Annals of Internal Medicine

CLINICAL GUIDELINE

Screening for Abnormal Blood Glucose and Type 2 Diabetes Mellitus: U.S. Preventive Services Task Force Recommendation Statement

Albert L. Siu, MD, MSPH, on behalf of the U.S. Preventive Services Task Force

Description: Update of the 2008 U.S. Preventive Services Task Force (USPSTF) recommendation on screening for diabetes in asymptomatic adults.

Methods: The USPSTF reviewed the evidence on screening for impaired fasting glucose, impaired glucose tolerance, and type 2 diabetes in asymptomatic, nonpregnant adults who are at average or high risk for diabetes and its complications.

Population: This recommendation applies to adults aged 40 to 70 years seen in primary care settings who do not have symptoms of diabetes and are overweight or obese.

Recommendation: The USPSTF recommends screening for abnormal blood glucose as part of cardiovascular risk assessment in adults aged 40 to 70 years who are overweight or obese. Clinicians should offer or refer patients with abnormal glucose to intensive behavioral counseling interventions to promote a healthful diet and physical activity. (B recommendation)

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For author affiliation, see end of text.

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* For a list of USPSTF members, see the **Appendix** (available at www.annals.org).

The U.S. Preventive Services Task Force (USPSTF) makes recommendations about the effectiveness of specific preventive care services for patients without related signs or symptoms.

It bases its recommendations on the evidence of both the benefits and harms of the service and an assessment of the balance. The USPSTF does not consider the costs of providing a service in this assessment.

The USPSTF recognizes that clinical decisions involve more considerations than evidence alone. Clinicians should understand the evidence but individualize decision making to the specific patient or situation. Similarly, the USPSTF notes that policy and coverage decisions involve considerations in addition to the evidence of clinical benefits and harms.

Summary of Recommendation and Evidence

The USPSTF recommends screening for abnormal blood glucose as part of cardiovascular risk assessment in adults aged 40 to 70 years who are overweight or obese. Clinicians should offer or refer patients with abnormal glucose to intensive behavioral counseling interventions to promote a healthful diet and physical activity. (B recommendation)

See the **Figure** for a summary of the recommendation and suggestions for clinical practice. **Appendix Table 1** describes the USPSTF grades, and **Appendix Table 2** describes the USPSTF classification of levels of certainty about net benefit (both tables are available at www.annals.org).

Rationale

Importance

Cardiovascular disease (CVD) is the leading cause of death in the United States, and nearly one quarter of deaths caused by CVD are considered to be preventable. Modifiable cardiovascular risk factors include abnormal blood glucose, hypertension, hyperlipidemia or dyslipidemia, smoking, overweight and obesity, physical inactivity, and an unhealthy diet. Type 2 diabetes mellitus is a metabolic disorder characterized by insulin resistance and relative insulin deficiency, resulting in hyperglycemia. Type 2 diabetes typically develops slowly, and progression from normal blood glucose to glucose abnormalities that meet generally accepted criteria for diabetes (**Table**) may take a decade or longer. Glucose abnormalities that do not meet the criteria for diabetes include impaired fasting glucose (IFG), an impaired response to oral glucose intake (impaired glucose tolerance [IGT]), or an increased average blood glucose level as evidenced by increased levels of hemoglobin A_{1c} (HbA_{1c}). Abnormal glucose metabolism is a risk factor for CVD and, in some individuals, may progress to meet the threshold for the diagnosis of diabetes.

See also:

Summary for Patients

Web-Only
CME quiz

U.S. Preventive Services TASK FORCE
www.USPreventiveServicesTaskForce.org

Figure. Screening for abnormal blood glucose and type 2 diabetes mellitus: clinical summary. IFG = impaired fasting glucose; IGT = impaired glucose tolerance.

Annals of Internal Medicine

U.S. Preventive Services TASK FORCE
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Population	**Adults aged 40 to 70 years who are overweight or obese**
Recommendation	**Screen for abnormal blood glucose. Offer or refer patients with abnormal glucose to intensive behavioral counseling interventions to promote a healthful diet and physical activity.** **Grade: B**

Risk Assessment	**Risk factors for abnormal glucose metabolism include overweight and obesity or a high percentage of abdominal fat, physical inactivity, and smoking. Abnormal glucose metabolism is also frequently associated with other cardiovascular risk factors, such as hyperlipidemia and hypertension.**
Screening Tests	**Glucose abnormalities can be detected by measuring hemoglobin A_{1c} or fasting plasma glucose or with an oral glucose tolerance test. Diagnosis of IFG, IGT, or type 2 diabetes should be confirmed with repeat testing (the same test on a different day is the preferred method of confirmation).**
Screening Interval	**Evidence on the optimal rescreening interval for adults with an initial normal glucose test is limited. Studies suggest that rescreening every 3 years may be a reasonable approach.**
Treatment and Interventions	**Effective behavioral interventions combine counseling on a healthful diet and physical activity and involve multiple contacts over extended periods. There is insufficient evidence that medications have the same benefits as behavioral interventions.**
Balance of Benefits and Harms	**The overall benefit of screening for IFG, IGT, and diabetes and implementing intensive lifestyle interventions is moderate.**
Other Relevant USPSTF Recommendations	**The USPSTF recommends screening and appropriate interventions for modifiable risk factors for cardiovascular events (overweight and obesity, physical inactivity, abnormal lipid levels, high blood pressure, and smoking). These recommendations are available on the USPSTF Web site (www.uspreventiveservicestaskforce.org).**

For a summary of the evidence systematically reviewed in making this recommendation, the full recommendation statement, and supporting documents, please go to www.uspreventiveservicestaskforce.org.

According to national data estimates from 2012, approximately 86 million Americans aged 20 years or older have IFG or IGT (1). Approximately 15% to 30% of these persons will develop type 2 diabetes within 5 years if they do not implement lifestyle changes to improve their health (1).

Modifiable risk factors for abnormal glucose metabolism (manifested as either diabetes or abnormal glucose levels below the threshold for diabetes) include overweight and obesity or a high percentage of abdominal fat, physical inactivity, and smoking. Abnormal glucose metabolism is also frequently associated with other cardiovascular risk factors, such as hyperlipidemia and hypertension.

Given the increasing prevalence of abnormal glucose metabolism in the U.S. population, the USPSTF sought to examine the benefits and harms of screening for IFG, IGT, and type 2 diabetes.

Table. Test Values for Normal Glucose Metabolism, IFG or IGT, and Type 2 Diabetes*

Test	Normal	IFG or IGT	Type 2 Diabetes
Hemoglobin A_{1c} level, %	<5.7	5.7–6.4	≥6.5
Fasting plasma glucose level			
mmol/L	<5.6	5.6–6.9	≥7.0
mg/dL		100–125	≥126
OGTT results†			
mmol/L	7.8	7.8–11.0	≥11.1
mg/dL		140–199	≥200

IFG = impaired fasting glucose; IGT = impaired glucose tolerance; OGTT = oral glucose tolerance test.
* From reference 46. All positive test results should be confirmed with repeat testing.
† After 2 h.

Benefits of Early Detection and Treatment

The USPSTF found inadequate direct evidence that measuring blood glucose leads to improvements in mortality or cardiovascular morbidity.

The USPSTF previously found adequate evidence that intensive behavioral counseling interventions for persons at increased risk for CVD have moderate benefits in lowering CVD risk. Populations in which these benefits have been shown include persons who are obese or overweight and have hypertension, hyperlipidemia or dyslipidemia, and/or IFG or IGT. Benefits of behavioral interventions include reductions in blood pressure, glucose and lipid levels, and obesity and an increase in physical activity. Studies that specifically

treat persons who have IFG or IGT with intensive lifestyle interventions to prevent the development of diabetes consistently show a moderate benefit in reducing progression to diabetes. Lifestyle interventions have greater effects on reducing progression to diabetes than metformin or other medications.

Harms of Early Detection and Treatment

The USPSTF found that measuring blood glucose is associated with short-term anxiety but not long-term psychological harms. The USPSTF found adequate evidence that the harms of lifestyle interventions to reduce the incidence of diabetes are small to none. The harms of drug therapy for the prevention of diabetes are small to moderate, depending on the drug and dosage used.

USPSTF Assessment

The USPSTF concludes with moderate certainty that there is a moderate net benefit to measuring blood glucose to detect IFG, IGT, or diabetes and implementing intensive lifestyle interventions for persons found to have abnormal blood glucose.

CLINICAL CONSIDERATIONS

Patient Population Under Consideration

This recommendation applies to adults aged 40 to 70 years seen in primary care settings who do not have symptoms of diabetes and are overweight or obese. The target population includes persons who are most likely to have glucose abnormalities that are associated with increased CVD risk and can be expected to benefit from primary prevention of CVD through risk factor modification.

Persons who have a family history of diabetes, have a history of gestational diabetes or polycystic ovarian syndrome, or are members of certain racial and ethnic groups (that is, African Americans, American Indians or Alaskan Natives, Asian Americans, Hispanics or Latinos, or Native Hawaiians or Pacific Islanders) may be at increased risk for diabetes at a younger age or at a lower body mass index. Clinicians should consider screening earlier in persons with 1 or more of these characteristics.

Screening Tests

Glucose abnormalities can be detected by measuring HbA_{1c} or fasting plasma glucose or with an oral glucose tolerance test. The **Table** shows test values for normal glucose metabolism, IFG, IGT, and type 2 diabetes. Hemoglobin A_{1c} is a measure of long-term blood glucose concentration and is not affected by acute changes in glucose levels due to stress or illness. Because HbA_{1c} measurements do not require a fasting state, they are more convenient than using a fasting plasma glucose or oral glucose tolerance test. The oral glucose tolerance test is done in the morning in a fasting state; blood glucose concentration is measured 2 hours after ingestion of a 75-g oral glucose load.

The diagnosis of IFG, IGT, or type 2 diabetes should be confirmed; repeat testing with the same test on a different day is the preferred method of confirmation.

Threshold for Behavioral Interventions

Many studies assessed intensive behavioral interventions for persons at increased CVD risk, but none report a consistent threshold for intervention among persons with abnormal glucose. Many studies include persons with multiple risk factors, and CVD risk increases with the number of risk factors and glucose level. Perceived readiness for change and access to appropriate interventions will probably influence treatment recommendations. Although direct evidence that preventing a diagnosis of type 2 diabetes results in improved health outcomes is limited, primary prevention that reduces the chances of a diagnosis may reduce the adverse consequences of disease management. Because the average reduction in glucose levels resulting from intensive behavioral interventions is modest, persons with higher glucose levels may be more likely to benefit and avoid a diabetes diagnosis than those whose glucose levels are closer to normal.

Type of Intervention

Behavioral interventions that have an effect on CVD risk and delay or avoid progression of glucose abnormalities to type 2 diabetes combine counseling on a healthful diet and physical activity and are intensive, with multiple contacts over extended periods. The evidence is insufficient to conclude that pharmacologic interventions have the same multifactorial benefits (for example, weight loss or reductions in glucose levels, blood pressure, and lipid levels) as behavioral interventions.

Screening Intervals

Evidence on the optimal rescreening interval for adults with an initial normal glucose test result is limited (2). Cohort and modeling studies suggest that rescreening every 3 years may be a reasonable approach for adults with normal blood glucose levels (3–7).

Other Approaches to Prevention

Because overweight and obesity, physical inactivity, abnormal lipid levels, high blood pressure, and smoking are all modifiable risk factors for cardiovascular events, the USPSTF recommends screening and appropriate interventions for these conditions (available at www.uspreventiveservicestaskforce.org).

The USPSTF recommends screening for obesity in adults and offering or referring those with a body mass index of 30 kg/m^2 or greater to intensive, multicomponent behavioral interventions. Although intensive interventions may not be practical in many primary care settings, patients may be referred from primary care to community-based programs for these interventions.

The USPSTF recommends offering or referring adults who are overweight (body mass index >25 kg/m^2) and have additional cardiovascular risk factors to intensive behavioral counseling interventions to promote a healthful diet and physical activity for CVD prevention.

The USPSTF recommends screening for lipid disorders in men aged 35 years or older and women aged 45 years or older who are at increased risk for coronary heart disease. The USPSTF also recommends screening for hypertension in adults aged 18 years or older and that clinicians ask all adults about tobacco use and provide tobacco cessation interventions to those who use tobacco products.

Useful Resources

The Community Preventive Services Task Force recommends combined diet and physical activity promotion programs for persons who are at increased risk for type 2 diabetes. It found that these programs are effective across a range of counseling intensities, settings, and facilitators. Effective programs commonly include setting a weight loss goal, individual or group sessions about diet and exercise, meetings with a trained diet or exercise counselor, or individually tailored diet or exercise plans. More information is available at www.thecommunityguide.org/diabetes/combineddietandpa.html.

OTHER CONSIDERATIONS

Research Needs and Gaps

The USPSTF found only 2 studies, both conducted in Europe (8, 9), that directly evaluated the mortality benefit of screening in asymptomatic adults. Neither study had follow-up beyond 10 years or measured nonfatal cardiovascular events. Screening studies that follow larger numbers of participants for 20 years or longer and measure both morbidity and mortality are needed. Further, screening studies in the U.S. population (in which the prevalence of undiagnosed diabetes is probably higher than that identified in European studies [3%]) are needed. More research is needed on the effects of screening among racial and ethnic minorities because they have a higher prevalence of diabetes than white persons. Clinical trials and additional modeling studies are needed to better elucidate the optimal frequency of screening and the age at which to start screening. More U.S. data are also needed on the benefits and harms of lifestyle interventions and medical treatments for screen-detected IFG, IGT, and diabetes over a longer follow-up period.

DISCUSSION

Burden of Disease

Impaired glucose metabolism initially develops as IFG or IGT and may progress to diabetes. From 2009 to 2012, an estimated 37% of U.S. adults aged 20 years or older had IFG or IGT and 12% had diabetes (1). After adjustment for population age differences, the percentage of U.S. adults aged 20 years or older with IFG or IGT was similar among white (35%), black (39%), and Hispanic persons (38%). However, diabetes prevalence rates were higher among racial and ethnic minorities than non-Hispanic white persons (7.6%). Among Hispanics, the age-adjusted rate for diagnosed diabetes was 12.8%, with higher rates among Mexican Americans (13.9%) and Puerto Ricans (14.8%). Among Asian Americans, the diabetes prevalence rate was 9.0%, with higher rates among Filipinos (11.3%) and Asian Indians (13.0%). From 2010 to 2012, diabetes prevalence rates were 13.2% for black persons and 15.9% for American Indians and Alaskan Natives.

Uncontrolled diabetes is a leading cause of cardiovascular mortality and morbidity and may also result in other complications, such as vision loss, renal failure, and amputation. Diabetes is the leading cause of kidney failure, accounting for more than 44% of new cases of end-stage renal disease in 2011. About 60% of nontraumatic lower-limb amputations occur in persons with diabetes. Among adults of a similar age, the risk for death is 1.5 times higher in those with diabetes than in those without it (1).

Scope of Review

To update its 2008 recommendation, the USPSTF reviewed studies from the prior evidence review and evidence from new trials published since then. The current review focused on screening for IFG, IGT, and type 2 diabetes in asymptomatic, nonpregnant adults who are at average or high risk for diabetes and its complications (2, 10). The USPSTF examined whether measuring blood glucose to detect diabetes, IFG, or IGT in asymptomatic adults results in improved health outcomes; whether interventions for IFG or IGT prevent or delay progression to type 2 diabetes; and whether interventions for screen-detected IFG, IGT, or type 2 diabetes provide an incremental benefit in health outcomes compared with no interventions or initiating interventions after clinical diagnosis.

The USPSTF also examined the harms of screening and interventions for IFG, IGT, and type 2 diabetes. The evidence review assessed the benefits and harms of aspirin use and intensive versus standard control of blood glucose levels, blood pressure, and lipid levels in persons with diagnosed diabetes. In addition, the USPSTF examined whether the effects of screening and interventions differ by subpopulation (for example, older adults, men vs. women, or racial and ethnic minorities).

Effectiveness of Early Detection and Treatment

Benefits of Screening

Since the previous review, 2 new trials conducted in Europe have examined the effects of screening versus no screening. ADDITION-Cambridge (Anglo-Danish-Dutch Study of Intensive Treatment In People With Screen-Detected Diabetes in Primary Care) (8) was a good-quality, cluster randomized, controlled trial with 19 226 participants, screening at 27 sites, and no screening at 5 sites. The hazard ratio (HR) for all-cause mortality at 10-year follow-up was 1.06 (95% CI, 0.90 to 1.25). No differences were found between the screened and nonscreened groups in cardiovascular-, cancer-, or diabetes-related mortality or death from other causes. Limitations of this study include lack of longer-term (>10 years) follow-up and lack of data on other macrovascular and microvascular outcomes, such as nonfatal cardiovascular events.

A second study (9), conducted at a single site in the United Kingdom (n = 4936), resulted in a moderate significant reduction in all-cause mortality (HR, 0.79 [CI, 0.63 to 1.00]). Data on other health outcomes were limited. The USPSTF considered this study to be of fair to poor quality because of its unclear randomization and allocation concealment methods and important baseline differences between the screened and nonscreened groups.

Given the limitations of these 2 studies, the USPSTF determined that the evidence is inadequate to determine the direct benefits and harms of screening versus no screening.

Interventions to Prevent or Delay Progression to Type 2 Diabetes

The USPSTF identified 10 studies (6 new and 4 included in the previous review) that focused on lifestyle interventions to prevent or delay progression to type 2 diabetes (2). A meta-analysis of these 10 trials showed a relative risk (RR) of 0.53 (CI, 0.39 to 0.72; I^2 = 88%). The USPSTF determined that there is adequate evidence that lifestyle interventions can prevent or delay progression to type 2 diabetes.

The USPSTF identified 8 studies published since the prior review that assessed the effects of pharmacologic interventions to prevent or delay progression to diabetes (2). Metformin, thiazolidinediones, and α-glucosidase inhibitors were all found to be effective in preventing or delaying progression to type 2 diabetes.

Effects of Screening Versus Not Screening and Initiating Interventions After Clinical Diagnosis

The USPSTF found no trials that evaluated the incremental benefit on health outcomes of initiating interventions after clinical diagnosis compared with at the time of screening.

The USPSTF identified 3 trials that suggested benefit of lifestyle interventions in patients with IFG or IGT. The Diabetes Prevention Program (11), conducted in the United States in 3234 participants, found that an intensive lifestyle modification intervention was associated with better quality of life at 3-year follow-up.

One Finnish (12) and 1 Chinese (13) trial, each with more than 500 participants, suggested improvements in all-cause mortality outcomes after 10 and 20 years, respectively (HR, 0.57 [CI, 0.21 to 1.58] and 0.96 [CI, 0.65 to 1.14], respectively), but these trials were underpowered to evaluate these outcomes. However, by 23-year follow-up, the Chinese trial found decreased risk for cardiovascular mortality (HR, 0.59 [CI, 0.36 to 0.96]) and all-cause mortality (HR, 0.71 [CI, 0.51 to 0.99]) in the intervention group compared with the control group (14). These findings were primarily due to significant differences in mortality outcomes between women in the intervention and control groups (all-cause mortality HR, 0.46 [CI, 0.24 to 0.87]; cardiovascular mortality HR, 0.28 [CI, 0.11 to 0.71]). The lifestyle intervention had no significant effect on all-cause or cardiovascular mortality in men (all-cause mortality HR, 0.97 [CI, 0.65 to 1.46]; cardiovascular mortality HR, 0.91 [CI, 0.50 to 1.65]). Post hoc analyses suggested that the reduced mortality associated with the intervention was mediated by its effect on delaying the onset of diabetes.

Pharmacologic interventions for screen-detected IFG, IGT, or diabetes showed no reduction in cardiovascular mortality based on a meta-analysis of 5 trials, with a mean follow-up of 3 to 6 years (risk ratio, 1.07 [CI, 0.84 to 1.35]; I^2 = 0%) (2).

Benefits of Intensive Versus Standard Control of Blood Glucose Levels, Blood Pressure, and Lipid Levels

Among patients with diagnosed diabetes (that is, not screen-detected), intensive glycemic control was not associated with reduced risk for all-cause or cardiovascular mortality compared with standard glycemic control (15). Intensive glycemic control was associated with reduced risk for nonfatal myocardial infarction and microvascular disease but increased risk for severe hypoglycemia (15, 16).

To assess whether intensive blood pressure control was associated with reduced cardiovascular mortality and morbidity compared with standard control, the USPSTF examined the results of 5 trials—ABCD (Appropriate Blood Pressure Control in Diabetes), ACCORD (Action to Control Cardiovascular Risk in Diabetes), ADVANCE (Action in Diabetes and Vascular Disease: Preterax and Diamicron-MR Controlled Evaluation), HOT (Hypertension Optimal Treatment), and the UKPDS (United Kingdom Prospective Diabetes Study) (17–22). These trials had heterogeneous populations, medications, and blood pressure goals. No clear benefit was found in all-cause or cardiovascular mortality with intensive blood pressure control. However, a consistent benefit of stroke reduction was found in study groups with intensive versus standard blood pressure control (23, 24). For example, in the ACCORD trial, the target systolic blood pressure of less than 120 mm Hg was associated with an RR of 0.58 (CI, 0.39 to 0.88) for stroke incidence compared with standard blood pressure control (target systolic blood pressure of <140 mm Hg).

The USPSTF found no studies on the effects of intensive versus standard lipid control in persons with screen-detected diabetes. The ACCORD study (25) found that intensive lipid-lowering therapy was associated with reduced risk for a composite cardiovascular outcome in men with diabetes but possible harm in women (interaction P = 0.01) (25).

Lipid-lowering therapy seemed to be similarly effective in RR reduction regardless of diabetes status. A Japanese study (26) that randomly assigned approximately 8000 participants to pravastatin versus placebo found similar estimates of risk for all-cause mortality,

stroke, and cardiovascular events in participants with diabetes, IFG or IGT, or normal blood glucose levels. A meta-analysis of 14 trials of statins (27) found similar risks for vascular events in both persons with diabetes (RR, 0.79 [CI, 0.72 to 0.87]) and without diabetes (RR, 0.79 [CI, 0.76 to 0.82]).

Benefits of Multifactorial Interventions

The ADDITION-Europe trial (28, 29) evaluated the effects of intensive versus standard control of blood glucose levels, blood pressure, and lipid levels in a population with screen-detected diabetes (mean HbA_{1c} level was 6.5% for both groups at baseline). No significant differences were found between study groups in risk for all-cause mortality (HR, 0.83 [CI, 0.65 to 1.05]) or cardiovascular mortality (HR, 0.88 [CI, 0.51 to 1.51]). In addition, no significant differences were found in risk for stroke (HR, 0.98 [CI, 0.57 to 1.71]), myocardial infarction (HR, 0.70 [CI, 0.41 to 1.21]), or revascularization (HR, 0.79 [CI, 0.52 to 1.18]) after 5-year follow-up.

The USPSTF identified 4 trials of multifactorial interventions in persons with existing diabetes. Baseline HbA_{1c} levels (range, 7.4% to 8.8%) were higher among these trial participants than in the ADDITION-Europe trial. The ADVANCE trial found reduced risk for all-cause mortality (RR, 0.83 [CI, 0.70 to 0.99]) and cardiovascular mortality (RR, 0.76 [CI, 0.60 to 0.98]) at 4-year follow-up (30). Similarly, the Steno-2 Study (31) showed a reduction in all-cause mortality (RR, 0.60 [CI, 0.40 to 0.90]) and cardiovascular mortality (RR, 0.47 [CI, 0.23 to 0.98]) after 13-year follow-up (31). However, SANDS (Stop Atherosclerosis in Native Diabetics) (32), conducted in American Indians, and JEDIT (Japanese Elderly Diabetes Intervention Trial) (33) in Japan showed no difference between intensive and standard therapy after 3- and 6-year follow-up, respectively.

Benefits of Aspirin Use

The USPSTF identified 2 systematic reviews (34, 35) that found no significant differences in RR reduction between aspirin use and nonuse in persons with diabetes (34, 35).

Differential Effects of Screening or Interventions by Subpopulation

The USPSTF found no studies that directly evaluated whether the effects of screening vary by subpopulation, such as by age, sex, or race and ethnicity.

Harms of Screening and Interventions

The USPSTF found limited evidence on the harms of screening for IFG, IGT, or diabetes. One study (36) found that invitation to screening and a new diagnosis of diabetes were associated with short-term anxiety, and 2 longer-term studies (37, 38) found no negative psychological effects associated with screening or a new diagnosis. The diagnosis of IFG or IGT may potentially create harm through labeling. No studies to date have shown this effect, however, and it is unclear whether the harms of labeling a person at risk would be counteracted by the potential benefits of reducing that person's chances of developing diabetes.

Two studies compared lifestyle interventions with usual care and reported no difference in all-cause withdrawal rates (39) or adverse events (40).

The Diabetes Prevention Program (41) reported no differences in serious or nonserious events between the metformin and placebo groups. One trial found that acarbose was associated with higher risk for withdrawal because of adverse events compared with placebo (42). One large trial found that nateglinide (43) was associated with increased risk for hypoglycemia compared with placebo (RR, 1.73 [CI, 1.57 to 1.92]); further, valsartan was associated (44) with hypotension-related adverse events (RR, 1.16 [CI, 1.11 to 1.23]). One trial (45) found that rosiglitazone was associated with increased risk for congestive heart failure (HR, 7.04 [CI, 1.6 to 31]), but the estimate was imprecise.

Estimate of Magnitude of Net Benefit

The USPSTF assessed the overall benefit of screening for IFG, IGT, and diabetes to be moderate. The effects of lifestyle interventions to prevent or delay progression to diabetes were consistent across a substantive body of literature. Limited data from longer-term studies suggest that these interventions may also be associated with improved health outcomes. The potential harms of measuring blood glucose and initiating lifestyle modifications that include healthy eating behaviors and increased physical activity are small to none, which leads the USPSTF to conclude with moderate certainty that these interventions have a moderate net benefit.

Response to Public Comment

A draft version of this recommendation statement was posted for public comment on the USPSTF Web site from 7 October 2014 to 5 November 2014. The USPSTF reviewed all public comments received. In response, the USPSTF revised the final recommendation to clarify the populations considered to be at increased risk and provided more details about lifestyle interventions found to be most effective for prevention. The USPSTF also reexamined the potential harms of labeling associated with screening and found limited harms.

Update of Previous USPSTF Recommendation

This is an update of the 2008 USPSTF recommendation statement in which the USPSTF recommended screening for diabetes in asymptomatic adults with hypertension (defined as sustained blood pressure of >135/80 mm Hg) (B recommendation). At that time, the USPSTF found insufficient evidence to assess the balance of benefits and harms of screening in adults without hypertension (blood pressure of ≤135/80 mm Hg) (I statement). Since the previous recommendation, 6 new

lifestyle intervention studies have shown consistent benefit of lifestyle modifications to prevent or delay progression to diabetes and longer-term follow-up has increased confidence that such interventions can improve clinical outcomes. This new body of evidence led the USPSTF to conclude that there is moderate net benefit to measuring blood glucose in adults who are at increased risk for diabetes.

Recommendations of Others

The American Diabetes Association (46) recommends screening for diabetes in adults aged 45 years or older and screening in persons with multiple risk factors regardless of age. The American Association of Clinical Endocrinologists (47), American Academy of Family Physicians (48), Diabetes Australia (49), Diabetes UK (50), and the Canadian Task Force on Preventive Health Care (51) recommend screening for diabetes in persons with risk factors only.

From the U.S. Preventive Services Task Force, Rockville, Maryland.

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Requests for Single Reprints: Reprints are available from the USPSTF Web site (www.uspreventiveservicestaskforce.org).

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Appendix: Members of the USPSTF

Members of the USPSTF at the time this recommendation was finalized† are Albert L. Siu, MD, MSPH, *Chair* (Mount Sinai School of Medicine, New York, and James J. Peters Veterans Affairs Medical Center, Bronx, New York); Kirsten Bibbins-Domingo, PhD, MD, MAS, *Co-Vice Chair* (University of California, San Francisco, San Francisco, California); David Grossman, MD, MPH, *Co-Vice Chair* (Group Health Research Institute, Seattle, Washington); Linda Ciofu Baumann, PhD, RN, APRN (University of Wisconsin, Madison, Wisconsin); Karina W. Davidson, PhD, MASc (Columbia University, New York, New York); Mark Ebell, MD, MS (University of Georgia, Athens, Georgia); Francisco A.R. García, MD, MPH (Pima County Department of Health, Tucson, Arizona); Matthew Gillman, MD, SM (Harvard Medical School and Harvard Pilgrim Health Care Institute, Boston, Massachusetts); Jessica Herzstein, MD, MPH (Independent Consultant, Washington, DC); Alex R. Kemper, MD, MPH, MS (Duke University, Durham, North Carolina); Alex H. Krist, MD, MPH (Fairfax Family Practice, Fairfax, and Virginia Commonwealth University, Richmond, Virginia); Ann E. Kurth, PhD, RN, MSN, MPH (New York University, New York, New York); Douglas K. Owens, MD, MS (Veterans Affairs Palo Alto Health Care System, Palo Alto, and Stanford University, Stanford, California); William R. Phillips, MD, MPH (University of Washington, Seattle, Washington); Maureen G. Phipps, MD, MPH (Brown University, Providence, Rhode Island); and Michael P. Pignone, MD, MPH (University of North Carolina, Chapel Hill, North Carolina). Former USPSTF member Michael LeFevre, MD, MSPH (University of Missouri, Columbia, Missouri) also contributed to the development of this recommendation.

† For a list of current USPSTF members, go to www.uspreventiveservicestaskforce.org/Page/Name/our-members.

Appendix Table 1. What the USPSTF Grades Mean and Suggestions for Practice

Grade	Definition	Suggestions for Practice
A	The USPSTF recommends the service. There is high certainty that the net benefit is substantial.	Offer/provide this service.
B	The USPSTF recommends the service. There is high certainty that the net benefit is moderate or there is moderate certainty that the net benefit is moderate to substantial.	Offer/provide this service.
C	The USPSTF recommends selectively offering or providing this service to individual patients based on professional judgment and patient preferences. There is at least moderate certainty that the net benefit is small.	Offer/provide this service for selected patients depending on individual circumstances.
D	The USPSTF recommends against the service. There is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits.	Discourage the use of this service.
I statement	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of the service. Evidence is lacking, of poor quality, or conflicting, and the balance of benefits and harms cannot be determined.	Read the Clinical Considerations section of the USPSTF Recommendation Statement. If the service is offered, patients should understand the uncertainty about the balance of benefits and harms.

Appendix Table 2. USPSTF Levels of Certainty Regarding Net Benefit

Level of Certainty*	Description
High	The available evidence usually includes consistent results from well-designed, well-conducted studies in representative primary care populations. These studies assess the effects of the preventive service on health outcomes. This conclusion is therefore unlikely to be strongly affected by the results of future studies.
Moderate	The available evidence is sufficient to determine the effects of the preventive service on health outcomes, but confidence in the estimate is constrained by such factors as: the number, size, or quality of individual studies; inconsistency of findings across individual studies; limited generalizability of findings to routine primary care practice; and lack of coherence in the chain of evidence. As more information becomes available, the magnitude or direction of the observed effect could change, and this change may be large enough to alter the conclusion.
Low	The available evidence is insufficient to assess effects on health outcomes. Evidence is insufficient because of: the limited number or size of studies; important flaws in study design or methods; inconsistency of findings across individual studies; gaps in the chain of evidence; findings that are not generalizable to routine primary care practice; and a lack of information on important health outcomes. More information may allow an estimation of effects on health outcomes.

* The USPSTF defines *certainty* as "likelihood that the USPSTF assessment of the net benefit of a preventive service is correct." The net benefit is defined as benefit minus harm of the preventive service as implemented in a general primary care population. The USPSTF assigns a certainty level on the basis of the nature of the overall evidence available to assess the net benefit of a preventive service.