Overview of medical care in adults with diabetes mellitus

**Author**  
David K McCulloch, MD

**Section Editor**  
David M Nathan, MD

**Deputy Editor**  
Jean E Mulder, MD

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: May 2017. | This topic last updated: Jan 04, 2017.

INTRODUCTION — The estimated overall prevalence of diabetes among adults in the United States ranges from 5.8 to 12.9 percent (median 8.4 percent) [[1,2](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/1,2)]. However, because of the associated microvascular and macrovascular disease, diabetes accounts for almost 14 percent of United States health care expenditures, at least one-half of which are related to complications such as myocardial infarction (MI), stroke, end-stage renal disease, retinopathy, and foot ulcers [[3](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/3)].

Numerous factors, in addition to directly related medical complications, contribute to the impact of diabetes on quality of life and economics. Diabetes is associated with a high prevalence of depression [[4](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/4)] and adversely impacts employment, absenteeism, and work productivity [[5](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/5)].

This review will provide an overview of the medical care for patients with diabetes (table 1). The management approach is consistent with guidelines from the American Diabetes Association (ADA) for health maintenance in patients with diabetes, which are published yearly [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. Consensus recommendations for the management of glycemia in type 2 diabetes were published in 2006 and are updated regularly. Detailed discussions relating to screening, diagnosis, and management of hyperglycemia are discussed separately. (See "Screening for type 2 diabetes mellitus" and "Clinical presentation and diagnosis of diabetes mellitus in adults" and "Initial management of blood glucose in adults with type 2 diabetes mellitus" and "Management of persistent hyperglycemia in type 2 diabetes mellitus".)

EVALUATION

Initial — Patients with newly diagnosed diabetes require a history and physical examination to assess the characteristics of onset of diabetes (asymptomatic laboratory finding or symptomatic polyuria and polydipsia), nutrition and weight history, physical activity, cardiovascular risk factors, history of diabetes-related complications, hypoglycemic episodes, diabetic ketoacidosis (DKA) frequency (type 1 diabetes only), and current management.

●If not measured in the past two to three months, we measure glycated hemoglobin (A1C) (See "Estimation of blood glucose control in diabetes mellitus", section on 'Glycated hemoglobin'.)

●If not measured in the past one year, we measure:

•Fasting lipid profile

•Liver function tests

•Urine albumin excretion (spot urine)

•Serum creatinine

•Serum thyroid-stimulating hormone (TSH, in type 1 diabetes only)

Type 2 diabetes accounts for over 90 percent of cases of diabetes in the United States, Canada, and Europe; type 1 diabetes accounts for another 5 to 10 percent, with the remainder due to other causes (table 2). The etiologic classification of diabetes, including distinguishing type 2 from type 1 diabetes, and monogenic forms of diabetes (formerly referred to as maturity onset diabetes of the young [MODY]) from type 1 and type 2 diabetes, is reviewed elsewhere. (See "Classification of diabetes mellitus and genetic diabetic syndromes".)

Diabetes-related complications — Patients with diabetes require ongoing evaluation for diabetes-related complications. A history and physical exam should be performed two to three times yearly to obtain information on nutrition, physical activity, management of diabetes and cardiovascular risk factors, and diabetes-related complications (table 1). We check blood pressure and visually inspect the feet at every visit, and in addition, perform a more thorough foot examination and refer patients for a dilated eye exam annually. We measure A1C every three months if A1C is not in the goal range and therapy requires adjustment and every six months in patients with stable glycemic control who are meeting A1C goals. We measure fasting lipids and urine albumin-to-creatinine ratio annually.

Morbidity from diabetes is a consequence of both macrovascular disease (atherosclerosis) and microvascular disease (retinopathy, nephropathy, and neuropathy). In type 2 diabetes, disease onset is insidious, and diagnosis is often delayed. As a result, diabetic complications may be present at the time of diagnosis of diabetes [[7](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/7)], and their frequency increases over time (figure 1). Once present, the progression of these complications can be slowed with interventions such as aggressive management of glycemia, blood pressure, and lipids; laser therapy for advanced retinopathy; and administration of an angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs) for nephropathy. (See "Treatment of lipids (including hypercholesterolemia) in secondary prevention", section on 'Treatment in diabetes' and "Diabetic retinopathy: Prevention and treatment" and "Moderately increased albuminuria (microalbuminuria) in type 1 diabetes mellitus" and "Moderately increased albuminuria (microalbuminuria) in type 2 diabetes mellitus" and "Treatment of diabetic nephropathy".)

These interventions appear to be reducing the incidence of several diabetes-related complications, including myocardial infarction (MI), stroke, lower-extremity amputation, and end-stage renal disease. In the United States, the greatest absolute declines have been reported for acute MI and stroke (between 1990 and 2010, 95.6 and 58.9 fewer cases per 10,000 persons per year for MI and stroke, respectively) [[8](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/8)]. Other countries have similarly reported reductions in the rate of cardiovascular complications and lower extremity amputation [[9-11](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/9-11)]. (See 'Reducing the risk of macrovascular disease' below.)

Routine eye examination — Patients with diabetes are at increased risk for visual loss, related both to refractive errors (correctable visual impairment), cataracts and glaucoma (which are more prevalent in persons with diabetes [[12,13](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/12,13)]), and to retinopathy.

Diabetic retinopathy — Recommendations for the type and frequency of routine eye examinations vary, based upon the type of diabetes mellitus and the presence of specific eye findings (table 3) [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. Serial examinations are indicated because of the increased incidence of retinopathy over time in patients with either type 1 or type 2 diabetes (figure 2). Screening for diabetic retinopathy is reviewed in detail separately. (See "Diabetic retinopathy: Screening".)

General measures to reduce risk and progression of retinopathy include good glycemic and blood pressure control. Prevention and treatment of retinopathy is reviewed separately. (See "Diabetic retinopathy: Prevention and treatment".)

Correctable visual impairment — A study using data from the National Health and Nutrition Examination Survey (NHANES) in the United States found that 11 percent of patients aged 20 years and older with diabetes had visual impairment (visual acuity <20/40 in their best eye with glasses) [[14](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/14)]. The impairment was correctable with an adequate corrective prescription for glasses or contact lenses in over two-thirds of the patients. These data indicate the need for visual acuity and refractive error assessment in addition to dilated eye examinations for retinopathy in diabetic patients to reduce injury risk and improve quality of life.

Routine foot examination — The feet should be visually inspected at each routine visit to identify problems with nail care, poorly fitting footwear resulting in barotrauma, fungal infections, and callus formation that may jeopardize acceptable foot care. A comprehensive foot examination should be performed annually on patients with diabetes to identify risk factors predictive of ulcers and amputation [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. Foot problems due to vascular and neurologic disease are a common and important source of morbidity in diabetic patients. Systematic screening examinations for neuropathic and vascular involvement of the lower extremities, and careful inspection of feet may substantially reduce morbidity from foot problems. (See "Evaluation of the diabetic foot".)

The comprehensive foot examination can be accomplished in the primary care setting and should include inspection, assessment of foot pulses, and testing for loss of protective sensation, as follows:

●The skin should be assessed for integrity, especially between the toes and under the metatarsal heads. The presence of erythema, warmth, or callus formation may indicate areas of tissue damage. Bony deformities, joint mobility, and gait and balance should also be assessed.

●Screen for peripheral artery disease by asking about a history of claudication and assessing the pedal pulses. Patients with clinical evidence of peripheral artery disease should have ankle brachial index testing. The presence of peripheral artery disease also suggests a high likelihood of cardiovascular disease (CVD). (See "Evaluation of the diabetic foot", section on 'Physical signs of peripheral artery disease' and "Noninvasive diagnosis of arterial disease", section on 'Ankle-brachial index'.)

●Test for loss of protective sensation using a Semmes-Weinstein 5.07 (10 g) monofilament at specific sites to detect loss of sensation in the foot (figure 3), plus any one of the following: vibration using a 128-Hz tuning fork, pinprick sensation, ankle reflexes, or vibration perception threshold with a biothesiometer. (See "Evaluation of the diabetic foot", section on 'Screening tests for peripheral neuropathy'.)

●Advice for prophylactic foot care should be given to all patients (see "Patient education: Foot care in diabetes mellitus (Beyond the Basics)"):

•Avoid going barefoot, even in the home.

•Test water temperature before stepping into a bath.

•Trim toenails to shape of the toe; remove sharp edges with a nail file. Do not cut cuticles.

•Wash and check feet daily.

•Shoes should be snug but not tight and customized if feet are misshapen or have ulcers.

•Socks should fit and be changed daily.

Patients who may have neuropathy (based on abnormal results from a microfilament and one other test) or who have calluses or other foot deformities should be referred to clinicians with expertise in diabetic foot care (podiatrist, nurse, diabetes foot clinic, or other, depending on available local resources).

Screening for increased urinary albumin excretion — Measurement of the urine albumin-to-creatinine ratio in an untimed urinary sample is the preferred screening strategy for moderately increased albuminuria in all patients with diabetes and should be repeated yearly. Screening for increased urinary albumin excretion can be deferred for five years after the onset of disease in patients with type 1 diabetes because increased albumin excretion is uncommon before this time; screening should begin at diagnosis in patients with type 2 diabetes because many have had diabetes for several years before diagnosis [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. Abnormal results should be repeated at least two or three times over a three- to six-month period because of the large number of false positives that can occur [[15](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/15)]. Establishing the diagnosis of increased urinary albumin excretion requires the demonstration of a persistent (at least two abnormal tests) elevation in albumin excretion. Fever, exercise, heart failure, and poor glycemic control are among the factors that can cause transient microalbuminuria [[15](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/15)].

Increased urinary protein excretion is the earliest clinical finding of diabetic nephropathy. The routine urine dipstick, however, is a relatively insensitive marker for proteinuria, not detecting protein until excretion exceeds 300 to 500 mg/day. Using a specific assay for albumin is a more sensitive technique. The normal rate of albumin excretion is less than 30 mg/day (20 mcg/min); persistent values between 30 and 300 mg/day (20 to 200 mcg/min) in a patient with diabetes is called persistent albuminuria or moderately increased albuminuria (historically called microalbuminuria) and is usually indicative of diabetic nephropathy (unless there is some other coexistent renal disease) [[16](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/16)]. Values above 300 mg/day(200 mcg/min) are considered to represent severely increased albuminuria (the new terminology for what was formerly called macroalbuminuria) and which is also called overt proteinuria, clinical renal disease, or dipstick positive proteinuria. (See "Moderately increased albuminuria (microalbuminuria) in type 1 diabetes mellitus" and "Moderately increased albuminuria (microalbuminuria) in type 2 diabetes mellitus".)

The availability of effective therapy for diabetic nephropathy with ACE inhibitors and ARBs is the rationale for yearly screening of all patients with either type 1 or type 2 diabetes for increased albumin excretion (figure 4A-B). Once a patient with diabetes is taking an ACE or an ARB for increased urinary albumin excretion, the value of continued yearly monitoring of the urine albumin-to-creatinine ratio is uncertain [[17](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/17)]. The treatment of increased urinary albumin excretion and diabetic nephropathy is reviewed in detail elsewhere. (See "Moderately increased albuminuria (microalbuminuria) in type 2 diabetes mellitus", section on 'Treatment' and "Moderately increased albuminuria (microalbuminuria) in type 1 diabetes mellitus", section on 'Treatment' and "Treatment of diabetic nephropathy".)

Screening for coronary heart disease — We do not routinely perform exercise stress testing in asymptomatic patients with diabetes. Instead, we perform an annual assessment of risk criteria (blood pressure, fasting lipid profile, smoking history) to identify patients at high risk for coronary heart disease (CHD) who might benefit from interventions such as aspirin, ACE inhibitors, and statin therapy. We no longer recommend that these criteria be used to identify patients for stress testing [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)].

For sedentary adults (age >50 years) with diabetes who are beginning an exercise program, we typically perform a physical examination and a resting electrocardiogram (ECG). In addition, all CVD risk factors should be treated (see 'Blood pressure control' below and 'Dyslipidemia' below). There are no randomized trial data to support the routine performance of exercise stress testing in asymptomatic patients with diabetes who are planning to begin an exercise program [[18,19](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/18,19)]. The decision to perform stress testing prior to beginning an exercise program should be individualized.

We do not typically perform exercise stress testing in asymptomatic patients as long as they are beginning a gentle exercise program with gradual progression as tolerated. However, the increased risk for asymptomatic coronary artery disease in those with diabetes and other risk factors suggests that an exercise tolerance test be considered prior to changing exercise levels in patients with diabetes who also have peripheral or carotid or coronary artery disease. (See "Screening for coronary heart disease in patients with diabetes mellitus".)

Patients with diabetes have an increased risk for atherosclerosis due both to diabetes and to the frequent presence of other risk factors. Furthermore, diabetic patients with CHD are more likely to be asymptomatic or have atypical symptoms than nondiabetic patients with CHD (see "Prevalence of and risk factors for coronary heart disease in diabetes mellitus", section on 'Silent ischemia and infarction'). Despite the frequency of silent ischemia, however, it has not been proven that identifying asymptomatic disease or providing early intervention will improve outcomes in this population. In addition, CHD risk factors (dyslipidemia, hypertension, smoking, positive family history of early coronary disease, and presence of increased urinary albumin excretion) [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)] do not predict the likelihood of having ischemic findings on stress testing or coronary angiography [[20,21](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/20,21)].

The evaluation and treatment of diabetic patients with known CHD is reviewed in detail elsewhere. (See "Treatment of acute myocardial infarction in diabetes mellitus" and "Coronary artery revascularization in patients with diabetes mellitus and multivessel coronary artery disease".)

Comorbid conditions — Adults with type 2 diabetes are at risk for comorbidities other than obesity, hypertension, and dyslipidemia. These disorders, which may be present at diagnosis or may develop over time, include hearing impairment, sleep apnea, fatty liver disease, periodontal disease, cognitive impairment, depression, anxiety, and fractures [[22](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/22)]. For patients with signs or symptoms of these conditions, additional assessment is warranted. Annual examination by a dentist is recommended in both dentate and nondentate diabetic patients [[23](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/23)]. (See "Etiology of hearing loss in adults" and "Overview of obstructive sleep apnea in adults" and "Epidemiology, clinical features, and diagnosis of nonalcoholic fatty liver disease in adults" and "Gingivitis and periodontitis in adults: Classification and dental treatment" and "Risk factors for cognitive decline and dementia" and "Screening for depression in adults" and "Bone disease in diabetes mellitus".)

Some studies suggest an increased risk of certain cancers (liver, pancreas, endometrium, colon/rectum, breast, bladder) in patients with type 2 diabetes, possibly related to the coincident obesity [[24-30](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/24-30)]. Adults with type 2 diabetes also have an increased risk of cancer mortality. In a systematic review of individual patient data from 97 prospective studies (820,900 patients), adults with diabetes compared with those without had an increased risk of death from cancer (hazard ratio [HR] 1.25, 95% CI 1.19-1.31) [[31](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/31)]. The increased risk of death was associated specifically with cancers of the liver, pancreas, ovary, colorectum, lung, bladder, and breast. In addition, the relative risk was substantially reduced when A1C levels were considered in multivariate analyses, consistent with a direct effect of hyperglycemia on cancer risk. (See "Colorectal cancer: Epidemiology, risk factors, and protective factors" and "Epidemiology and etiologic associations of hepatocellular carcinoma" and "Epidemiology and risk factors of urothelial (transitional cell) carcinoma of the bladder" and "Epidemiology and nonfamilial risk factors for exocrine pancreatic cancer" and "Epidemiology, pathology, and pathogenesis of renal cell carcinoma", section on 'Diabetes mellitus'.)

Patients with diabetes should undergo recommended age- and gender-specific cancer screening [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. (See "Preventive care in adults: Recommendations", section on 'Cancer'.)

GLYCEMIC CONTROL

Monitoring and target A1C — Glycated hemoglobin (A1C) goals in patients with diabetes should be tailored to the individual, balancing the demonstrated benefits with regard to prevention and delay in microvascular complications with the risk of hypoglycemia. A reasonable goal of therapy might be an A1C value of ≤7.0 percent for most patients (using an assay aligned to the Diabetes Control and Complications Trial [DCCT] in which the upper limit of normal is 6.0 percent) (calculator 1). Glycemic targets are generally set somewhat higher (eg, <8 percent) for older adult patients and those with comorbidities or a limited life expectancy and little likelihood of benefit from intensive therapy. More stringent control (A1C <6 percent) may be indicated for individual patients with type 1 diabetes and during pregnancy. (See "Glycemic control and vascular complications in type 2 diabetes mellitus", section on 'Glycemic targets' and "Treatment of type 2 diabetes mellitus in the older patient", section on 'Glycemic targets' and "Glycemic control and vascular complications in type 1 diabetes mellitus", section on 'Glycemic targets' and "Pregestational diabetes mellitus: Glycemic control during pregnancy", section on 'Target A1C level'.)

Prospective, randomized clinical trials such as the DCCT, the United Kingdom Prospective Diabetes Study (UKPDS), and the Kumamoto Study have demonstrated that intensive therapy aimed at lower levels of glycemia results in decreased rates of retinopathy, nephropathy, and neuropathy [[32-35](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/32-35)]. Every 1 percent drop in A1C was associated with improved outcomes, and there was no threshold effect. These benefits have to be weighed against an increased risk of severe hypoglycemia associated with intensive therapy (particularly in type 1 diabetes). Although the goal of the intensive interventions in these studies was normoglycemia, with an A1C less than 6.1 percent, the average A1C achieved in the intensive therapy groups of these trials was around 7 percent. (See "Glycemic control and vascular complications in type 1 diabetes mellitus" and "Glycemic control and vascular complications in type 2 diabetes mellitus", section on 'Microvascular disease'.)

The importance of tight glycemic control for protection against cardiovascular disease (CVD) in diabetes has been established in the DCCT/Epidemiology of Diabetes Interventions and Complications (EDIC) study for type 1 diabetes [[36](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/36)]. However, trials examining the effects of intensive therapy (achieved A1C levels of approximately 6.5 compared with 7.5 percent) on CVD in patients with long-standing type 2 diabetes had either no effect [[37](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/37)] or were associated with higher overall and cardiovascular mortality [[38](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/38)]. Thus, the trials in patients with type 2 diabetes that achieved A1C levels of approximately 6.5 percent had lower microvascular disease but either no better or worse cardiovascular effects. These trials are reviewed in detail separately. (See "Glycemic control and vascular complications in type 2 diabetes mellitus", section on 'Macrovascular disease'.)

Based upon these data, the American Diabetes Association (ADA) recommends the following [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]:

●Aim to achieve normal or near-normal glycemia with an A1C goal of <7 percent. More stringent goals (ie, a normal A1C, <6.5 percent) can be considered in individual patients. Less stringent treatment goals (eg, <8 percent) may be appropriate for patients with a history of severe hypoglycemia, patients with limited life expectancies, older adults, and individuals with comorbid conditions.

●Obtain an A1C at least twice yearly in patients who are meeting treatment goals and who have stable glycemic control and quarterly in patients whose therapy has changed or who are not meeting glycemic goals.

Nonpharmacologic therapy in type 2 diabetes — There are three major components to nonpharmacologic therapy of blood glucose in type 2 diabetes (see "Initial management of blood glucose in adults with type 2 diabetes mellitus", section on 'Intensive lifestyle modification'):

●Dietary modification

●Exercise

●Weight reduction

In addition to improving glycemic control, these changes in lifestyle also slow progression of impaired glucose tolerance to overt diabetes [[39](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/39)] (see "Prevention of type 2 diabetes mellitus"). Diet and exercise are important components of therapy in patients with type 1 diabetes. (See "Nutritional considerations in type 1 diabetes mellitus" and "Nutritional considerations in type 2 diabetes mellitus" and "Effects of exercise in adults with diabetes mellitus".)

Surgical treatment of obese patients with diabetes results in a large degree of sustained weight loss and, in parallel, the largest improvements in blood glucose control (see "Management of persistent hyperglycemia in type 2 diabetes mellitus", section on 'Surgical treatment of obesity'). Pharmacotherapy for weight loss may also be used for patients with type 2 diabetes but may not be effectively sustained due to side effects. (See "Obesity in adults: Drug therapy".)

Pharmacologic therapy for type 2 diabetes — The ADA and the European Association for the Study of Diabetes (EASD) issued a 2006 consensus statement for the management of glycemia in type 2 diabetes, which has been updated regularly [[40-42](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/40-42)]. Because of the difficulty in achieving and sustaining goal glycemia and significant weight loss, the consensus group concluded that metformin therapy should be initiated concurrent with lifestyle intervention at the time of diagnosis. (See "Initial management of blood glucose in adults with type 2 diabetes mellitus".)

The therapeutic options for patients who fail initial therapy with lifestyle intervention and metformin are to add a second oral or injectable agent, including insulin, or to switch to insulin (algorithm 1). (See "Management of persistent hyperglycemia in type 2 diabetes mellitus" and "Insulin therapy in type 2 diabetes mellitus".)

Regardless of the initial response to therapy, the natural history of most patients with type 2 diabetes is for blood glucose concentrations and A1C to rise over time (figure 5) [[32,43](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/32,43)]. The UKPDS suggested that worsening beta-cell dysfunction with decreased insulin release was primarily responsible for disease progression [[43](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/43)]. More severe insulin resistance or decreased compliance with the dietary regimen also may contribute to progression.

Type 2 diabetic patients often need large daily doses of insulin (>65 units per day and often much more) to achieve acceptable glycemic control. Most patients with type 2 diabetes can be treated initially with one or two daily injections, in contrast with patients with type 1 diabetes for whom intensive insulin therapy with multiple daily injections is indicated. (See "Insulin therapy in type 2 diabetes mellitus" and "Management of blood glucose in adults with type 1 diabetes mellitus".)

REDUCING THE RISK OF MACROVASCULAR DISEASE — Aggressive risk factor reduction lowers the risk of macrovascular complications in patients with diabetes. Thus, smoking cessation is essential for patients who smoke. Cardiovascular morbidity can also be significantly reduced with aggressive management of hypertension, cholesterol (goal low-density lipoprotein [LDL] less than 100 mg/dL [2.6 mmol/L]), and use of aspirin (75 to 162 mg/day) in patients with or at high risk for cardiovascular disease (CVD).

Men and women with diabetes are at increased risk for developing and dying from CVD [[31,44-46](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/31,44-46)]. Compared with nondiabetics, men and women with diabetes have decreased life expectancy (six to eight years less). At the time of diagnosis of type 2 diabetes, many patients already have one or more risk factors for macrovascular disease (obesity, hypertension, dyslipidemia, smoking) and many have evidence of overt atherosclerosis (past myocardial infarction [MI], ischemic changes on electrocardiogram [ECG], or peripheral vascular disease) [[7,47,48](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/7,47,48)]. (See "The metabolic syndrome (insulin resistance syndrome or syndrome X)".)

A number of modifiable risk factors for coronary heart disease (CHD) (increased LDL cholesterol, decreased high-density lipoprotein [HDL] cholesterol, elevated systolic blood pressure, hyperglycemia, smoking) were identified in a cohort of over 3000 type 2 diabetics from the United Kingdom Prospective Diabetes Study (UKPDS) [[49](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/49)]. These and other observations suggest that a substantial reduction in cardiovascular mortality could be achieved by smoking cessation, aggressive treatment of hypertension and dyslipidemia, and possibly daily low-dose aspirin (figure 6) [[50](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/50)]. (See 'Multifactorial risk factor reduction' below.)

With regard to CVD risk reduction among patients with type 2 diabetes, the benefit of good blood pressure control has been confirmed, whereas benefit from strict glycemic control has not been conclusively demonstrated [[51](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/51)]. Among patients with type 1 diabetes, the Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) study demonstrated long-term benefit of intensive glycemic management on cardiovascular outcomes, reducing fatal and nonfatal heart disease and stroke by 57 percent compared with conventional diabetes management [[36](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/36)]. (See "Glycemic control and vascular complications in type 1 diabetes mellitus" and "Glycemic control and vascular complications in type 2 diabetes mellitus" and "Treatment of hypertension in patients with diabetes mellitus".)

Smoking cessation — A survey in the United States (2001 to 2010) found that the adjusted prevalence of cigarette smoking was lower and quit attempts higher among adults with versus without diabetes [[52](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/52)]. A meta-analysis of many of the cardiovascular risk reduction trials showed that cessation of smoking had a much greater benefit on survival than most other interventions (figure 6) [[50](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/50)]. These findings suggest that discontinuation of smoking is one of the most important aspects of therapy in diabetic patients who smoke. (See "Overview of smoking cessation management in adults".)

Aspirin

Candidates — For the secondary prevention of CVD in patients with diabetes, we recommend aspirin (75 to 162 mg daily). For the primary prevention of CVD in patients with diabetes at increased cardiovascular risk (10-year risk >10 percent), we suggest aspirin (75 to 162 mg daily), although the evidence supporting this approach is weak. We do not routinely use aspirin for the prevention of CVD in adults with diabetes at low risk (10-year CVD risk <10 percent). (See 'Guidelines' below.)

●**Secondary prevention** – The merits of daily aspirin therapy in patients with existing CVD are widely accepted. A meta-analysis from the Antithrombotic Trialists' Collaboration of randomized trials of antiplatelet therapy for the secondary prevention of CVD in high-risk patients showed that aspirin produced statistically significant and clinically important reductions in the risk of subsequent MI, stroke, and vascular death among a wide range of high-risk patients (acute MI or ischemic stroke, unstable angina, prior MI or stroke, peripheral artery disease, and other high-risk groups) [[53](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/53)]. (See "Aspirin in the primary prevention of cardiovascular disease and cancer".)

In the subset of patients with diabetes, there was a nonsignificant 7 percent decrease in serious cardiovascular events [[53](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/53)].

●**Primary prevention** – The benefits of daily aspirin for the primary prevention of CVD in patients with diabetes and CVD risk factors (but without known CVD) is uncertain [[54](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/54)]. In a meta-analysis of 10 trials evaluating aspirin for the primary prevention of CVD in patients with diabetes, aspirin modestly but significantly reduced the risk of major cardiovascular events compared with placebo or no treatment (relative risk [RR] 0.90, 95% CI 0.81-0.99) [[55](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/55)]. Aspirin did not significantly reduce the risk of any of the individual endpoints (MI, CHD, stroke, CVD, or all-cause mortality). There were differences in effect according to underlying CVD risk, gender, and compliance.

The decision to use aspirin for the prevention of cardiovascular events in patients with diabetes should be made using shared decision-making on an individual basis, taking into account potential benefits and risks (see 'Bleeding' below). It is likely that there is some level of risk of CVD events that would result in a positive benefit-to-risk ratio. Larger trials in patients without overt vascular disease but who are at high risk to develop it are required to clarify this issue. Two large trials investigating the role of aspirin for the primary prevention of cardiovascular events in patients with diabetes are underway [[56-58](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/56-58)].

Bleeding — One of the main adverse effects of aspirin is bleeding. The United States Physicians' Health Study found a nonsignificant trend toward an increase in hemorrhagic stroke and an increased risk of gastrointestinal bleeding in those who took aspirin [[59](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/59)]. In a Japanese trial, there was an increase in nonfatal intracranial hemorrhage (23 versus 10 events) and subarachnoid hemorrhage (eight versus four events) in patients taking aspirin [[60](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/60)]. Extracranial hemorrhage requiring transfusion or hospitalization was also more common in the aspirin group (62 versus 34 events, hazard ratio [HR] 1.85, 95% CI 1.22-2.81).

In a population-based cohort study examining the incidence of gastrointestinal and intracranial bleeding in patients with and without diabetes taking aspirin, the incident rate of major bleeding was similar in those with and without diabetes (5.5 and 5.8 per 1000 person-years, respectively) [[61](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/61)]. The presence of diabetes itself increased the incidence of major bleeding, independent of aspirin use. In the absence of aspirin use, the incidence rate of major bleeding was 5.35 and 3.32 per 1000 person-years in those with and without diabetes, respectively. These data suggest that treatment with aspirin only marginally increases the risk of bleeding in patients with diabetes. If this finding is due to reduced efficacy of aspirin in suppressing platelet function in patients with diabetes, it may explain why aspirin is less effective in the primary prevention of cardiovascular events in patients with diabetes than in those without diabetes.

Aspirin does not appear to increase retinal hemorrhagic complications in patients with diabetic retinopathy, even if advanced. In the Early Treatment Diabetic Retinopathy Study, patients with mild to severe nonproliferative or early proliferative diabetic retinopathy had one eye treated with scatter retinal photocoagulation. The 3711 participants were also randomly assigned to receive either aspirin (650 mg/day) or placebo. During the study, periodic fundus photography of the eyes not receiving photocoagulation detected vitreous or preretinal hemorrhages in 32 versus 30 percent of patients treated with aspirin or placebo, respectively [[62](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/62)]. Approximately 40 percent of these hemorrhages produced a loss of visual acuity to less than 20/40. However, the severity and rate of resolution of these hemorrhages were not different between the aspirin- and placebo-treated groups.

This study, as well as a meta-analysis of other randomized, clinical trials, concluded that there were no ocular contraindications to the use of aspirin (650 mg/day) in persons with diabetes who require this medicine for treatment of CVD or for other medical indications [[62,63](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/62,63)].

Guidelines — Based upon these data, the American Diabetes Association (ADA) recommends the following approach [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]:

●Aspirin (75 to 162 mg/day) is recommended for secondary prevention in diabetic patients with a history of MI, vascular bypass, stroke or transient ischemic attack, peripheral vascular disease, claudication, or angina.

●Aspirin (75 to 162 mg/day) should be considered for primary prevention in any patient with diabetes at increased cardiovascular risk (10-year risk >10 percent), which would include most men or women >50 years who have at least one additional cardiovascular risk factor (eg, cigarette smoking, hypertension, obesity, albuminuria, dyslipidemia, or a family history of CHD). The ADA recognizes that the evidence to support this recommendation is weak.

●Aspirin is not recommended for CVD prevention for adults with diabetes at low risk (10-year risk <5 percent), such as men or women with diabetes aged <50 years with no major additional risk factors. In this population, the potential adverse effects from bleeding likely offset the potential benefits.

●For adults <50 years with diabetes who have multiple other cardiovascular risk factors (10-year risk between 5 and 10 percent), clinical judgement is required.

●Clopidogrel (75 mg/day) is recommended for patients with CVD and documented aspirin allergy. (See "Prevention of cardiovascular disease events in those with established disease or at high risk", section on 'Antithrombotic therapy'.)

●Dual antiplatelet therapy is reasonable for up to one year after an acute coronary syndrome.

Blood pressure control — Hypertension is a common problem in type 1 and especially in type 2 diabetes. The ADA recommends measuring blood pressure at every routine diabetes visit [[6,64](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6,64)]. Early and effective treatment of blood pressure is important, both to prevent CVD and to minimize the rate of progression of diabetic nephropathy and retinopathy.

Among patients with diabetes, goal blood pressure depends upon the method used to measure blood pressure. When the manual ausculatory method is used to measure blood pressure, we favor a goal systolic pressure of 125 to 130 mmHg. When blood pressure is measured using an automated oscillometric device, with which multiple consecutive blood pressure readings are recorded while the patient is sitting and resting alone, the goal is somewhat lower (120 to 125 mmHg). The data supporting these goals and the choice of antihypertensive drugs are discussed in detail separately. (See "Treatment of hypertension in patients with diabetes mellitus", section on 'Conclusions about goal blood pressure' and "Treatment of diabetic nephropathy" and "Blood pressure measurement in the diagnosis and management of hypertension in adults", section on 'Technique of measurement'.)

Dyslipidemia — Lipid abnormalities are common in patients with diabetes mellitus and undoubtedly contribute to the increase in risk of CVD. The ADA recommends screening for lipid disorders at the time of diabetes diagnosis, at an initial medical evaluation, and every five years thereafter and more often if indicated [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)].

We and others recommend lifestyle intervention (diet, weight loss, increased physical activity) to improve the lipid profile in all patients with diabetes [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. The initiation of statins is based upon cardiovascular risk rather than an LDL cholesterol level (table 4). In patients with clinical CVD or over age 40 years, statin therapy should be added to lifestyle intervention regardless of baseline lipid levels. For patients without clinical CVD and under age 40 years, statin therapy can be considered in addition to lifestyle intervention in those with multiple CVD risk factors. The intensity of statin therapy can be adjusted based upon CVD risk, side effects, tolerability, and LDL cholesterol levels. For patients with clinical CVD, high-intensity statin therapy is typically added to lifestyle therapy. In individuals without overt CVD, the goal LDL is <100 mg/dL (2.6 mmol/L), whereas in patients with overt CVD, a lower LDL goal (<70 mg/dL [1.8 mmol/L]) is an option [[19](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/19)]. Triglyceride levels <150 mg/dL (1.7 mmol/L) and HDL levels >40 mg/dL (1.0 mmol/L) for men and >50 mg/dL (1.3 mmol/L) for women are preferable.

The optimal therapy of dyslipidemia is discussed in detail separately. (See "Management of elevated low density lipoprotein-cholesterol (LDL-C) in primary prevention", section on 'Rationale for LDL-C lowering in primary prevention' and "Treatment of lipids (including hypercholesterolemia) in secondary prevention", section on 'Treatment in diabetes' and "Intensity of lipid lowering therapy in secondary prevention of cardiovascular disease", section on 'Summary and recommendations' and "Clinical trials of cholesterol lowering in patients with cardiovascular disease or diabetes", section on 'ACCORD Lipid trial'.)

Metformin — Metformin has been suggested to reduce the risk of macrovascular complications, independently of its effects on glycemic control. However, this effect is far from established. These issues are discussed in detail elsewhere. (See "Glycemic control and vascular complications in type 2 diabetes mellitus", section on 'UKPDS' and "Metformin in the treatment of adults with type 2 diabetes mellitus".)

Multifactorial risk factor reduction — The benefit of multiple risk factor intervention to reduce coronary risk in type 2 diabetes was demonstrated in the relatively small Steno-2 trial of 160 subjects with microalbuminuria who were randomly assigned to either conventional therapy or an intensive therapy regimen, which included the following [[65](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/65)]:

●Reduced dietary fat

●Light to moderate exercise

●Smoking cessation

●Tight glycemic control (target A1C <6.5 percent with intensive therapy)

●Tight blood pressure control (target <140/85 mmHg for most of the study and <130/80 mmHg for the last two years)

●Angiotensin-converting enzyme (ACE) inhibitor therapy regardless of blood pressure

●Lipid-lowering therapy (target total cholesterol <190 mg/dL [4.9 mmol/L] for most of the study and <175 mg/dL [4.5 mmol/L] for the last two years; target fasting serum triglyceride <150 mg/dL [1.7 mmol/L])

●Aspirin

●Vitamin C, vitamin D, folate, and chrome picolinate

The attained differences between the two groups revealed significantly greater improvements with intensive therapy in glycemic control (A1C -0.5 versus +0.2 percent with conventional therapy), blood pressure control (-14/12 versus -3/8 mmHg), and total cholesterol (-50 versus -3 mg/dL [-1.3 versus -0.08 mmol/L]).

At a mean of 7.8 years, patients on intensive therapy had a significant reduction in the primary aggregate endpoint of cardiovascular death, nonfatal MI, coronary artery bypass grafting, percutaneous coronary intervention, stroke, amputation, or peripheral vascular surgery (18 versus 38 percent, HR 0.47, 95% CI 0.22-0.74). Significant reductions were also seen in progression of nephropathy, retinopathy, and autonomic neuropathy.

After the intervention study ended, 130 remaining patients participated in an observational follow-up study (5.5 years), during which time all participants were encouraged to follow intensive multifactorial treatment regimens [[66](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/66)]. At the end of the follow-up period, A1C values were similar in the groups previously assigned to intensive and conventional therapy (7.7 and 8.0 percent, respectively). Blood pressure, body mass index (BMI), and fasting serum cholesterol and triglycerides were also similar.

During the entire follow-up period (13.3 years), there were fewer deaths (30 versus 50 percent) in the intensive therapy group (HR for death 0.54, 95% CI 0.32-0.89). Intensive therapy was also associated with a lower risk of cardiovascular deaths (HR 0.43, 95% CI 0.19-0.94), which was a predefined secondary endpoint. Progression of diabetic retinopathy, nephropathy, and autonomic neuropathy occurred less frequently in the intensive group. These results suggest a sustained benefit of multifactorial risk reduction.

In spite of evidence that aggressive risk factor reduction lowers the risk of both micro- and macrovascular complications in patients with diabetes, the vast majority of patients do not achieve recommended goals for A1C, blood pressure control, and management of dyslipidemia [[65,67](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/65,67)]. It is notable that only one patient in the observational Steno study described above reached all five treatment goals at the end of follow-up. Thus, renewed efforts to implement multifactorial risk factor reduction strategies early in the course of type 2 diabetes are necessary. (See 'Adequacy of care' below.)

OTHER ASPECTS OF HEALTH MAINTENANCE

Routine health maintenance — The potential exists for the clinician to overlook health maintenance not specifically targeted at diabetes, given the intensity and complexity of care required for prevention and treatment of complications in diabetic patients [[68](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/68)]. (See "Preventive care in adults: Recommendations".)

Vaccination — Patients with diabetes mellitus should receive influenza vaccination yearly and pneumococcal vaccination, repeating the pneumococcal vaccine once after age 65 years if the initial vaccination was prior to age 65. In observational studies, influenza vaccine has been shown to be similarly effective in adults <65 years of age with diabetes as in older patients with or without diabetes [[69,70](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/69,70)]. (See "Seasonal influenza vaccination in adults" and "Pneumococcal vaccination in adults", section on 'Indications'.)

The hepatitis B vaccination should be given to unvaccinated adults with diabetes mellitus who are ages 19 to 59 years. For older adult patients with diabetes, vaccination can be administered at the discretion of the treating clinician based upon the risk of acquiring hepatitis B virus (HBV) and the likelihood of an adequate immune response to vaccination. This recommendation is based on outbreaks of hepatitis B in patients who were undergoing blood glucose monitoring in nursing homes or assisted-living facilities, a subsequent analysis of the risk of acquiring HBV among all diabetics in the United States, and a cost-effectiveness analysis [[71](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/71)]. Tetanus and diphtheria vaccinations should also be updated. (See "Hepatitis B virus vaccination" and "Tetanus-diphtheria toxoid vaccination in adults".)

Women of childbearing age — We recommend that the most reliable method of contraception be used, when not contraindicated by other health concerns, because the risk of unplanned pregnancy is significant.

Contraception and pregnancy planning should be discussed with all diabetic women who are premenopausal. For women who do not wish to become pregnant, American Diabetes Association (ADA) guidelines state that the selection of a contraceptive method for an individual patient should use the same guidelines that apply to women without diabetes [[6](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6)]. Types of hormonal and nonhormonal contraception and important factors in choosing a contraceptive method are reviewed separately. (See "Pregestational diabetes: Preconception counseling, evaluation, and management", section on 'Contraception and timing of pregnancy' and "Contraceptive counseling and selection" and "Risks and side effects associated with estrogen-progestin contraceptives".)

For women with diabetes who are contemplating pregnancy, prepregnancy counseling and planning is important. Prior to pregnancy, glycemic control should be optimized, and both angiotensin-converting enzyme (ACE) inhibitor and statin medications should be discontinued (table 5). (See "Pregestational diabetes: Preconception counseling, evaluation, and management", section on 'Medication management'.)

ADEQUACY OF CARE — Despite extensive data suggesting large benefits with preventive and treatment strategies and despite increasing media attention, many patients with diabetes are not receiving recommended levels of health care, including older patients [[72,73](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/72,73)]; patients with limited proficiency in English, financial hardships, or complex comorbidities; and those from countries with fewer resources to manage diabetes [[19,74-76](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/19,74-76)]. Even when recommended screening data are obtained, rates of medication adjustment to address abnormal results are low [[77,78](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/77,78)].

There are several reasons for the large discrepancy between what should be done and what is being done:

●Treatment of acute and chronic disease – Traditional medical practice is organized to respond quickly to acute patient problems but does not adequately serve the needs of those with a chronic illness such as diabetes mellitus [[79](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/79)].

●Clinical inertia – Failure to make adjustments in a therapeutic regimen in response to an abnormal clinical result has been termed "clinical inertia" [[80](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/80)]. Numerous factors may be contributory: lack of awareness of therapeutic goals, reluctance to treat asymptomatic conditions, concern about patient's pill burden, time limitations, or attention to acute medical issues that take priority over risk factor management [[81](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/81)]. In one study of modifications in therapy for various cardiovascular risk conditions, medication adjustments were made for 66 percent of patients whose A1C level was >8 percent [[81](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/81)].

●Lack of an organized system for care – Outcomes are better when diabetic patients are seen in the context of organized programs with a coordinated team of health professionals [[19,82](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/19,82)]. However, most of the trials examining the effectiveness of disease management programs report surrogate outcomes (eg, A1C, low-density lipoprotein [LDL] cholesterol) rather than patient-important outcomes, such as quality of life, cardiovascular disease (CVD), and mortality [[83](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/83)].

Several approaches have been tried in order to improve the care of patients with diabetes. These include the following:

●"Diabetes mini-clinics" [[84,85](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/84,85)]

●Better organization and delivery of patient education [[86,87](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/86,87)]

●Structured behavioral intervention [[88,89](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/88,89)]

●Management by nurse specialists under the supervision of a diabetologist [[90,91](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/90,91)]

●Multidisciplinary disease management programs [[92-94](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/92-94)]

●Group medical visits [[95](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/95)]

●Telecare intervention via web-based systems or mobile devices [[96-98](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/96-98)]

The growing use of electronic health records with embedded guidelines and reminders at the point of care about appropriate interventions may make it easier to deliver more appropriate diabetes care in a number of settings. Processes of care (performance of retinal examination, foot exam, A1C measurements, lipid testing, nephropathy screening, flu vaccination, aspirin therapy) may be more readily improved by disease management interventions than intermediate outcomes (blood pressure control, lipid control, or A1C level) [[94](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/94)].

Several organizations are encouraging adherence to routine standards of care for diabetic patients by auditing charts or by asking for data on random samples of diabetic patients. The most comprehensive set of diabetes measures was launched by the American Diabetes Association (ADA), cosponsored by the National Committee for Quality Assurance. Individual providers or groups of providers may apply to receive recognition that they are delivering a certain standard of diabetes care. Recognition requires review of the medical chart, laboratory data, and a patient survey and measures eye, foot, and renal care; cardiac risk reduction; glycemic control; and patient satisfaction (table 6). Further information is available through the [National Committee for Quality Assurance](http://external-redirect.do/?target_url=http%3A%2F%2Fwww.ncqa.org%2Ftabid%2F139%2FDefault.aspx&TOPIC_ID=1750).

INDICATIONS FOR REFERRAL — Intensive insulin therapy is recommended for the majority of patients with type 1 diabetes, and therefore, patients with type 1 diabetes should be referred to an endocrinologist for management of diabetes.

The majority of patients with type 2 diabetes (greater than 90 percent) receive their routine care from primary care providers. A major unresolved controversy is the place of the generalist and the specialist in the treatment of patients with type 2 diabetes. Studies comparing care by specialists and generalists have generated conflicting findings [[99-103](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/99-103)]. For most patients with type 2 diabetes, care can be delivered by primary care providers and their health care teams in coordination with other specialists where appropriate. Patients in need of insulin therapy should be managed by or in consultation with an endocrinologist, if at all possible.

The decision to refer to an endocrinologist with expertise in diabetes management usually hinges on the complexity of the patient, the ability of the primary care team to achieve established goals of care in an individual, the need to manage diverse complications, and other factors such as the capacity of the primary care practitioner to teach self-management skills such as monitoring and insulin injections. Conversely, some specialty diabetes treatment practices have recognized the large overlap in the care that they provide with primary care and have taken on the responsibility of providing primary care for their patients. The ideal balance between primary and subspecialty care for the ever-increasing population of patients with type 2 diabetes will vary based on the resources and expertise available in different communities.

SOCIETY GUIDELINE LINKS — Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Diabetes mellitus in adults".)

INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

●Basics topics (see "Patient education: The ABCs of diabetes (The Basics)" and "Patient education: Type 1 diabetes (The Basics)" and "Patient education: Type 2 diabetes (The Basics)" and "Patient education: Treatment for type 2 diabetes (The Basics)" and "Patient education: Diabetic retinopathy (The Basics)" and "Patient education: Reducing the costs of medicines (The Basics)")

●Beyond the Basics topics (see "Patient education: Diabetes mellitus type 1: Overview (Beyond the Basics)" and "Patient education: Diabetes mellitus type 2: Overview (Beyond the Basics)" and "Patient education: Diabetes mellitus type 2: Treatment (Beyond the Basics)" and "Patient education: Reducing the costs of medicines (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

●Morbidity from diabetes involves both macrovascular (atherosclerosis) and microvascular (retinopathy, nephropathy, and neuropathy) disease. Interventions can limit end organ damage, and therefore, patients with diabetes require initial and ongoing evaluation for diabetes-related complications. We perform a history and physical exam two to three times yearly to obtain information on nutrition, physical activity, reduction of cardiovascular risk factors, current management, and diabetes-related complications (table 1). (See 'Initial' above and 'Diabetes-related complications' above.)

●Glycemic control can minimize risks for retinopathy, nephropathy, and neuropathy in both type 1 and type 2 diabetes and has been shown to decrease the risk for cardiovascular disease (CVD) for type 1 diabetes. (See 'Glycemic control' above and "Glycemic control and vascular complications in type 2 diabetes mellitus" and "Glycemic control and vascular complications in type 1 diabetes mellitus".)

●Glycated hemoglobin (A1C) goals in patients with diabetes should be tailored to the individual, balancing the improvement in microvascular complications with the risk of hypoglycemia. A reasonable goal of therapy might be an A1C value of ≤7.0 percent for most patients (using an assay in which the upper limit of normal is 6.0 percent). Glycemic targets are generally set somewhat higher (eg, <8 percent) for older adult patients and those with comorbidities or a limited life expectancy and little likelihood of benefit from intensive therapy. More stringent control (A1C <6 percent) may be indicated for individual patients with type 1 diabetes and during pregnancy. (See 'Monitoring and target A1C' above and "Glycemic control and vascular complications in type 2 diabetes mellitus", section on 'Glycemic targets' and "Glycemic control and vascular complications in type 1 diabetes mellitus", section on 'Glycemic targets' and "Pregestational diabetes mellitus: Glycemic control during pregnancy", section on 'Target blood glucose values'.)

●Prevention of cardiovascular morbidity is a major priority for patients with diabetes, especially type 2. Smoking cessation is essential for patients who smoke. Cardiovascular morbidity can also be significantly reduced with aggressive management of hypertension, cholesterol, and use of aspirin (75 to 162 mg/day) in patients with or at high risk for CVD. (See 'Reducing the risk of macrovascular disease' above and "Treatment of hypertension in patients with diabetes mellitus", section on 'Goal blood pressure'.)

●Many patients with diabetes are not receiving recommended levels of health care, and development of systems of care, involving disease management principles, may be important in delivering improved care. (See 'Adequacy of care' above.)

●Intensive insulin therapy is recommended for the majority of patients with type 1 diabetes, and therefore, patients with type 1 diabetes should be referred to an endocrinologist for management of diabetes. For most patients with type 2 diabetes, care can be delivered by primary care providers and their health care teams in coordination with other specialists where appropriate. Patients in need of insulin therapy should be managed by or in consultation with an endocrinologist, if at all possible. The decision to refer to an endocrinologist with expertise in diabetes management usually hinges on the complexity of the patient, the ability of the primary care team to achieve established goals of care in an individual, the need to manage diverse complications, and other factors such as the capacity of the primary care practitioner to teach self-management skills such as monitoring and insulin injections. (See 'Indications for referral' above.)

Use of UpToDate is subject to the [Subscription and License Agreement](https://www.uptodate.com/contents/license).

**REFERENCES**

|  |  |
| --- | --- |
| 1 | [Li C, Balluz LS, Okoro CA, et al. Surveillance of certain health behaviors and conditions among states and selected local areas --- Behavioral Risk Factor Surveillance System, United States, 2009. MMWR Surveill Summ 2011; 60:1.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/1) |
| 2 | Centers for Disease Control and Prevention. 2011 National Diabetes Fact Sheet <http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf> (Accessed on June 20, 2013). |
| 3 | [Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA 2003; 289:76.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/3) |
| 4 | [Kan C, Silva N, Golden SH, et al. A systematic review and meta-analysis of the association between depression and insulin resistance. Diabetes Care 2013; 36:480.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/4) |
| 5 | [Tunceli K, Bradley CJ, Nerenz D, et al. The impact of diabetes on employment and work productivity. Diabetes Care 2005; 28:2662.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/5) |
| 6 | [Standards of Medical Care in Diabetes-2017: Summary of Revisions. Diabetes Care 2017; 40:S4.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/6) |
| 7 | [Harris MI, Klein R, Welborn TA, Knuiman MW. Onset of NIDDM occurs at least 4-7 yr before clinical diagnosis. Diabetes Care 1992; 15:815.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/7) |
| 8 | [Gregg EW, Li Y, Wang J, et al. Changes in diabetes-related complications in the United States, 1990-2010. N Engl J Med 2014; 370:1514.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/8) |
| 9 | [Kennon B, Leese GP, Cochrane L, et al. Reduced incidence of lower-extremity amputations in people with diabetes in Scotland: a nationwide study. Diabetes Care 2012; 35:2588.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/9) |
| 10 | [Booth GL, Kapral MK, Fung K, Tu JV. Recent trends in cardiovascular complications among men and women with and without diabetes. Diabetes Care 2006; 29:32.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/10) |
| 11 | [Vamos EP, Bottle A, Edmonds ME, et al. Changes in the incidence of lower extremity amputations in individuals with and without diabetes in England between 2004 and 2008. Diabetes Care 2010; 33:2592.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/11) |
| 12 | [Pasquale LR, Kang JH, Manson JE, et al. Prospective study of type 2 diabetes mellitus and risk of primary open-angle glaucoma in women. Ophthalmology 2006; 113:1081.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/12) |
| 13 | [Obrosova IG, Chung SS, Kador PF. Diabetic cataracts: mechanisms and management. Diabetes Metab Res Rev 2010; 26:172.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/13) |
| 14 | [Centers for Disease Control and Prevention (CDC). Correctable visual impairment among persons with diabetes--United States, 1999-2004. MMWR Morb Mortal Wkly Rep 2006; 55:1169.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/14) |
| 15 | [Mogensen CE, Vestbo E, Poulsen PL, et al. Microalbuminuria and potential confounders. A review and some observations on variability of urinary albumin excretion. Diabetes Care 1995; 18:572.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/15) |
| 16 | [Mogensen CE. Prediction of clinical diabetic nephropathy in IDDM patients. Alternatives to microalbuminuria? Diabetes 1990; 39:761.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/16) |
| 17 | [Qaseem A, Hopkins RH Jr, Sweet DE, et al. Screening, monitoring, and treatment of stage 1 to 3 chronic kidney disease: A clinical practice guideline from the American College of Physicians. Ann Intern Med 2013; 159:835.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/17) |
| 18 | [Colberg SR, Sigal RJ, Fernhall B, et al. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement. Diabetes Care 2010; 33:e147.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/18) |
| 19 | [American Diabetes Association. Standards of medical care in diabetes--2014. Diabetes Care 2014; 37 Suppl 1:S14.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/19) |
| 20 | [Wackers FJ, Young LH, Inzucchi SE, et al. Detection of silent myocardial ischemia in asymptomatic diabetic subjects: the DIAD study. Diabetes Care 2004; 27:1954.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/20) |
| 21 | [Scognamiglio R, Negut C, Ramondo A, et al. Detection of coronary artery disease in asymptomatic patients with type 2 diabetes mellitus. J Am Coll Cardiol 2006; 47:65.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/21) |
| 22 | [American Diabetes Association. 3. Comprehensive Medical Evaluation and Assessment of Comorbidities. Diabetes Care 2017; 40:S25.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/22) |
| 23 | [Centers for Disease Control and Prevention (CDC). Dental visits among dentate adults with diabetes--United States, 1999 and 2004. MMWR Morb Mortal Wkly Rep 2005; 54:1181.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/23) |
| 24 | [Inoue M, Iwasaki M, Otani T, et al. Diabetes mellitus and the risk of cancer: results from a large-scale population-based cohort study in Japan. Arch Intern Med 2006; 166:1871.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/24) |
| 25 | [Stattin P, Björ O, Ferrari P, et al. Prospective study of hyperglycemia and cancer risk. Diabetes Care 2007; 30:561.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/25) |
| 26 | [Hemminki K, Li X, Sundquist J, Sundquist K. Risk of cancer following hospitalization for type 2 diabetes. Oncologist 2010; 15:548.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/26) |
| 27 | [Giovannucci E, Harlan DM, Archer MC, et al. Diabetes and cancer: a consensus report. Diabetes Care 2010; 33:1674.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/27) |
| 28 | [Larsson SC, Mantzoros CS, Wolk A. Diabetes mellitus and risk of breast cancer: a meta-analysis. Int J Cancer 2007; 121:856.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/28) |
| 29 | [Tsilidis KK, Kasimis JC, Lopez DS, et al. Type 2 diabetes and cancer: umbrella review of meta-analyses of observational studies. BMJ 2015; 350:g7607.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/29) |
| 30 | [Liao WC, Tu YK, Wu MS, et al. Blood glucose concentration and risk of pancreatic cancer: systematic review and dose-response meta-analysis. BMJ 2015; 349:g7371.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/30) |
| 31 | [Emerging Risk Factors Collaboration, Seshasai SR, Kaptoge S, et al. Diabetes mellitus, fasting glucose, and risk of cause-specific death. N Engl J Med 2011; 364:829.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/31) |
| 32 | [Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. Lancet 1998; 352:837.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/32) |
| 33 | [Diabetes Control and Complications Trial Research Group, Nathan DM, Genuth S, et al. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993; 329:977.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/33) |
| 34 | [United Kingdom Prospective Diabetes Study (UKPDS). 13: Relative efficacy of randomly allocated diet, sulphonylurea, insulin, or metformin in patients with newly diagnosed non-insulin dependent diabetes followed for three years. BMJ 1995; 310:83.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/34) |
| 35 | [Ohkubo Y, Kishikawa H, Araki E, et al. Intensive insulin therapy prevents the progression of diabetic microvascular complications in Japanese patients with non-insulin-dependent diabetes mellitus: a randomized prospective 6-year study. Diabetes Res Clin Pract 1995; 28:103.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/35) |
| 36 | [Nathan DM, Cleary PA, Backlund JY, et al. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. N Engl J Med 2005; 353:2643.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/36) |
| 37 | [ADVANCE Collaborative Group, Patel A, MacMahon S, et al. Intensive blood glucose control and vascular outcomes in patients with type 2 diabetes. N Engl J Med 2008; 358:2560.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/37) |
| 38 | [Action to Control Cardiovascular Risk in Diabetes Study Group, Gerstein HC, Miller ME, et al. Effects of intensive glucose lowering in type 2 diabetes. N Engl J Med 2008; 358:2545.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/38) |
| 39 | [Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002; 346:393.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/39) |
| 40 | [Nathan DM, Buse JB, Davidson MB, et al. Management of hyperglycemia in type 2 diabetes: A consensus algorithm for the initiation and adjustment of therapy: a consensus statement from the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care 2006; 29:1963.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/40) |
| 41 | [Nathan DM, Buse JB, Davidson MB, et al. Medical management of hyperglycemia in type 2 diabetes: a consensus algorithm for the initiation and adjustment of therapy: a consensus statement of the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care 2009; 32:193.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/41) |
| 42 | [Inzucchi SE, Bergenstal RM, Buse JB, et al. Management of hyperglycemia in type 2 diabetes, 2015: a patient-centered approach: update to a position statement of the American Diabetes Association and the European Association for the Study of Diabetes. Diabetes Care 2015; 38:140.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/42) |
| 43 | [U.K. prospective diabetes study 16. Overview of 6 years' therapy of type II diabetes: a progressive disease. U.K. Prospective Diabetes Study Group. Diabetes 1995; 44:1249.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/43) |
| 44 | [Franco OH, Steyerberg EW, Hu FB, et al. Associations of diabetes mellitus with total life expectancy and life expectancy with and without cardiovascular disease. Arch Intern Med 2007; 167:1145.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/44) |
| 45 | [Livingstone SJ, Levin D, Looker HC, et al. Estimated life expectancy in a Scottish cohort with type 1 diabetes, 2008-2010. JAMA 2015; 313:37.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/45) |
| 46 | [Tancredi M, Rosengren A, Svensson AM, et al. Excess Mortality among Persons with Type 2 Diabetes. N Engl J Med 2015; 373:1720.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/46) |
| 47 | [Uusitupa MI, Niskanen LK, Siitonen O, et al. Ten-year cardiovascular mortality in relation to risk factors and abnormalities in lipoprotein composition in type 2 (non-insulin-dependent) diabetic and non-diabetic subjects. Diabetologia 1993; 36:1175.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/47) |
| 48 | [Stamler J, Vaccaro O, Neaton JD, Wentworth D. Diabetes, other risk factors, and 12-yr cardiovascular mortality for men screened in the Multiple Risk Factor Intervention Trial. Diabetes Care 1993; 16:434.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/48) |
| 49 | [Turner RC, Millns H, Neil HA, et al. Risk factors for coronary artery disease in non-insulin dependent diabetes mellitus: United Kingdom Prospective Diabetes Study (UKPDS: 23). BMJ 1998; 316:823.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/49) |
| 50 | [Yudkin JS. How can we best prolong life? Benefits of coronary risk factor reduction in non-diabetic and diabetic subjects. BMJ 1993; 306:1313.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/50) |
| 51 | [Mogensen CE. Combined high blood pressure and glucose in type 2 diabetes: double jeopardy. British trial shows clear effects of treatment, especially blood pressure reduction. BMJ 1998; 317:693.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/51) |
| 52 | [Fan AZ, Rock V, Zhang X, et al. Trends in cigarette smoking rates and quit attempts among adults with and without diagnosed diabetes, United States, 2001-2010. Prev Chronic Dis 2013; 10:E160.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/52) |
| 53 | [Antithrombotic Trialists' Collaboration. Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients. BMJ 2002; 324:71.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/53) |
| 54 | [Capodanno D, Angiolillo DJ. Aspirin for Primary Cardiovascular Risk Prevention and Beyond in Diabetes Mellitus. Circulation 2016; 134:1579.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/54) |
| 55 | [Kunutsor SK, Seidu S, Khunti K. Aspirin for primary prevention of cardiovascular and all-cause mortality events in diabetes: updated meta-analysis of randomized controlled trials. Diabet Med 2017; 34:316.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/55) |
| 56 | [De Berardis G, Sacco M, Evangelista V, et al. Aspirin and Simvastatin Combination for Cardiovascular Events Prevention Trial in Diabetes (ACCEPT-D): design of a randomized study of the efficacy of low-dose aspirin in the prevention of cardiovascular events in subjects with diabetes mellitus treated with statins. Trials 2007; 8:21.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/56) |
| 57 | [Nicolucci A. Aspirin for primary prevention of cardiovascular events in diabetes: still an open question. JAMA 2008; 300:2180.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/57) |
| 58 | [Gaziano JM, Greenland P. When should aspirin be used for prevention of cardiovascular events? JAMA 2014; 312:2503.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/58) |
| 59 | [Steering Committee of the Physicians' Health Study Research Group. Final report on the aspirin component of the ongoing Physicians' Health Study. N Engl J Med 1989; 321:129.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/59) |
| 60 | [Ikeda Y, Shimada K, Teramoto T, et al. Low-dose aspirin for primary prevention of cardiovascular events in Japanese patients 60 years or older with atherosclerotic risk factors: a randomized clinical trial. JAMA 2014; 312:2510.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/60) |
| 61 | [De Berardis G, Lucisano G, D'Ettorre A, et al. Association of aspirin use with major bleeding in patients with and without diabetes. JAMA 2012; 307:2286.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/61) |
| 62 | [Chew EY, Klein ML, Murphy RP, et al. Effects of aspirin on vitreous/preretinal hemorrhage in patients with diabetes mellitus. Early Treatment Diabetic Retinopathy Study report no. 20. Arch Ophthalmol 1995; 113:52.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/62) |
| 63 | [Bergerhoff K, Clar C, Richter B. Aspirin in diabetic retinopathy. A systematic review. Endocrinol Metab Clin North Am 2002; 31:779.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/63) |
| 64 | [Buse JB, Ginsberg HN, Bakris GL, et al. Primary prevention of cardiovascular diseases in people with diabetes mellitus: a scientific statement from the American Heart Association and the American Diabetes Association. Circulation 2007; 115:114.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/64) |
| 65 | [Gaede P, Vedel P, Larsen N, et al. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. N Engl J Med 2003; 348:383.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/65) |
| 66 | [Gaede P, Lund-Andersen H, Parving HH, Pedersen O. Effect of a multifactorial intervention on mortality in type 2 diabetes. N Engl J Med 2008; 358:580.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/66) |
| 67 | [Ji L, Hu D, Pan C, et al. Primacy of the 3B approach to control risk factors for cardiovascular disease in type 2 diabetes patients. Am J Med 2013; 126:925.e11.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/67) |
| 68 | [Fenton JJ, Von Korff M, Lin EH, et al. Quality of preventive care for diabetes: effects of visit frequency and competing demands. Ann Fam Med 2006; 4:32.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/68) |
| 69 | [Lau D, Eurich DT, Majumdar SR, et al. Effectiveness of influenza vaccination in working-age adults with diabetes: a population-based cohort study. Thorax 2013; 68:658.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/69) |
| 70 | [Looijmans-Van den Akker I, Verheij TJ, Buskens E, et al. Clinical effectiveness of first and repeat influenza vaccination in adult and elderly diabetic patients. Diabetes Care 2006; 29:1771.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/70) |
| 71 | [Centers for Disease Control and Prevention (CDC). Use of hepatitis B vaccination for adults with diabetes mellitus: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2011; 60:1709.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/71) |
| 72 | [Lutfiyya MN, McCullough JE, Mitchell L, et al. Adequacy of diabetes care for older U.S. rural adults: a cross-sectional population based study using 2009 BRFSS data. BMC Public Health 2011; 11:940.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/72) |
| 73 | [McBean AM, Yu X. The underuse of screening services among elderly women with diabetes. Diabetes Care 2007; 30:1466.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/73) |
| 74 | [Fernandez A, Schillinger D, Warton EM, et al. Language barriers, physician-patient language concordance, and glycemic control among insured Latinos with diabetes: the Diabetes Study of Northern California (DISTANCE). J Gen Intern Med 2011; 26:170.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/74) |
| 75 | [Kerr EA, Heisler M, Krein SL, et al. Beyond comorbidity counts: how do comorbidity type and severity influence diabetes patients' treatment priorities and self-management? J Gen Intern Med 2007; 22:1635.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/75) |
| 76 | [Alegre-Díaz J, Herrington W, López-Cervantes M, et al. Diabetes and Cause-Specific Mortality in Mexico City. N Engl J Med 2016; 375:1961.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/76) |
| 77 | [Grant RW, Buse JB, Meigs JB, University HealthSystem Consortium (UHC) Diabetes Benchmarking Project Team. Quality of diabetes care in U.S. academic medical centers: low rates of medical regimen change. Diabetes Care 2005; 28:337.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/77) |
| 78 | [Khunti K, Wolden ML, Thorsted BL, et al. Clinical inertia in people with type 2 diabetes: a retrospective cohort study of more than 80,000 people. Diabetes Care 2013; 36:3411.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/78) |
| 79 | [Wagner EH, Austin BT, Von Korff M. Organizing care for patients with chronic illness. Milbank Q 1996; 74:511.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/79) |
| 80 | [Phillips LS, Branch WT, Cook CB, et al. Clinical inertia. Ann Intern Med 2001; 135:825.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/80) |
| 81 | [Rodondi N, Peng T, Karter AJ, et al. Therapy modifications in response to poorly controlled hypertension, dyslipidemia, and diabetes mellitus. Ann Intern Med 2006; 144:475.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/81) |
| 82 | [Pimouguet C, Le Goff M, Thiébaut R, et al. Effectiveness of disease-management programs for improving diabetes care: a meta-analysis. CMAJ 2011; 183:E115.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/82) |
| 83 | [Egginton JS, Ridgeway JL, Shah ND, et al. Care management for Type 2 diabetes in the United States: a systematic review and meta-analysis. BMC Health Serv Res 2012; 12:72.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/83) |
| 84 | [Hurwitz B, Goodman C, Yudkin J. Prompting the clinical care of non-insulin dependent (type II) diabetic patients in an inner city area: one model of community care. BMJ 1993; 306:624.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/84) |
| 85 | [MacKinnon M. General practice diabetes care: the past, the present and the future. Diabet Med 1990; 7:171.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/85) |
| 86 | [Gruesser M, Bott U, Ellermann P, et al. Evaluation of a structured treatment and teaching program for non-insulin-treated type II diabetic outpatients in Germany after the nationwide introduction of reimbursement policy for physicians. Diabetes Care 1993; 16:1268.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/86) |
| 87 | [Sperl-Hillen J, Beaton S, Fernandes O, et al. Comparative effectiveness of patient education methods for type 2 diabetes: a randomized controlled trial. Arch Intern Med 2011; 171:2001.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/87) |
| 88 | [Pillay J, Armstrong MJ, Butalia S, et al. Behavioral Programs for Type 2 Diabetes Mellitus: A Systematic Review and Network Meta-analysis. Ann Intern Med 2015; 163:848.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/88) |
| 89 | [Pillay J, Armstrong MJ, Butalia S, et al. Behavioral Programs for Type 1 Diabetes Mellitus: A Systematic Review and Meta-analysis. Ann Intern Med 2015; 163:836.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/89) |
| 90 | [Thompson DM, Kozak SE, Sheps S. Insulin adjustment by a diabetes nurse educator improves glucose control in insulin-requiring diabetic patients: a randomized trial. CMAJ 1999; 161:959.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/90) |
| 91 | [Legorreta AP, Peters AL, Ossorio RC, et al. Effect of a comprehensive nurse-managed program: an HMO prospective study. Am J Manag Care 1996; 2:1024.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/91) |
| 92 | [Espinet LM, Osmick MJ, Ahmed T, Villagra VG. A cohort study of the impact of a national disease management program on HEDIS diabetes outcomes. Dis Manag 2005; 8:86.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/92) |
| 93 | [Rothman RL, Malone R, Bryant B, et al. A randomized trial of a primary care-based disease management program to improve cardiovascular risk factors and glycated hemoglobin levels in patients with diabetes. Am J Med 2005; 118:276.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/93) |
| 94 | [Mangione CM, Gerzoff RB, Williamson DF, et al. The association between quality of care and the intensity of diabetes disease management programs. Ann Intern Med 2006; 145:107.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/94) |
| 95 | [Housden L, Wong ST, Dawes M. Effectiveness of group medical visits for improving diabetes care: a systematic review and meta-analysis. CMAJ 2013; 185:E635.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/95) |
| 96 | [Huang Z, Tao H, Meng Q, Jing L. Management of endocrine disease. Effects of telecare intervention on glycemic control in type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. Eur J Endocrinol 2015; 172:R93.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/96) |
| 97 | [Montori VM, Helgemoe PK, Guyatt GH, et al. Telecare for patients with type 1 diabetes and inadequate glycemic control: a randomized controlled trial and meta-analysis. Diabetes Care 2004; 27:1088.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/97) |
| 98 | [Liang X, Wang Q, Yang X, et al. Effect of mobile phone intervention for diabetes on glycaemic control: a meta-analysis. Diabet Med 2011; 28:455.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/98) |
| 99 | [Verlato G, Muggeo M, Bonora E, et al. Attending the diabetes center is associated with increased 5-year survival probability of diabetic patients: the Verona Diabetes Study. Diabetes Care 1996; 19:211.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/99) |
| 100 | [Greenfield S, Rogers W, Mangotich M, et al. Outcomes of patients with hypertension and non-insulin dependent diabetes mellitus treated by different systems and specialties. Results from the medical outcomes study. JAMA 1995; 274:1436.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/100) |
| 101 | [Greenfield S. Comparison by systems and specialties of medical outcomes in patients with hypertension and non-insulin dependent diabetes mellitus. Am J Manag Care 1996; 2:535.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/101) |
| 102 | [Ho M, Marger M, Beart J, et al. Is the quality of diabetes care better in a diabetes clinic or in a general medicine clinic? Diabetes Care 1997; 20:472.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/102) |
| 103 | [Zgibor JC, Songer TJ, Kelsey SF, et al. Influence of health care providers on the development of diabetes complications: long-term follow-up from the Pittsburgh Epidemiology of Diabetes Complications Study. Diabetes Care 2002; 25:1584.](https://www.uptodate.com/contents/overview-of-medical-care-in-adults-with-diabetes-mellitus/abstract/103) |

Topic 1750 Version 59.0

  All rights reserved. 

© 2017 UpToDate, Inc.

***Contributor Disclosures:*** **David K McCulloch, MD**Nothing to disclose. **David M Nathan, MD**Nothing to disclose. **Jean E Mulder, MD**Nothing to disclose.

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.