Optimizing Care for the Older Adult with Diabetes is supported by an educational grant from Novo Nordisk Inc. It has been accredited by the American Association of Diabetes Educators (AADE) for nurses, dietitians, pharmacists, and pharmacy technicians.
The following program is a taped presentation by Melinda D. Maryniuk.

As Director of Clinical Education Programs for Strategic Initiatives at the Joslin Diabetes Center in Boston, Massachusetts, Ms. Maryniuk is responsible for supporting the clinical, educational, and quality improvement activities for the 25 Joslin affiliates. She also coordinates the education activities for the HealthCare Services Department, including several national diabetes education initiatives. Her areas of special interest include nutrition, patient education, behavior change, and increasing access to quality diabetes education services.

Ms. Maryniuk has worked in the field of diabetes education for nearly 30 years and has lectured and published extensively for both patient and professional audiences around the country and internationally. She is active within the American Diabetes Association, having served on the Board of Directors, as chair of the Education Recognition Program Committee and as an Associate Editor for ADA programs publications. Within the American Dietetic Association, Ms. Maryniuk served as Chair of the Diabetes Care and Education Practice Group as well as Chair of the Division of Clinical Dietetics and Research of the Council on Practice. She is the 2004 recipient of the American Dietetic Association Foundation Award for Excellence in the Practice of Clinical Nutrition as well as the 2005 Outstanding Educator in Diabetes for the American Diabetes Association.

Ms. Maryniuk has a BS from the University of Tennessee-Knoxville and a MEd from Tufts University. She completed a dietetic internship at the Frances Stern Nutrition Center in Boston.

We will now join Ms. Maryniuk.
At the end of this program, participants should be able to:

- Discuss the prevalence of and risk factors for diabetes among older adults
- Explain diagnosis and treatment goals of diabetes in older adults, identifying potentially complicating factors
- Describe the management of diabetes in older adults, including special considerations for choosing pharmacologic therapies for this population
- Review the potential complications of diabetes in older adults and describe the role of diabetes self-management education in minimizing complications
The program objectives are slightly different for pharmacy technicians and are listed on this slide.

Objectives- Pharmacy Technicians

At the end of this program, pharmacy technician participants should be able to:

- Discuss the prevalence of and risk factors for diabetes among older adults
- Explain diagnosis and treatment goals of diabetes in older adults to patients, identifying potentially complicating factors
- Describe to patients the management of diabetes in older adults, including special considerations for choosing pharmacologic therapies for this population
- Review the potential complications of diabetes in older adults and describe the role of diabetes self-management education in minimizing complications
In this presentation, we have defined older adults as people aged 65 years or older. As the slide text indicates, there are many reasons for focusing on the management of diabetes in older adults. For example, diabetes is highly prevalent in this population—at least 20% of persons over age 65 have diabetes. According to the Centers for Disease Control and Prevention (CDC), the risk for death among people with diabetes is about twice that of people without diabetes of a similar age.

Clearly, the population of older adults is heterogeneous, and many of the important differences between individuals are not based on chronological age. Both the overall health status and the age of the person need to be considered when developing a management plan for an individual with diabetes.
As illustrated by this chart, the prevalence of type 2 diabetes begins to increase as people reach their mid-40s and then begins to rise dramatically at age 65. African Americans, represented here by the light and dark green bars, and Hispanics, represented by the pink and maroon bars, have higher rates of diabetes than white adults in the same age categories.

Epidemiologic surveillance data from the National Health and Nutrition Survey for the 3 study periods between 1999 and 2004 show that control of diabetes, as indicated by mean A1C levels, also varies by race/ethnicity. A study of US residents over the age of 18 found that levels declined over the study period from 7.52% to 6.90% in white non-Hispanic adults and from 8.26% to 7.61% in black non-Hispanic adults. However, mean A1C levels rose from 8.10% to 8.36% in Hispanic adults. The investigators did not report A1C trends by racial/ethnic background in older adults, although the average A1C in the total adult population over the age of 65 decreased from 7.49% to 6.72% over the study period.

Overall, this study suggests that educational efforts and the availability of newer glucose-lowering medications are having a beneficial effect on overall glycemic control in the US. However, the trends identified in this study also suggest that additional education and access to health care are needed, especially in specific subpopulations.
Today, about 23.6 million U.S. residents (approximately 7.8% of the overall population) and about 7.5 million persons over the age of 65 (approximately 20% of the older adult population) have diabetes. As shown on the slide, diabetes is a leading cause of death in older residents of the US, particularly among black (non-Hispanic) and Hispanic persons. Furthermore, diabetes is closely linked to heart disease and stroke, two other major causes of death. High as these rates are, the CDC notes that diabetes is likely to be underreported as a primary or contributing cause of death.

The high prevalence of diabetes in older adults is especially worrisome because the size of this population is expected to increase to about 71 million by the year 2030. If the proportion of older adults with diabetes remains constant or increases in the intervening years, the number of diabetes-related deaths is also likely to rise dramatically.
Major risk factors for developing type 2 diabetes are listed on this slide and are:

- Aging
- Being overweight (body mass index [BMI] of 25–30 kg/m²) or obese (BMI >30 kg/m²)
- Being physically inactive
- Being a member of a high-risk ethnic population (e.g., African American, Latino, Native American, Asian American, Pacific Islander)
- Having a first-degree relative with diabetes
- Having a history of gestational diabetes or delivering a baby greater than 9 pounds
- Having hypertension (BP ≥140/90 mm Hg) or receiving treatment for hypertension
- Having an HDL cholesterol level <35 mg/dL and/or a triglyceride level >250 mg/dL
- Having impaired glucose tolerance or impaired fasting glucose on a previous test
- Having a history of cardiovascular disease
- Having polycystic ovarian syndrome (in women)
What’s the relationship between aging and weight gain? Although the proportion of visceral (abdominal) fat typically increases as individuals age, persons who are overweight or obese have marked increases in visceral fat. Increased visceral fat is associated with reduced insulin sensitivity in skeletal muscle tissue (ie, insulin resistance), decreased glucose uptake due to impaired insulin action, and reduced hepatic insulin sensitivity, which can result in increased hepatic glucose production. These metabolic changes lead to an imbalance in the glucose homeostasis mechanism. In response, pancreatic beta cells initially produce more insulin. In time, however, increased demand leads to a deterioration in beta-cell function. Type 2 diabetes is present when pancreatic insulin production no longer meets metabolic demands.

It is important to recognize that unintended weight loss is also a common problem in older adults, and that it has been shown to be an independent marker of risk of mortality.
Now it is time for a checkpoint question.

Increased visceral fat is associated with:

(a) Enhanced hepatic insulin sensitivity
(b) Increased glucose uptake
(c) Decreased hepatic glucose production
(d) Reduced pancreatic beta-cell function
The correct answer is (d).

Increased visceral fat is associated with reduced pancreatic beta-cell function.
Diagnosis of diabetes in older adults is often difficult. The presenting symptoms may be general in nature and resemble common physiological changes associated with aging. The classic symptoms of diabetes may be absent or not recognized because they are thought to be due to another disease or a medication the patient is taking. Diabetes may be diagnosed after discovery of a complication, such as cardiovascular disease or diabetic retinopathy. Sometimes, hyperglycemia is detected incidentally when routine lab work is done during an outpatient visit to their health care provider.

Diabetes can affect the ability to perform activities of daily living and reduce a person’s independence. One study showed that adults over the age of 60 years who have diabetes experienced a 2- to 3-fold increase in the risk of being unable to walk 400 meters, do housework, or prepare meals. Another study found that women with diabetes who were ≥65 years had a 42% increase in the risk of becoming disabled.
The following recommendations are current as of June 2009. As with other evidence-based recommendations, they are revised regularly based on emerging data.

Regular screening at 3-year intervals has been recommended for adults 45 years of age or older. This screening includes:

- Either a fasting plasma glucose (FPG) or a 2-hour oral glucose tolerance test (OGTT; 75-g glucose load)
- For patients with impaired fasting glucose (IFG), consider using the OGTT for screening

The ADA recommends more frequent screening, beginning at a younger age, in individuals who are overweight (BMI ≥25 kg/m²) when any of the following major risk factors are present:

- Little or no physical activity
- Member of high-risk ethnic group or first-degree relative with diabetes
- Previously identified impaired glucose tolerance (IGT) or impaired fasting glucose (IFG)
- Hypertension (blood pressure >140/90 mm Hg)
- An HDL cholesterol <35 mg/dL and/or triglycerides >250 mg/dL
- History of delivering a baby greater than 9 lbs or a history of gestational diabetes
- History of vascular disease
- Polycystic ovary syndrome or other condition(s) associated with insulin resistance
The table on this slide shows American Diabetes Association (ADA) and American Association of Clinical Endocrinologists (AACE) goals for treating diabetes in the general population.

Some specific issues apply to the treatment of hyperglycemia in older adults with diabetes. They are often at an increased risk for medication-induced hypoglycemia because they often take multiple medications. Use of insulin and oral medications such as sulfonylureas increase the risk of hypoglycemia, especially when used together with commonly prescribed medications such as angiotensin-converting enzyme (ACE) inhibitors and non-selective beta-blockers. Severe hypoglycemia is of particular concern for older adults because they are at increased risk for injurious falls. Aggressive therapy, therefore, has traditionally not been used in this population. However, many experts now believe that older adults who are expected to live long enough to benefit from long-term intensive diabetes management (greater than ~10 years) and are physically active, cognitively intact, and willing to perform self-management, should be treated to target. The goal for these adults is to bring the A1C as close to normal as safely possible, avoiding significant hypoglycemia.
According to the California Healthcare Foundation/American Geriatrics Society (CHF/AGS) Panel on Improving Care for Elders with Diabetes, a higher A1C target may be warranted for frail older adults with diabetes and a high burden of comorbid conditions, short life expectancy, or significant difficulty in adhering to treatment recommendations. The Guidelines for the Care of the Older Adult With Diabetes developed by the Joslin Diabetes Center and Clinic contains a similar recommendation.

Instead of setting aggressive glucose target levels, the health care provider may choose to adopt therapeutic goals that enhance their quality of life, treat symptoms associated with diabetes and its related conditions, and address common geriatric syndromes such as polypharmacy, depression, cognitive impairment, urinary incontinence, injurious falls, and pain.

No specific glycemic target values have been established for frail older adults. The CHF/AGS Panel has suggested that an A1C target of less than 8% might be reasonable in cases where the risks of an aggressive treatment regimen would likely outweigh the benefits of improved glycemic control. According to the Joslin Diabetes Center Guideline, chronically ill, institutionalized patients with a short life expectancy do not require aggressive glucose control, but do require adequate control to facilitate healing and prevent dehydration, symptoms of hyperglycemia or hypoglycemia, and weight loss.
Many factors can affect glycemic control in older adults with diabetes. Older adults often present with more than one chronic disease and may be taking multiple medications, sometimes obtained from more than one pharmacy. Therefore, the potential for drug-drug, drug-food, and drug-disease interactions should be investigated.

Many older individuals live on a fixed income and do not have private health insurance to supplement Medicare or Medicaid. Thus the cost of therapy, particularly oral medications and the newer injectable therapies, can be problematic. Common social changes include moving to a less affluent neighborhood or a relative’s home. Such changes may result in isolation and less access to medical care.

Clinical depression and/or cognitive impairment are common in older adults. These conditions complicate self-care and sometimes make it impossible. Although the changes associated with the milder forms of depression and cognitive impairment may be difficult for patients, family members, and friends to detect, even these subtle changes can result in self-care deficits and reduced glycemic control.

Renal and hepatic function may decline with age, putting elderly persons at risk for the accumulation of certain medications and increased adverse drug reactions.

Finally, physical and physiological changes can result in decreased mobility or physical activity. Elderly adults with reduced manual dexterity and visual acuity may have difficulty opening medication bottles, drawing up insulin doses, or following labeling instructions.
Adherence to therapy (taking medications, following a meal and activity plan) is often poor in the general population of adults with diabetes, and adherence to therapy may also be limited in older adults with diabetes.

A study of adults ≥65 years of age who were enrolled in a managed care plan found that:

- Increased medication adherence was associated with reduced health care costs
- Insulin injections administered with a vial and syringe were associated with reduced adherence

However, since this was an observational study, it was not possible to establish a causal relationship between medication adherence and economic costs or insulin delivery systems.

In another study that included both older and younger adults (mean age, 45.4 years), insulin delivery systems other than a vial and syringe (such as pens or pumps) were shown to increase adherence and reduce health care costs.

Several studies have shown that adherence to therapy may be compromised by difficulty in paying for medications.
Self-monitoring of blood glucose (SMBG) is a means of assessing daily control of hyperglycemia and minimizing the risk for hypoglycemia. Individual instruction in using glucose meters is needed, as is assessment of a person’s ability to perform SMBG.

Routine medical visits are especially important for managing diabetes in the older adult. These visits may include:

- Screening for depression and assessment of cognitive impairment
- A1C testing for assessment of blood glucose control. This should be done at least every 6 months or more frequently as needed.
- Management of cardiovascular risk factors, such as hypertension and elevated triglyceride or low-density lipoprotein cholesterol levels
- An annual dilated eye examination
- An annual foot exam, which includes assessment of protective sensation, foot structure, vascular status, and skin integrity. In addition, the patient should be encouraged to perform daily foot exams at home.
- Test for urine albumin excretion with spot urine albumin/creatinine ratio, which should be done upon diagnosis of diabetes and at least annually thereafter
- Nutritional status, which should be assessed at each visit. Items to be assessed include ability to shop for and prepare meals; intake of carbohydrates, fats, and fiber; weight history; dentition; alcohol consumption; and use of dietary supplements.
The finding of major clinical trials that tight glycemic control reduces the risk of developing many complications of diabetes has given rise to increasingly complex treatment regimens. Therefore, cognitive functions that enable complex behaviors are particularly important for patients with diabetes. However, older adults with diabetes are at greater risk for cognitive dysfunction than are older adults without diabetes. Therefore, an annual assessment of cognition and the ability to perform activities of daily living (ADLs) is especially important for older adults with diabetes.

There are a number of standardized measures, questionnaires, and tests that can be readily performed in the clinical setting. The Mini Mental State Examination (MMSE) includes specific questions related to attention, orientation, memory, calculation, and language. The clock-drawing test (CDT) is a validated screen for cognitive dysfunction. The Mendez method of scoring the CDT has been shown to be most accurate in predicting deficits in cognitive function and correlates with the MMSE. The clock-in-a-box (CIB) test is a modified CDT that serves as a fast and reliable index of executive function. The Geriatric Depression Scale (GDS) is a well-validated, 15-item tool that is often used to screen for depressive symptoms in older adults. Informant-based activities of daily living (ADL) questionnaires measure functionality in bathing, toileting, grooming, dressing, and eating, and instrumental ADL (IADL) questionnaires measure functionality in traveling, shopping, housework, managing finances, using the telephone, and taking medications. Last but not least, the patient’s gait and balance should also be assessed.
And now, another checkpoint question.

Diabetes screening should occur more frequently than every 3 years in a 67-year-old white patient with a BMI of 27 kg/m² and:

(a) An intensive exercise routine
(b) BP = 135/85 mm Hg
(c) HDL cholesterol = 33 mg/dL
(d) Triglycerides = 232 mg/dL
The answer is (c).

Diabetes screening should occur more frequently than every 3 years in a 67-year-old white patient with a BMI of 27 kg/m² and an HDL cholesterol level of 33 mg/dL.

The answer is (c).

Diabetes screening should occur more frequently than every 3 years in a 67-year-old white patient with a BMI of 27 kg/m² and an HDL cholesterol level of 33 mg/dL because the low HDL-C is considered an additional risk factor.
The AADE 7™ Self-Care Behaviors are applicable throughout the lifespan of persons with diabetes. Each behavior is critical for attaining self-sufficiency in diabetes management, and each behavior must reflect the particular needs, physical and cognitive capabilities, and self-care responsibilities of the individual with diabetes. In the next slides we will look at the ways in which the first four AADE 7™ self-care behaviors—healthy eating, being active, monitoring, and taking medication—apply to older adults with diabetes. But first, just a few comments on the last 3 behaviors listed.

Diabetes is a complex disease with unpredictable manifestations, and individuals with diabetes often need to make rapid, informed decisions about eating, physical activity, and medication management. But as individuals age, they often lose some of the flexibility and reasoning needed to solve complex, unfamiliar problems. However, appropriate educational interventions can help many older adults to refine their problem-solving skills and anticipate the types of problems they are likely to encounter.

Risk reduction is especially important for older adults with diabetes, who are at an increased risk for hypoglycemia, drug interactions, injurious falls, and other potentially severe conditions and situations related to diabetes. Diabetes educators and other health care providers can help older adults to learn about standards of care and preventive services to reduce these risks.

Coping with diabetes often seems overwhelming to many adults with diabetes, and the challenges of diabetes may seem especially formidable to older adults, who may also be dealing with other health problems, the death of a spouse or close friend, and financial problems. As noted earlier, rates of depression are elevated in older adults with diabetes. Health care providers can assist this group to differentiate between healthy and unhealthy coping mechanisms and to adopt healthy coping strategies.
The ADA recommends that all older adults with diabetes receive medical nutrition therapy (MNT) from a registered dietitian. MNT, which is covered by Medicare and many private insurance plans, includes:

- Assessing the patient’s nutritional status and physical activity patterns
- Identifying factors that may impact the nutritional care plan, such as dentition, food intolerances, allergies, mechanical difficulties, and altered taste perception
- Identifying lifestyle or social factors that may interfere with compliance to the prescribed meal plan, such cognitive dysfunction or limited finances
- Developing a meal plan that is customized to the patient’s needs and minimizes complexity
  - The meal plan should ensure that carbohydrates are spread throughout the day to avoid large blood glucose fluctuations
  - Obese patients may benefit from modest energy restriction and increased physical activity
  - The energy needs of an older adult may be less than those of a younger person of the same weight
  - A daily multivitamin supplement may be appropriate, especially for patients with reduced energy intake
- Interdisciplinary teams should oversee the provision of MNT to hospitalized patients and residents of long-term care facilities.

### Healthy Eating: Basic MNT Principles

- Older adults with diabetes should receive medical nutrition therapy (MNT) from a registered dietitian
- Dietary and physical activity patterns should be assessed to identify factors that might impact nutritional care plan
- When planning meals, it is important to minimize complexity, spread carbohydrates throughout the day, initiate moderate caloric restriction for obese patients, and consider using a daily multivitamin supplement
- An interdisciplinary team should oversee MNT for hospitalized patients, focusing on meals with a consistent carbohydrate content and a discharge plan that includes a diabetes-specific meal plan prescription
- In long-term care facilities, an interdisciplinary team should integrate MNT into overall patient management

Everyone should be more physically active—no matter what their age. As shown on this side, regular physical activity has many benefits for older adults (improving glucose tolerance, reducing blood pressure, improving joint flexibility, and lowering the risk of falls). However, it is important that exercise be supervised by the patient’s health care provider. During a physical examination, the patient should be evaluated for risk factors such as microvascular disease or loss of sensation in the feet. The patient’s ability to perform various types of exercise should be assessed. For example, individuals with retinopathy should not lift weights. Individuals should be advised of the importance of performing self-monitoring of blood glucose (to detect hyper- and hypoglycemia) and the appropriate actions to take in response to test results. Exercise-induced hypoglycemia and late-onset postexercise hypoglycemia (which can occur up to 24 or more hours following activity) are important concerns. Additionally, during exercise, the patient should remain adequately hydrated. Finally, all individuals with diabetes should wear easily visible medical identification.
The 3<sup>rd</sup> self care behavior is monitoring. Self-monitoring of blood glucose (SMBG) allows patients to evaluate their individual response to therapy and assess whether glycemic goals are being achieved. The frequency and timing of SMBG should be dictated by the particular needs, goals, and capabilities of a patient. Age should not be the primary criterion for decisions concerning SMBG. The patient’s monitoring technique should be assessed at regular intervals. Blood glucose monitors are available for patients with physical limitations.

Special blood glucose monitors are available for patients with impaired manual dexterity, and “talking” monitors and monitors with large numerical displays and backlights are available for patients with visual limitations. Current information about specialized blood glucose monitors is available in the annual resource guide published in *Diabetes Forecast*. 

References:

Fourth, and last in this review of self management behaviors is taking medication. Various types of pharmacological therapies for diabetes are currently available. As shown on the slide, several important considerations apply when selecting any type of medication for an older adult. The ways in which the drug is metabolized and eliminated are important because hepatic and renal function typically decrease with advancing age. Therefore, extra precautions should be taken with drugs metabolized by the liver or excreted by the kidney. Medications for the older adult should often be started at the lowest possible dose and slowly titrated upwards.

Due to the potential for drug interactions, other medications the patient is taking may need to be changed or their dosage reduced. Because older adults are at greater risk for adverse drug reactions than younger patients, it is important to know the history of the use of the drug in the older population. It is also important to be aware of any contraindications. For example, metformin is contraindicated if the serum creatinine level exceeds 1.5 mg/dL in men or 1.4 mg/dL in women. Finally, it is important to determine the likelihood that the patient will be able to adhere to the medication regimen. Simplified regimens (eg, combination products, if appropriate) along with pillboxes or timers can assist patients with diminished cognitive abilities.

It is also important to determine whether the patient has an insurance plan with prescription drug coverage, and what types of antidiabetes medications are covered by the plan.

The 2009 consensus algorithm of the American Diabetes Association and European Association for the Study of Diabetes (ADA/EASD 2009 algorithm) provides valuable guidance on the initiation and adjustment of drug therapy in patients with type 2 diabetes.
As shown on the slide, some medications can lower or raise blood glucose levels. Drugs associated with hypoglycemia include:

- Alcohol: impairs gluconeogenesis and enhances the response to insulin
- ACE inhibitors: are associated with hypoglycemia
- High-dose salicylates—doses >4 g/day: may alter the pharmacokinetics of sulfonylureas, increase utilization of glucose by peripheral tissues, reduce gluconeogenesis, and potentiate insulin secretion
- Nonspecific beta blockers (eg, propranolol): inhibit gluconeogenesis and glycogenolysis, therefore can mask signs of hypoglycemia, such as tachycardia, tremor, and anxiety
- Pentamidine: initially damages pancreatic beta cells, causing hypoglycemia; longer-term use results in hyperglycemia.

Now on the other side you see drugs that can cause hyperglycemia include:

- Alcohol (chronic use): increases blood glucose levels
- Glucocorticoids (eg, prednisone): increase gluconeogenesis and depress insulin action
- Atypical antipsychotic agents: are associated with development of diabetes
- Diuretics: can inhibit insulin secretion indirectly, by the depletion of potassium
- Sympathomimetics: increase glycogenolysis and gluconeogenesis
- Phenytoin: can inhibit insulin secretion
- Diazoxide: inhibits insulin secretion
- Beta blockers: block glucose- or glucagon-mediated beta-adrenergic stimulation that normally promotes pancreatic insulin

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“Guidelines for Improving the Care of the Older Person with Diabetes Mellitus” was developed by a joint panel of the California Healthcare Foundation and the American Geriatrics Society and published in 2003 (AGS guidelines). A limitation of the AGS guidelines is that they were prepared before the approval of many important glucose-lowering medications and other agents now widely used by persons with diabetes. However, they remain valuable because they provide a conceptual framework for the comprehensive and individualized treatment of older adults with diabetes. Furthermore, they provide some useful guidance on the use of specific medications or classes of medications in this population. Some of these recommendations are summarized on this slide. For example as long as the patient is not receiving anticoagulant therapy or not otherwise contraindicated, offer daily aspirin or, for those patients taking ACE or ARB meds, monitor renal function.

Additional recommendations from the AGS guidelines not listed on this slide which bear mentioning include:

• The older adult who smokes should be assessed for willingness to quit and offered pharmacological interventions and counseling to assist with smoking cessation.

• If an older adult has diabetes and requires medical therapy for hypertension, the target blood pressure should be less than 140/80 if it is tolerated.

• Because older adults may have reduced tolerance for blood pressure reduction, hypertension should be treated gradually to avoid complications.

• The older adult who has diabetes and hypertension should be offered pharmacological and behavioral interventions to lower blood pressure within 3 months if systolic blood pressure is 140 to 160 mm Hg or diastolic blood pressure is 90 to 100 mm Hg or within 1 month if blood pressure is greater than 160/100 mm Hg.
The table on this slide summarizes the 4 main types of oral antidiabetes agents (OADs) and the 2 types of injectable antidiabetes agents other than insulin and insulin analogs.

Among the OADs, the insulin secretagogue category includes the sulfonylureas (eg, glimepiride, glipizide) and the glinides (repaglinide, nateglinide). Insulin sensitizers include the biguanides (or, metformin) and the thiazolidinediones (TZDs; pioglitazone and rosiglitazone). Alpha-glucosidase inhibitors are represented by the agents acarbose and miglitol. The dipeptidyl peptidase-4 (DPP-4) inhibitors are currently represented in the U.S. by sitagliptin and saxagliptin. Combinations of oral medications (eg, insulin sensitizer + insulin secretagogue; 2 insulin sensitizers) are also available. Combination agents can be helpful for selected patients because they simplify the medication regimen.

There are 2 categories of injectable antidiabetes drugs other than insulin and insulin analogs. The glucagon-like peptide-1 (GLP-1) agonists include the approved agent exenatide, lixisenatide (currently under review by the US Food and Drug Administration), exenatide long-acting release (LAR; a long-acting exenatide formulation being evaluated in phase 3 clinical trials). The amylin agonists are currently represented by pramlintide.
Sulfonylureas represent the oldest currently available class of OADs. Most of these agents are indicated for both monotherapy and combination therapy. The sulfonylureas include glimepiride, glipizide, chlorpropamide, and glyburide.

Because the sulfonylureas act continuously to stimulate beta cells, their most common side effect is hypoglycemia. Severe hypoglycemia, which may be life-threatening, has been identified as a common cause of hospitalization in people aged ≥80 years with type 2 diabetes. Other side effects of sulfonylureas include headache, nausea/diarrhea, rashes, and a bitter metallic taste.

Sulfonylureas are metabolized in the liver and excreted though the kidney. Therefore, they should be used with caution in older adults and may be contraindicated when impaired renal or hepatic function is present. Chlorpropamide, a first-generation sulfonylurea, should not be used in older adults due to its long half-life and increased risk for hypoglycemia.

One advantage of using sulfonylurea drugs is that many of them are available generically, making them relatively inexpensive. Extended-release formulations are available, as well as combination products, making it possible to simplify the medication regimen for many patients.
Glinides

- Include nateglinide (Starlix®) and repaglinide (Prandin®)
- Quickly absorbed, rapid onset of action
- Hypoglycemia may be less frequent with nateglinide than with sulfonylureas
- Well suited to patients with irregular schedules because they are taken shortly before meals
- Nateglinide: use with caution in patients with moderate-to-severe liver disease
- Repaglinide: initiate treatment with 0.5 mg dose in patients with severe renal impairment; use with caution in patients with impaired liver function


The next group or class are the glinides, represented by nateglinide (Starlix®) and repaglinide (Prandin®) are absorbed quickly and have a rapid onset of action. Glinides are well suited to many patients with irregular schedules because they are taken shortly before meals. These agents are generally well tolerated. The risk of hypoglycemia is lower with the glinides, especially with nateglinide, than with the sulfonylureas. Gastrointestinal adverse effects, such as diarrhea and nausea, occur infrequently. Weight gain may occur during glinide therapy. Careful monitoring is required for patients who take repaglinide in combination with gemfibrozil, and patients taking these agents together should not take itraconazole.

The pharmacokinetic and safety profiles of the glinides are similar in patients under the age of 65 and in those older than 65. Although greater sensitivity of some older adults to nateglinide and repaglinide therapy cannot be ruled out, routine dose adjustments on the basis of age are not required with either agent. The slide summarizes precautions related to the use of these agents in patients with renal or hepatic impairment.
The 2 classes of insulin sensitizers are the biguanides and thiazolidinediones (TZDs). Metformin is the only available biguanide in most parts of the world. The ADA/EASD 2009 algorithm recommends that metformin therapy be initiated concurrently with lifestyle intervention when type 2 diabetes is diagnosed. Metformin is available in immediate- and extended-release formulations and can be used alone or as part of a combination regimen.

Metformin can lower cholesterol and triglyceride levels and is weight neutral. Use of metformin in patients with renal dysfunction increases the risk for lactic acidosis, a potentially life-threatening condition. However, the incidence of lactic acidosis in patients receiving metformin is very low (<1 case per 100,000 treated patients). Metformin should not be used in patients with renal or hepatic insufficiency, in persons who abuse alcohol, or those with congestive heart failure. Patients using metformin should have their creatinine levels monitored at least annually, and with every dose increase. Metformin treatment should not be initiated in patients ≥80 years of age unless measurement of creatinine clearance shows that renal function is not reduced.
The two TZDs are pioglitazone and rosiglitazone. Each agent is approved for use with metformin, sulfonylureas, glinides, and insulin, and each is available in coformulations with metformin and with glimepiride. The TZDs are contraindicated in patients with established New York Heart Association Class III or IV heart failure, and should be avoided in patients with hepatic insufficiency. TZDs should also be used with caution in patients with a history of fluid retention, since they can cause this condition. They are also associated with weight gain. A recently reported retrospective study in over 69,000 patients found that use of a TZD increased the risk of bone fracture by 43% in men and women.

Tier 2 of the ADA/EASD 2009 algorithm (less well-validated therapies) includes pioglitazone but not rosiglitazone. Consensus group members unanimously advised against using rosiglitazone because two meta-analyses have suggested a 30–40% increase in the risk for myocardial infarction with this agent.
The alpha-glucosidase inhibitors include acarbose (Precose®) and miglitol (Glyset®). Compared to other OADs, these agents are infrequently used.

Although the alpha-glucosidase inhibitors are weight neutral, they often cause gastrointestinal side effects, especially flatulence, diarrhea, and abdominal pain. The incidence of these effects tends to diminish with continued treatment. During clinical trials, between 25% and 45% of participants discontinued their alpha-glucosidase inhibitor because of gastrointestinal effects. These agents are contraindicated in patients with chronic intestinal disorders. In other respects, the alpha-glucosidase inhibitors have a good safety and tolerability profile. During clinical trials, no overall differences in safety or efficacy were observed in older patients and patients under the age of 65 years.

Acarbose and miglitol do not cause hypoglycemia when used alone. However, if they are used with insulin or an insulin secretagogue, they may increase the risk of hypoglycemia associated with those medications. Should hypoglycemia occur, it must be treated with a monosaccharide, such as glucose, and not a di- or polysaccharide like one would find in juice or crackers, since the alpha-glucosidase inhibitors reduce, or slow down, carbohydrate catabolism.
The fourth category of OADs are the dipeptidyl peptidase four (DPP-4) inhibitors are currently represented in the US by sitagliptin (Januvia™) and the recently approved saxagliptin (Onglyza™). DPP-4 inhibitors are small molecules whose actions enhance the effects of incretin hormones, increasing glucose-mediated insulin secretion and suppressing glucagon secretion.

Sitagliptin is indicated as an adjunct to meal planning and exercise to improve glycemic control in adults with type 2 diabetes. It can be given alone or in combination with other agents. When used in combination with a sulfonylurea, the sulfonylurea dose may need to be reduced to prevent hypoglycemia. The risk for hypoglycemia with sitagliptin monotherapy is very low.

The usual recommended dose of sitagliptin is 100 mg once daily, taken with or without food. Patients with moderate renal insufficiency should receive a lower dose of 50 mg once daily, and those with severe renal insufficiency or with end-stage renal disease should receive a dose of 25 mg once daily. Because the dose of sitagliptin must be adjusted on the basis of renal function, renal function assessment is recommended before initiation of sitagliptin and periodically thereafter.

Serious hypersensitivity reactions, including anaphylaxis, angioedema, and exfoliative skin conditions, have rarely been reported. During clinical trials, no overall differences in safety or effectiveness were observed between patients ≥65 and <65 years.
Now we’ll move on to the three categories of injectable agents for type 2 diabetes are insulin and insulin analogs, glucagon-like peptide-1 (GLP-1) agonists (incretin mimetics) and amylin agonists (amylinomimetics). Further information about the first two categories is provided in later slides.

Pramlintide (Symlin®) is a synthetic analog of the beta-cell hormone amylin. It slows gastric emptying and suppresses glucagon production and secretion in a glucose-dependent manner and also reduces postprandial glucose excursions. It is indicated for the treatment of types 1 and 2 diabetes. In type 2 diabetes, it is approved as an adjunct treatment in patients who use mealtime insulin therapy and have failed to achieve desired glucose control despite optimal insulin therapy, with or without a concurrent sulfonylurea and/or metformin. It is administered subcutaneously before each major meal at an initial dose of 60 mcg. Dose adjustments are made after the nausea, routinely experienced at the start of therapy, has subsided. Patients may also experience other gastrointestinal adverse effects, such as vomiting. The drug is associated with weight loss. In clinical trials, no consistent age-related differences in the activity of pramlintide were observed in patients older than 65 years. However, because of the risk of hypoglycemia, pramlintide should only be used in patients known to fully understand and adhere to insulin adjustments and glucose monitoring. Since it slows gastric emptying, pramlintide should not be considered for patients taking drugs that alter gastrointestinal motility (eg, atropine) or agents that slow the intestinal absorption of nutrients (eg, alpha-glucosidase inhibitors).
The functions of incretins, hormones secreted by the small intestine in response to food ingestion, are disrupted in patients with type 2 diabetes. Glucagon-like peptide-1 (GLP-1) is one of the two major incretins. GLP-1 agonists (also called incretin mimetics) mimic the action of GLP-1, increasing glucose-mediated insulin secretion and suppressing glucagon secretion during hyperglycemia. Like GLP-1, the GLP-1 agonists also slow gastric emptying, thereby reducing food intake. They also have a beneficial effect on body weight. Additional beneficial effects are shown on the slide including reducing postprandial blood glucose excursions.

Of the GLP-1 agonists, exenatide (Byetta®) has been approved by the US FDA, liraglutide is currently under review by the FDA, and a long-acting formulation of exenatide (exenatide LAR) is being evaluated in phase 3 clinical trials. Additional GLP-1 agonists are at earlier stages of development. Exenatide is indicated as adjunctive therapy to improve glycemic control in patients with type 2 diabetes who are taking metformin, a sulfonylurea, a TZD, metformin + a sulfonylurea, or metformin + a TZD, but have not achieved adequate glucose control. The usual dose is 5 to 10 mcg per dose, administered twice daily within the 60-minute period before the morning and evening meals. Between 30% and 40% of patients experience nausea, vomiting, or diarrhea when beginning exenatide. Exenatide is not recommended for use in patients with end-stage renal disease or severe renal impairment. Pancreatitis is a rare but potentially life-threatening adverse effect. In phase 3 clinical trials, liraglutide was evaluated as monotherapy or as add-on therapy to metformin, sulfonylureas, or TZDs, or combinations of oral agents. In these trials, liraglutide demonstrated a safety, tolerability, and efficacy profile that is generally similar to that of exenatide.
As shown in this table, different interventions and classes of medications are variably effective at decreasing A1C levels when used as monotherapy.

Although lifestyle interventions that decrease weight and increase activity can have a marked impact on A1C levels, their benefits may be short-lived. The high rate of weight regain limits the role of lifestyle interventions as an effective means of controlling glycemia in the long term.

**Insulin** is the most effective agent for lowering glycemia. When used in adequate doses, insulin can decrease any level of elevated A1C to, or close to, the therapeutic goal. Unlike the other blood glucose-lowering medications, there is no maximum dose of insulin beyond which a therapeutic effect will not occur.

In addition to their differing effects in reducing A1C, some of these medications and medication classes have properties that may make them particularly desirable for an individual patient. For example, metformin, alpha-glucosidase inhibitors, and DPP-4 inhibitors are weight neutral, whereas GLP-1 agonists and pramlintide are associated with weight loss. Insulin and pioglitazone are associated with improved lipid profiles.
A class of medications associated with weight loss is:
(a) Sulfonylureas
(b) Biguanides
(c) TZDs
(d) GLP-1 agonists
The correct answer is (d).

GLP-1 agonists are associated with weight loss, biguanides are weight neutral, and sulfonylureas and TZDs are associated with weight gain.
The final category of medications to review is insulin. Insulin and insulin analogs are highly effective glucose-lowering agents. They are considered first-line therapy for individuals with type 2 diabetes and severe hyperglycemia, ketonuria, intolerance of other diabetes medications, or contraindications to the use of other diabetes medications. Because type 2 diabetes is a progressive disease, most patients eventually need to transition to insulin to maintain their glycemic targets. Insulin is also commonly used during acute illnesses, surgery, and hospitalizations.

The graph on this slide depicts the insulin secretion profile of a person without diabetes who eats 3 meals per day. The insulin plasma concentrations are shown in orange. Insulin secretion in response to glucose intake has 2 phases. The first phase, which occurs within 10 minutes of glucose administration, consists of the secretion of stored insulin. This response is often tested using an intravenous (IV) glucose tolerance test (IVGTT). Loss of first-phase insulin secretion in response to an IVGTT is typically the earliest detectable abnormality in type 2 diabetes. Second-phase insulin secretion begins about 20 minutes after glucose intake and represents insulin newly synthesized in pancreatic beta cells. The goal of insulin therapy is to mimic this profile as closely as possible, taking into account individual requirements and capabilities.
Short-acting insulin and rapid-acting insulin analogs are used in intensive insulin therapy to mimic normal insulin action. Short-acting insulin is also used during surgery and rapid-acting analogs are used in insulin pumps.

Intermediate-acting insulin and long-acting insulin analogs are used to mimic the basal secretion of insulin.

Premixed insulin and insulin analogs were developed for the convenience of patients. They combine a short-acting insulin with intermediate-acting insulin or a rapid-acting insulin analog with a long-acting insulin analog.

Except for the formulation in the last row of the table, all of the insulins and insulin analogs shown here are U-100 products, meaning that they have an insulin concentration of 100 units/mL. In contrast, U-500 insulin has a concentration of 500 units/mL. U-500 insulin is intended for the treatment of patients with marked insulin resistance (daily requirement >200 units), since a large dose may be administered subcutaneously in a reasonable volume. Because of the marked differences in concentration, U-500 insulin and U-100 insulin or insulin analogs must never be used interchangeably.

<table>
<thead>
<tr>
<th>Category</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-acting insulin</td>
<td>Regular human insulin (Humulin®, Novolin® R)</td>
</tr>
<tr>
<td>Rapid-acting insulin analogs</td>
<td>Insulin lispro (Humalog®), insulin aspart (NovoLog®), insulin glulisine (Apidra®)</td>
</tr>
<tr>
<td>Intermediate-acting insulin</td>
<td>NPH human insulin (Humulin® N, Novolin® N)</td>
</tr>
<tr>
<td>Long-acting insulin analogs</td>
<td>Insulin glargine (Lantus®), insulin detemir (Levemir®)</td>
</tr>
<tr>
<td>Premixed insulin</td>
<td>Humulin® 70/30, Humulin® 50/50, Novolin® 70/30</td>
</tr>
<tr>
<td>Premixed insulin analogs</td>
<td>Humalog® Mix75/25 ™, Humalog® Mix50/50 ™, NovoLog® Mix 70/30</td>
</tr>
<tr>
<td>U-500 short-acting insulin</td>
<td>Humulin® U-500</td>
</tr>
</tbody>
</table>

Wyne KL et al. Type 2 Diabetes: Principles and Practice. 2nd ed. 2008
This slide shows the postprandial time course of the various insulin preparations plotted against physiologic insulin secretion in a person without diabetes. As indicated by the graph, the time course of the insulin analogs most closely resembles endogenous insulin secretion. (An analog is an agent whose function is generally similar to that of another agent [in this case, insulin] but whose origin and structure are different.)

The various insulin preparations in use today have been developed with recombinant DNA (rDNA) technology to provide major improvements in purity over insulin obtained from animal sources. Insulin analogs are rDNA preparations whose amino acid sequences have been altered to produce the desired pharmacological profile.

The 3 short-acting insulin analogs (insulin lispro, insulin aspart, and insulin glulisine) have absorption profiles that approximate mealtime patterns of exogenous insulin release. In contrast, the long-acting insulin analogs (insulin glargine and insulin detemir) have absorption profiles that approximate basal insulin profiles.
The health care provider should consider several factors when determining whether to initiate insulin therapy in older adults. Older adults should be evaluated to determine whether their cognitive skills will enable them to master the injection schedule and perform self-monitoring of blood glucose (SMBG).

It is also important to establish whether an older adult has the manual dexterity to self-administer insulin with one of the available delivery systems and to perform SMBG. A related consideration is whether use of special equipment, such as a needle guide or vial stabilizer, would compensate for a deficit in manual dexterity.

Similarly, it is important to assess whether the older adult has sufficient visual acuity to dose insulin accurately, with or without the use of syringe magnifiers or other assistive devices.

The health care provider should also be alert to the presence of quality of life issues that might influence the decision about initiating insulin therapy. Transitioning to insulin often helps to improve patients’ quality of life, especially when they have symptomatic hyperglycemia. However, the presence of diabetic complications, significant comorbidity, and the individual’s life expectancy should be considered in determining whether the benefits of insulin therapy outweigh its risks.
Using a device other than a syringe is often a preferable insulin delivery option for an older adult. The most frequently used alternative systems are disposable or durable insulin pens, and dosers. These systems offer simple and accurate dosing; large, easy to read numbers; and ease of handling.

A questionnaire-based study that included 112 elderly patients (mean age, 69.4 years) and measured ease of use demonstrated that a disposable insulin doser was preferable to the vial and syringe method of insulin delivery. Another study in older and younger adults (mean age, 45.4 years) showed that switching from vial and syringe to an insulin pen device was associated with improved adherence to therapy and lower health care costs.

Detailed descriptions of insulin delivery systems and assistive devices for people with visual or other disabilities can be found in the annual American Diabetes Association Resource Guide, which is available in the January issue of Diabetes Forecast or online at forecast.diabetes.org.
The table on this slide, which is based on the ADA/EASD 2009 algorithm, summarizes some important features to consider when selecting one or more classes of glucose-lowering medications for an older adult with type 2 diabetes. The ratings are somewhat artificial, in that they are based on the use of the agents as monotherapy, even though some of these products are indicated for use, or can be used, with other medications.

Another limitation is that this table does not differentiate among the different members of a drug class. For example, it does not differentiate chlorpropamide (which the ADA/EASD algorithm identifies as being associated with a high risk for hypoglycemia) from other sulfonylureas, which are associated with lower risk. Similarly, it does not distinguish between rosiglitazone, which appears to be associated with an elevated risk for myocardial infarction (MI), and pioglitazone, which may actually reduce the risk for MI. Thus, pioglitazone may be a beneficial therapy for older adults at high risk for MI, whereas the ADA/EASD 2009 algorithm recommends that rosiglitazone not be used.

Despite these limitations, this table is a reminder that many factors should be taken into account when selecting a regimen for an older adult with type 2 diabetes, and that treatment must be individualized for the particular patient. For example, weight loss might be a very desirable feature for an obese patient, whereas avoidance of gastrointestinal disturbances might be important for a patient with a history of gastrointestinal problems.
This slide shows six geriatric syndromes that the California Healthcare Foundation/American Geriatrics Society Panel on Improving Care for Adults with Diabetes has identified as being of greater concern in older adults with diabetes than in the overall population of older adults. Older adults with diabetes are significantly more likely to develop major depression than other older adults, and older adults with diabetes and depression incur higher non-mental health costs than those without depression. However, pharmacological and psychological treatment of older adults is effective in reducing depressive symptoms. As mentioned previously, older adults with diabetes are at risk for drug side effects and drug-drug interactions due to polypharmacy. Medications may contribute to geriatric syndromes, including depression, cognitive impairment, urinary incontinence, and falls. Therefore, the older adult with diabetes should maintain an updated medication list for review by health care providers. In older adults, diabetes is associated with decreased cognitive function, which often manifests as decreased memory, learning, or verbal skills. Hyperglycemia is a treatable cause of cognitive impairment.

Urinary incontinence, which is associated with social isolation, depression, falls, and fractures, is more common in women with diabetes than in the general population of older women. Reversible or treatable causes of urinary incontinence include urinary tract infection, urine retention, fecal impaction, and use of certain medications. Falls may also be associated with reversible factors, such as lack of exercise or excessive doses of psychotropic medications. Neuropathic pain is often underreported and undertreated in older adults with diabetes, although it can usually be treated successfully once it has been identified.
Insulin resistance and relative insulin deficiency can result in high levels of blood glucose; if undetected or untreated, hyperosmolar hyperglycemic state (HHS) can occur. Infection is the most frequent cause of HHS, but it can also be caused by myocardial infarction, stroke, or drugs or disease states that cause dehydration (e.g., diuretics, diarrhea, or severe burns). Since HHS generally occurs in patients with type 2 diabetes who produce some insulin, marked ketosis and acidosis are not usually presenting features. Prompt recognition and treatment are vital, because HHS can be life-threatening.

Common signs and symptoms of HHS include thirst, dehydration, hypotension, confusion, stupor, aphasia, seizures, and coma. The blood glucose level typically exceeds 600 mg/dL and serum osmolality exceeds 320 mOsm/kg. Treatment of HHS includes rehydration with normal saline solution, since dehydration is the primary initial concern. If fluid replacement does not correct the hyperglycemia, administration of insulin, with or without potassium, may be needed. The precipitating event must also be identified and treated.
As shown on this slide, older adults are at increased risk for medication-induced hypoglycemia for many reasons. Even mild recurrent episodes of hypoglycemia may have a negative impact on the quality of life of older adults. Recognizing hypoglycemia in older adults is complicated by the fact that some older individuals have impaired coordination, cognitive impairment, or dementia even during euglycemia. Older adults are at an increased risk of injuries from falls or stumbles due to hypoglycemia. Hypoglycemia has also been associated with stroke or myocardial infarction, although controversy exists about the correlation between hypoglycemia and new cardiovascular events.

Ideally, education of patients, family members, and caregivers can prevent hypoglycemia. Hypoglycemia education should cover the recognition of typical symptoms as well as atypical symptoms that may occur in elderly persons. (Frequently, older patients with hypoglycemia do not experience adrenergic symptoms, such as nervousness, sweating, or trembling, because their adrenergic response to low blood glucose levels may be diminished or absent. Instead, they are likely to experience neuroglycopenic symptoms, such as diminished motor skills or confusion.) Education should also cover the importance of self-monitoring of blood glucose, eating habits that reduce the risk for hypoglycemia, and alcohol as a risk factor for hypoglycemia. Educators should encourage patients to wear a visible type of medical identification.
Treatment of hypoglycemia depends on the blood glucose (BG) level and the patient’s symptoms. Glycemic thresholds for the onset of symptoms differ among individuals, but symptoms often occur when the BG level drops to 70 mg/dL.

To treat hypoglycemia in a patient who is able to swallow, the basic approach is to check the blood glucose then consume 15 grams of a fast-acting carbohydrate such as a commercially available liquid glucose product, juice, or sweetened soda and then check the BG in 15 minutes, if possible. If the BG level is still below 70 mg/dL, treatment should be repeated even if the symptoms have disappeared. Patients should be advised that hypoglycemia may recur, so they should check their BG 60 minutes later. They should also be cautioned against using high-fat foods, such as chocolate, to treat hypoglycemia, since they take longer to raise BG levels.

Treatment for severe hypoglycemia (requiring the assistance of another person) depends on whether the individual is able to swallow. If the individual can swallow, glucose gel, honey, or syrup can be placed inside the cheek. If the individual cannot swallow, a glucagon injection, to stimulate hepatic glucose production, can be given. A family member or friend can be taught how and when to inject glucagon. After the glucagon injection, the individual should consume liquid carbohydrate as soon as swallowing is possible, since the effects of glucagon are short-lived. Severe hypoglycemia may require medical assistance and the use of intravenous glucose.
The data on this slide emphasize the impact of macrovascular disease in individuals with diabetes. Cardiovascular disease (CVD), including coronary heart disease, cerebrovascular disease, and peripheral vascular disease, is the leading cause of death in people with diabetes.

In recent years, many large randomized controlled clinical trials have been conducted to determine whether intensive glycemic control, usually defined as an A1C below or around 7%, can reduce CVD events in persons with diabetes. To date, these studies have not shown a significant reduction in CVD outcomes during the randomized part of the trials. However, data from the long-term extensions of the landmark Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS) suggest that treatment to A1C targets below or around 7% in the years soon after the diagnosis of diabetes is associated with long-term reduction in the risk of macrovascular disease. Therefore, the American Diabetes Association (ADA) considers an A1C goal of <7% to be reasonable for many adults to achieve macrovascular risk reduction. However, the ADA also recommends that less stringent goals be considered for patients (such as some older adults) with a history of severe hypoglycemia, limited life expectancy, advanced microvascular or macrovascular complications, and extensive comorbidity.
The data on this slide concerning the microvascular complications of diabetes emphasize the profound impact of retinopathy, nephropathy, and neuropathy on people with diabetes.

Subgroup analyses of clinical trials such as the DCCT and UKPDS, as well as microvascular evidence from the recent Action in Diabetes and Vascular Disease: Preterax and Diamicron MR Controlled Evaluation (ADVANCE) trial, suggest that there is a small but incremental benefit in microvascular outcomes when A1C values are kept as close to normal as possible. Therefore, the American Diabetes Association recommends that health care providers consider even lower goals than the general goal of <7% if this can be achieved without significant hypoglycemia or other adverse effects of treatment. Patients likely to benefit from such a regimen include individuals with a short duration of diabetes, long life expectancy, and no significant CVD. Thus, selected older adults might benefit from extremely stringent glucose control.

Even when reduction of A1C levels to near-normal levels is not advisable, more modest A1C reductions can have a beneficial impact on microvascular outcomes. In general, every percentage point drop in A1C levels (eg, from 8.0% to 7.0%) can reduce the risk of microvascular complications by 40%.

In addition to the demonstrated benefits of A1C reduction, other interventions can reduce the severity of some microvascular complications. For example, treating diabetic retinopathy with laser therapy can reduce the development of severe vision loss by an estimated 50% to 60%. Detecting and treating early diabetic kidney disease by lowering blood pressure can reduce the decline in kidney function by 30% to 70%. The benefits mentioned above are helpful as many elderly patients present with these complications.
We have come to our final checkpoint question.
The most frequent cause of HHS is:

(a) Polypharmacy
(b) Infection
(c) Renal insufficiency
(d) Severe burns
The correct answer is (b).

The most frequent cause of HHS is infection.
The American Association of Diabetes Educators provides useful guidance concerning education of the older adult with diabetes. Self-care should be encouraged whenever possible. Although older adults sometimes take longer to learn than younger adults, they have been shown to be able to learn self-monitoring of blood glucose and insulin administration skills as well as younger people. Caregivers should be included in the education sessions when appropriate.

Education should occur in a comfortable environment. Keep in mind that the older adult may be susceptible to sensory overload. Speak slowly and clearly when interacting with an individual with a hearing impairment, and use large-print materials when working with an individual with a visual impairment. Provide practical rather than theoretical information and help the patient to solve specific problems and to simplify complex procedures. Focus on one or two key points per session, schedule short sessions when possible, and allow time to practice new skills and to review previously covered material.

Medicare coverage for diabetes education includes:

- **Diabetes self-management training (DSMT).** When prescribed by a physician or nurse practitioner, Medicare covers 10 hours of DSMT during the first year after the diagnosis of diabetes and 2 hours of follow-up training every subsequent year.

- **Medical nutrition therapy (MNT).** When prescribed by a physician, Medicare covers 3 hours of training during the first year after diagnosis and 2 hours of follow-up education every subsequent year.
I’d like to emphasize some of the key points we’ve reviewed. Providing optimal care for the older adult with diabetes is similar to the process of providing excellent care to younger adults, although some special considerations apply. Older adults are at higher risk for developing diabetes than younger persons, but their diabetes often remains undiagnosed because it manifests itself in different ways or because its symptoms may be confused with the symptoms of other age-related disorders. Diabetes management in older adults is especially challenging because this population is extremely heterogeneous. While the treatment of each person with diabetes, irrespective of age, should be individualized, the provision of individualized care to older adults is particularly important.

Many special considerations apply to the treatment of this population. Careful medication selection and monitoring of medication effects is essential, both because older adults are likely to be taking several different medications and because they are more likely to experience adverse drug reactions than younger adults. The availability of multiple classes of oral and injectable antidiabetes medications makes it possible to identify one or more agents whose characteristics meet the needs of the individual patient. For patients who transition from an oral antidiabetes agent to insulin, possible limitations in vision and manual dexterity make the choice of an insulin delivery system very important.

Addressing the geriatric syndromes of depression, polypharmacy, cognitive impairment, urinary incontinence, injurious falls, and neuropathic pain is exceptionally challenging in people with diabetes, who are at greater risks for these syndromes than their contemporaries without diabetes. Older adults with diabetes are at elevated risk for the hyperosmolar hyperglycemic state (HHS) and hypoglycemia, and it is important for health care providers to provide education that will help them to avoid these potentially life-threatening complications. Providing diabetes self-management education and education about medical nutrition therapy is challenging but usually gratifying for the diabetes educator, since many older adults learn to perform much or all of their diabetes-related care independently.
Some additional resources for older adults are listed on this slide. They include:

- American Association of Retired Persons (AARP)
- Medicare Information on Diabetes
- U.S. Administration on Aging
- National Council on the Aging (NCOA)
- FirstGov for Seniors
- National Diabetes Education Program

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