

## Diagnosis of diabetes

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### Abstract

The diagnosis of diabetes is not as straightforward as it may seem. This brief communication describes how to diagnose [and not to diagnose] diabetes in a simple manner. This information will be of use to general practitioners as well as students of diabetology.

### Introduction

Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycaemia. The diagnosis of diabetes thus, is based upon the presence of hyperglycaemia.

### Diagnostic Criteria

The American Diabetes Association (ADA) and WHO use similar, but not exactly the same, definitions for diagnosis of diabetes (Table).<sup>1-3</sup> In both definitions, plasma, glucose values are mentioned. The WHO additionally lists whole blood venous and whole blood capillary cut offs.

### 4. Casual (random) plasma glucose

Post-challenge glucose is estimated by performing an oral glucose tolerance (OGTT), following directions laid down by WHO. While a single abnormal value of blood glucose is enough in symptomatic persons, two abnormal readings are mandatory in asymptomatic individuals to diagnose diabetes.<sup>1</sup>

### Caveats: Clinical

In symptomatic persons, an abnormally high random plasma glucose >200mg/dl, with classic symptoms of hyperglycaemia or hyperglycaemia crisis, is enough to diagnose diabetes. In an asymptomatic person, a test result should be repeated "when feasible", to rule out a laboratory error.<sup>1</sup> Where a random plasma glucose level of ≥100mg/dl and <200mg/dl is detected, a FPG should be measured, or an OGTT performed, or an HbA1c measured as per International Diabetes Federation guidelines.<sup>3</sup>

**Table:** Diagnostic criteria for diabetes and 'prediabetes'.

Status	Body fluid	Normal (mg/dl)	Impaired (prediabetes) (mg/dl)	Diabetes (mg/dl)	Professional body
Fasting	plasma	<100	≥100-125	≥126	ADA, WHO
	Venous whole blood (WHO)	<100	≥100-110	≥110	WHO
	Capillary whole blood (WHO)	<100	≥100-110	≥110	WHO
Post-load	OGTT plasma 2hours glucose load	<140	≥140-199	≥200	ADA,WHO
	Venous whole blood	<120	≥120-<180	≥180	WHO
	Capillary whole blood	<140	≥140-199	≥200	WHO
HbA1c		< 5.7%	5.7% - 6.4%	≥6.5%	ADA, WHO

ADA= American Diabetes Association; WHO= World Health Organization.

### Diagnostic Tests

Diabetes can be diagnosed by any of the following tests:

1. Fasting plasma glucose (FPG)
2. Oral glucose tolerance test (FPG and glucose value 2 hours after 75g glucose load).
3. Glycated haemoglobin (HbA1c)

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Two concordant results, for example, two HbA1c readings, or one HbA1c and one plasma glucose, or two plasma glucose readings above the diagnostic threshold allow confirmation of diagnosis. Two discordant readings should prompt a repeat of the test result which is in diabetic range. For example, a person with a normal fasting and high HbA1c should undergo repeat testing by HbA1c.<sup>1</sup>

### Caveats: Procedural

Fasting plasma glucose should be tested after abstaining from caloric intake for at least 8 hours. The two-hour post-

load plasma glucose should be tested after performing an oral glucose tolerance test (OGTT), as per 75g anhydrous glucose (82.5g glucose monohydrate, dissolved in 250-300ml water over 5 minutes).<sup>2</sup> In children, a glucose load of 1.75g glucose/kg body weight is used, up to a maximum of 75g glucose.<sup>2</sup> Two hours are counted from the beginning of the drink

The OGTT is performed in the morning, after three days of undistracted diet (>150g carbohydrate/day) and usual physical activity. OGTT is preceded by a dinner containing 30-50 g carbohydrate on the previous night, taken 8-14 hours prior to the test. Water (non-caloric) can be taken during a fast. Smoking is not allowed during an OGTT.

### Caveats: Biochemical

One must be aware of the fluid being used in a particular laboratory, ie, venous whole blood, capillary whole blood, or plasma for determination of glucose levels. When glucose is used to establish the diagnosis of diabetes, it should be measured in venous plasma as per recommendations.<sup>4</sup> There is a difference between glucose and sugar: diabetes is diagnosed and treated on the basis of glucose values, not sugar levels.

Glucose preservatives (fluoride) cannot and do not, prevent glycolysis completely. Laboratories that use whole blood should assay the sample immediately, or centrifuge it immediately (within 30 minutes), or store it at 0-4°C.<sup>4</sup> There is diurnal variation in FPG, with the mean FPG being higher in the morning than in the afternoon, indicating that many diabetes cases would be missed in patients seen in the afternoon.<sup>4</sup>

### Glycated Haemoglobin

Glycated haemoglobin (HbA1c) (using a method that is certified by the National Glycohaemoglobin Standardization Programme) has been suggested by the ADA as a diagnostic criterion for diabetes. A threshold  $\geq 6.5\%$  defines diabetes, while 5.7-6.4% implies prediabetes.

In situations of abnormal red cell turnover, such as pregnancy, recent blood loss or transfusion, anaemia, haemoglobinopathy, only blood glucose criteria should be used to diagnose diabetes.<sup>1</sup>

### How Not To Diagnose Diabetes

Diabetes cannot be diagnosed on the basis of glycosuria or ketonuria, as there can be other causes of these laboratory abnormalities. Diabetes should not be diagnosed on the basis of symptoms or signs alone. But, an individual should be promptly tested by recommended tests for hyperglycaemia in such situations.<sup>4</sup> History such as ants being attracted to urine should also prompt proper investigation for diabetes.

### References

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