Achieving Control of Diabetic Risk Factors in Primary Care Settings

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AUDIENCE

This activity is designed for primary care physicians, nurse-practitioners, and other diabetes care providers; medical directors; and managed care organizations. There are no prerequisites.

OBJECTIVES

At the conclusion of this activity, participants should be able to:

1. Describe the epidemiology of diabetes and its complications.
2. Explain the relationship between glycemic control and outcomes.
3. Highlight the importance of control of hypertension and other risk factors for cardiovascular disease in patients with diabetes.
4. Identify barriers to achieving quality care for adult diabetes patients and to describe ways to surmount these barriers.

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The prevalence of diabetes mellitus, specifically type 2 diabetes, is increasing in the United States. It is a complex endocrine disorder that causes hyperglycemia and disease of multiple organ systems. Diabetes increases the risk of cardiovascular disease, both independently and because of its association with hypertension and lipid abnormalities. An increasing amount of evidence shows that blood glucose and blood pressure control can avert complications of diabetes. Despite these studies and the availability of guidelines for diabetes management, many patients receive suboptimal care. This review discusses the epidemiology, pathophysiology, and treatment of diabetes; American Diabetes Association (ADA) practice guidelines; barriers to achieving high-quality care; and successful study protocols in managed care settings.

··· EPIDEMIOLOGY ···

The prevalence of diagnosed diabetes in the US population rose 33% in the 1990s, from 4.9% in 1990 to 6.5% in 1998. The most striking increase (70%) was among those aged 30 to 39 years, but the prevalence rose in all age groups, in whites as well as ethnic minorities.[1] The true prevalence of diabetes is likely higher. Because many people have undiagnosed diabetes, it was estimated that by 1994 as many as 12.3% of persons aged 40 to 74 years old had type 2 diabetes.[2] People with diabetes are at significant risk for numerous health complications: cardiovascular disease, including ischemic heart disease, stroke, peripheral arterial disease, and amputation; nephropathy, neuropathy, and retinopathy; and the specific metabolic complications associated with diabetes such as ketoacidosis, hyperosmolar syndrome, and hypoglycemia.[3] All-cause mortality rates are twice as high in males and

females with diabetes compared to non-diabetic persons, resulting in many premature deaths. Cardiovascular disease is by far the leading cause of death for adults with diabetes. In fact, persons with diabetes are 3 times as likely as nondiabetic people to have fatal coronary artery disease.[4] As there are currently no interventions that prevent diabetes on a population level, these trends suggest the incidence of diabetes-related morbidity and mortality will increase unless risk factors for diabetes-related complications are addressed.

··· PATHOPHYSIOLOGY ···

The 3 organs primarily responsible for the maintenance of normoglycemia are the liver, the pancreas, and skeletal muscle. Muscle tissue often is not recognized as being more important than adipocytes in glucose homeostasis; however, there is much more muscle mass in the body and it is highly metabolically active. In the fasting state, glucose levels are maintained by gluconeogenesis in the liver. In healthy people this process regulates blood sugar in the range of 60 to 110 mg/dL. With ingestion of carbohydrates, glucose levels in the blood increase, stimulating insulin production by the beta cells of the pancreas. This inhibits gluconeogenesis in the liver and stimulates glucose uptake by muscle, fat, and other peripheral tissues.

People with diabetes have an abnormal elevation in plasma glucose. In contrast to type 1 diabetes, where hyperglycemia is due to the absence of insulin production, type 2 diabetes is characterized by an absolute or relative insulin deficiency, but not insulin absence. Type 2 diabetes usually occurs after a period of time best characterized as insulin resistance. Initially, there is a deficiency in insulin action relative to the level of glucose present, even while insulin levels are increased. Thus, there is increased basal hepatic glucose production, and muscle and other tissues absorb less glucose. This results in an elevated fasting (morning) blood glucose level, with further elevations after meals. Eventually, the pancreatic beta cells that produce insulin decompensate: insulin production decreases, producing severe hyperglycemia and overt diabetes.[5,6] Most drug therapy seeks either to increase insulin levels further or to restore insulin sensitivity by stimulating glucose uptake by muscle, decreasing liver glucose production, or both. Weight loss and exercise also can improve insulin resistance and thus improve glycemic control.[7]

The epidemiologic and experimental literature strongly supports an association between the degree and duration of hyperglycemia and the development of microvascular complications (retinopathy, nephropathy, neuropathy).[8] More recent data also support a relationship between hyperglycemia and cardiovascular complications.[9] There is a strong relationship between diabetes (and insulin resistance) and both hypertension and hyperlipidemia (in particular, elevated triglycerides and low levels of high-density lipoprotein [HDL]). Although the pathophysiology remains unclear, all these factors result in accelerated atherosclerosis among people with diabetes.[10]

··· MODIFIABLE RISK FACTORS ···

Glycemia

The Diabetes Control and Complications Trial first established that lowering blood glucose levels was associated with decreased microvascular complications in patients with type 1 diabetes.[11] For type 2 diabetes, the bulk of the evidence is from the United Kingdom Prospective Diabetes Study (UKPDS), in which newly diagnosed adults with type 2 diabetes were assigned to either intensive or conventional glucose-lowering therapy. Over 10 years of follow-up, the mean glycosylated hemoglobin (HbA_{1c}) was 7% in patients receiving intensive therapy compared with 7.9% in patients receiving conventional therapy. This was associated with a 12% reduction in any diabetes-related endpoint, including sudden death, death from hyperglycemia or hypoglycemia, fatal or nonfatal myocardial infarction, angina, heart failure, stroke, renal failure, amputation, peripheral vascular disease, blindness, or retinal photocoagulation. There was a 25% reduction of microvascular complications.[12] In an analysis that treated the study participants as an observational cohort, each point reduction in mean HbA_{1c} was associated with a 21% reduction in deaths related to diabetes and a 14% reduction in myocardial infarction. The data imply that complications are strongly correlated with the level of hyperglycemia and that any reduction in HbA_{1c} was likely to lower the risk of complications with no evidence of a threshold effect.[9]

Despite a reduction in morbidity, there was no difference in all-cause or cardiovascular mortality.[12] However, an early study of drug control of glucose in diabetes (the University Group Diabetes Program) had suggested that intensive control actually

increased cardiovascular mortality.[13] The UKPDS alleviates concerns that intensive therapy, particularly with insulin, would actually be harmful. This study also demonstrated the worsening of glucose control over time. After 3 years, only 55% of those on pharmacologic therapy were still at goal HbA_{1c} (7%); after 9 years, fewer than 25% of participants were still on monotherapy.[14]

There may be shorter-term benefits when glycemic control is achieved. In a 12-week, placebo-controlled study of 539 people with type 2 diabetes, lowering HbA_{1c} was associated with improved symptoms, improved quality-of-life measurements (including general perceived health and vitality), fewer restricted-activity days, and less work absenteeism.[15]

Blood Pressure

Type 2 diabetes and hypertension are very closely interrelated, and there is substantial evidence that hypertension contributes to the development of ischemic heart disease, stroke, lower extremity amputations, retinopathy, and nephropathy/end-stage renal disease among people with diabetes.[16] A systematic review of primary and secondary hypertension prevention trials found that among adults with diabetes, primary prevention (with diuretics) was effective in reducing cardiovascular mortality (treatment odds ratio [OR] = 0.64; 95% confidence interval [CI] = 0.50, 0.82), although not all-cause mortality (OR = 0.84; 95% CI = 0.62, 1.17). In secondary prevention trials including patients with diabetes, treatment reduced all-cause mortality (OR = 0.82; 95% CI = 0.69, 0.99), although not cardiovascular mortality. Most of these trials were with β-blockers or angiotensin-converting enzyme (ACE) inhibitors.[17] The UKPDS also included a hypertension substudy. Tight control of blood pressure (using atenolol or captopril initially) achieved a mean blood pressure of 144/82 mm Hg. Of note, 29% of patients in this arm required 3 or more agents to meet the goals for tight blood pressure control. Tight control resulted in a 24% reduction in diabetes-related endpoints (95% CI = 8%, 38%) and a 32% reduction in deaths related to diabetes (95% CI = 6%, 51%). There was also less visual deterioration in the group with tight blood pressure control.[18] An epidemiologic analysis showed that each 10-mm decrease in mean systolic blood pressure was associated with a 12% reduction in risk for any diabetes complication, with 15% fewer diabetes-related deaths, 11% fewer myocardial infarctions, and 13% fewer microvascular complications.[19] In summary, the UKPDS provides evidence that blood pressure control is as important as glycemic control.

Dyslipidemia

Abnormal lipids are an important risk factor for cardiovascular disease in both diabetic persons and nondiabetic persons. The most common lipid abnormalities in diabetic patients are high triglyceride levels and low HDL levels; low-density lipoprotein (LDL) and total cholesterol levels may not be necessarily elevated. However, diabetic persons may have increases in highly atherogenic subtypes of LDL.[20] Several secondary prevention trials with diabetic subgroup analyses have demonstrated that drug therapy aimed at lowering cholesterol levels (primarily LDL) in diabetic patients decreased the risk of new coronary heart disease events.[21]

Quality of Care

Another modifiable factor is care. There are 2 related issues here—having regular care for diabetes and the type of care received. Poor compliance with scheduled visits was an important predictor of diabetic complications in 1 Italian study.[22] Patients without a regular care provider within a health maintenance organization (HMO) had poor compliance with diet and self-monitoring, had less frequent HbA_{1c} testing, and were more likely to have poorly controlled diabetes (as measured by an HbA_{1c} level >10%).[23] Thirteen percent of diabetic adults surveyed in 1994 had not seen a doctor in the past year; an additional 17% reported having a doctor, but did not have at least 1 visit to a provider specifically for diabetes care.[24] As to the type of care provider, although endocrinologists may be most qualified to care for diabetes, most diabetes care in the United States is delivered by generalist physicians. In the 1991 National Ambulatory Care Survey, only 8% of adult diabetes-related visits were to endocrinologists; 74% were to internists, family physicians, or general practice physicians.[25]

Regular primary care seems to have a significant impact on morbidity and mortality among patients with diabetes. In a study of 131,595 seniors with diabetes on Medicare, Bertoni et al found that seniors who had at least 1 primary care visit over 2 years were at a lower risk of death and serious diabetes-related complications than seniors who either had no outpatient providers or only non-primary care providers over the same period. Some have argued that a higher number of visits indicate sicker patients, not better care; but we found that after adjusting for age, demographic factors, and comor-

bidities, those with more than 5 to 8 primary care visits over 2 years were less likely to die or develop serious diabetic complications than those with no primary care visits or only 1 to 4 visits.[26] This could reflect better patient compliance or increased opportunities for prevention, but in light of these findings and the ADA recommendations (see below), it seems prudent that adults with diabetes see their physicians for diabetes care at least 4 times per year.

Table. Examinations for Diabetes Patients

History	Physical
Initial Examination	
Symptoms of hyperglycemia	Weight, height (BMI)
Prior complications or symptoms of complications	Blood pressure
Comorbid diseases, especially	Cardiovascular (including pulses)
Cardiovascular	Eye (dilated retinal exam)
Peripheral vascular	Thyroid
Renal insufficiency	Skin
Liver disease	Extremity (especially feet)
Endocrine disorders	Skin
Cardiovascular risk factors	Neurologic (especially sensation)
Physical exercise	Laboratory studies
Tobacco use	Fasting glucose
Alcohol use	HbA_{1c}
Dietary habits	Lipid profile
Past drug or dietary treatment	Creatinine
Past laboratory values	Urinalysis, microalbuminuria
Social history	ECG
Follow-up Examination	
Symptoms of hyperglycemia or hypoglycemia	Every visit
Symptoms of complications	Weight and blood pressure
Results of self-monitoring	Inspection of skin, extremities
Compliance with regimens	Annually
Progress toward goals	Dilated retinal exam
Dietary management	Comprehensive foot exam
Glucose control	Periodic assessment for other
Blood pressure control	complications
Lipid control	Laboratory studies
Undercurrent illness	HbA_{1c}
Lifestyle modification	4/y if not at goal
Exercise	2/y if stable
Alcohol moderation	Lipid profile
Tobacco cessation	Annually (less if normal)
Psychosocial issues	Microalbuminuria
	May be indicated yearly

BMI = body mass index; ECG = electrocardiogram; HBA_{1c} = glycosylated hemoglobin.

··· DIAGNOSIS AND EVALUATION OF DIABETES ···

The ADA publishes clinical practice recommendations widely regarded as the standard against which care is measured.[27,28] The text is maintained online at www.diabetes.org. Diabetes is diagnosed using several criteria. In the context of such symptoms of diabetes as polyuria, polydipsia, or weight loss, a random plasma glucose concentration of ≥200 mg/dL is diagnostic of diabetes. A fasting glucose concentration of ≥126 mg/dL is now the standard definition of diabetes. If an oral glucose tolerance test is administered (no longer considered routine practice), a 2-hour postingestion glucose concentration of ≥200 mg/dL is diagnostic. An often-used test to measure glycemic control is the serum HbA_{1c} level. HbA_{1c} is formed when serum glucose binds to hemoglobin in circulating red blood cells. This occurs even in nondiabetic individuals (level is <6% in nondiabetic persons). Glycosylated hemoglobin is closely correlated to fasting blood glucose values, thus serving as a useful marker of glycemic control over time.[29]

For the initial evaluation of newly diagnosed patients or the first encounter with a patient known to have diabetes, the physician should take a complete history with attention to the elements outlined in the **Table**. The paradigm of a partnership between the patient and care provider should be used in discussing and agreeing on the goals of therapy. The initial short-term goals should focus on symptom control (if the patient is symptomatic) and education about diabetes. There also could be an introductory discussion about the importance of reducing the long-term risks associat-

ed with diabetes. Unless significantly hyperglycemic, all patients should be advised about nutrition and weight loss as the initial interventions, which may improve hypertension if present. Regardless of therapy choice, all also should be counseled on lifestyle changes (cessation of tobacco use, moderation of alcohol intake, exercise) and glucose self-monitoring. Medicare currently does cover glucose monitors and test strips even for patients who don't use insulin.

Many of the nonpharmacologic and education objectives can be addressed through referral to diabetes educators, specialty nurses, and dietitians. Nearly all diabetic adults should be referred once yearly to ophthalmology and to other specialists as needed (podiatry, in particular).[28]

After the initial visit, frequent visits or contact may be needed at first. Then, at least quarterly visits are recommended. At each visit the physician and patient should review progress on glycemic control and, if indicated, blood pressure and lipid control. The comprehensive foot exam entails inspection of the feet including between the toes, assessment of skin integrity, presence of callus, areas of erythema, bony deformities, nail status, detection of pulses, and an assessment for neuropathy. The Semmes-Weinstein 5.07 (10-g) monofilament is particularly useful for this. Patients with early abnormalities may need specialized shoes or other care best provided by podiatric or orthopedic specialists.[28]

A general theme for both glucose and blood pressure control is to start with nonpharmacologic therapy and then add medicines. At each follow-up, an assessment is made to either maximize 1 agent, switch agents, or add additional agents to the treatment regimen.

··· NONPHARMACOLOGIC THERAPY ···

A cornerstone of nonpharmacologic therapy is dietary modification. It is important to consider whether weight reduction is a goal of therapy and to recommend modestly hypocaloric diets for overweight patients or to suggest maintenance of caloric intake. Other goals include limiting fat and maintaining adequate protein intake. It is recommended that 10% to 20% of calories come from protein, <10% calories from saturated fat, and <10% from polyunsaturated fat and that the cholesterol intake is limited to <300 mg daily. The remainder (60% to 70%) of calories should come from carbohydrates and monounsaturated fats. There is no longer an emphasis on sugar (sucrose) avoidance, as different sugars and starches all contribute to the glycemic load of a meal. Diets lower in sodium may help control hypertension. Finally, exercise is also beneficial for weight control, glucose utilization, and lipid lowering.[28]

··· PHARMACOLOGIC THERAPY ···

Glucose Control

Patients with severe chemical hyperglycemia, significant symptoms of hyperglycemia, ketoacidosis or hyperosmolar syndrome, pregnancy, and those thought to have type 1 diabetes should be treated initially with insulin.

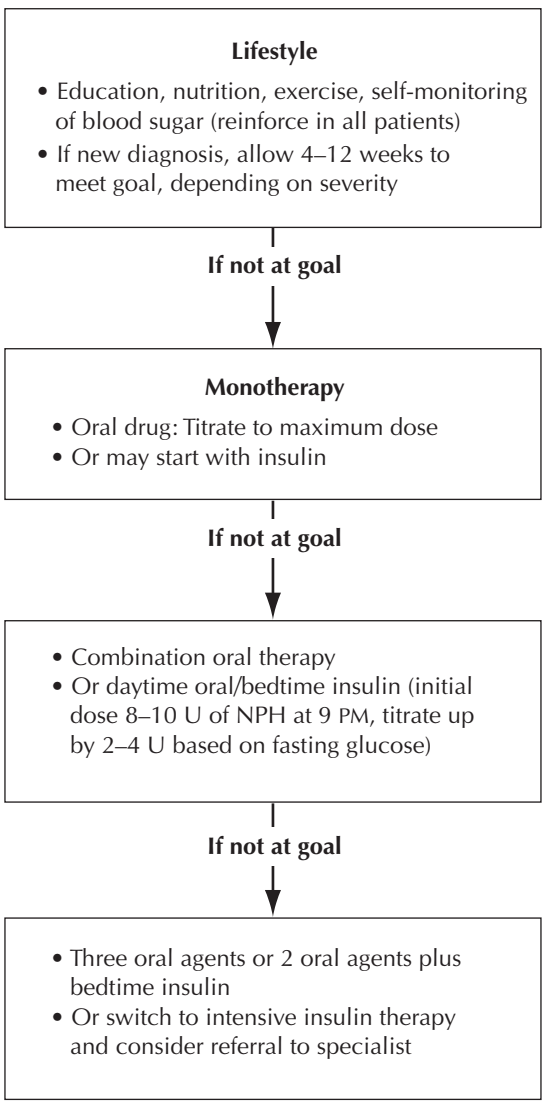
After an initial period of dietary measures, all other patients can be started on oral antidiabetic agents. (**Figure 1**) The recommendations shown in Figure 1 are based on a recent review of oral agents,[7] the ADA practice recommendations,[28] and insulin studies.[30-32] Of the oral agents available, the sulfonylureas and metformin are more commonly used and well studied. Metformin therapy should not be started in patients with renal or hepatic insufficiency because of the risk of lactic acidosis. The newer thiazolindediones (pioglitazone and rosiglitazone) still require liver function monitoring. Several studies have suggested these 2 drugs can be effective as monotherapy or in combination with other agents and/or insulin.[33-35]

A common starting dose for insulin therapy is 0.3 U/kg per day in divided doses, either NPH or 70/30 mix twice a day. There is significant evidence that adding bedtime intermediate-acting insulin (initial dose is 8-10 U of NPH; titrate up by 2-4 U/day if fasting blood sugar remains persistently elevated above 140 mg/dL) to a sulfonylurea and/or metformin during the day can improve glycemic control.[31] A recent study suggests that intermediate-acting insulin twice daily may be more effective therapy in patients with type 2 diabetes than long-acting (Ultralente) once-a-day insulin.[32]

Hypertension Control

The algorithm for blood pressure control presented in **Figure 2** is adapted from the recommendations of the Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure and the National High Blood Pressure Education Program Working Group report on hypertension in diabetes.[16,36] The target blood pressure had been

Figure 1. Treatment Options in Type 2 Diabetes Mellitus



*If patient is pregnant, a type 1 diabetic, or suffers from ketoacidosis or severe hyperglycemia, he or she must start with insulin.
Goals: Fasting blood glucose <126 mg/dL; glycosylated hemoglobin (HbA_{1c}) <7.0%. Frequency of testing: HBA_{1c} quarterly until value is stable, then twice a year. Frequency of follow-up: Every 2-4 weeks initially (alternatively, visits to a registered nurse or phone calls); once values are stable, every 3 months.
Adapted from references 7, 28, and 31.

<130/85 mm Hg; however, as of January 2001 the ADA recommended a goal of <130/80.[37] All patients should receive instruction on lifestyle modification (weight reduction, moderation of alcohol intake, reduced sodium consumption, and smoking cessation). Those not at goal blood pressure (<130/80 mm Hg) should start on a long-acting, once-daily medication.

Angiotensin-Converting Enzyme Inhibitors. The beneficial effects of ACE inhibitors are substantial. The Heart Outcomes Prevention Evaluation substudy in diabetic patients aged 55 years or older with risk factors for cardiovascular disease found that ramipril 10 mg/day reduced myocardial infarction, stroke, cardiovascular death, and overt nephropathy. The effect of ramipril went beyond blood pressure reduction.[38] One randomized trial in 156 type 2 diabetic patients with normal blood pressure who were normoalbuminuric found that enalapril 10 mg/day attenuated the decline in renal function over a 6-year follow-up period.[39] Studies such as these have led some to suggest it might be cost effective to treat all middle-aged diabetic patients with ACE inhibitors[40]; however, that is not yet part of care guidelines. Results of long-term studies of angiotensin receptor blockers (including studies of patients with diabetes) are not yet available, although this class of drug appears to be well tolerated.[41] An alternative drug to consider as monotherapy is a low-dose diuretic.[17]

Other Antihypertensive Agents. Contrary to some older literature, cardioselective β-blockers are not contraindicated in patients with type 2 diabetes. The UKPDS demonstrated that atenolol was as effective as captopril in controlling blood pressure and reducing morbidity, without an increase in significant hypoglycemia.[42] An analysis of the risk of hypoglycemia among elderly diabetic Medicaid recipients found no increased risk due to cardioselective β-blockers.[43] Nevertheless, before starting these agents, patients should be cautioned about the risk that β-blockers may mask the symptoms of hypoglycemia. There is less certainty about the role of long-acting calcium channel blockers in diabetic patients, given the early termination of the nisoldipine arm of the Appropriate Blood Pressure Control in Diabetes Trial, the results of which contradicted an earlier finding that nitrendipine was beneficial for diabetic patients.[44,45] This area requires further study.

Lipid Control

As with all patients with hypercholesterolemia, diabetic patients should follow a diet low in saturat-

ed fat and cholesterol. For most adults with type 2 diabetes and dyslipidemia, the main goal is to lower LDL levels to ≤100 mg/dL. Goals for other lipids include total cholesterol <200 mg/dL, HDL >45 mg/dL in men and >55 mg/dL in women, and triglycerides <200 mg/dL.[28] Nicotinic acid and bile acid resins may have adverse metabolic effects in diabetic patients and are not recommended. The statin drugs (HMG-CoA [3-hydroxy-3-methylglutaryl coenzyme A] reductase inhibitors) provide good results, are well tolerated by diabetic patients, and are the first choice of therapy.[21] Raising HDL levels may be difficult, but sometimes weight loss and increased physical activity improve HDL. Glycemic control also can be beneficial. Elevated triglycerides usually respond to glycemic control, which thus should be the initial intervention. Fibric acid drugs (eg, gemfibrozil) may be indicated if glucose control does not result in acceptable triglyceride levels. High-dose statin drugs also may lower triglycerides.[28] Overall, there is limited current evidence about the best drugs to lower triglycerides.

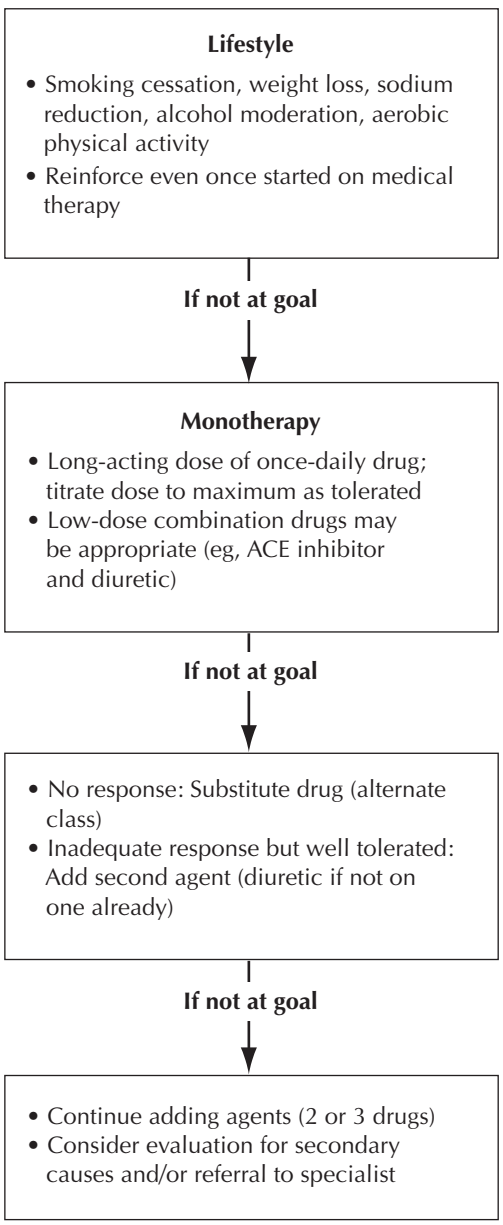
Aspirin Therapy

Aspirin. An additional intervention to reduce cardiovascular mortality in most adult patients with diabetes is daily low-dose aspirin therapy. Although there have been only a few trials including diabetic participants, the evidence is favorable that cardiovascular events are reduced with aspirin therapy. The ADA recommends that aspirin (81-325 mg enteric-coated daily) be used as secondary prevention in men and women with diabetes who have had myocardial infarction or other cardiovascular disease diagnoses, as well as for primary prevention in diabetic adults aged 30 years or older with another cardiovascular disease risk factor (smoking, hypertension, dyslipidemia, family history) who do not have a contraindication to aspirin therapy.[46]

··· ADHERENCE TO PRACTICE RECOMMENDATIONS ···

Despite the publication of ADA and other guidelines, substantial deviations from recommended standards have been documented in different practice settings. Weiner and colleagues reported that 84% of elderly Medicare patients in Maryland, Iowa, and Alabama in 1990-1991 were not receiving ideal HbA_{1c} testing, 45% had not had cholesterol tests, and 54% did not see an ophthalmologist.[47] A follow-up study in these states in 1993-1995 showed that 44% of diabetes

Figure 2. Treatment Options for Hypertension and Diabetes



ACE = angiotensin-converting enzyme.
Goal: Blood pressure <130/80 mm Hg. Frequency of testing: Every clinic visit. Frequency of follow-up: Every 2-3 months initially; monitor therapy as part of quarterly visits once patient is on stable drug regimen.
Adapted from references 16, 36, and 37.

patients had an annual HbA_{1c} test, 68% had cholesterol screening, 74% had creatinine testing and blood pressure control, and blood pressure was assessed in 97%.[48] In a survey of 3 managed care organizations in 1993, the range of HbA_{1c} annual testing was 34% to 81%, and the range of annual eye exams was 23% to 46%.[49] In a 1997 survey of diabetic members of a California HMO, 89% reported having an HbA_{1c} test; 78%, an eye exam; and 65%, a foot exam in the past year (diabetes was identified only through pharmacy claims and did not include diet-only patients).[50]

Fortunately, these studies suggest a trend toward improvement in compliance with treatment recommendations over time. Medicare and several other payers have participated in quality improvement efforts for diabetes treatment since the 1990s. Addition of diabetic treatment markers to the Health Plan Employer Data and Information Set (HEDIS) should reinforce this trend.

··· BARRIERS TO ACHIEVING SUCCESS ···

Physician Knowledge

Lack of knowledge regarding diabetes care guidelines and lack of experience in treating diabetic patients have been suggested as possible reasons why compliance with quality measures is low. There is evidence that education can change provider behavior. In a study of 9 physicians in 5 groups in Louisiana given targeted education (contact by colleague, patient education tools, and literature), rates of HbA_{1c} testing increased, a drop in median HbA_{1c} was observed, and fewer patients had poorly controlled diabetes after the intervention.[51]

However, a 1993 survey of primary care physicians in Alabama, Maryland, and Iowa who cared for at least 25 Medicare diabetic patients showed high scores for knowledge of glycemic treatment goals and monitoring guidelines.[52] This same survey queried physicians regarding barriers to care of diabetes. The leading responses were patient nonadherence, inadequate reimbursement, insufficient time, lack of extra support personnel, lack of clear guidelines, and lack of specialty consulting assistance. Only 9% reported using treatment algorithms, and only 50% used diabetes-specific flow sheets.

A more recent study compared 2 independent resident/attending group practices within 1 residency program. The 2 practices had fairly low compliance with ADA recommendations. One received problem-based learning intervention, and the other served as a control. Participants had 8 hours of group discussions where they reviewed compliance data and literature and planned their own intervention. The intervention practice had a reduction in the mean clinic HbA_{1c} level, whereas the control practice had an increase; the intervention practice also had increased compliance with other ADA guidelines. The authors concluded a "locally adapted clinical practice guide can be effective in improving process measures and outcomes of care."[53]

Physician Practice

Some evidence suggests that experience with diabetes care and use of organizational tools are associated with better compliance with care guidelines. In a study of 435 patients and 47 physicians in the Pacific Northwest, review criteria were met for only 4% of the patients. However, there was better compliance with laboratory tests and blood pressure testing than with self-management recommendations (diet, self-monitoring, smoking cessation). Practices with more diabetic patients had better compliance. In addition, the best practices were more likely to use tools such as guidelines, flow sheets, and diabetes registries.[54]

An interesting barrier to diabetic control is the failure of a provider to intensify therapy when glucose levels are high. This situation was termed "clinical inertia" by the Emory Diabetes Clinic, which asked providers about goals, treatment changes, and barriers to treatment after each of 1416 visits by diabetic patients over a 6-month period.[55] Providers correctly identified patients whose diabetes was well and poorly controlled according to guidelines. In 147 visits, the provider indicated goals were too strict either because of poor compliance, chronic illness, or age; in another 125 visits, the provider and the surveyor agreed on goals but disagreed on management. Of the remaining 1144 visits, for which the surveyor and the provider agreed on goals and management, therapy was advanced in only 23% of 636 visits from patients whose diabetes was poorly controlled. The providers, who treated primarily a poor minority population, cited "improving trends," compliance, and other acute illness as barriers to intensified therapy in patients with poorly controlled diabetes.[56] These data show that even specialists may not adhere to guidelines.

Patient Compliance

Diabetes self-management (by diet, exercise, and monitoring of blood sugar levels) is a crucial aspect

of diabetes care. Primary care providers cited patient noncompliance with dietary advice as an important reason for the poor effectiveness of nutritional interventions in diabetic patients.[57] In a 1997 survey of mostly white, educated females with diabetes, only 55% of type 2 patients reported they had been advised to check their blood glucose levels, while 18% reported they had not received nutritional advice. High compliance with medication (93%) and self-testing (75%) and lower compliance with lifestyle advice (including diet) have been reported.[58]

Costs also can present barriers to adherence. Half of the providers in 1 survey cited patient expense related to nutritionist referrals as a moderate or significant problem. Affording multiple prescriptions and self-testing supplies is a problem for many patients with limited insurance.

··· INTERVENTIONS TO IMPROVE DIABETES CARE ···

Randomized clinical trials have demonstrated significant reductions in glucose levels. However, all these trials had the benefit of study personnel who used specific protocols, follow-up visits scheduled at defined intervals, and patients who were generally compliant. Clearly, it would be difficult to translate resource- and manpower-intensive study protocols into routine patient care.

Although some have advocated "comanagement" between primary care doctors and specialists to provide comprehensive care for diabetic patients (usually with an integrated data system), US healthcare providers have limited experience with this concept.[59] However, 2 studies within managed care systems have demonstrated that disease management strategies have a favorable effect.[60,61] These strategies were directed by physicians other than the primary care provider and implemented by registered nurses and other health providers, and they were in addition to the usual patient-primary care provider visits. These disease management strategies were able to improve glycemic control.

In the first study, 138 diabetes patients (117 with type 2 diabetes) were randomized to an enhanced usual care program or to an intervention.[60] The intervention group received an initial 45-minute visit with a nurse in which glycemic control, medications, and self-monitoring were assessed, and instructions were given. All patients were referred to a 12-hour education program. Patients were seen after 2 weeks and then followed every 2 weeks by phone, with quarterly face-to-face follow-up with the nurse. The nurse followed an algorithm to intensify the glucose control regimen under the supervision of an endocrinologist and a family practitioner. The primary care provider was notified of all medication changes. All other ongoing care remained with the primary care provider. At the end of the study, the mean decrease in HbA_{1c} was 1.7 points] in the intervention group versus 0.6 points in the control group. Self-reported health status also improved with the intervention. The intervention was not associated with changes in body weight, adverse events, or an increased number of outpatient visits.

The second study, in a California HMO, utilized a cluster visit model. Adults with poor glycemic control (8.5% HbA_{1c}, or no HbA_{1c} measurement conducted in the prior year) were randomized to the Diabetes Cooperative Care Clinic versus usual care.[61] The clinic team included a dietitian, behaviorist, pharmacist, nurse educator, and diabetologist. Patients attended monthly 2-hour cluster visits for 6 months. Follow-up phone calls were made every 2 weeks The intervention group had a lower mean HbA_{1c} at 6 months than the control group. Due to improvement over time in the HbA_{1c} levels in the control group, the control and the intervention groups achieved equal glycemic control by 12 months. The intervention group used slightly fewer services than the control group. The authors concluded "improved glycemic control may lead to an earlier reduction in health care utilization, which would offset costs of intervention."

··· CONCLUSION ···

Diabetes can be a difficult disease to manage. However, mounting evidence suggests that aggressive therapy aimed at correction of hyperglycemia, control of other risk factors for diabetes-related complications, and early treatment of complications can lower the burden of diabetes-related morbidity and mortality.

Based on the reported barriers to achieving high-quality diabetes care and the findings of the various studies reported above, the first step individual providers or healthcare organizations should take to improve the care they give patients with diabetes should be assessment of their current practices. How many patients with diabetes do they have? Do they have registries and chart-based reminder and data organization systems? Do they utilize practice

guidelines? Are they in compliance with the ADA practice recommendations? Armed with this information, the providers can implement a plan tailored to the practice environment. Nonpharmacologic therapies and self-monitoring of diabetes need to be reinforced. Increasing the frequency of follow-up (and emphasizing the importance of patient compliance with visits) while in the titration phase of glucose and blood pressure control may be necessary, and adhering to algorithms may improve adherence with goals.

Managed care organizations may find that additional resources for case management, disease management, and patient education may improve the health of their diabetic patients. Managed care organizations, insurance companies, and public health officials may consider academic detailing and financial incentives as important dissemination tools to change individual providers' behaviors. Further work is needed, however, to establish whether long-term outcomes and costs respond favorably to these approaches.

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CME QUESTIONS: TEST #070002

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Instructions

After reading the article "Achieving Control of Diabetic Risk Factors in Primary Care Settings," select the best answer to each of the following questions. In order to receive 1 CME credit, at least 7 of the 10 answers must be correct. Estimated time for this activity is 1 hour. CME credits are distributed on a yearly basis.

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1. The therapeutic goal for glycosylated hemoglobin (HbA_{1c}) in a patient with diabetes is:

a) <8.0%
b) <6.5%
c) <7.0%
d) <8.5%
e) <10%

2. Which of the following drugs have favorable long-term data supporting their use for management of hypertension in diabetes?

a) β-blockers
b) diuretics
c) angiotensin-converting enzyme inhibitors
d) b and c only
e) a, b, and c

3. Patients with diabetes and hypertension should have their blood pressure lowered to:

a) 140/90 mm Hg
b) 130/80 mm Hg
c) 160/80 mm Hg
d) 120/80 mm Hg
e) 130/90 mm Hg

4. Most adults with diabetes should have which of the following tests performed at least annually?

a) dilated eye exam
b) lipid profile
c) urine microalbuminuria
d) comprehensive foot exam
e) all of the above

5. Which of the following drugs have favorable long-term data supporting their use for management of hypercholesterolemia in diabetes?

a) niacin
b) statins
c) cholestyramine
d) a and b only
e) a, b, and c

6. Aspirin therapy is only indicated for diabetic patients who have had a heart attack or stroke already.

a) true
b) false

CME TEST FORM
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(Test valid through April 30, 2002. No credit will be given after this date.)

Please circle your answers:

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3. **a b c d e**
4. **a b c d e**
5. **a b c d e**
6. **a b**
7. **a b**
8. **a b**
9. **a b c d e**
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7. The leading cause of death among patients with diabetes is cardiovascular disease.
a) true
b) false

8. Randomized clinical trials have failed to show any benefit from adding bedtime insulin therapy to daytime oral diabetes therapy.
a) true
b) false

9. Which of the following has been demonstrated to increase compliance with diabetes treatment recommendations?
a) diabetes registries
b) flow sheets
c) provider education
d) practice guidelines
e) all of the above

10. Dietary recommendations for patients with diabetes include:
a) cholesterol <300 mg/day
b) saturated fat <10% of calories per day
c) no sucrose/less than 2000 calories daily
d) a and b only
e) a, b, and c