

Managing Diabetes in Older Adults

This program is supported by an
educational grant from Novo Nordisk Inc.

Managing Diabetes in Older Adults is supported by an educational grant from Novo Nordisk Inc. It has been accredited by the American Association of Diabetes Educators (AADE) for pharmacists, nurses, and dietitians.

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The following program is a taped presentation by Barbara Kocurek.

Ms. Kocurek graduated from the University of Pittsburgh in 1987 with a Bachelor of Science in Pharmacy and she received her PharmD degree from the Medical College of Virginia in 1989. Since that time she has been involved in diabetes education in various health care settings. Currently she is the Diabetes Education Coordinator for the Baylor Health Care System Diabetes Education Services located in north Texas. She oversees the American Diabetes Association (ADA) recognition and data management for 11 outpatient diabetes education centers.

Ms. Kocurek served on the National Certification Board for Diabetes Educators (NCBDE) from 1998–2002 and was Chair for the 2000–2001 year. She is currently on the Examination Review Committee for NCBDE. In 2002–2003 she served as a member of the AADE's Nominating Committee and in 2004 served on the Professional Development, Education, and Resources Committee.

Objectives

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

- ❑ Discuss the prevalence 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.

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- 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.

Why Focus on Older Adults?

- ❑ Diabetes is highly prevalent among older adults
- ❑ Diabetes increases mortality among older adults
- ❑ Presence of coexisting illnesses in older adults complicates diagnosis and management of diabetes
- ❑ Increasing life expectancies make prevention/delay of diabetes-related complications more important in this age group
- ❑ Older adults may benefit from improved glycemic control, as do younger patients

ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.
Bertoni AG et al. *Ann Epidemiol*. 2004;14:362–367.
CDC. Diabetes surveillance system. 2004.
Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.

For the purposes of this presentation, we have defined older adults as people who are 65 years of age or older. We have avoided further classification into groups such as young-old, middle-old, and old-old. The age ranges for these groups vary between different reports, so we have sought to avoid any confusion in the use of these terms. Clearly, the population of older adults is heterogeneous, and many of the important differences between individuals cannot be defined or categorized simply on the basis of chronological age.

The focus of this presentation is on older adults because:

- Diabetes is highly prevalent among older adults (at least 20% of persons over 65 years of age have diabetes)
- Older adults with diabetes have an increased mortality rate compared with older adults without diabetes (100/1000 person-years [PY] versus 61/1000 PY, respectively).
- They often have coexisting illnesses, which can complicate the diagnosis and management of diabetes
- Older adults are living longer making the prevention or delay of diabetes-related complications more important in this age group
- And finally, older adults most likely benefit from improved glycemic control, as do younger patients

Health and the Aging Process

- ❑ Individuals of the same chronological age vary considerably in health and functional health status
- ❑ Prevalence of illness and functional impairment rise with age
- ❑ Not all health deficits are equally important
- ❑ Overall health status as well as chronological age should be considered in the management of diabetes

Mitnitski AB et al. *BMC Geriatrics*. 2002;2:1.

A person's health can play a role in the aging process.

Individuals of the same chronological age vary considerably in health and functional health status. We know that describing a person by their age does not necessarily tell us how healthy or unhealthy they are. Many of us have met people in their 70s who look and function as if they were in their 50s and, conversely, those in their 50s who appear to be much older than their chronological age.

We also know that the prevalence of illness and functional impairment rise with age and that not all health deficits are equally important. For example, heart disease is much more serious than knee problems.

The overall health status as well as the chronological age of a person need to be considered when developing a management plan for a person with diabetes.

Prevalence

- 20.8 million (7%) Americans have diabetes
 - 14.6 million diagnosed
 - 6.2 million undiagnosed
- Diabetes prevalence increases with age
- Diabetes is the 7th leading cause of death among US adults 65 years and older (2002 data)

CDC. National diabetes fact sheet. 2005.
ADA. *Diabetes Care*. 2007;30(Suppl 1):S4-S41.
Anderson et al. *National Vital Statistics Reports*. 2005.

The prevalence of diabetes in the United States is currently estimated to be 20.8 million people or 7% of the total population.

There are 14.6 million people who have been diagnosed with diabetes and 6.2 million people who have not been diagnosed.

The prevalence of diabetes increases with age and diabetes ranks as the 7th leading cause of death among US adults 65 years and older, based on data from 2002.

Diabetes and the Older Adult

- Over 36 million Americans are ≥65 years old
 - ~80% have 1 chronic condition
 - ~50% have 2 or more chronic conditions
 - ~20% have diabetes

- 71 million will be ≥65 years old by 2030
 - Estimated 19.6% of the population
 - Increased racial and ethnic diversity

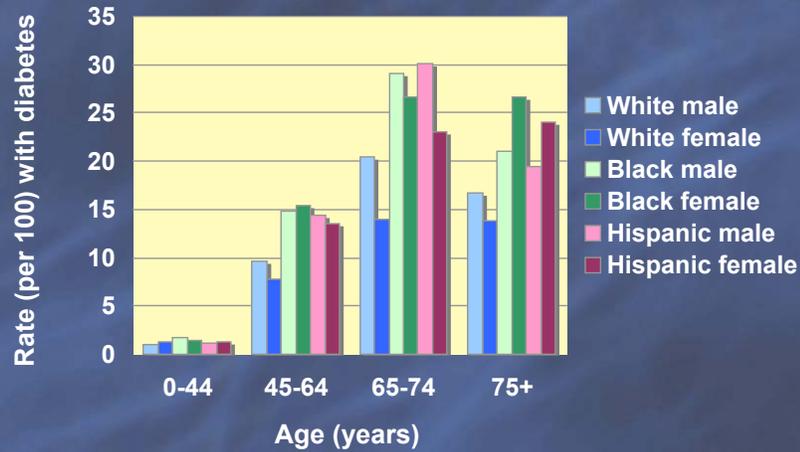
CDC. *MMWR*. 2003;52:101–106.
CDC. Healthy Aging: Preventing disease and improving quality of life among older Americans. 2007.

Currently more than 36 million Americans are 65 years or older and of these

- Approximately 80% have at least 1 chronic condition
- Approximately 50% have 2 or more chronic conditions
- And about 20% of these people have diabetes

The number of adults 65 years and older is expected to rise to 71 million by the year 2030. It is estimated that this will represent 19.6% of the population and that there will be increased racial and ethnic diversity of this population.

Diabetes and the Older Adult



Adapted from CDC's Diabetes Surveillance System. 2004.

As illustrated in this chart, the prevalence of type 2 diabetes begins to increase as the population reaches the mid-40s, and then increases dramatically after 65 years of age. You can see that African Americans, represented by the light and dark green bars, and Hispanics, represented by the pink and purple bars, have a higher rate of diabetes as compared with Caucasian older adults of the same age.

Risk Factors for Type 2 Diabetes

- Advancing age
- Overweight (BMI 25-30 kg/m²)
- Obesity (BMI >30 kg/m²)
- Physical inactivity
- Ethnicity
- Family history (first-degree relative)
- History of gestational diabetes or delivery of infant >9 lb
- History of vascular disease

ADA. *Diabetes Care*. 2007;30(Suppl 1):S4-S41.

The risk factors for developing type 2 diabetes include:

- Aging
- Being overweight, which is defined as a body mass index (BMI) of 25–30 kg/m² or being obese, which is defined as a BMI of greater than 30 kg/m²
- Being physically inactive
- Ethnicity (for example, Native, African, and Hispanic Americans have a higher risk of developing type 2 diabetes)
- Having a first-degree relative with diabetes
- A history of gestational diabetes or delivering a baby greater than 9 pounds
- A history of vascular disease

Aging, Obesity, and Diabetes

- ❑ Aging is associated with:
 - ↓ lean body mass
 - ↑ body fat
 - ↑ visceral (abdominal) fat
- ❑ Among US adults 65 years and over
 - ~36% are overweight
 - ~21% are obese
- ❑ Weight gain, obesity, and visceral fat are associated with increased risk of diabetes

Evans WJ, Cyr-Campbell D. *J Am Diet Assoc.* 1997;97:632–638.
National Center for Health Statistics. *Vital Health Stat Series.* 2004.
ADA. *Diabetes Care.* 2007;30(Suppl 1):S48–S65.
Mokdad AH et al. *JAMA.* 2003;289:76–79.

Shimokata H et al. *J Gerontol.* 1989;44:M66-M73.
Gabriely I et al. *Diabetes.* 2002;51:2951-2958.

Aging is also associated with a decrease in lean body mass and an increase in body fat, especially visceral or abdominal fat. The visceral body fat is often measured by waist circumference. A 40-inch waist circumference for men or 35 inches for women is often used in conjunction with the BMI to assess a person's risk for type 2 diabetes.

Lifestyle changes such as decreased physical activity with no change in food intake often leads to weight gain as we age. Among US adults over the age of 65 years, about 36% are overweight and about 21% are obese.

Weight gain, obesity, and visceral fat are associated with endocrine changes such as insulin resistance and increased risk of diabetes.

Effect of Obesity on Glucose Tolerance

Increased visceral fat is associated with:

□ Changes in skeletal muscle

↓ Insulin sensitivity

↓ Glucose uptake

□ Changes in hepatic metabolism

↓ Insulin sensitivity

↑ Glucose production

Kahn SE et al. *J Nutr.* 2001;131:354S–360S.
ADA. *Diabetes Care.* 2007;30(Suppl 1):S42–S47.
ADA. *Diabetes Care.* 2007;30(Suppl 1):S48–S65.

Increased visceral fat is associated with:

- Decreased insulin sensitivity in skeletal muscle tissue, commonly referred to as insulin resistance
- Decreased glucose uptake because of impaired insulin action
- And decreased insulin sensitivity in the liver. This lack of sensitivity can result in increased glucose production by the liver

These metabolic alterations result in imbalance in the glucose homeostasis mechanism. As a result, the beta cells of the pancreas produce more insulin as blood glucose levels rise; however, in time the cells can “wear out” because of increased demand. Type 2 diabetes develops when the insulin production of the pancreas can no longer meet the metabolic demands.



Checkpoint: Test Your Knowledge So Far

Advancing age is associated with:

- (a) Increased lean body mass
- (b) Decreased body fat
- (c) Increased visceral fat and risk of diabetes

Now it's time for a knowledge check.

Is advancing age associated with:

- (a) Increased lean body mass or
- (b) Decreased body fat or
- (c) Increased visceral fat and risk of diabetes?

The answer is (c)

Advancing age is associated with increased visceral fat and risk of diabetes.

I hope you answered (c). Advancing age is associated with increased visceral fat and risk of diabetes.

Undiagnosed Diabetes Is More Common in Older Adults

- ❑ Symptoms often resemble general physiological changes of aging
 - Fatigue, decreased vision, slow wound healing
 - Classic symptoms of diabetes (eg, polydipsia, polyuria) are often absent or not recognized
- ❑ Diagnosis often follows presentation of chronic complications
 - Cardiovascular disease, dyslipidemia, hypertension, impaired renal function
 - Hyperglycemia may be detected incidentally

Hiltunen LA, Keinanen-Kiukkaanniemi SM. *Cent Eur J Public Health*. 2004;12:78–83.
Selvin E et al. *Diabetes Care*. 2006;29:2415–2419.
Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
Rosenstock J. *Drugs Aging*. 2001;18:31–44.

Diagnosis of diabetes in older adults may be difficult for many reasons.

The presenting symptoms may be general in nature and resemble common physiological changes associated with aging (for example, weakness, fatigue, decreased vision, slow wound healing, and gastrointestinal changes).

Often the classic symptoms of diabetes such as polydipsia and polyuria are not present in patients with type 2 diabetes or symptoms of diabetes are not recognized because they are thought to be due to another disease or a medication the patient is taking.

It is not uncommon for diabetes to 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 at a physician office visit.

Diabetes Affects Independence

- **Adults with diabetes, aged >60 years experienced 2x to 3x increased risk of inability to:**
 - walk 400 meters
 - do housework
 - prepare meals
- **In a study of women ≥ 65 years old, diabetes was found to result in a 42% increased risk of becoming disabled**

Gregg EW et al. *Diabetes Care*. 2002;25:61–67.
Gregg EW et al. *Diabetes Care*. 2000;23:1272–1277.

Diabetes can affect activities of daily living and impact a person's independence.

Adults with diabetes greater than 60 years of age experienced a two to three times increase in the risk of inability to:

- Walk 400 meters
- Do housework or
- Prepare meals

One study found that women 65 years or older had a 42% increased risk of becoming disabled when they had diabetes.

Recommendations for Screening

- Regular screening (at least once every 3 years) recommended for all adults at age 45 years and above.
- Screening should be more frequent when patient is overweight (BMI ≥ 25 kg/m²) and additional risk factors are present:
 - Habitually physically inactive
 - Member of high-risk ethnic group or first-degree relative with diabetes
 - Previously identified IGT or IFG
 - Hypertension (BP $\geq 140/90$ mm Hg)
 - HDL cholesterol < 35 mg/dL and/or triglycerides > 250 mg/dL
 - History of delivering infant > 9 lb or gestational diabetes
 - History of vascular disease
 - Have polycystic ovary syndrome

ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.

Routine regular screening at 3-year intervals has been recommended for adults 45 years of age or older.

- For screening, either a fasting plasma glucose (FPG) or a 2-hour oral glucose tolerance test (OGTT, 75-g glucose load) may be used
- For patients with impaired fasting glucose (IFG), consider using the OGTT for screening to better define the risk for diabetes

The ADA has recommended more frequent screening beginning at a younger age, in individuals who are overweight; that is, a BMI of greater than 25 kg/m² when any of the following additional risk factors are present. These risk factors include:

- Little to no physical activity
- Member of high-risk ethnic group or first-degree relative with diabetes
- Previously identified impaired glucose tolerance (IGT) or 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
- Or polycystic ovary syndrome or other condition(s) that are associated with insulin resistance

Treatment Goals for Older Adults

- ❑ Currently, no long-term studies in patients >65 years demonstrate benefits of tight glycemic, blood pressure, and lipid control
- ❑ However, many older adults may benefit from intensive, long-term diabetes control and should be treated. These patients generally
 - Have life expectancy of ~10 years
 - Are active
 - Are cognitively intact
 - Are able to take responsibility for self-management
- ❑ Older adults should be treated using the same general principles used for younger patients:
 - Control hyperglycemia
 - Avoid hypoglycemia
 - Minimize, delay, prevent long-term complications
 - Achieve individual treatment targets

Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
California Healthcare Foundation. *J Am Geriatr Soc*. 2003;51:S265–S280.
ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.
Chelliah A, Burge MR. *Drugs Aging*. 2004;21:511–530..
Murphy SL. *National Vital Statistics Reports*. 2000.

Some controversy exists regarding how aggressively diabetes should be treated in the older adult. Currently, there are no long-term studies in patients older than 65 years that demonstrate the benefits of tight glycemic, blood pressure, and lipid control.

However, older adults who are expected to live long enough to benefit from long-term intensive diabetes management (~10 years) and who are physically active, cognitively intact, and willing to take on the responsibility of self-management, should be treated to target.

Older patients should be treated using the same stated goals as for younger patients. These goals include:

- Control of hyperglycemia
- Avoidance of hypoglycemia
- And prevention or delay of long-term complications

There are some specific considerations for older adults with diabetes. They are often more prone to medication-induced hypoglycemia. Use of sulfonylureas and some other antidiabetic agents increase the risk of hypoglycemia, as do other commonly prescribed medications such as angiotensin-converting enzyme inhibitors and non-selective beta-blockers.

Severe hypoglycemia is of particular concern for older adults who are at increased risk for injurious falls. Aggressive therapy, therefore, has traditionally not been used. However, with increased life expectancies, men and women who are 65 years of age can potentially live another 15 to 25 years. Therefore, factors to consider include:

- Presence and severity of long-term complications
- Quality of life
- Presence of other medical disorders

Treatment Goals: General Population

	ADA	AACE
A1C	<7%	≤6.5%
Fasting/preprandial glucose (mg/dL)	90–130	<110
Postprandial glucose (mg/dL)	<180*	<140†

*Peak postprandial capillary plasma glucose.
†2-hour postprandial glucose.

ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.
ACE/AACE. *Endocr Pract*. 2006;12(Suppl 1):6–12.
AACE. *Endocr Pract*. 2002;8(Suppl 1):40–82.

The glycemic goals for treating diabetes in the general population are shown here.

The ADA recommends maintaining the A1C below 7.0%; the American Association of Clinical Endocrinologists (AACE) recommends maintaining the A1C at or below 6.5%.

The glycemic targets shown are based on landmark studies demonstrating that the risk of developing microvascular and macrovascular complications increases substantially once blood glucose and A1C levels exceed the recommended values.

Setting Individual Targets and Goals

- ❑ Treatment, goals, and targets for the older adult should be individualized based on patient's condition and desires.
- ❑ In healthy older adults, reducing A1C to ADA or AACE recommended levels may be reasonable.
- ❑ AGS suggests considering more relaxed A1C for older adults when:
 - Their condition is very frail
 - Life expectancy is <5 years
 - Risks of an aggressive regimen of glycemic control will outweigh the benefits

ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.
California Healthcare Foundation. *J Am Geriatr Soc*. 2003;51: S265–S280.
ACE/AACE. *Endocr Pract*. 2006;12(Suppl 1):6–12.

Treatment goals for the older adult should be individualized based on the patient's condition and goals.

In healthy older adults, reducing A1C to <7% (the ADA recommended level) or to ≤6.5% (the AACE recommended level) may be reasonable.

No specific glycemic target values have been recommended for older adults who are in frail condition. It has been suggested by the California Healthcare Foundation and the American Geriatric Society (AGS) that an A1C target of less than 8% might be reasonable in some cases where the risks of an aggressive treatment regimen would likely outweigh the benefits of improved glycemic control.

Factors Affecting Glycemic Control in Older Adults

- ❑ Comorbid conditions
- ❑ Economics
- ❑ Social changes
- ❑ Difficulty preparing or eating food
- ❑ Polypharmacy
- ❑ Altered senses
- ❑ Altered circulation
- ❑ Altered renal, hepatic function
- ❑ Decreased mobility or physical activity

Rosenstock J. *Drugs Aging*. 2001;18:31–44.
Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.

This slide lists various factors that must be considered in the older adult with diabetes.

Older individuals often present with more than 1 chronic disease and can often be on multiple medications, getting them from more than 1 pharmacy. The potential for drug interactions should always be investigated.

Many older individuals live on a fixed income; many do not have private health insurance to supplement Medicare/Medicaid. The cost of therapy, particularly oral medications, can be difficult for some older adults.

Changes in the environment, such as moving from their home to a relative's home or to assisted living, or finding themselves unable to prepare food properly in their own home, must be taken into consideration. Social changes may lead to isolation, decrease in ability to care for themselves, and less access to medical care. Many older individuals need the support of family, in-home or visiting health practitioners, or long-term care to manage their diabetes.

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

Physical and mental impairment because of age or physiological changes can result in decreased mobility or physical activity. Elderly adults with reduced dexterity and visual acuity may have difficulty opening medication bottles, measuring insulin doses, or following labeling instructions.

Adherence to Therapy

- ❑ Adherence to therapy is often poor among most adults.
- ❑ A study of adults ≥ 65 years old in managed care found:
 - Increased adherence to medications by patients was associated with reduced health care costs.
 - Insulin use with vial and syringe was associated with reduced adherence to drug treatment.
- ❑ In a separate study of adults ≥ 18 years old, improved insulin delivery systems (compared with vial and syringe) were shown to increase adherence and reduce health care costs.
- ❑ Adherence to therapy may be affected by ability to pay for medications.

Balkrishnan R et al. *Clin Ther.* 2003;25:2958–2971.
Cramer JA. *Diabetes Care.* 2004;27:1218–1224.
Lee WC et al. *Clin Ther.* 2006;28:1712–1725.

Adherence to therapy (taking medications, following a meal and activity plan) is often poor among all adults.

A study of adults 65 years of age or older in a managed care setting found that:

- Increased adherence to medications by patients was associated with reduced health care costs and that
- Regimens involving insulin injections using vial and syringe were associated with reduced adherence to drug treatment. The limitations of this observational study did, however, preclude causal determination as well as inability to assess any daily variability associated with insulin regimens.

Conversely, in a separate study involving both older and younger adults (mean age, 45.4 years), improved insulin delivery systems (as compared with vial and syringe) were shown to increase adherence and reduce health care costs.

The ability to pay for medications also affects adherence to therapy.

Monitoring

- Self-monitoring of blood glucose (SMBG)
- Routine medical visits
 - Screening for depression and cognitive impairment
 - A1C
 - Lipids, cholesterol, and blood pressure
 - Dilated eye exam
 - Foot exam
 - Microalbumin
 - Nutritional status

Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
ADA. *Diabetes Care*. 2007;30(Suppl 1):S4–S41.
California Healthcare Foundation. *J Am Geriatr Soc*. 2003;51: S265–S280.

Self-monitoring of blood glucose (SMBG) may help to assess daily control of hyperglycemia and to minimize the risk of hypoglycemia. Individual instruction in use of glucose meters is needed, as is assessment of dexterity and ability to perform SMBG.

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

- Screening for depression and assessment for 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 triglycerides, low-density lipoprotein cholesterol, and hypertension
- 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 doing daily foot exams.
- Microalbumin testing should be done at diagnosis and then at least annually thereafter
- And nutritional status should also be assessed at each visit.



Checkpoint: Test Your Knowledge So Far

An Hispanic woman, who is over the age of 45 years, with a history of having delivered a 10-lb infant, should be screened for diabetes:

- (a) once every 3 years
- (b) once every 5 years
- (c) more frequently than every 3 years

Here's another knowledge check.

An Hispanic woman, who is over the age of 45 years, with a history of having delivered a 10-lb infant, should be screened for diabetes:

- (a) once every 3 years or
- (b) once every 5 years or
- (c) more frequently than every 3 years

The answer is (c).

An Hispanic woman, who is over the age of 45 years, with a history of delivering a 10-lb infant, should be screened for diabetes more frequently than every 3 years.

The answer is (c).

An Hispanic woman, who is over the age of 45 years, with a history of delivering a 10-lb infant, should be screened for diabetes more frequently than every 3 years. The woman's age, ethnic group, and history of delivering a large infant put her at high risk for diabetes. Therefore, more frequent screening is indicated.

Management of Diabetes in the Older Adult

- ❑ Medical nutrition therapy
- ❑ Regular physical activity
- ❑ Pharmacological treatment
- ❑ Monitoring blood glucose
- ❑ Self-management education

Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
Oiknine R, Mooradian AD. *Biomed Pharmacother*. 2003;57:231–239.

The basic principles of diabetes management are the same for all patients regardless of age and these include:

- Medical nutrition therapy
- Regular physical activity
- Pharmacological treatment
- Blood glucose monitoring and
- Self-management education

However, some special considerations do apply to older adults.

Medical Nutrition Therapy

- Assess current dietary and physical activity patterns
 - Factors that may impact nutritional care plan
 - Food intolerances, allergies, mechanical difficulties, altered taste perception
 - Lifestyle or social factors: poor motivation, cognitive dysfunction, limited finances, impaired shopping capabilities

- Meal planning
 - Minimize complexity
 - Spread carbohydrates throughout the day to avoid large blood glucose fluctuations
 - Obese patients may benefit from modest caloric restriction and an increase in physical activity; energy needs may be less than for a younger individual of the same weight
 - Consider a daily multivitamin supplement, especially for patients with reduced caloric intake

(continued)

ADA. *Diabetes Care*. 2007;30(Suppl 1):S48–S65.

Optimally, all older adults with diabetes should receive medical nutrition therapy (MNT) from a registered dietitian. MNT is covered by Medicare and many insurance plans for people with diabetes. MNT consists of:

- Assessing the patient's nutritional status and physical activity patterns
- Identifying factors that may impact his/her 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 as poor motivation, cognitive dysfunction, limited finances, and impaired shopping capabilities and
- Developing a meal plan that is customized to the patient's needs and that 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 that for a younger person of the same weight
 - A daily multivitamin supplement may be appropriate, especially for patients with reduced energy intake

Medical Nutrition Therapy (cont'd)

□ Meal planning (cont'd)

- Hospitalized patients
 - Establish an interdisciplinary team and implement MNT
 - Provide consistent carbohydrate content of meals
 - Do not use the term “ADA diet”
 - Clear or full liquid diets: approx. 200 g/d of carbohydrate
 - Diabetes-specific discharge planning
- Residents of long-term care facilities
 - No dietary restrictions are warranted for elderly patients
 - Provide consistent amount and timing of carbohydrate intake
 - Use interdisciplinary approach to integrate MNT into overall management
 - Use caution with weight-loss diets: undernutrition is likely

ADA. *Diabetes Care*. 2007;30(Suppl 1):S48–S65.

- An interdisciplinary team should be established to provide MNT in hospitalized patients.
- Implementing a diabetes meal-planning system that provides consistency in the carbohydrate content of specific meals should be considered. The carbohydrate content of breakfast, lunch, dinner, and snacks may vary, but the day-to-day carbohydrate content of meals should be kept constant.
- The term “ADA diet” should not be used since the ADA no longer endorses a single meal plan prescription.
- For patients requiring clear or full liquid diets, about 200 grams per day of carbohydrate should be provided in equally divided amounts at meal and snack times.
- Discharge planning should include a diabetes-specific meal plan prescription.

Meal planning guidelines for nursing home residents with diabetes should include:

- That there are no dietary restrictions
- A regular menu should be served, with consistency in the amount and timing of carbohydrate intake
- An interdisciplinary team approach is necessary to integrate MNT into the overall management of the patient
- Undernutrition is common in institutionalized elderly patients, so weight-loss diets should be prescribed with caution

Benefits of Regular Physical Activity

Regular moderate physical activity may reduce all-cause mortality among adults aged 65 years and older.

↑ glucose tolerance

↑ insulin sensitivity

↓ blood pressure

↑ joint flexibility

↑ sense of well-being

↑ circulation

↑ lean body mass + muscle

May ↓ risk of falls

Sundquist K et al. *Am J Prev Med.* 2004;27:22–27
ADA. *Diabetes Care.* 2007;30(Suppl 1):S4–S41.
Mullooly CA. *The Art and Science of Diabetes Self-Management Education.* 2006.
Gillespie LD et al. *Cochrane Database Syst Rev.* 2001:CD000340.

This slide lists benefits that may result from regular physical activity, which should be encouraged in many older adults following consultation with, and at the discretion of, their health care provider. These benefits include:

- Improved glucose tolerance with increased insulin sensitivity
- Reduced blood pressure and improvements in circulation
- Improved joint flexibility
- An improved sense of well-being
- An increase in lean body mass and muscle
- And possibly a decreased risk of falls

Regular Physical Activity: Precautions for the Older Adult

- Physical examination
- Activity selection
- Hydration, source of glucose replacement
- Monitoring of blood glucose levels
- Exercise-induced hypoglycemia and post-exercise hypoglycemia
- Medical identification

Mullooly CA. *The Art and Science of Diabetes Self-Management Education*. 2006.
Willey KA, Singh MAF. *Diabetes Care*. 2003;26:1580–1588.

Proper recommendations and supervision of exercise are critical for older adults.

A physical examination should be conducted and the patient evaluated for potential risk factors such as the presence of microvascular disease or loss of sensation in the feet.

The individual's preference(s) for activities should be discussed and functional ability to perform various types of exercise should be assessed (for example, those with retinopathy should not lift weights).

During exercise, it is important that the patient be adequately hydrated. This is of special concern in older adults, who are at increased risk of dehydration.

Individuals should be advised of the importance of self-monitoring of blood glucose (for both hyper- and hypoglycemia) and be instructed as to appropriate actions following test results. Monitoring before and after exercise is recommended. Immediate sources of glucose replacement should be discussed.

Exercise-induced hypoglycemia and late-onset postexercise hypoglycemia (which can occur 4 or more hours following activity) are important concerns for older adults.

All individuals with diabetes should wear easily visible medical identification.

Pharmacological Therapy

- Oral antidiabetic drugs (OADs)
- Injectables
 - Insulin and insulin analogs
 - Incretin mimetics
- Inhalation
 - Insulin
- Combination therapy

Nathan DM et al. *Diabetes Care*. 2006;29:1963–1972.
Oiknine R, Mooradian AD. *Biomed Pharmacother*. 2003;57:231–239.
Rosenstock J. *Drugs Aging*. 2001;18:31–34.

Type 2 diabetes is a progressive disease; therefore, insulin should be initiated when glycemic goals can no longer be achieved with oral antidiabetic drugs, or in some cases when a patient's blood glucose is excessively high.

Currently, many physicians use combination therapy, such as a secretagogue and sensitizer, at diagnosis to address the dual nature of type 2 diabetes.

Incretin mimetics are relatively new agents that help to control blood glucose by enhancing pancreatic insulin secretion, slowing gastric emptying, and decreasing appetite.

Specific Considerations for Selecting Medications for Older Adults

- How is the drug metabolized?
- What other medications are being prescribed?
- What is known about the drug's use in older adults?
- What is the level of cognitive ability?
- Are there specific contraindications to use of the drug?

Steil CF. *Art and Science of Diabetes Self-Management Education*. 2006.
Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
Halter JB. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.

Selecting the appropriate medication for the older adult should take into account the considerations listed on the slide.

Metabolism and elimination of the drug from the body. Hepatic and renal function decrease with advancing age. (If drugs are metabolized in the liver and excreted by the kidney, extra precautions should be used.)

In the older adult medications should be started at the lowest possible doses and slowly titrated.

Due to the potential for drug interactions, other medications the patient is taking should be evaluated.

Because older adults are at increased risk for adverse drug reactions as compared with younger patients, it is important to know about the use of the drug in the older population.

It is also important to assess what the patient is able to do in regard to adhering to a medication regimen. The most effective medication regimen won't work if the patient can't follow it. Simplified regimens along with pillboxes or timers can be used to assist with medication adherence.

And, finally, it is important to know contraindications of the drug (for example, metformin is contraindicated if the creatinine is greater than 1.5 mg/dL in men or greater than 1.4 mg/dL in women).

Medications That Can Affect Blood Glucose Levels

Lower blood glucose

Alcohol
ACE inhibitors
Salicylates—large doses
(>4 g/day)
Beta-blockers—
nonselective
Pentamidine

Raise blood glucose

Alcohol—chronic ingestion
Glucocorticoids
Atypical (Second generation)
antipsychotic agents
Diuretics
Sympathomimetics
Phenytoin sodium
Diazoxide
Beta blockers—nonselective

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
Chelliah A, Burge MR. *Drugs Aging*. 2004;21:511–530.
Moran SA, LeRoith D. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.

It is also important to be aware that some medications can lower or raise blood glucose levels.

Drugs that have been associated with hypoglycemia include:

- Alcohol, which impairs gluconeogenesis and enhances the response to insulin
- ACE inhibitors, which are commonly used in people with diabetes, have been associated with hypoglycemia
- High-dose salicylates may alter the pharmacokinetics of sulfonylureas, increase utilization of glucose by peripheral tissues, cause reduction of gluconeogenesis, and may potentiate insulin secretion
- Nonspecific beta-blockers such as propranolol inhibit gluconeogenesis and glycogenolysis and can mask the signs of hypoglycemia such as tachycardia, tremor, and anxiety
- Pentamidine initially causes damage to the beta cells of the pancreas resulting in hypoglycemia; however, longer-term use results in hyperglycemia.

Drugs that can cause hyperglycemia include:

- Chronic use of alcohol can raise blood glucose levels
- Glucocorticoids, such as prednisone, which increase gluconeogenesis and depress insulin action
- Second generation or atypical antipsychotic agents have also been associated with the development of diabetes
- Diuretics can inhibit insulin secretion indirectly, by depletion of potassium
- Sympathomimetics, which increase glycogenolysis and gluconeogenesis
- Phenytoin can also inhibit insulin secretion
- Diazoxide inhibits the secretion of insulin
- Beta blockers – block glucose- or glucagon-mediated beta-adrenergic stimulation that normally promotes pancreatic insulin secretion

Types of OADs

- ❑ **Insulin secretagogues**
 - Stimulate insulin release
- ❑ **Insulin sensitizers**
 - Improve response to insulin
- ❑ **Alpha-glucosidase inhibitors**
 - Delay carbohydrate digestion
- ❑ **DPP-4 inhibitors**
 - Increase insulin release by slowing breakdown of incretin hormones
- ❑ **Combination formulations**
 - Insulin sensitizer + insulin secretagogue
 - Combination of 2 sensitizers

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
Januvia™ Prescribing Information. 2006.

Currently there are 5 classes of OADs.

Insulin secretagogues stimulate insulin release from pancreatic beta cells.

There are 2 types of insulin sensitizers, both of which improve response to insulin, resulting in improved glucose utilization at the cellular level.

Alpha-glucosidase inhibitors delay carbohydrate digestion by enzymatic inhibition.

The DPP-4 (dipeptidyl peptidase-4) inhibitors are the newest class of oral agents. They increase insulin release by slowing breakdown of incretin hormones GIP (gastric inhibitory peptide) and GLP-1 (glucagon-like polypeptide-1).

Several combinations of these medications are now available, which can help to simplify medication regimens by decreasing the number of pills per day a patient takes.

Secretagogues

□ Sulfonylureas

- Monotherapy or combination therapy
- Most common side effect is hypoglycemia
- Most are contraindicated with renal or hepatic insufficiency
- Chlorpropamide is not recommended for use in older adults
- Many generics are available

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
California Healthcare Foundation. *J Am Geriatr Soc*. 2003;51:S265–S280.
Amaryl® Prescribing Information. 2006.
Greco D, Angileri G. *Diab Nutr Metab*. 2004;17:23–26.

Sulfonylureas are the class of medications that have been on the market the longest. Most of the sulfonylureas are indicated for both monotherapy and combination therapy.

Because of the continuous action of sulfonylureas on the beta cells, the 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 and older with type 2 diabetes. Hypoglycemia can be of special concern for the older adult who may have inconsistent eating patterns. Patients should be instructed on the signs, symptoms, treatment, and prevention of hypoglycemia.

Other side effects of sulfonylureas include headache, nausea/diarrhea, rashes, and a bitter metallic taste.

Sulfonylureas are metabolized in the liver and excreted through the kidney. 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.

One advantage of using sulfonylurea drugs is that many of them are available generically, making them relatively inexpensive.

Secretagogues

- Nateglinide (Starlix[®]) and Repaglinide (Prandin[®])
 - Fast-acting, rapid absorption and onset
 - Nateglinide may be used with caution in patients with impaired renal or hepatic function
 - Repaglinide should be used with caution in patients with moderate to severe liver disease

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
Greco D, Angileri G. *Diab Nutr Metab*. 2004;17:23–26.

Nateglinide and repaglinide are fast-acting with a rapid absorption and onset. Because they work on the pancreas, they can also cause hypoglycemia; however, because they are short-acting, it is less likely to happen as compared with the sulfonylureas. These medications may be useful in patients who do not have regular eating schedules, as they should take the medication only when they eat.

Nateglinide may be used with caution in patients with impaired renal or hepatic function.

Repaglinide should be used with caution in patients with moderate to severe liver disease.

Sensitizers and Biguanides

- Thiazolidinediones (rosiglitazone [Avandia®] and pioglitazone [Actos®])
 - Combination therapy available
 - Should not be used with active liver disease
 - Should not be used with congestive heart failure (NYHA class 3 and 4)
 - Should be used with caution in patients with fluid retention
 - Association with increased risk of forearm, hand, or foot fractures in women
- Biguanides (metformin)
 - May be used as monotherapy or as part of combination therapy
 - Should not be used with renal or hepatic insufficiency
 - Should not be used with congestive heart failure requiring pharmacologic treatment
 - Can lower cholesterol and triglycerides
 - Not associated with weight gain
 - Risk of lactic acidosis (very rare)

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
California Healthcare Foundation. *J Am Geriatr Soc*. 2003;51:S265–S280.

The 2 classes of insulin sensitizers include the biguanides and thiazolidinediones.

Rosiglitazone and pioglitazone are the 2 available thiazolidinediones.

- Rosiglitazone is available in combination therapy with metformin.
- Neither of these drugs should be used in patients with hepatic problems or heart failure.
- They should be used with caution in patients with a history of fluid retention as they can cause fluid retention.
- These drugs have recently been found to be associated with an increased risk of forearm, hand, or foot fractures in women.
- There have also been rare reports of vision changes due to swelling in the back of the eye with rosiglitazone.

Metformin, the only biguanide currently available, is used alone or as part of combination therapy.

- The biggest concern with this drug is the risk of lactic acidosis, although this is very rare. It should not be used in patients with renal or hepatic insufficiency, in alcoholics, or those with congestive heart failure. Patients using metformin should have creatinine levels monitored at least annually, and with every dose increase.
- The benefits of using metformin are that it can lower cholesterol and triglycerides and it is not associated with weight gain.

Alpha-Glucosidase Inhibitors

- Acarbose (Precose®) and Miglitol (Glyset®)
 - Not associated with weight gain
 - Should not use with intestinal disorders
 - Not associated with hypoglycemia when used alone; *however*, may increase the risk arising from concomitant medications
 - Need to use a monosaccharide, such as glucose, to treat hypoglycemia due to inhibition of carbohydrate catabolism

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.

A class of medications not commonly used are the alpha-glucosidase inhibitors, which include acarbose and miglitol.

An advantage of these medications is that they are not associated with weight gain.

A disadvantage is that they should not be used in patients with intestinal disorders as they cause gastrointestinal side effects, which is one of the reasons for their lack of popularity.

They 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 from these medications. If hypoglycemia does occur, the patient needs to use a monosaccharide, such as glucose, to treat their hypoglycemia because of the drug's mechanism of action.

DPP-4 Inhibitors

□ Sitagliptin (Januvia™)

- Indicated for monotherapy or combination therapy with metformin or thiazolidinediones
- Once-a-day dosing
- Considerations for older patients with renal insufficiency
 - Required dose adjustment for moderate renal insufficiency
 - Assess renal function prior to and after initiating
 - Limited experience in older adults at this time

Januvia™ Prescribing Information. 2006.
Idris I, Donnelly R. *Diabetes Obes Metab.* 2007;9:153–165.

The DPP-4 inhibitor, sitagliptin, is the newest OAD on the market. It's believed that DPP-4 inhibitors function by blocking the dipeptidyl peptidase-4 enzyme, thus slowing the inactivation of incretin hormones (GLP-1 and GIP). Incretin hormones increase insulin synthesis and release from pancreatic beta cells.

DPP-4 inhibitors are indicated in type 2 diabetes as an adjunct to diet and exercise for improved glycemic control as monotherapy or as combination therapy with metformin or a thiazolidinedione.

The recommended dose is 100 mg once daily, but caution should be used in dose selection for older patients with renal insufficiency, since sitagliptin is substantially excreted by the kidney. Because older patients are more likely to have decreased renal function, it is recommended that renal function be assessed prior to and periodically after initiating therapy in these patients.

For patients with moderate renal insufficiency, a creatinine clearance (CrCl) of 30–50 mL/min, the recommended dose is 50 mg once daily. For patients with severe renal insufficiency, a CrCl less than 30 mL/min, or end-stage renal disease, the recommended dose is 25 mg once daily.

At this point, there is limited experience with sitagliptin in older adults.

Decreases in A1C with Type 2 Diabetes Interventions

Intervention	Expected decrease in A1C (%)
Lifestyle (↓weight, ↑activity)	1.0–2.0
Metformin	1.5
Sulfonylureas	1.5
Glinides	1.0–1.5
Thiazolidinediones (TZDs)	0.5–1.4
α-Glucosidase inhibitors	0.5–0.8
Insulin	1.5–2.5
Exenatide (Byetta®)	0.5–1.0
Pramlintide (Symlin®)	0.5–1.0

Nathan DM et al. *Diabetes Care*. 2006;29:1963–1972.

Different interventions and classes of medications are variably effective at decreasing A1C levels. This table shows the decrease in A1C that can be expected when a given intervention is utilized.

Lifestyle changes targeted at decreasing weight and increasing activity may be associated with a 1%–2% decrease in A1C.

Oral antidiabetic medications result in A1C decreases of between 0.5% and 1.5%.

- Typically, metformin and the sulfonylureas decrease A1C by ~1.5%.
- Repaglinide is almost as effective as metformin and the sulfonylureas, while nateglinide results in a smaller decrease.
- Data on the thiazolidinediones have demonstrated A1C decreases of between 0.5% and 1.4%.
- Alpha-glucosidase inhibitors are somewhat less effective in lowering glycemia, reducing A1C by only 0.5% to 0.8%.

Insulin is the most effective medication for lowering blood glucose. When used in adequate doses, it can decrease A1C from any level to normal glycemia. In clinical trials targeting an A1C of about 7%, insulin has typically resulted in A1C decreases between 1.5% to 2.5%.

Exenatide (Byetta®), an injectable GLP-1 agonist, appears to lower A1C by 0.5% to 1.0%. It is currently approved for use in the United States with a sulfonylurea and/or metformin.

Pramlintide (Symlin®), an injectable amylin agonist approved for use only as adjunct therapy with insulin, decreased A1C in clinical trials by 0.5% to 1.0%.



Checkpoint: Test Your Knowledge So Far

Which of the following medications may lower blood glucose levels?

- (a) Glucocorticoids
- (b) Sympathomimetics
- (c) ACE inhibitors
- (d) Atypical (second generation) antipsychotics

Here's another knowledge check:

Which of the following medications may lower blood glucose levels? Is it

- (a) Glucocorticoids or
- (b) Sympathomimetics or
- (c) ACE inhibitors or
- (d) Atypical (second generation) antipsychotics?

The answer is (c).

ACE inhibitors may lower blood glucose levels.

The answer is (c).

ACE inhibitors may lower blood glucose levels when administered to patients with diabetes.

When to Consider Insulin Therapy?

- First-line therapy in cases with:
 - Severe hyperglycemia
 - Ketonuria
 - OAD intolerance or contraindication
- When adequate glycemic control with OAD(s) is no longer provided
- During acute illness, surgery, hospitalization

Stell CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
Skyler JS. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Marre M. *Int J Obes*. 2002;26(Suppl 3):S25-S30.
Nathan DM. *N Engl J Med*. 2002;347:1342-1349.

Insulin and insulin analogs are highly effective glucose-lowering agents and should be considered first line in patients with severe hyperglycemia, ketonuria, and in patients with intolerance or contraindications to oral antidiabetes medications.

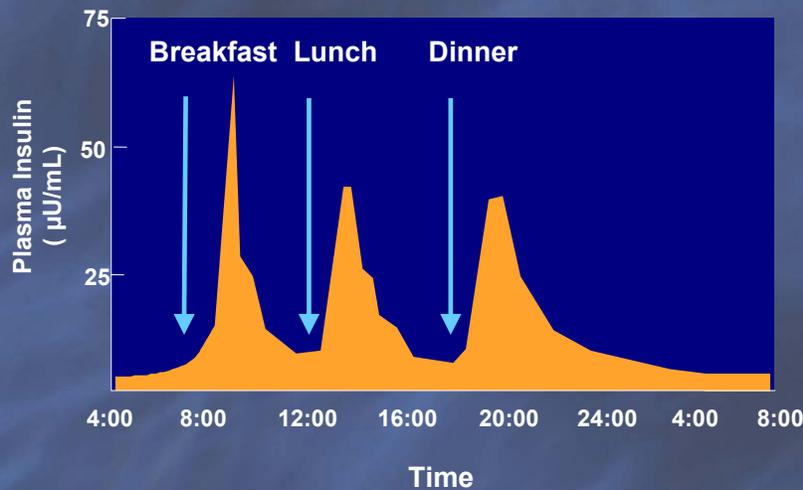
Some prescribers will use insulin as initial therapy to achieve glycemic control, then change to an oral agent if appropriate.

As discussed earlier, because type 2 diabetes is a progressive disease, insulin is usually needed to maintain adequate glycemic control. Ideally, insulin should be initiated before a patient fails orals; however, because of the resistance to using insulin, that is not usually the case.

Insulin is also commonly used during acute illnesses, surgery, and hospitalizations.

A very valid concern with the use of insulin is the risk for hypoglycemia and weight gain. These concerns, however should not preclude its use. Patients need to be educated on the importance of following their exercise and meal plan as well as the signs, symptoms, prevention, and treatment of hypoglycemia.

Physiologic Serum Insulin Profile



The graph shown here depicts the physiologic serum insulin secretion profile of a nondiabetic individual who eats 3 meals per day. The insulin plasma concentrations are shown in yellow. As you can see, following the ingestion of a meal, there is a rapid burst of insulin released from the pancreas. The secretion of insulin in response to a glucose load has 2 phases.

The first phase occurs within 10 minutes of receiving a glucose load and is 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 the earliest detectable abnormality in type 2 diabetes.

The second phase of insulin secretion begins about 20 minutes after a glucose load and represents insulin newly synthesized in the beta cells.

The goal of insulin therapy is to mimic this profile as closely as possible, taking into account individual requirements and capabilities.

Short- and Rapid-Acting Insulin and Rapid-Acting Insulin Analogs

Short-acting insulin

- ❑ Regular human insulin (Humulin® R, Novolin® R)

Rapid-acting insulin analogs

- ❑ Insulin lispro (Humalog®)
- ❑ Insulin aspart (NovoLog®)
- ❑ Insulin glulisine (Apidra®)

Rapid-acting insulin

- ❑ Human insulin inhalation powder (Exubera®)

Skyler JS. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Apidra® Prescribing Information. 2005.
Exubera® Prescribing Information. 2007.

Short-acting insulin and rapid-acting insulin analogs are used in multiple daily injection (MDI) therapy and in intensive insulin therapy to mimic normal insulin action. Regular insulin is also used during surgery and rapid-acting analogs are used in insulin pumps.

Inhaled insulin has an onset of action similar to that of the rapid-acting insulin analogs. In type 1 diabetes, it is used in combination with a longer-acting insulin. In type 2 diabetes, it may be used as monotherapy or in combination with oral agents or with longer-acting insulins.

Regular insulin is considered a short-acting insulin and is available as

- Novolin® R and
- Humulin® R

The rapid-acting insulin analogs include:

- Humalog® - insulin lispro
- NovoLog® - insulin aspart
- Apidra® - insulin glulisine

Exubera®, human insulin inhalation powder, is considered a rapid-acting insulin.

Intermediate-Acting Insulin and Long-Acting Insulin Analogs

Intermediate-acting insulin

- ❑ NPH human insulin (Humulin® N, Novolin® N)

Long-acting insulin analog

- ❑ Insulin glargine (Lantus®)
- ❑ Insulin detemir (Levemir®)

Skylar JS. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Lantus® Prescribing Information. 2004.
Levemir® Prescribing Information. 2005.
Novolin® N Prescribing Information. 1999.
Humulin® N Prescribing Information. 2000.

The intermediate- and long-acting insulins are used to mimic the basal secretion of insulin.

Currently, NPH is the only intermediate-acting insulin on the market.

- NPH human insulin is available as Humulin® N or Novolin® N

There are 2 long-acting insulin analogs:

- Insulin glargine (Lantus®) and
- Insulin detemir (Levemir®)

Premixed Insulin and Premixed Insulin Analogs

Premixed insulin

- Humulin® 70/30
- Humulin® 50/50
- Novolin® 70/30

Premixed insulin analogs

- Humalog® Mix75/25™
- Humalog® Mix50/50™
- NovoLog® Mix 70/30

Skyler JS. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Humalog® Prescribing Information. 2006.

Premixed formulations were developed for the patients' convenience, by combining short-acting insulin with intermediate-acting insulin. Newer products are combinations of the rapid-acting analogs with longer-acting analog products.

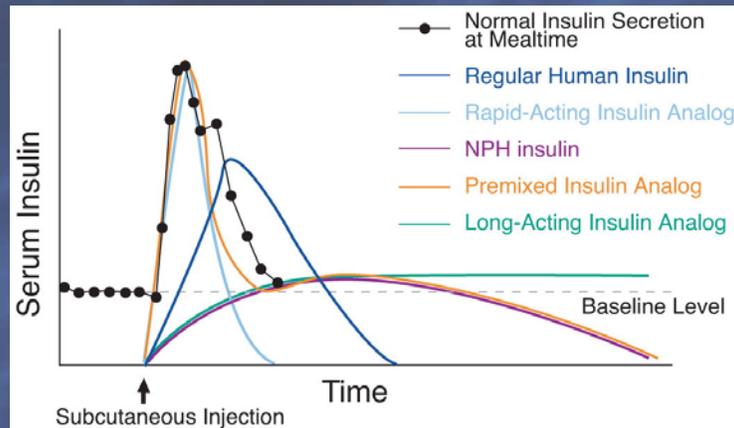
The premixed insulins include:

- Humulin® 70/30, Humulin® 50/50 – 50% NPH human insulin isophane suspension, 50% Regular human insulin injection (rDNA origin)
- Novolin® 70/30 – 70% NPH human insulin isophane suspension, 30% Regular human insulin injection (rDNA origin)

The premixed insulin analogs include:

- Humalog® Mix75/25™ – (75% insulin lispro protamine suspension and 25% insulin lispro injection [rDNA origin])
- Humalog® Mix50/50™ – (50% insulin lispro protamine suspension and 50% insulin lispro injection [rDNA origin])
- NovoLog® Mix 70/30 – (70% insulin aspart [rDNA origin] protamine suspension and 30% insulin aspart [rDNA origin] injection)

Time–Action Profiles of Insulin Theoretical Representations



This slide shows the general time course of the various insulin preparations plotted against normal insulin secretion following a meal. As you can see, the insulin analogs most closely resemble normal endogenous insulin secretion.

Special Considerations for Initiation of Insulin Therapy in Older Adults

- ❑ **Mental status**
 - Ability to learn and recall dosing regimen
 - Ability to properly mix different insulin formulations and adjust dosage
 - Resistance to injections
- ❑ **Manual dexterity**
 - Ability to use insulin delivery system
 - Ability to self-inject
- ❑ **Visual acuity**
 - Ability to dose accurately
- ❑ **Quality of life**

Oiknine R, Mooradian AD. *Biomed Pharmacother.* 2003;57:231–239.
Spollett GR. *The Art and Science of Diabetes Self-Management Education.* 2006.
Halter JB. *Therapy for Diabetes Mellitus and Related Disorders.* 2004.

This slide lists some issues to consider when initiating insulin therapy in older adults.

Older adults should be evaluated for their ability to learn and recall their dosing regimen, and to perform blood glucose monitoring.

Manual dexterity is an important consideration, especially with regard to their ability to use an insulin delivery system as well as administer self-injections.

Reduced visual acuity may affect the patient's ability to dose insulin accurately.

Tools are available to assist the older adult with maintenance of an insulin regimen; some insulin delivery systems may require less manual dexterity and accommodate reduced visual acuity, as compared with syringe and vial.

The initiation of insulin can help to improve a patient's quality of life especially if they have symptomatic hyperglycemia. However, the presence of complications and life expectancy should be part of the evaluation whether the benefits of the insulin use outweigh the risks.

Insulin Delivery Systems

- Vial and syringe
- Prefilled disposable insulin doser
- Prefilled disposable insulin pens
- Durable insulin pens and dosers
- External insulin pumps (CSII)
- Inhaled

Ratner RE. *Practical Diabetology*. 2004;23:14–24.
Lee WC et al. *Clin Ther*. 2006;28:1712–1725.
Berg B et al. *Ups J Med Sci*. 2001;106(Suppl 2):11.
EXUBERA® Inhaler. Prescribing Information. 2007.
ADA. *Diabetes Forecast*. 2006;59:RG1-RG69.

A number of delivery systems are available as alternatives to vial and syringe to meet the various needs of insulin-using individuals. These include insulin pens and dosers with cartridges, prefilled disposable insulin pens or dosers, jet injectors, and inhalers.

Some of these systems may be helpful to older adults because of simple and accurate dosing; large, easy-to-see numbers; and easier handling when dexterity problems are present.

One study in which 112 elderly patients (mean age, 69.4 years) responded to a questionnaire demonstrated that a disposable insulin doser was preferred over vial and syringe in ease-of-use assessments.

Another study in both 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 these alternative systems may be found on manufacturers' Web sites or from the ADA Resource Guide.

Insulin Pens and Dosers

Humalog® Mix75/25™ Pen



NovoLog® Mix 70/30 FlexPen®



Novolin® InnoLet® doser

Ratner RE. *Practical Diabetology*. 2004;23:14–24.
Venekamp WJ et al. *Curr Med Res Opin*. 2006;
22:315–325.
EXUBERA® Inhaler. Prescribing Information. 2007.

Examples of some insulin delivery systems currently available include:

- The Novolin® InnoLet® doser pictured at the bottom of this slide. It is available prefilled with Regular, NPH, or 70/30 Mix human insulin.
- The FlexPen®, which is pictured in the center of the slide, is prefilled with either the rapid-acting insulin analog (NovoLog®), or long-acting insulin analog (Levemir®), or analog mix (NovoLog® Mix 70/30).
- The Humalog® Pen is pictured at the top of the slide and is prefilled with the rapid-acting insulin analog (Humalog®), or analog mix (Humalog® Mix75/25™; Humalog® Mix50/50™).

Other devices available but not pictured include:

- The Humulin® Pen – which is prefilled with human insulin (NPH or 70/30 Mix).
- Then HumaPen® Memoir™ – a reusable pen injector for use with Humalog® or Humulin®; it displays the last dose given on a digital display; 16 doses are stored in memory.
- The EXUBERA® inhaler for use with EXUBERA® (insulin human [rDNA origin]) inhalation powder.

New Injectable Therapies

□ Incretin mimetics (exenatide [Byetta[®]])

- Mimics the action of incretins (eg, GLP-1)
- Increases glucose-mediated insulin secretion
- Slows gastric emptying
- Associated with gastrointestinal side effects

□ Amylinomimetic agents (pramlintide [Symlin[®]])

- Synthetic analog of beta-cell hormone amylin
- Slows gastric emptying
- Suppresses glucagon secretion
- Associated with gastrointestinal side effects

Nathan DM et al. *Diabetes Care*. 2006;29:1963–1972
Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.

New therapies include incretin mimetics and amylinomimetic agents. Both of these classes of medications act on incretin hormones, which have an impact on glycemic control. Incretin hormones include GLP-1, which is naturally produced by the small intestine and stimulates insulin secretion.

Exenatide (Byetta[®]), the first incretin mimetic on the market, is a synthetic form of a protein found in the saliva of the Gila monster. It

- Is currently approved for use in type 2 diabetes with sulfonylurea and/or metformin
- Mimics the action of incretins such as GLP-1
- Potentiates glucose-mediated insulin secretion
- Suppresses glucagon secretion
- Slows gastric emptying
- The usual dose is 5–10 mcg twice daily given by subcutaneous injection
- 30%–40% of patients experience nausea, vomiting, or diarrhea when starting this drug

Pramlintide [Symlin[®]] is a synthetic analog of the beta-cell hormone amylin.

- It is currently approved for use in
 - Type 1 diabetes as adjunctive therapy with insulin and
 - Type 2 diabetes as adjunctive therapy with insulin, with or without sulfonylurea and/or metformin
- Its mechanism of action is to slow gastric emptying and suppress glucagon production and secretion in a glucose-dependent manner
- It also decreases postprandial glucose excursions
- Pramlintide is administered by subcutaneous injection prior to meals and
- Nausea is the most common side effect, reported in up to 48% of patients

Concerns for Older Adults with Diabetes: Selected Geriatric Syndromes

- ❑ Depression
- ❑ Polypharmacy
- ❑ Cognitive impairment
- ❑ Urinary incontinence
- ❑ Injurious falls
- ❑ Neuropathic pain

California Healthcare Foundation. *J Am Geriatr Soc.* 2003;51:S265–S280.
Sclater A, Alagiakrishnan K. *Geriatrics.* 2004;59:22–27.

The AGS guidelines identify the following geriatric syndromes as concerns for older adults with diabetes:

- Depression (up to 25% of older adults are estimated to be depressed)
- Polypharmacy; it is not uncommon for older adults to be on multiple medications
- Cognitive impairment
- Urinary incontinence
- Injurious falls - Diabetes is a risk factor for orthostatic hypotension (OH), which may cause up to 16% of all falls, and may contribute to as many as 26%. As with diabetes, prevalence of OH increases with advancing age.
- Neuropathic pain

Hyperosmolar Hyperglycemic State (HHS)

- ❑ Most common in elderly with undiagnosed or untreated type 2 diabetes
- ❑ Precipitating factors
 - Infection is the most common cause
 - Drugs, acute/chronic diseases that ↑ blood glucose
 - Dehydration
- ❑ Most common cause of diabetic coma in older patients
- ❑ Life-threatening

Arnold MS, Trence DL. *The Art and Science of Diabetes Self-Management Education*. 2006.
Umpierrez GE, et al. *Diabetes Spectrum*. 2002;15:28–36.

Insulin resistance and relative insulin deficiency can result in high levels of blood glucose; if undetected or untreated, hyperosmolar hyperglycemic state, often referred to as HHS, can occur.

This condition is most often a result of a precipitating factor (most often an infection, but may be myocardial infarction or stroke. Other causes can include drugs or disease states that cause dehydration such as diuretics, diarrhea, and severe burns).

Because HHS generally occurs in patients with type 2 diabetes who are capable of some insulin production, marked ketosis and acidosis are not usually presenting features. HHS can be life-threatening so prompt recognition and treatment are vital.

Symptoms and Treatment of HHS

- ❑ Clinical signs
 - Thirst, coma or confusion, dehydration
 - Blood glucose >600 mg/dL
 - Serum osmolality >320 mOsm/kg
 - Ketosis absent or mild
- ❑ Corrective measures
 - Rehydrate
 - Correct precipitating event
 - Treat hyperglycemia with insulin
 - Potassium replacement for electrolyte imbalance

Arnold MS, Trence DL. *The Art and Science of Diabetes Self-Management Education*. 2006. ADA. *Diabetes Care*. 2004;27(Suppl 1):S94–S102.

The severe hyperglycemic and hyperosmolar state associated with HHS typically leads to profound dehydration and confusion or coma.

Common signs and symptoms of HHS include stupor, dehydration, and hypotension. The neurologic signs and symptoms can range from aphasia to seizures or coma.

Treatment of HHS should be prompt and include

- Rehydration with normal saline as dehydration is the primary initial concern
- Correcting the precipitating event and
- If fluid replacement does not correct the hyperglycemia, then insulin and potassium may be needed

Hypoglycemia in the Older Adult

- ❑ Higher risk for medication-induced hypoglycemia due to:
 - Decreased or slowed glucagon response
 - Inadequate food intake
 - Slowed intestinal absorption
 - Renal insufficiency
 - Reduced awareness of warning cues
 - Polypharmacy
- ❑ Increased risk of morbidity
 - Associated with stroke, myocardial infarction
 - Injuries from falls

Spollett GR. *The Art and Science of Diabetes Self-Management Education*. 2006.
Halter JB. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Campbell S. *J Pharm Practice*. 2000;13:267.
Chelliah A, Burge M. *Drugs Aging*. 2004;21:511–530.
Camacho P, et al. *Drugs Aging*. 2000;17:463–476.

Older adults are at increased risk for medication-induced hypoglycemia for various reasons:

- They have slowed glucagon response
- They often have inadequate or inconsistent food intake
- Slowed intestinal absorption and renal changes can occur with aging
- Patients with cognitive impairment may not recognize signs and symptoms of hypoglycemia in time to treat it
- And, finally, multiple medications may increase the risk of hypoglycemia due to drug–drug or drug–disease interactions.

Even mild recurrent episodes of hypoglycemia are likely to negatively affect the quality of life in older adults. Decreased coordination is not uncommon among older adults, and symptoms resembling cognitive impairment or dementia may make the recognition of hypoglycemia more difficult.

Hypoglycemia has been associated with stroke or myocardial infarction, although controversy exists as to correlation with new cardiovascular events. Older adults are at an increased risk of injuries from falls or stumbles as a result of hypoglycemia.

Hypoglycemia Treatment

- ❑ Fast-acting carbohydrate – 15:15 rule
 - ½ cup juice or soda
 - 1 cup low fat milk
 - 1 tbsp honey or jam
- ❑ Check blood glucose
- ❑ Follow with meal or snack
- ❑ If not able to swallow: glucagon followed by liquid carbohydrates as soon as possible
- ❑ Severe or prolonged hypoglycemia may require intravenous glucose and professional assistance

Steil CF. *The Art and Science of Diabetes Self-Management Education*. 2006.
Cryer PE et al. *Diabetes Care*. 2003;26:1902-1912.

Treatment of hypoglycemia depends on the blood glucose level and patient's symptoms. Glycemic thresholds for the onset of symptoms of hypoglycemia differ among individuals; however, a lower limit of 70 mg/dL has been suggested as a reasonable threshold.

When educating a patient on treating hypoglycemia, the basic steps are to treat with 15 grams of a fast-acting carbohydrate such as glucose tablets, juice, soda, milk, honey, or jam and then check their blood glucose (BG) in 15 minutes if possible. If BG level is still low (<70 mg/dL), treatment should be repeated whether or not the symptoms have disappeared.

- Patients should be advised that hypoglycemia may reappear if a meal or snack is not eaten within the next hour.
- Patients should avoid using high fat foods for treatment, as they take longer to raise BG levels.

Treatment guidelines for severe hypoglycemia need to take into consideration whether the patient is able to swallow or not:

- If they are able to swallow then either glucose gel, honey, or syrup may be placed inside the cheek.
- If they are unable to swallow then glucagon injection can be given to stimulate hepatic glucose production. A close friend or relative should be instructed on when and how to inject glucagon. Liquid carbohydrate should follow as soon as the patient is able, since the effects of glucagon are short-lived.
- Severe hypoglycemia may require medical assistance and the use of intravenous glucose.

Hypoglycemia Prevention

- ❑ Educate loved ones and caregivers
 - Recognizing typical symptoms
 - Understanding that atypical symptoms may occur, especially in the elderly
 - Proper monitoring of blood glucose
 - Eating habits, alcohol-related risks
- ❑ Increase involvement and awareness of entire health care team
- ❑ Encourage patient to wear medical ID

Greco D, Angileri G. *Diabetes Nutr Metab*. 2004;17:23–26.
Chelliah A, Burge M. *Drugs Aging*. 2004;21:511–530.

Ideally hypoglycemia can be avoided through prevention. This is especially important for those older adults who live alone, or have limited assistance available.

As part of the diabetes team we can educate patients and their families and/or caregivers on the risk of hypoglycemia and how to recognize, prevent, and treat it.

With some patients it may be helpful to educate them on a regular basis about hypoglycemia.

Asking the patient about occurrences of hypoglycemia, and working with the health care team to evaluate the causes may provide opportunities for education and treatment.

As an educator you can learn about the risks associated with each medication and remember to consider increased risks associated with older adults. Be alert to A1C levels and understand that “normal” values may indicate control that is aggressive enough to put an elderly patient at increased risk for hypoglycemia.

Lastly, encourage patients who are at risk for hypoglycemia to wear medical ID.

Long-Term Diabetes Complications in the Older Adult

□ Macrovascular complications

- Cardiovascular disease: leading cause of death
- Cerebrovascular accidents increase with age
- Coronary artery disease: 2X to 4X greater risk
- Peripheral vascular disease: 10X risk of amputations
 - Among persons with diabetes, lower extremity amputation rate in patients ≥ 65 years of age is nearly double that of patients < 65 years of age

CDC. National diabetes fact sheet, 2005.
CDC. Diabetes surveillance system, 2004.
Halter JB. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
Rosenstock J. *Drugs Aging*. 2001;18:31-44.

Cardiovascular disease is responsible for ~65% of deaths in people with diabetes.

The incidence of cerebrovascular accidents increases with age.

Coronary artery disease is 2 to 4 times greater in individuals with diabetes than in the general population; additionally, the risk for myocardial infarction increases with age.

The atherosclerosis that occurs with peripheral vascular disease can lead to serious circulatory problems;

- Elderly patients with diabetes have a risk of lower extremity amputation that is 10 times higher than that of persons the same age without diabetes.
- Among persons with diabetes, the lower extremity amputation rate among patients 65 years or older is nearly double that of patients less than 65 years of age.

Controlling hyperglycemia, hypertension, and hyperlipidemia; encouraging regular exercise; and frequent visits to the health care team can help decrease macrovascular complications.

Long-Term Diabetes Complications in the Older Adult

□ Microvascular complications

- Retinopathy
- Nephropathy
- Neuropathy
 - Nearly 30% of people with diabetes have impaired sensation in the feet
 - Diabetes-related nerve damage is a major contributing cause of lower extremity amputations

Aiello LP et al. *Therapy for Diabetes Mellitus and Related Disorders*. 2004.
CDC. National diabetes fact sheet, 2005.
United States renal data system. Annual data report, 2004.
Byham-Gray LD. *The Art and Science of Diabetes Self-Management Education*. 2006.
Jungmann E. *Drugs Aging*. 2003;20:419–435.

The long-term microvascular complications of diabetes include: retinopathy, which is present in more than 50% of insulin-taking patients with type 2 diabetes who have had diabetes for more than 20 years; aging, which can decrease acuity; and cataracts and macular degeneration which are more common in older adults with diabetes. Keeping blood glucoses and blood pressure in target ranges can help prevent these complications. Early detection can help prevent the progression of these complications; therefore, annual dilated eye examinations are important.

Diabetic nephropathy is the most common single cause of end-stage renal disease in the United States and Europe; it develops in 40%–50% of patients who have had type 1 diabetes for more than 20 years; it is less common in those with type 2 diabetes except for certain ethnic groups; the prevalence rates for end-stage renal disease are highest among persons 65 years and older. Again, keeping blood glucoses and blood pressure in target ranges as well as smoking cessation can help prevent or delay progression of this complication.

Microalbumin should be tested yearly for detection of nephropathy.

Peripheral neuropathy is the most common complication; it develops in 60%–70% of those who have had diabetes for more than 10 years; Other types of neuropathy can result in sensory deficit increases, sexual dysfunction, and gastrointestinal and dental problems.

- Almost 30% of people with diabetes have impaired sensation in their feet
- Peripheral neuropathy is a major contributing cause of lower extremity amputations
- Prevention of this complication includes controlling blood glucoses and regular medical visits, which should include foot exams and an annual check for nerve function. Medicare does cover podiatrist visits every 9 weeks along with special footwear for patients with diabetes-related foot problems. Finally, patients should be reminded about their part—they can perform daily foot inspections to detect any problems and seek treatment if necessary.



Checkpoint: Test Your Knowledge So Far

Adults with diabetes have _____ times the risk of coronary artery disease and stroke compared with adults without diabetes.

- (a) 1
- (b) 2–4
- (c) 10

Here is the last knowledge check of the program. Adults with diabetes have _____ times the risk of coronary artery disease and stroke as compared with adults without diabetes. Is it:

- (a) 1 or
- (b) 2–4 or
- (c) 10?

The answer is (b).

Adults with diabetes have 2–4 times the risk of coronary artery disease and stroke compared with adults without diabetes.

The answer is (b).

Adults with diabetes have 2–4 times the risk of coronary artery disease and stroke as compared with adults without diabetes.

Diabetes Education for the Older Adult

- ❑ Assessment
- ❑ Problem-solving
- ❑ Simplifying
- ❑ Reviewing
- ❑ Promoting self-care
- ❑ Medicare coverage: DSMT and MNT

US Dept of Health and Human Services. 2004.

Although much of Medicare spending is on diabetes and related complications, only a very small portion of this is spent on diabetes education.

The AADE provides the following suggestions for education of the older adult.

The education should occur in a comfortable environment. Older adults have been shown to be able to learn blood glucose monitoring and insulin administration as accurately as younger people. If necessary, speak clearly and slowly, and use visual aids with large print. Try not to sound patronizing. Provide meaningful and practical information.

Keep in mind that the older adult may be susceptible to sensory overload. Assist the patient in problem solving and simplifying. Focus on 1 or 2 key points. Use short sessions, repeat the messages, and allow practice opportunities.

When setting goals, it is important to identify the individual's priorities and not impose your own.

Self-care should be encouraged whenever possible. Older patients sometimes take longer to learn but may be able to perform much of their diabetes-related care independently. If indicated, include caregivers in the education.

Medicare coverage for diabetes education includes:

- Diabetes self-management training (DSMT): If prescribed by a physician or nurse practitioner, 10 hours of training is covered for the 1st year and 2 hours of follow-up training every year thereafter
- Medical nutrition therapy (MNT) is covered if prescribed by a physician, 3 hours of training are covered for the 1st year and 2 hours of follow-up training every year thereafter

Remember that your care recommendations should take into consideration cost, accessibility, safety, support systems, and effect on the quality of life.

Summary

- Risk of developing diabetes increases with age
- Diagnosis and management of diabetes in older adults is complicated by the heterogeneity of the population
- Treatment of diabetes in older adults must be highly individualized
- Special considerations for treatment include
 - Careful selection of medications
 - Risks for HHS, hypoglycemia
 - Psychological/social issues and risk of depression
 - Role of diabetes education

In summary, older adults with diabetes require basic management tools PLUS certain special considerations.

They are at higher risk for developing diabetes.

Screening criteria are required because of the magnitude of underdiagnosis and undertreatment in the aging population. Diagnosis and management may be complicated by comorbidities and the heterogeneity of the health status of the older adult population.

Treatment requires thorough assessment of the situation including the environment, physical and mental capability, and quality of life.

Concomitant medications, polypharmacy, and other diseases are more prevalent in older adults.

Untreated hyper- and hypoglycemia are more dangerous in the older adult.

And education and support should be customized to meet the needs of each individual.

Additional Resources for Older Adults:

- ❑ AARP (American Association of Retired Persons)
<http://www.aarp.org/>
- ❑ Medicare Information on Diabetes
<http://www.medicare.gov/Health/Diabetes.asp>
- ❑ US Administration on Aging
<http://www.aoa.dhhs.gov/>
- ❑ NCOA (National Council on the Aging)
<http://www.ncoa.org/index.cfm>
- ❑ FirstGov for Seniors
<http://www.firstgov.gov/Topics/Seniors.shtml>
- ❑ National Diabetes Education Program
<http://www.ndep.nih.gov/index.htm>

Some additional resources for older adults are listed on this slide. They include:

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

**Thank you for participating
in the activity**

***Managing Diabetes in
Older Adults.***

Thank you for participating in the activity, Managing Diabetes in Older Adults.
Please proceed to the post-test.