

Screening for Diabetes

Diabetes mellitus is characterized by a lack of insulin secretion and/or increased cellular resistance to insulin resulting in hyperglycemia and other metabolic disturbances. Symptoms of diabetes can include excessive thirst and hunger, frequent urination, weight loss, blurred vision, and recurrent infections; however, the disease is often asymptomatic in its early stages. The disease is associated with severe neurological, cardiovascular, ocular, and renal complications. An estimated 6 million undiagnosed cases exist among adults in the United States.

This document presents recommendations for diabetes screening activities. It provides guidance to those who are contemplating or engaged in activities to identify individuals with a significant probability of having diabetes mellitus.

TYPES OF DIABETES—Diabetes is a group of disease states that may be classified as follows.

Insulin-dependent diabetes mellitus (IDDM)

IDDM usually, although not always, appears before the age of 30 yr and has an abrupt onset of symptoms that requires prompt medical treatment. Approximately 10% of all people diagnosed with diabetes have this type. Because of the acute nature of its symptoms, IDDM usually does not remain undetected for very long. This fact, combined with its low incidence, makes it unlikely that any case of IDDM will be uncovered by any type of screening program currently available. There are, however, assays

now in clinical development that can identify individuals with anti-insulin or anti-islet cell antibodies. Such assays may become useful for identifying individuals at risk for IDDM.

Non-insulin-dependent diabetes mellitus (NIDDM)

Found primarily in adults >30 yr of age, the disease typically is symptom free for many years, and the onset and progression of symptoms can be slow. The incidence of NIDDM increases with age. NIDDM accounts for ~90% of all diagnosed cases of diabetes. Because of the subtle progression of the disease, most unidentified cases of diabetes are NIDDM. Thus, asymptomatic individuals with NIDDM are the main focus of screening.

Gestational diabetes mellitus (GDM)

GDM is a disorder with onset or first recognition of symptoms during pregnancy. It is estimated to occur in ~3% of pregnancies and usually disappears after delivery. However, women diagnosed with GDM are at increased risk for developing diabetes at a later date. GDM symptoms generally are mild and not life threatening to the woman. However, hyperglycemia is associated with increased fetal morbidity; therefore, maintenance of normal glucose levels is required. Identification of GDM cases should be viewed as an important component of obstetrical care.

Impaired glucose tolerance (IGT)

People with IGT have hyperglycemia but at a level lower than that which qualifies

as a diagnosis of diabetes, and symptoms of diabetes are absent. IGT has not been demonstrated to cause the severe chronic microvascular complications of diabetes (e.g., nephropathy); however, a significant proportion of people with IGT also have risk factors that increase their likelihood of developing coronary heart disease (e.g., hypertension, decreased high-density lipoprotein levels, increased plasma triglycerides) and many will develop diabetes. Although screening may identify IGT as a risk factor, screening for IGT alone is not justified.

Other types of diabetes

Few patients have diabetes that is secondary to other diseases, medications, or chemicals. The influence of drugs on glucose tolerance is an important consideration in screening. Interpretation of screening test results should take into account the patient's medical history (e.g., prescription drug use).

DIABETES PREVALENCE AND RISK FACTORS

—The prevalence of diagnosed diabetes in the general population >40 yr of age is estimated to be ~6% with an equal prevalence of undiagnosed cases. However, specific subgroups (i.e., high-risk groups) have a much higher prevalence of the disease than the population as a whole. These subgroups have certain attributes or risk factors that either directly cause diabetes or are statistically associated with it.

The correlation of a risk factor with development of diabetes is never 100%. However, the greater the number of risk factors present in an individual, the greater the chance of that individual developing diabetes. Conversely, the chance of finding diabetes in an individual without a risk factor is low. In summary, the likelihood of identifying an asymptomatic individual with diabetes in the general population through random screening is small; however, in high-risk groups the likelihood will be much greater.

The major risk factors or high-

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risk groups for NIDDM include 1) a family history of diabetes (i.e., parents or siblings with diabetes); 2) obesity (i.e., >20% over ideal body weight); 3) race (American Indian, Hispanic, or Black); 4) age >40 yr plus any of the preceding factors; 5) previously identified IGT (note that certain prescription drugs, including glucocorticoids, furosemide, thiazides, estrogen-containing products, β -blockers, and nicotinic acid, may produce hyperglycemia); 6) hypertension or significant hyperlipidemia (e.g., cholesterol \geq 240 mg/dl or triglycerides \geq 250 mg/dl); and 7) in women, a history of GDM or delivery of babies >9 lb.

SCREENING PROGRAM

OBJECTIVES—The primary purpose of a screening program is to identify individuals without symptoms who are likely to meet the diagnostic criteria for diabetes. The rationale for screening rests on the premise that by identifying asymptomatic individuals before diabetes becomes debilitating, the high morbidity and mortality associated with the complications of diabetes can be prevented or forestalled. This hypothesis is supported by many studies suggesting that tight control of blood glucose levels (i.e., normal or near normoglycemia) in a hyperglycemic individual may help prevent or retard the onset of complications. Also, identification of individuals with hyperglycemia will often concomitantly identify individuals with associated abnormalities such as hypertension or abnormal lipoprotein metabolism. Note that the relatively innocuous treatment regimen of NIDDM (usually exercise and improved diet to achieve weight loss) has ancillary cardiovascular and other health benefits regardless of its benefit in the treatment of diabetes.

A successful screening program will identify individuals in high-risk groups who are likely to be diagnosed with diabetes. It is important to remember that a positive screening test is not evidence of diabetes but rather that it conveys a high probability that the indi-

vidual has the disease; individuals with a positive screening test must be referred to a physician for follow-up testing for a diagnosis of diabetes to be made.

RECOMMENDATIONS FOR DIABETES SCREENING PROGRAMS

—General guidelines for conducting diabetes screening in physicians' offices and in community screening programs are given below. A community screening program is defined as screening not performed in a physician's office or not under the direct and close supervision of a physician.

1. A major objective of a community screening program should be to identify individuals with \geq 1 diabetes risk factor (see above). This can be done by means of a written or verbal questionnaire. Individuals with \geq 1 risk factor should be referred to a physician for evaluation and testing. In community screening programs, individuals indicating they have any of the physical symptoms of diabetes should be referred for appropriate medical evaluation.
2. Screening by measurement of plasma glucose levels should be limited to 1) individuals identified as being at risk for having diabetes or for developing it in the future and 2) pregnant women, ideally between the 24th and 28th wk. In addition, individuals presenting with possible complications of diabetes (e.g., retinopathy, proteinuria), or with any of the classic symptoms of diabetes (e.g., excessive thirst and/or hunger, polyuria) should be tested.
3. The screening test of choice is a fasting plasma glucose test. Fasting is defined as no consumption of food or beverage other than water for at least 3 h before testing. A plasma glucose level >115 mg/dl is an indication for

diagnostic testing. Individuals with plasma glucose levels \leq 115 mg/dl should be retested in 3 yr if they still have \geq 1 of the defined diabetes risk factors.

4. Plasma glucose testing also may be performed on individuals who have taken food or drink shortly before testing. Such tests are referred to as random plasma glucose measurements. If food or drink (other than water) has been ingested within 3 h preceding the test, a random plasma glucose level \geq 160 mg/dl is considered positive. Individuals testing positive should be referred to a physician for diagnostic testing.
5. Plasma glucose testing of pregnant women should not be performed in community screening programs; such individuals should be referred to a physician for an oral glucose tolerance test.
6. Minors and individuals with diagnosed diabetes should not be tested for plasma glucose levels in a community screening program.
7. A community screening program must have an established mechanism for referring individuals to a physician for further evaluation. Follow-up should be conducted to verify that the individual has pursued medical attention. A written record must be given to all individuals tested (with a paper or computerized copy retained by the organization/facility conducting the screening) containing the following information:
 - Individual's name, address, and phone number
 - List of the individual's identified risk factors for diabetes
 - If a plasma glucose determination was performed, the date

- of the test, type of test (fasting or random), and test results
- If the individual has ≥ 1 diabetes risk factor and/or a positive screening test, a statement that the individual should seek further medical evaluation for possible diabetes; alternative health-care resources should be made available to individuals without access to a physician
 - If plasma glucose testing was performed, the written record should include a statement about the possibility of a false-positive or false-negative result
8. Personnel conducting community screening programs must be adequately trained and demonstrate competency in the testing procedure used and in related program policies and procedures. Occupational Safety and Health Administration guidelines must be followed. Topics that should be included in the training are:
- How to screen individuals for the presence of diabetes risk factors (i.e., administer a risk assessment questionnaire)
 - Performance of the plasma glucose test (i.e., obtaining the sample and proper use of the plasma glucose measurement device)
 - Collection, retention, and distribution of screening test data
 - Infection-control procedures and their rationale
 - Waste-disposal procedures
 - Referral procedures
9. Adequate waste disposal for collecting and safely removing used test materials must be available.
10. Adequate infection-control procedures must be established and followed. These include:
- Workers conducting plasma glucose tests or handling materials that have been exposed to blood should wear disposable latex or vinyl gloves that should be changed after contact with each patient or sample
 - Handwashing with soap and water between tests is desirable. Hands must be washed immediately if they come in contact with blood
 - A new disposable lancet must be used for each test. It should be disposed of immediately after use in a puncture-resistant container designed for receiving used lancets. If a lancet-holding device is used, it should have a disposable cap or tip that is changed and disposed of after each use. Lancets should not be re-capped for disposal
 - Lancet holders and other non-disposable test items that become contaminated with blood during the test process should be disinfected immediately with a 1:10 dilution of sodium hypochlorite (bleach) or other suitable disinfectant
 - Workers with open cuts or lesions should not participate in plasma glucose testing
 - Tables and counters that are difficult to disinfect and clean should be covered with a disposable nonabsorbent material that can be disinfected and disposed of in the event of contamination with blood
 - A permanent record must be kept of accidental punctures with used lancets (including the name and address of the individual on whom the lancet was used). The worker should be advised to seek medical evaluation for any illness occurring within 12 wk of the exposure

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