

Type 2 Diabetes Prevention and Treatment

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Disclosure Statements: Dr. Beard, Dr. Mintz, Ms. Gangel, and Ms. LaRocque have returned disclosure forms indicating that they have no financial interest in or affiliation with any commercial supporter or providers of any commercial services discussed in this educational material.

Learning Objectives

After reading this *CME Bulletin*, you should be able to:

- List the five primary tests patients with diabetes should undergo regularly and the guideline-recommended targets for each.
- Summarize the importance of achieving recommended glycemic targets and describe available treatment options including initiating insulin therapy.
- Summarize strategies to address and manage barriers to diabetes care.

Introduction

Type 2 diabetes has reached epidemic proportions in the United States. The American Association of Clinical Endocrinologists (AACE) estimates that as of 2007, approximately 23.6 million individuals had type 2 diabetes, of whom 5.7 million remain undiagnosed.¹ The Centers for Disease Control and Prevention (CDC) estimates that one in three US individuals born in 2000 will eventually be diagnosed with diabetes.² The substantial increase in diagnoses is due in part to a large portion of the US population aging. Additionally, some minority groups at increased risk of developing diabetes are becoming the fastest-growing segment of the US population. Finally, the US trend toward overweight and sedentary lifestyle will contribute to an even greater increase in the number of type 2 diabetes diagnoses over the next few decades.³ As the number of type 2 diabetes cases continues to increase, family physicians will continue to play a significant role in diagnosing type 2 diabetes, and in educating and treating individuals with this disease.

Diagnosis, Screening, Symptoms, and Risk Factors

Type 2 diabetes is characterized by elevated fasting blood glucose levels secondary to insufficient insulin action.⁴ Other signs and symptoms of diabetes onset may include weight loss, fatigue, frequent urination, blurred vision, increased thirst or hunger, and slow-healing wounds or sores.³ Patients may even be asymptomatic. Some individuals can develop type 2 diabetes as much as 9 to 12 years before diagnosis.

Screening for diabetes should be undertaken every 3 years in those with risk factors for its development. Screening should include a fasting blood glucose test or 2-hour glucose tolerance test. Hemoglobin A1c (HbA1c) is not considered an appropriate screening test because of a lack of globalized standardization in testing, lack of clarity in diagnostic thresholds, and alterations in levels caused by variations in red blood cell life span. *Table 1* outlines the criteria for diagnosis of diabetes and its precursors.

Risk factors associated with type 2 diabetes that warrant screening include¹:

- Age older than 45 years
- Dyslipidemia
- Family history of diabetes in first-degree relative
- History of gestational diabetes or delivery of an infant weighing >9 lb (4 kg)
- Hypertension
- Impaired fasting glucose tolerance or impaired fasting glucose
- Obesity
- Polycystic ovarian syndrome and metabolic syndrome
- Race: Black, Hispanic, Native American, some Asian Americans, and native Hawaiian and other Pacific Islanders
- Sedentary lifestyle

Complications

The goal of effective diabetes management is to prevent macrovascular complications such as hypertension, stroke, and heart disease, as well as debilitating acute and chronic microvascular complications, including nephropathy, neuropathy, and retinopathy.^{5,6} Other complications of diabetes include birth defects and spontaneous abortion, immune system dysfunction, and periodontal disease.

Cardiovascular disease (CVD) is the leading cause of premature death among individuals with diabetes; approximately 65% of individuals with diabetes die of heart disease or stroke.^{3,7} The Multiple Risk Factor

Table 1. Diagnostic Criteria for Pre-diabetes and Diabetes

Test	Impaired Fasting Glucose Criteria	Impaired Glucose Tolerance Criteria	Diabetes Criteria
Fasting blood glucose	100-125 mg/dL	N/A	≥126 mg/dL
Random glucose	N/A	N/A	≥200 mg/dL with symptoms of hyperglycemia*
2-hour, 75-g glucose tolerance test	N/A	140-199 mg/dL	≥200 mg/dL

*Polyuria, polydipsia, and unexplained weight loss.

Information from American Diabetes Association, Standards of Medical Care in Diabetes – 2009. *Diabetes Care*. 2009;32 Suppl 1:S13-61.



Intervention Trial (MRFIT) found that the absolute risk of CVD mortality among men with diabetes was three times greater than for men without diabetes.⁷ A decrease in CVD incidence among patients with diabetes can be achieved most successfully through smoking cessation, followed by aspirin therapy, treatment of hypertension and hyperlipidemia, and the use of angiotensin-converting enzyme (ACE) inhibitors.

Hypertension is a common comorbidity of diabetes as well as a risk factor for CVD, renal insufficiency, diabetic retinopathy, and, possibly, neuropathy.⁸ It is estimated that hypertension is 1.5 to 3 times more common in individuals with diabetes than in those without. Individuals with type 2 diabetes should have their blood pressure levels measured at every office visit and should be encouraged to maintain a systolic blood pressure level of <130 mmHg and a diastolic blood pressure level of <80 mmHg, which is lower than the standard hypertension treatment recommendations.⁷ Initial treatment favors an ACE inhibitor or angiotensin receptor blocker (ARB) followed by a thiazide diuretic if the creatinine clearance is 50 mL/min or greater, or a loop diuretic if the creatinine clearance is lower; multiple medications may be needed after these to meet blood pressure goals, with the choice of medication based on the patient's clinical status.⁹

Another frequent complication of diabetes and an added CVD risk factor is dyslipidemia. Lifestyle alterations are an initial step toward lowering lipids via reduced cholesterol, transfat, and saturated fat intake, as well as increased exercise and weight loss. Regardless of baseline lipid levels, patients with diabetes and confirmed CVD, or who are over 40 years with one or more CVD risk factors, should be placed on statin therapy with the goal of lowering low-density lipoprotein (LDL) cholesterol levels by 30% to 40%. Those patients with diabetes and no CVD risk factors should have a goal LDL cholesterol level of less than 100 mg/dL; for those with confirmed CVD or at high CVD risk, a goal of less than 70 mg/dL is an option. Lowering triglycerides levels to less than 150 mg/dL is a secondary goal once LDL cholesterol is controlled. Additions of niacin or a fibrate to statins can assist patients in meeting goals.¹⁰

Approximately 20% to 40% of individuals with type 2 diabetes will develop some form of nephropathy.¹¹ One third of all US cases of end-stage renal disease (ESRD) are the result of diabetic nephropathy.

According to the CDC, diabetes is the leading cause of new diagnoses of blindness in the United States.¹² More than 60% of patients who have had type 2 diabetes for 20 or more years also have retinopathy.¹³ Several studies, including the Wisconsin Epidemiologic Study of Diabetic Retinopathy, the Diabetes Control and Complications Trial (DCCT), and the United Kingdom Prospective Diabetes Study (UKPDS) found that intensive glycemic control, along with blood pressure control, can reduce the risk of retinopathy by 34% to 76%.¹³

Testing

Five tests are recommended for disease management in patients with diabetes; three are specific to complications associated with type 2 diabetes.

Hemoglobin A1c

The HbA1c test measures blood glucose control over 2 to 3 months and should be performed 2 to 4 times per year, based on a patient's level of glycemic control.¹⁴ HbA1c levels are not clinically helpful when rapid assessment of changes in diabetes therapy is needed or when monitoring diabetes in pregnancy. HbA1c levels are also affected by red blood cell loss, anemia, or rapid red blood cell turnover. In these instances, a fructosamine (glycated albumin or glycated serum protein) can detect changes in glucose control over a 2- to 3-week interval.

Because the HbA1c test cannot provide a measure of short-term glycemic control or hypoglycemia, patients should also be encouraged to self-monitor blood glucose levels and tailor their medication as well as nutritional and physical activity needs accordingly to meet glycemic

goals.¹⁴ Each patient's needs and goals are unique; therefore, the frequency and timing of self-monitoring should be patient-specific.¹⁴

Cholesterol

For most patients with diabetes, fasting lipid profiles should be monitored at least annually. Screening may be altered to every 2 years if the patient requires no treatment and the LDL cholesterol level is <100 mg/dL, HDL cholesterol level is >50 mg/dL, and triglycerides are <150 mg/dL.

Renal Evaluation

Early diagnosis of nephropathy and regular monitoring of renal function is critical in managing the progression of nephropathy in individuals with type 2 diabetes. Microalbuminuria, defined as persistent albumin in the urine in the range of 30 to 299 mg/24 hours, is a marker for the development of diabetic nephropathy and increased CVD risk.¹⁵ Random measuring of the albumin-creatinine ratio is considered the easiest and most accurate method for tracking microalbuminuria because of its ease for spot-multiple measurements instead of a prolonged measurement over 24 hours.¹⁶ Treatment with an ACE inhibitor or ARB has been shown to slow progression of nephropathy in diabetes.¹⁴

Eye Examination

Because the diagnosis of diabetes is frequently delayed and early stage diabetic retinopathy can be asymptomatic, the American Diabetes Association (ADA) recommends that beginning at diagnosis, every individual with type 2 diabetes undergo an initial dilated and comprehensive eye examination followed by an annual eye examination performed by an ophthalmologist or optometrist experienced in diagnosing diabetic retinopathy.¹⁴

Foot Examination

The ADA recommends an annual foot examination for all individuals with diabetes. A comprehensive foot examination should include inspection for structural abnormalities, assessment of pedal pulses, and testing for proprioception, vibration, the presence or absence of patellar and Achilles reflexes, as well as loss of protective sensation using a 10-g Semmes-Weinstein monofilament.¹⁴

Achieving Glycemic Goals

The importance of achieving recommended glycemic targets cannot be underestimated. Although the recommended HbA1c level for many individuals is <7%, optimal glucose levels should be determined on an individual basis.^{14,17,18} Gaining overall glucose control can preserve β -cell function, improve long-term glycemic control, and slow development or prevent complications of diabetes.³

The relationship between microvascular complications and glycemic control has been well-documented.¹⁴ Reducing the risk or slowing the progression of nephropathy, neuropathy, and retinopathy is straightforward: in addition to managing blood pressure, individuals with type 2 diabetes should optimize glucose control.¹⁴

The relationship between intensive glycemic control and a reduction in macrovascular CVD risk is less clear; therefore, the target HbA1c levels for individuals with type 2 diabetes and established or significant CVD may be less stringent.¹⁷ Three recent studies, the Action in Diabetes and Vascular Disease – Preterax and Diamicon Modified Release Controlled Evaluation (ADVANCE), the Veterans Affairs Diabetes Trial (VADT), and the Action to Control Cardiovascular Risk in Diabetes (ACCORD), have compared the effects of standard versus intensive glycemic control on CVD outcomes in relatively high CVD-risk individuals with type 2 diabetes.¹⁷ The ADVANCE and VADT studies demonstrated no significant reduction in CVD outcomes as a result of intensive glycemic control, but the ACCORD trial was

terminated early due to increased mortality among participants who followed a course of intensive glycemic control with a target HbA1c level of <6%. Citing evidence from the ACCORD, ADVANCE, and VADT trials, the ADA, along with the American College of Cardiology Foundation and the American Heart Association, continues to recommend lowering the HbA1c level to $\leq 7\%$ to reduce the risk of microvascular and neuropathic complications in patients with type 2 diabetes without high risk for CVD. With respect to macrovascular complications, the DCCT, UKPDS, and ADVANCE trials showed that a general glycemic goal of <7% can be encouraged for select individuals, i.e., those with short duration of diabetes, with long life expectancy, and without significant CVD. For individuals with a history of severe hypoglycemia, long-standing diabetes, limited life expectancy, extensive comorbidities, and advanced microvascular and macrovascular complications including CVD, glycemic goals should be less stringent and tailored to the individual's needs.¹⁷

Management and Treatment Options

A Team Effort

The ADA recommends that individuals with type 2 diabetes receive medical care and supervision from a team that may include, among others, physicians, physician assistants, nurses, nurse practitioners, dietitians, pharmacists, and mental health professionals with expertise in treating individuals with diabetes.^{14,19} In addition, however, individuals with type 2 diabetes should be encouraged to take an active part in self-care. Self-care includes self-monitoring of blood glucose, adhering to an appropriate diet, exercising regularly, and managing behavioral and psychological issues as they arise.¹⁹

Diabetes Self-Management Education

The role of diabetes self-management education (DSME) in self-care has been studied extensively and shown to improve individual outcomes.¹⁹ Effective DSME should facilitate informed decision making and problem solving, teach self-care behaviors, and encourage individuals with diabetes to actively collaborate with their healthcare teams to improve clinical outcomes, health status, and life experiences. For the greatest long-term success, DSME programs should be culturally sensitive and age-appropriate and incorporate behavioral and psychological strategies to reach goals.¹⁹

Self-Monitoring of Blood Glucose

Major clinical trials of insulin treatment have demonstrated that self-monitoring of blood glucose (SMBG) is effective in helping patients track their individual responses to therapy. Individuals who successfully manage their type 2 diabetes with diet and exercise may self-monitor blood glucose levels as few as 1 or 2 times per week.¹⁶ A meta-analysis of SMBG among non-insulin-dependent individuals determined that consistent self-monitoring was associated with a $\geq 0.4\%$ reduction in HbA1c level.¹⁴ SMBG may result in higher scores on a depression subscale in patients with newly diagnosed type 2 diabetes, so SMBG needs to be tailored to a patient's motivation and risks.²⁰

Self-monitoring should occur more frequently under certain conditions, including changes to medications, diet, or exercise routines; increases in life stressors; periods of illness; when glycemic goals are not being maintained and when signs or symptoms of, or risk factors for, hypoglycemia are present.¹⁶ In order to achieve the greatest benefit from the self-monitoring process, individuals should be taught to properly measure glucose levels and interpret the data in order to make meaningful adjustments to nutrition, exercise, or medications as indicated.¹⁴

The ADA recommends that individuals using an insulin pump or multiple daily insulin injections should measure their blood glucose levels 3 or more times per day.¹⁴ The target

for preprandial plasma glucose is 70–130 mg/dL, while the peak 2-hour postprandial plasma glucose range should be <180 mg/dL. An HbA1c level of 7% corresponds to an average blood glucose level of 150 mg/dL.

Medical Nutrition Therapy and Lifestyle Changes

Lifestyle modifications, including regular physical activity, an appropriate nutrition plan, and corresponding weight management, are critical to the successful treatment of type 2 diabetes.¹⁶ *Table 2* summarizes treatment goals for adults with type 2 diabetes.

The ADA recommends that individuals with type 2 diabetes perform at least 150 minutes per week of moderate-intensity aerobic activity and, in the absence of contraindications, resistance training 3 times per week.¹⁴ Microvascular and/or macrovascular complications must be considered when determining the type and duration of aerobic activity.¹⁶ Physical activity can lead to hypoglycemia during or after the activity; therefore, individuals should be made aware of the symptoms and treatment of hypoglycemia. Guidelines for preventing hypoglycemia associated with physical activity are available at <http://www.diabetes.org>.

Medical nutrition therapy (MNT) is a key component in the successful management of type 2 diabetes and should be supervised by a registered dietician or nutritionist.¹⁶ The goals of MNT include achieving and maintaining normal or close-to-normal blood glucose and blood pressure levels; establishing a lipid and lipoprotein profile that reduces the risk of vascular disease; preventing or slowing the development of chronic complications; addressing individual nutrition needs and improving the likelihood of diet adherence by limiting food choices only when scientific evidence warrants.²¹

Overweight and obesity, defined as a body mass index (BMI) of ≥ 25 kg/m² and ≥ 30 kg/m², respectively, are significant risk factors for the development of type 2 diabetes, as well as independent risk factors for CVD, dyslipidemia, and hypertension.²² Studies have shown that a reduction of as few as 10 to 20 lb (4.5 to 9 kg) or 5% to 10% of an individual's body weight can improve hyperglycemia and insulin action, decrease fasting blood glucose concentrations, and reduce the need for some medications in certain individuals with type 2 diabetes.²² Lifestyle modifications that result in weight loss have been shown to be more effective than metformin (Glucophage) in reducing HbA1c levels, as well as in decreasing triglyceride levels and visceral adiposity.²³

Table 2. Treatment Goals for Adults With Type 2 Diabetes

Hemoglobin A1c Level	Glucose Level (mg/dL)	Blood Pressure Level* (mmHg)	Cholesterol - Lipid Profile (mg/dL)
<7.0%†	Preprandial plasma glucose range: 70–130 Peak postprandial plasma glucose <180	• Systolic <130 • Diastolic <80	• LDL cholesterol <100 • LDL cholesterol <70 with high CVD risk‡ • Triglycerides <150 • HDL cholesterol Men >40 years; Women >50 years

LDL= low-density lipoprotein; HDL=high-density lipoprotein; CVD=cardiovascular disease.

Information from Checking Your Blood Glucose, Diabetes.org, <http://www.diabetes.org/type-2-diabetes/blood-glucose-checks.jsp>.

†Less-stringent hemoglobin A1c goal for individuals with severe or frequent hypoglycemia or high risk for significant CVD.

*Lower blood pressure goals for individuals with nephropathy.

‡Information from Grundy SM, Cleeman JI, Merz CN, et al. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines. *Circulation*. 2004;110:227-239.

Table 4. Insulin Types

Type	Onset (h)	Peak (h)	Duration of Effect (h)	Recommended Interval Between Dosing and Meal Initiation (min)
Aspart (Novolog)	0.25	1 to 3	3 to 5	10 to 20
Lispro (Humalog)	0.25	0.5 to 1.5	2 to 5	15 (or immediately after a meal)
Glulisine (Apidra)	<0.25	0.5 to 1.5	1 to 2.5	15 (or within 20 minutes after starting a meal)
Regular (Humulin R, Novolin R, Velosulin BR)	0.5 to 1	2 to 4	8 to 12	30 to 60
NPH (Humulin N, Novolin N)	1 to 1.5	4 to 12	24	N/A
Glargine (Lantus)	1 to 2	1 to 2	Up to 24*	N/A
Detemir (Levemir)	6 to 8	3 to 14	5 to 24	N/A

NPH=neutral protamine Hagedorn; h=hours; min=minutes.

*Although the introduction of insulin glargine provided the first insulin analog with a relatively peakless 24-hour glucose-lowering profile, insulin glargine's effects may not always last 24 hours and can still require two injections a day.

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Psychological Barriers

Numerous studies have linked emotional challenges with decreased self-care behavior, inferior metabolic outcomes, morbidity, mortality, functional limitations, and reduced quality of life.²⁶ Anxiety, depression, eating disorders, and cognitive impairment can negatively affect an individual's ability to successfully manage type 2 diabetes, and efforts should be made to regularly assess psychosocial status.¹⁴

Referral to a mental health professional is recommended in the presence of evidence of depression and the possibility of self-harm, debilitating anxiety, evidence of cognitive impairment severe enough to affect judgment, gross nonadherence to the treatment regimen, or indications of an eating disorder.

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Self-Assessment Quiz

- In order to prevent complications, individuals with type 2 diabetes should undergo regular testing and screening at specified intervals. Which one of the following should be measured at least annually?
 - Blood pressure level.
 - Hemoglobin A1c level.
 - Fasting lipid level.
 - Albumin-creatinine ratio.
- Which one of the following guideline-recommended targets is appropriate for patients with type 2 diabetes?
 - Systolic blood pressure level of <140 mmHg, and diastolic blood pressure level of <90 mmHg.
 - Lowering low-density lipoprotein (LDL) cholesterol levels by 30% to 40% regardless of baseline lipid levels.
 - Hemoglobin A1c of 7% to 8%.
 - Urine microalbumin level of 30 to 299 mg/24 hours.
- Optimizing glycemic control in patients with type 2 diabetes has been shown to reduce the risk or slow the progression of which of the following?
 - Neuropathy.
 - Macrovascular cardiovascular disease.
 - Pancreatic beta cell regeneration.
 - Diabetic dyslipidemia.
- Which one of the following drug classes should be used with caution in patients with type 2 diabetes who also have hepatic disease?
 - Biguanides.
 - Thiazolidinediones.
 - Meglitinides.
 - Amylin analogs.
- Which one of the following statements about management and treatment options for type 2 diabetes is true?
 - The ADA recommends moderate-intensity aerobic activity no more than 3 times per week.
 - Physical activity can lead to hypoglycemia; therefore, individuals should be made aware of its symptoms.
 - The use of metformin has been shown to be more effective than weight loss in reducing Hemoglobin A1c levels.
 - Individuals who successfully manage their type 2 diabetes with diet and exercise do not need to self-monitor blood glucose levels.

Answers: 1. C, 2. B, 3. A, 4. B, 5. B

To complete the quiz, see instructions for AAFP members at right.

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Table 3. Noninsulin Medications for Type 2 Diabetes

Type	Classes & Examples	Primary Action	Hemoglobin A1c Reduction	Side Effects	Effects on Weight
Insulin sensitizers	Biguanides Metformin (Fortamet, Glumetza, Glucophage, Riomet)	Decreases hepatic glucose production, increases hepatic insulin sensitivity	0.8% to 2%	Nausea, diarrhea, metallic taste, possible lactic acidosis	Decreases of 5%
	Thiazolidinediones Pioglitazone (Actos), Rosiglitazone (Avandia)	Enhances insulin action, decreases hepatic glucose production	1.1% to 1.6%	Should be used with caution in patients with CHF or hepatic disease. Can cause mild-to-moderate edema.	Minor increase of 3-6 lb (.36-2.72 kg)
Insulin secretagogues	Sulfonylureas Glipizide (Glucotrol), glyburide (Diabeta, Glynase, Micronase), glimepiride (Amaryl)	Stimulates pancreatic insulin secretion	0.9% to 1.8%	Hypoglycemia, weight gain, hyperinsulinemia	Modest increase
	Meglitinides Repaglinide (Prandin)	Stimulates pancreatic insulin secretion	0.6% to 1.9%	Hypoglycemia, weight gain, hyperinsulinemia	Modest increase
	Nateglinide (Starlix)	Stimulates pancreatic insulin secretion	0.5% to 0.6%	Minimal risk of hypoglycemia	Stable
	DPP-4 Inhibitors Sitagliptin (Januvia)	Prevents GLP-1 breakdown, slows breakdown of some sugars	0.6% to 1.05%	Hypoglycemia, URI, headache, renal clearance	Stable
Injectables	GLP-1 Mimetics Exenatide (Byetta)	Stimulates insulin secretion, suppresses glucagon secretion, promotes β -cell production	0.6% to 0.8%	Anti-exenatide antibodies; nausea, hypoglycemia most common; occasional vomiting, diarrhea, jitters, dizziness, headache	Stable or reduced
	Amylin Analogs Pramlintide (Symlin)	Acts with insulin to delay gastric emptying, inhibits glucagon release	0.3% to 0.6%	Nausea, hypoglycemia most common; occasional vomiting, stomach pain, dizziness, indigestion, anorexia	Stable or reduced

CHF= congestive heart failure; URI=upper respiratory tract infection.

Information from Stendardo S, Vail B, Grunberger G, et al. *Diabetes - Treatment of Type 2 Diabetes and the Role of Insulin*. Leawood, Kan: American Academy of Family Physicians, 2008; Beard M, Morris C, Capoccia K, et al. Type 2 Diabetes. *FP Essentials™*, Edition No. 319, AAFP Home Study. Leawood, Kan: American Academy of Family Physicians, December 2005; Diabetes Medications Table 1, Oral Agents to Treat Type 2 Diabetes, National Diabetes Education Program, http://www.ndep.nih.gov/diabetes/WTMD/diabetes_suppl_1.htm; Diabetes Medications Table 5, Incretins and Amylins, National Diabetes Education Program, http://www.ndep.nih.gov/diabetes/WTMD/diabetes_suppl_2.htm.

Pharmacotherapy

Factors to consider before prescribing a particular treatment option include age at diabetes onset, weight, cholesterol level, kidney and liver function status, stomach sensitivity or hypoglycemia, cost, and likelihood of adherence.

Noninsulin Medications

Several classes of oral antidiabetes medications are available to help lower blood glucose levels. Oral antidiabetic therapy is less effective in individuals who have had type 2 diabetes for more than 10 years, in those who use more than 20 units of insulin per day, or in individuals who are very thin. *Table 3* provides a summary of noninsulin medications for type 2 diabetes.

In addition to lifestyle modifications, the ADA outlines an algorithm describing the initiation of well-validated core oral hypoglycemic medications for diabetes control. This algorithm emphasizes metformin as the Step 1 medication based on effectiveness, cost, and reversal of metabolic changes in diabetes. Step 2 therapy adds an oral sulfonylurea, and Step 3 progresses to intensive insulin therapy. Less-validated alternatives include the use of a thiazolidinedione, GLP-1 agonist, or basal insulin between Step 1 metformin and the addition of intensive insulin therapy in Step 3.²⁴ The AACE has a

diabetes treatment guideline with a more liberal use of newer agents and a more aggressive use of combination oral agents.¹

Insulin

Approximately 30% of individuals who have type 2 diabetes are unable to maintain glycemic control using lifestyle modifications and/or antidiabetic agents; these individuals will eventually require insulin. No single schedule of insulin therapy is appropriate for all individuals; factors to consider include an individual's weight, level of exercise, diet, alcohol use, insulin resistance/ β -cell failure, and daily pattern of fasting/post-prandial hyperglycemia.²⁵ *Table 4* summarizes insulin types and their actions and recommended dosing intervals.

Barriers to Diabetes Care

Approximately 20% of individuals undergoing pharmacotherapy for type 2 diabetes do not adhere to prescribed hypoglycemic medications. Nonadherence to therapy may be the result of one or more factors, including an individual's socioeconomic or educational background, a belief that the physician should be the primary manager of the disease, the complexity of the medication regimen, fear of insulin use, fear of weight gain, denial of the disease's existence, or fear of its effect on quality of life.