweight or obese (BMI ≥25 kg/m2 or ≥23 kg/m2 in Asian Americans) adults who have one or more of the following risk factors:

- **First-degree relative with diabetes**

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- First-degree relative with diabetes
- **High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)**

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- High-risk race/ethnicity (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- **History of CVD**

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- **Hypertension** (≥ 140/90 mmHg or on therapy for hypertension)

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- Hypertension (≥ 140/90 mmHg or on therapy for hypertension)
- **HDL cholesterol level <35 mg/dL and/or a triglyceride level >250 mg/dL**

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- **Women with polycystic ovary syndrome**

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- **Physical inactivity**

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- **Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)**

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- Other clinical conditions associated with insulin resistance (e.g., severe obesity, acanthosis nigricans)

2. **Patients with prediabetes (A1C ≥ 5.7% , IGT, or IFG) should be tested yearly.**

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4. For all other patients, testing should begin at age 45 years.

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4. For all other patients, testing should begin at age 45 years.

5. If results are normal, testing should be repeated at a minimum of 3-year intervals, with consideration of more frequent testing depending on initial results and risk status.

A1C :

2.1 To avoid misdiagnosis or missed diagnosis, **the A1C test should be** performed using a method that is certified by NGSP and **standardized** to the Diabetes Control and Complications Trial (DCCT) assay. B

2.2 Marked **discordance between measured A1C and plasma glucose** levels should raise the possibility of A1C assay interference due to hemoglobin variants (i.e., **hemoglobinopathies**) and consideration of using an assay without interference or plasma blood glucose criteria to diagnose diabetes. B

2.3 In conditions associated with an altered relationship between A1C and glycemia, such as **sickle cell disease, pregnancy** (second and third trimesters and the postpartum period), **glucose-6-phosphate dehydrogenase deficiency, HIV, hemodialysis, recent blood loss or transfusion, or erythropoietin therapy**, only plasma glucose criteria should be used to diagnose diabetes. B

Type 1 Diabetes :

2.4 Plasma blood glucose rather than A1C should be used to diagnose the acute onset of type 1 diabetes in individuals with symptoms of hyperglycemia. E

2.5 Screening for type 1 diabetes risk with a panel of autoantibodies is currently recommended only in the setting of a research trial or in first-degree family members of a proband with type 1 diabetes. B

2.6 Persistence of two or more autoantibodies predicts clinical diabetes and may serve as an indication for intervention in the setting of a clinical trial. B

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Prediabetes and Type 2 Diabetes (1) :

2.7 **Screening** for prediabetes and type 2 diabetes with an informal assessment of **risk factors** or validated tools should be considered in asymptomatic adults B

2.8 Testing for prediabetes and/or type 2 diabetes in asymptomatic people should be considered in adults of any age who are **overweight or obese** (BMI ≥25 kg/m^2 or ≥23 kg/m^2 in Asian Americans) and who have one or more additional **risk factors** for diabetes **(Table 2.3)** B

2.9 For all people, testing should **begin at age 45 years** B

2.10 If tests are normal, repeat testing carried out at a minimum of **3-year** intervals is reasonable C

Prediabetes and Type 2 Diabetes (2) :

2.11 To test for prediabetes and type 2 diabetes, fasting plasma glucose, 2-h plasma glucose during 75-g oral glucose tolerance test, and A1C are **equally** appropriate B

2.12 In patients with prediabetes and type 2 diabetes, identify and, if appropriate, treat **other cardiovascular disease risk factors** B

2.13 Risk-based screening for prediabetes and/or type 2 diabetes should be considered after the onset of puberty or after 10 years of age, whichever occurs earlier, in **children** and adolescents who are **overweight** (BMI ≥85th percentile) or **obese** (BMI ≥95th percentile) and who have **additional risk factors** for diabetes (see **Table 2.4** for evidence grading of risk factors)

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Table 2.4—Risk-based screening for type 2 diabetes or prediabetes in asymptomatic children and adolescents in a clinical setting

Testing should be considered in youth* who are overweight (≥85% percentile) or obese (≥95 percentile) A and who have one or more additional risk factors based on the strength of their association with diabetes:

- Maternal history of diabetes or GDM during the child's gestation A
- Family history of type 2 diabetes in first- or second-degree relative A
- Race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander) A
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, or small-for-gestational-age birth weight) B

*After the onset of puberty or after 10 years of age, whichever occurs earlier. If tests are normal, repeat testing at a minimum of 3-year intervals, or more frequently if BMI is increasing, is recommended.

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ARE YOU AT RISK FOR TYPE 2 DIABETES?

American Diabetes Association.

Diabetes Risk Test

1. **How old are you?**
   Less than 40 years (0 points)
   40—49 years (1 point)
   50—59 years (2 points)
   60 years or older (3 points)

2. **Are you a man or a woman?**
   Man (1 point) Woman (0 points)

3. **If you are a woman, have you ever been diagnosed with gestational diabetes?**
   Yes (1 point) No (0 points)

4. **Do you have a mother, father, sister, or brother with diabetes?**
   Yes (1 point) No (0 points)

5. **Have you ever been diagnosed with high blood pressure?**
   Yes (1 point) No (0 points)

6. **Are you physically active?**
   Yes (0 points) No (1 point)

7. **What is your weight status?** *(see chart at right)*

Write your score in the box.

Add up your score.

If you scored 5 or higher:
You are at increased risk for having type 2 diabetes. However, only your doctor can tell for sure if you do have type 2 diabetes or prediabetes (a condition that precedes type 2 diabetes in which blood glucose levels are higher than normal). Talk to your doctor to see if additional testing is needed.

Height	Weight (lbs.)		
4' 10"	119-142	143-190	191+
4' 11"	124-147	148-197	198+
5' 0"	128-152	153-203	204+
5' 1"	132-157	158-210	211+
5' 2"	136-163	164-217	218+
5' 3"	141-168	169-224	225+
5' 4"	145-173	174-231	232+
5' 5"	150-179	180-239	240+
5' 6"	155-185	186-246	247+
5' 7"	159-190	191-254	255+
5' 8"	164-196	197-261	262+
5' 9"	169-202	203-269	270+
5' 10"	174-208	209-277	278+
5' 11"	179-214	215-285	286+
6' 0"	184-220	221-293	294+
6' 1"	189-226	227-301	302+
6' 2"	194-232	233-310	311+
6' 3"	200-239	240-318	319+
6' 4"	205-245	246-327	328+
	(1 Point)	(2 Points)	(3 Points)

You weigh less than the amount in the left column (0 points)

Adapted from Bang et al., Ann Intern Med 151:775-783, 2009.
Original algorithm was validated without gestational diabetes as part of the model.

diabetes.org/socrisktest

Table 2.5—Criteria defining prediabetes*

FPG 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L) (IFG)
OR
2-h PG during 75-g OGTT 140 mg/dL (7.8 mmol/L) to 199 mg/dL (11.0 mmol/L) (IGT)
OR
A1C 5.7–6.4% (39–47 mmol/mol)

*For all three tests, risk is continuous, extending below the lower limit of the range and becoming disproportionately greater at the higher end of the range.

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Gestational Diabetes Mellitus (1) :

2.14 Test for undiagnosed diabetes **at the first prenatal visit** in those with risk factors using standard diagnostic criteria B

2.15 Test for gestational diabetes mellitus **at 24-28 weeks of gestation** in pregnant women not previously known to have diabetes A

2.16 Test women with gestational diabetes mellitus for prediabetes or diabetes **at 4-12 weeks postpartum**, using the 75-g oral glucose tolerance test and clinically appropriate nonpregnancy diagnostic criteria B

Classification and Diagnosis of Diabetes:
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Gestational Diabetes Mellitus (2) :

2.17 Women with a history of gestational diabetes mellitus should have **lifelong screening** for the development of diabetes or prediabetes at least **every 3 years** B

2.18 Women with a history of gestational diabetes mellitus found to have **prediabetes** should receive intensive **lifestyle interventions** or **metformin** to prevent diabetes A

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DIAGNOSIS OF GDM :

GDM diagnosis can be accomplished with either of two strategies:

1. "**One-step**" 75-g OGTT

or

2. "**Two-step**" approach with a 50-g (non fasting) screen followed by a 100-g OGTT for those who screen positive

Screening for and DIAGNOSIS OF GDM

One-step strategy

Perform a **75-g OGTT** , with plasma glucose measurement when patient is fasting and at 1 and 2 h, at **24–28 weeks** of gestation in women not previously diagnosed with diabetes.

The OGTT should be performed in the morning after an overnight fast of at least 8 h.

The diagnosis of **GDM** is made when **any** of the following plasma glucose values are met or exceeded:

- Fasting: **92** mg/dL
- 1 h: **180** mg/dL
- 2 h: **153** mg/dL

International Association of the Diabetes and Pregnancy Study Groups (IADPSG)

Metzger BE, Lowe LP, Dyer AR, et al.; HAPO Study Cooperative Research Group. Hyperglycemia and adverse pregnancy outcomes. N Engl J Med 2008;358:1991–2002

Screening for and DIAGNOSIS OF GDM

Two-step strategy

Step 1: Perform a **50-g GCT** (non fasting), with plasma glucose measurement at 1 h, at **24–28 weeks** of gestation in women not previously diagnosed with diabetes.

If the plasma glucose level measured 1 h after the load is **≥130** mg/dL, **135** mg/dL, or **140**mg/dL, proceed to a 100-g OGTT.

Step 2: The **100-g OGTT** should be performed when the patient is fasting.

The diagnosis of GDM is made if at least **two*** of the following four plasma glucose levels (measured fasting and 1 h, 2 h, 3 h during OGTT) are met or exceeded:

	Carpenter-Coustan	or	NDDG
✳ Fasting	**95** mg/dL		105 mg/dL
✳ 1 h	**180** mg/dL		190 mg/dL
✳ 2 h	**155** mg/dL		165 mg/dL
✳ 3 h	**140** mg/dL		145 mg/dL

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The higher cutoff yielded sensitivity of 70–88% and specificity of 69–89%, while the lower cutoff was 88–99% sensitive and 66– 77% specific.

Step 2: The **100-g OGTT** should be performed when the patie
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The use of A1C at 24–28 weeks of gestation as a screening test for GDM does not function as well as the GCT

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*American College of Obstetricians and Gynecologists (ACOG) notes that one elevated value can be used for diagnosis

Carpenter MW, Coustan DR. Criteria for screening tests for gestational diabetes. Am J Obstet Gynecol 1982;144:768–773
National Diabetes Data Group. Classification and diagnosis of diabetes mellitus and other categories of glucose intolerance. Diabetes 1979; 28:1039–1057

Screening for and DIAGNOSIS OF GDM

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Step 2: The 100-g OGTT should be performed when the patient is fasting.

The diagnosis of GDM [illegible] he following four plasma glucose levels ([illegible] 3 h during OGTT) are met or exceeded:

If the two-step approach is used, it would appear advantageous to use the lower diagnostic thresholds as shown in step 2

	Carpenter-[illegible]	NDDG
✷ Fasting	**95** mg/dL	**105** mg/dL
✷ 1 h	**180** mg/dL	**190** mg/dL
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Cystic Fibrosis-Related Diabetes

2.19 Annual screening for cystic fibrosis-related diabetes with an oral glucose tolerance test should begin by age 10 years in all patients with cystic fibrosis not previously diagnosed with cystic fibrosis-related diabetes B

2.20 A1C is not recommended as a screening test for cystic fibrosis-related diabetes B

2.21 Patients with cystic fibrosis-related diabetes should be treated with insulin to attain individualized glycemic goals A

2.22 Beginning 5 years after the diagnosis of cystic fibrosis-related diabetes, annual monitoring for complications of diabetes is recommended E

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Post transplantation Diabetes Mellitus

2.23 Patients should be screened after organ transplantation for hyperglycemia, with a formal diagnosis of post transplantation diabetes mellitus being best made once a patient is stable on an immunosuppressive regimen and in the absence of an acute infection E

2.24 The oral glucose tolerance test is the preferred test to make a diagnosis of post transplantation diabetes mellitus B

2.25 Immunosuppressive regimens shown to provide the best outcomes for patient and graft survival should be used, irrespective of post transplantation diabetes mellitus risk E

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Monogenic Diabetes Syndromes

The diagnosis of monogenic diabetes should be considered in children and adults diagnosed with diabetes in early adulthood with the following findings:

- Diabetes diagnosed within the first 6 months of life (with occasional cases presenting later, mostly *INS* and *ABCC8* mutations)
- Diabetes without typical features of type 1 or type 2 diabetes (negative diabetes-associated autoantibodies, nonobese, lacking other metabolic features especially with strong family history of diabetes)
- Stable, mild fasting hyperglycemia (100-150 mg/dL [5.5-8.5 mmol/L]), stable A1C between 5.6 and 7.6% (between 38 and 60 mmol/mol), especially if nonobese

Monogenic Diabetes Syndromes

2.26 All children diagnosed with diabetes in the first 6 months of life should have immediate genetic testing for neonatal diabetes A

2.27 Children and adults, diagnosed in early adulthood, who have diabetes not characteristic of type 1 or type 2 diabetes that occurs in successive generations (suggestive of an autosomal dominant pattern of inheritance) should have genetic testing for maturity-onset diabetes of the young A

2.28 In both instances, consultation with a center specializing in diabetes genetics is recommended to understand the significance of these mutations and how best to approach further evaluation, treatment, and genetic counseling E

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Thank you