Management of Type 2 Diabetes

Sorting Through the Confusion and Current Clinical Recommendations for Management An Overview for Pharmacists and Pharmacy Technicians

Author:
Mary Jo Carden, RPh, JD
Principal, Carden Associates

Editor:
Marsha K. Millonig, MBA, RPh
President/CEO
Catalyst Enterprises, LLC

E.L.F. Publications, Inc. is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmaceutical education. This program has been approved for 1.5 contact hour (0.15 CEU).
Universal Program Numbers:
406-000-08-003-H01P & 406-000-08-003-H01T
The expiration date for this program is 1/31/10.

Learning Objectives:

Pharmacists:
After completing this lesson, pharmacists should be able to:

- Provide an overview of current dietary guidelines for individuals with type 2 diabetes .
- Describe recently approved brand and generic medication therapies for type 2 diabetes .
- Understand current treatment protocols for the management of individuals with type 2 diabetes .
- Discuss recent warnings and risks when taking certain medications and the impact on treatment.
- Describe resources for current information on type 2 diabetes .
- Explain important patient counseling for patients with type 2 diabetes .

Pharmacy Technicians:
After completing this lesson, pharmacy technicians should be able to:

- Understand the importance of diet and exercise for individuals with type 2 diabetes .
- Describe recently approved brand and generic medication therapies for type 2 diabetes .
- Understand current treatment protocols for the management of individuals with type 2 diabetes .
- Know about recent warnings and risks associated with certain medicines and their impact on treatment.
- Describe resources for current information on type 2 diabetes .

The incidence of type 2 diabetes continues to increase in the United States. New therapies and approaches are constantly being considered to manage this disease state. Pharmacists are an integral health care professional to assist patients in managing type 2 diabetes. Developments in the treatment and management of type 2 diabetes can be overwhelming for any pharmacist and warnings and issues related to certain medication therapy can create confusion for pharmacists and their patients. This program will provide pharmacists an overview of the current dietary and medication therapy guidelines for the treatment and management of type 2 diabetes. This program will specifically consider newly available brand and generic therapies and the impact of recent warnings for certain medications on treatment protocols.

I. Introduction

Diabetes affects an estimated 194 million adults worldwide and more than 20 million individuals in the United States. Approximately 90% to 95% of affected individuals have type 2 diabetes. Type 2 diabetes is a condition where the body does not produce enough insulin and/or the cells in the body do not respond normally to insulin. Diabetes is the sixth leading cause of death by disease in the United States, and costs approximately $132 billion per year in direct and indirect medical expenses. Type 2 diabetes usually occurs in adults over the age of 40, but is becoming increasingly common in younger people.

In 2002, nearly 250,000 people died of diabetes. Diabetes also leads to other serious, expensive complications and disabilities such as stroke, heart disease, kidney disease, blindness, and amputations of legs, arms, and other extremities.

The incidence of type 2 diabetes has lead to massive public health initiatives to help prevent occurrence and to properly diagnose and manage those with diabetes and those who are at high risk for diagnosis. The prevalence of type 2 diabetes has also created a lucrative and growing market for pharmaceutical interventions used to manage the condition and prevent further complications. Pharmacists and the pharmacy technicians that assist them in providing patient care play an important role in assisting patients in preventing diabetes and in ensuring proper diagnosis and medication management for diabetes and the underlying conditions that often result because of it.

Much of the existing information regarding current prevention and treatment guidelines for type 2 diabetes may be confusing to pharmacists and pharmacy technicians alike. New studies often update the existing recommendations understood by pharmacists and pharmacy technicians. In the past 2 years, the Food and Drug Administration (FDA) has approved several new medications for the condition, some with novel mechanisms of action; new generics are anticipated in 2008 and beyond; and some newer, existing medications have been under scrutiny based upon clinical and consumer research that exposes dangers and high costs associated with these products. Sorting out all this information can be difficult for pharmacists and technicians. This article provides an overview for pharmacists and pharmacy technicians to gain a better understanding of the current guidelines and recommendations for prevention and treatment of Type 2 diabetes.

II. Etiology and overview of type 2 diabetes

Type 2 diabetes occurs when an individual's pancreas ceases to produce insulin sufficient to properly control glucose levels in the body. Individuals diagnosed with type 2 diabetes usually are overweight at the time of diagnosis, although individuals who are not overweight, particularly older adults are also diagnosed with type 2 diabetes. At the time of diagnosis, most individuals show signs of insulin resistance. Insulin resistance occurs because organs and muscles do not properly receive the insulin produced by the pancreas and then a negative feedback loop produces greater amounts of insulin in an effort to force cells to accept insulin. The cells of individuals with type 2 diabetes do not properly convert glucose to energy because of the lack of insulin and therefore, these individuals have a state of hyperglycemia, or abnormally high levels of blood glucose levels. The process of developing type 2 diabetes is gradual and individuals are often not diagnosed until symptoms commonly associated with the condition occur.

Risk factors for diabetes include:

- being overweight because fat interferes with the ability of cells to convert glucose;
- lack of physical activity;
- race, African Americans, Hispanic Americans, Asian Americans and Native Americans are more at risk;
- being over age 45;
- a diagnosis of prediabetes, characterized by elevated blood sugar that does not rise to the level of diabetes;
- a history of gestational diabetes;
- family history and other genetic factors;
- hypertension; and
- HDL levels less than 35 mg/dL or triglycerides of greater than 250 mg/dL.

A diagnosis of type 2 diabetes usually occurs when an individual presents with one or more of the following signs and symptoms:

- increased thirst caused by cell dehydration that occurs because the sugar in the bloodstream pulls water from the cells through osmosis;
- constant state of hunger even after eating because cells are deprived of energy in the form of sugar;
- constant fatigue because lack of energy from sugar;
- blurred vision caused by fluid from the cells in the lens of eyes causing the inability to focus;
- delayed healing of sores or infections; women often experience an increased number of vaginal and bladder infections;
- smoking; and,
- a condition called acanthosis nigricans, dark, velvety patches of skin in the creases and folds of the body, particularly the neck and armpits; usually this is a sign of insulin resistance.

In the United States, nearly 41 million Americans age 40-74 years have prediabetes and are at risk for developing stroke, heart disease, and eventually a diagnosis of type 2 diabetes. Often, individuals with prediabetes have no signs or symptoms associated with diabetes, which is why it is critical for individuals with risk factors for developing type 2 diabetes to be carefully monitored and encouraged by pharmacists and other health care professionals to exercise, not smoke, maintain a healthy weight, and have an overall healthy diet.

III. Clinical considerations for type 2 diabetes and prediabetes diagnosis

The preferred diagnostic method is to measure fasting blood glucose levels in the morning. A diagnosis of type 2 diabetes is determined by any one of the following levels:

- fasting blood glucose levels (8 hours of fasting) of 126 mg/dL;
- the oral glucose tolerance test: blood glucose levels of 200 mg/dL or more 2 hours after drinking a beverage with water dissolved in 75 mg of glucose.
- random blood glucose levels of 200 mg/dL taken at any time along with the presence of diabetic symptoms.

Two tests exist to determine the presence of prediabetes conditions: impaired fasting glucose and impaired glucose tolerance. Individuals tested using the impaired fasting glucose test have levels of 100-125 mg/dL after an overnight 8 hour fast and individuals tested using the impaired glucose tolerance test have levels of 140-199 mg/dL 2 hours after an oral glucose tolerance test.

Pharmacists and pharmacy technicians must be aware that many individuals with both diabetes and prediabetic conditions are often not diagnosed. As the first line of access to many individuals in the community, pharmacists should be aware of individuals who might be at risk for diabetes and make recommendations for testing.

IV. Current medication treatment options for type 2 diabetes

The year 2007 proved to be an interesting one in the treatment of type 2 diabetes . In 2006 and 2007, new medications with unique mechanisms of action were approved and some medications in a relatively new class of medications, known as the thiazolidinediones (TZDs), were controversial because studies suggested that use of these products might exacerbate heart failure and other cardiac conditions in certain individuals. Furthermore, a government-commissioned comparison study examined the effectiveness and costs of existing medications for type 2 diabetes and made recommendations regarding medications considered most effective for treatment. This article reviews existing management recommendations and classes of treatment for type 2 diabetes and specifically examines the new classes of medications, the warnings for TZDs, and the recommendations provided by the comparative effectiveness studies.

Overview of treatment options for type 2 diabetes

The goals of any pharmacological or non-pharmacological treatment for type 2 diabetes are to stabilize fasting and long-term blood glucose levels, ensure that individuals receive appropriate education and training for self management, maintain a healthy weight, and treat and prevent conditions commonly associated with type 2 diabetes , including hyperlipidemia, and hypertension.

Generally accepted parameters for type 2 diabetes management include a hemoglobin A1c level of 7% or less; pre-prandial blood glucose levels of 90-130 mg/dL; and peak postprandial levels of 180 mg/dL or less. Certain individuals such as older individuals, patients with other complex medical conditions, psychiatric conditions, or adverse social conditions might have different goals with less stringent glycemic control. Other factors that must be considered in treatment include the reduction of cardiovascular risk factors and the stabilization of lipid levels.

Most type 2 diabetics receive therapy with oral anyti-hyperglycemic agents, but insulin will likely be required as later treatment when oral therapies are no longer effective. Recently, the FDA approved a new injectable treatment in a new class of medications called incretins. If this class of medications proves successful, then more individuals with type 2 diabetes might be adding non-insulin injectable therapy to their regimen.

Most people with type 2 diabetes are currently managed with a combination of medications from different classes. Some of these medications are individual agents while some are available in combination form. This article focuses primarily on new pharmacological treatment for type 2 diabetes beginning with newer treatments, except Glucophage® (metformin hydrochloride, Bristol-Myers Squibb Company) that is described first because it is often used in combination with other products and is considered a standard treatment. A brief overview of some surprising findings regarding the potential impact of tight glucose control and experimental treatments follows in section V below.

Metformin

Metformin is commonly used in the treatment of type 2 diabetes alone or in combination because it is considered by experts to be a well-researched and generally well-tolerated agent. It is generically available so it is also very cost effective for patients. A 2003 studies called the Diabetes Prevention Program found that in addition to diet and exercise, metformin can also prevent the onset of diabetes in a pre-diabetic patient. Furthermore, use of this agent is promoted in the government sponsored comparative effectiveness study.

Metformin, in the class of medications known as biguanides, works to reduce glucose production in the body and also postprandial levels. Its unique mechanism of action decreases hepatic production of insulin, decreases intestinal absorption of glucose, and improves insulin sensitivity by increasing glucose uptake and utilization. Insulin secretion is stabilized while fasting and daylong levels actually decrease. Unlike other older, generically available oral agents, such as the class known as the sulfonylureas, metformin does not cause hypoglycemia or hyperinsulinemia except if used with other agents that result in this side effect.

Metformin works well in patients who are obese because it has been associated with visceral fat reduction. The presence of visceral fat often contributes to insulin resistance. It also

has been shown to be extremely effective against cardiovascular morbidity and mortality that often occurs in individuals with type 2 diabetes, especially in comparison to sulfonylureas and insulin with similar long-term measures of H1Ac. This is one of the reasons that metformin is recommended by consumer groups as a safe and effective product in comparative effectiveness studies, particularly considering recent concerns with cardiovascular disease associated with the TZDs.

A 2004 study found that metformin has also been shown to be effective in improving lipid profiles. This study found this effect is generally limited to metformin, the TZDs, and alpha-glucosidase inhibitors. Again, this considered another positive benefit of the use of metformin.

The dosage of metformin varies with each individual according to tolerance and glucose control. Maximum daily dosages in most adults should not exceed 2,550 mg. Individuals should be dosed at the lowest dose possible with gradual dose increases, generally 500 mg twice daily with meals or 850 mg daily. If dosage increases are necessary, it should begin with 500 mg increases daily at weekly intervals or one 850 mg tablet daily at every other week intervals. When using extended release tablets, administration is typically one time per day.

The most severe reaction from the use of metformin is the risk of lactic acidosis, a very rare but serious side effect that has generally been known only to occur in individuals with risk factors. Patients with the following risk factors should not be prescribed metformin: individuals with elevated creatinine levels of (Cr >/= 1.5 mg/mL in males or >/= 1.4 mg/mL in females), congestive heart failure, metabolic acidosis, and hypoxia. Individuals who are age 80 and over should not be given metformin unless creatinine clearance is normal. Another common side effect associated with metformin is vitamin B12 deficiency, which is known to occur in 10%-30% of individuals taking the medication and occurs more commonly in individuals prescribed the medication for 10-15 years.

Nearly 50% of patients who begin therapy with metformin will experience mild gastrointestinal conditions that subside within the first couple of weeks of therapy and are reduced when taken with food. Side effects are more common in dosage levels above 2,000 mg per day.

New Agents Affecting the Incretin System

The newest frontier in the treatment of type 2 diabetes focus on the incretin system. Incretins are naturally occurring hormones found in the gastrointestinal tract that enhance glucose-dependent insulin release from the pancreas and help to regulate overall glucose control in the body. While basal level incretins occur in the body, levels increase upon the introduction of food into the body through the gastrointestinal tract in comparison to when glucose is administered intravenously. These findings suggested the benefits of the incretin system in controlling type 2 diabetes.

Two types of endogenous incretins have been identified as important factors in regulating glucose levels in type 2 diabetics: glucagon-like peptide 1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP). Release of GLP-1 and GIP rapidly stimulate the release of blood insulin only when blood glucose is increased which then increases the capacity of the pancreas to release insulin only after eating. When increased levels of glucose are present in the body, GLP-1 signals alpha cells to suppress glucagon release. Incretins have also been shown to have a positive effect on preservation of beta islet cells in the pancreas.

Research has found that in people with diabetes, levels of GLP-1 are diminished, the insulinotropic response to GIP is diminished but not absent, and these two factors result in loss of glycemic control. Current research and therapy goals are to enhance the presence of incretin by suppressing rapid uptake, mimicking the impact of the incretins in the body.

Two medications that impact the incretin system have been approved within the past two years: Januvia™ (sitagliptin, Merck & Company), an oral medication that reduces the uptake of naturally occurring incretins; and Byetta (exenatide injection, Eli Lilly & Company), an injectable medication that mimics the production of incretins. Other medications in are under investigation.

Januvia

The FDA approved Januvia for the treatment of type 2 diabetes in 2007. Januvia acts as a dipeptidyl peptidase-4 (DPP-4) inhibitor that blocks a receptor site that causes the rapid uptake of incretins after release. The goal is to ensure higher levels of endogenous incretin levels.

Januvia is an orally administered medication with a recommended dosage of 100 mg once daily for individuals with type 2 diabetes. Januvia has been administered concomitantly with oral sulfonylureas, metformin, and TZDs but should not be administered with insulin. Januvia alone and in combination with other products has been shown to reduce overall HA1c levels compared to placebo without weight gain.

Dosages should be decreased as follows for individuals with impaired or end-stage renal disease: 50 mg once daily for individuals with CrCl ≥30 to <50 mL/min ~Serum Cr levels [mg/dL] men: >1.7– ≤3.0; women: >1.5– ≤2.5; 25 mg once daily for individuals with CrCl <30 mL/min ~Serum Cr levels mg/dL] Men: >3.0; : >2.5. Prior to beginning therapy, patients' kidney function should be monitored and monitoring should continue through duration of therapy.

The most serious reactions seen in post-marketing surveillance includes serious allergic and hypersensitivity reactions associated with the skin, including Stevens-Johnson's syndrome, angioedema, and other reactions. If any of these reactions occur, treatment should be stopped immediately, the condition should be evaluated and treated, and alternative treatment for diabetes considered. Mild-moderate gastrointestinal side effects, including nausea, abdominal pain, and diarrhea, are the only other reported side effects. Instances of hypoglycemia occurred when used in conjunction with sulfonylureas.

Another DPP-4 inhibitor, Galvus (vildagliptin, Novartis), has been submitted for review under a new drug application (NDA) with the FDA. Approval has been delayed primarily because of issues related to serious skin conditions that occurred in tests with monkeys and FDA's request for

additional information regarding patients with kidney impairment. According to business industry sources, FDA might make a determination in early 2008.

Byetta

Byetta is the first medication in its class that acts as an incretin mimetic. It is an injectable product that mimics the effects of endogenous GLP-1. Byetta immediately improves beta-cell secretion of insulin during phases of elevated blood glucose. It also suppresses first phase insulin response, slows gastric emptying, and reduces food intake and reduces body weight. These rapid responses result in improved HA1c levels and glycemic control. Byetta is approved for use in combination with other products including sulfonylureas, metformin, and TZDs with suboptimal glucose control.

In clinical studies, significant weight loss occurred in the Byetta group compared to those using placebo. Study groups dosed with higher levels of Byetta were found to have greater weight loss. Weight loss was not correlated directly with reductions in HA1c and even patients who did not experience weight loss experienced improvements in glycemic control.

Byetta is available as a prefilled pen that contains 5 micrograms of active ingredient for all patients. Pharmacists and technicians should understand the dosing regimen for Byetta and pharmacists should counsel patients on the appropriate administration intervals. Byetta cannot be taken after a meal because its mechanism of action works with the incretin system that responds to introduction of food into the system.

Dosage should begin with 5 micrograms twice daily 60 minutes (one hour) before the morning or evening meals and then depending upon response, increased to 10 micrograms twice daily over a period of a month. The product is administered as a subcutaneous injection in the thigh, abdomen, or upper arm. A demonstration video for the proper administration for Byetta is included on the product website, www.byetta.com. Pharmacists should review this video to provide proper counseling and administration techniques and also recommend that patients watch this video to reinforce prescriber and pharmacist education.

TZDs, the Facts and Controversy

The TZD class of medications includes Avandia® (rosiglitazone maleate, GlaxoSmithKline) and Actos® (pioglitazone HCl, Takeda Pharmaceutical Company Ltd.). These companies also market the TZDs as combination products with other generically available oral diabetic medications: Avandamet® (rosiglitazone maleate/metformin HCL); Avandaryl™ (rosiglitazone maleate/glimepiride), which is a combination with a sulfonylurea; Actos PlusMet® (pioglitazone HCl/metformin HCl); and, Duetact™ (pioglitazone HCl/glimepiride).

This class of medications are often dubbed “insulin sensitizers” because of their ability to reduce insulin resistance and to allow cells to use insulin more efficiently. These drugs also reduce the rate of insulin production by the liver. TZDs primary advantage over other medications for type 2 diabetes is that they do not cause hypoglycemia.

Specifically, TZDs are agonists of peroxisome proliferator –activated receptor gamma (PPARγ), a receptor that regulates the transcription of genes used in glucose and lipid metabolism. These receptors are primarily present in fat tissue, but are also located on other insulin sensitive tissues. When PPARγ is stimulated, a greater number of insulin-sensitive adiocytes are produced that results in greater glucose control but might also result in protection of pancreatic beta-cell function in the long-term.

Rosiglitazone has also been specifically shown to decrease the amount of free fatty acids (FFAs) and retain fat where it belongs while reducing the potential for lipotoxicity in the pancreas, liver, and other muscles. The mechanism of action is based on the suppression of tumor necrosis factor (TNF-α) through two means: increasing the insulin sensitivity of the cell and improving the anti-lipocytic effect of insulin and reducing levels of TNF-α that are known to decrease the anti-lipocytic effect of insulin.

FDA approved Actos and Avandia for marketing in 1999 and more than 1 million individuals take Avandia alone. Much of the popularity associated with TZDs relates to the promising results associated with beta-cell preservation. In 2006, total sales for both products was $2 billion. In early 2007, the use of these products raised additional questions because of study findings released posing potential safety concerns for individuals with certain heart conditions. The findings of these studies follow.

In May 2007, the New England Journal of Medicine published a meta-analysis of the impact of rosiglitazone on cardiac morbidity and mortality. The study examined a literature review, website review, and FDA findings on rosiglitazone. To be considered, studies were required to be conducted over at least a 24-week period, include a control group of patients using rosiglitazone, and include findings of information related to cardiac morbidity and mortality. Of a possible 116 available studies, 42 met the inclusion criteria. The meta-analysis found that based on the studies, the odds ratio for a myocardial infarction (MI) in the rosiglitazone group was approximately 1.43 ($p=0.03$) and for death from cardiovascular causes was 1.64 ($p=0.06$). Participants had a mean age of 56 years old and average HA1c of 8.2% The study concluded that the use of rosiglitazone is associated with an increased risk of MI and death from cardiovascular incidence that is considered of borderline significance and recommended that patients strongly consider these risks when using TZDs.

Upon release of these findings, FDA issued a safety alert on the issues associated with the use of rosiglitazone and also took additional action to consider issues associated with the potential negative cardiovascular outcomes associated with rosiglitazone. In August 2007, FDA added a black box warning to the professional labeling and required that a patient-specific MedGuide be distributed warning of the potential for worsening of cardiovascular failure when using rosiglitazone (including combination products). Despite the lack of specific findings associated with the use of pioglitazone and its combination products on worsening of heart failure or other cardiovascular incidence, warnings were also added to these products.

In September 2007, the Journal of the American Medical Association published the findings of a second meta-analysis that examined the long-term impact of the use of rosiglitazone on cardiovascular health. The search included Medline, GlaxoSmithKline's clinical trials register, FDA website, and other reviews and analyses. Studies included those that randomized for rosiglitazone use with at least 12-months of follow-up care with monitoring for cardiovascular incidence with numerical data on adverse events. Four studies of 140 reviewed were included in the final analysis. This study also found that patients who use rosiglitazone for a period of 12 months or more are at significantly increased risk of MI (relative risk of 1.42; p=0.06) and heart failure (relative risk 2.09; p<0.001) without a significant risk of cardiac mortality (relative risk 0.90; p=0.53).

As a result of these findings, in November 2007, FDA upgraded the warnings released in August 2007 and specifically added an additional black box warning associated with rosiglitazone. This warning indicates that when compared to placebo, rosiglitazone shows an increased risk of the potential for myocardial ischemic events, including MI and angina. The strengthened warnings were not added to pioglitazone labeling.

In the wake of these findings, health care professionals might find it difficult to determine how to proceed in treating patients with type 2 diabetes. Pharmacists should never advise patients to immediately discontinue treatment with any type 2 diabetes product, but rather should consult with their physician to determine whether a change in therapy is necessary. Another retrospective study of elderly individuals with diabetes suggests that the risks of cardiovascular incidents associated with the use of TZDs might outweigh the benefits of using these products, especially in the elderly and even those without baseline cardiovascular risk. The findings also suggest that more research is necessary to determine whether the cardiovascular risks are specific to rosiglitazone or actually exhibit a class effect. Until this research is concluded, health care professionals must make individualized determinations to weigh the benefits and risks associated with using TZDs. In the interim, some prescribers might choose to initiate or therapy with metformin alone or in combination, a product that as suggested earlier is well researched, cost effective, and is considered to be safe.

Pharmacists play an important role in helping to identify patients with diabetes who might be experiencing cardiovascular symptoms. Pharmacists should note sudden changes in patient weight and determine whether an individual is experiencing edema caused by a cardiovascular issue. Furthermore, pharmacists should communicate the risks to patients and inform the patient of the risks that may be identified, including sudden weight gain, shortness of breath or decrease exercise tolerance levels.

The suspected risks associated with the use of TZDs and the high incidence of cardiovascular events among individuals with type 2 diabetes has spawned much research into the relationship between the use of medications and the incidence of CVEs, as well as the impact of glycemic control. Tight glycemic control might not yield the reductions in cardiovascular incidences as once suggested and could change the way that type 2 diabetes is treated in the future.

IV. New Research in the Treatment of Type 2 Diabetes and the Future of Management

A. Is lowering glucose levels the answer to reducing cardiovascular incidence among type 2 diabetics?

Researchers engaged in a study, Action to Control Cardiovascular Risk in Diabetes (ACCORD) with approximately 10,000 participants, funded by the National Institutes of Health sought to examine the impact of lower than recommended blood glucose levels on the incidence of cardiovascular events in patients with type 2 diabetes. The researchers halted their efforts after 257 individuals in the treatment-intensive group died of cardiovascular complications compared with 203 in the standard group. The treatment intensive group had HA1c levels of less than 6%, the standard for individuals without a diagnosis of diabetes. The findings did not point to a single class of medications as the primary reason for the increased incidence of cardiovascular death. Patients were given a combination of all current class of diabetes medications available on the market: metformin;TZDs, primarily rosiglitazone; insulin; sulfonylureas; exenatide; and acarbose.

Researchers caution that more research is necessary to conclusively determine the link between the lowered HA1c levels to cardiovascular death. In the meantime, patients should strive to maintain HA1c levels to the current recommended levels of about 7%. These findings will be published in a scientific journal.

B. Other frontiers in the treatment and management of type 2 diabetes

Clinical research in the field of type 2 diabetes today focuses on prevention of the condition by examining the impact of beta-cell preservation and other cellular level interventions, including medications and transplant, to preserve and protect the pancreas. Goals also include identifying early cellular level risk factors and prevention of those risk factors. These goals are also paired with the goals of identifying the reasons for certain concomitant conditions commonly associated with type 2 diabetes and seeking ways to prevent or cure these conditions. Today's research combines traditional medications with new biotech innovations that allow researchers to learn more about the cause and treatment of type 2 diabetes at the cellular level.

Summary

Type 2 diabetes is a growing and costly problem in the United States. Today, pharmacists can play a key role in preventing the incidence by encouraging patients to engage in healthy behaviors. With face-to-face access to patients, pharmacists can help individuals develop a plan for a healthy life style and coach these individuals to achieve goals.

Pharmacists also play a role in identifying patients who are at risk or have developed type 2 diabetes. Pharmacists should communicate diabetic risks with patients and counsel them on the signs and symptoms. For patients who have developed diabetes and require medications, pharmacists can help play a role in providing the latest information about

medication treatments and work with physicians to optimize therapy. Pharmacists should never suggest sudden discontinuation of any therapy and should not unnecessarily alarm patients as new research emerges. Rather, pharmacists ensure that their knowledge is current and correct and evaluate communications to patients based on this information.

Pharmacists can also become certified diabetes educators through the American Association of Diabetes Educators to become part of an individual's care plan with the goal of optimizing the overall treatment of type 2 diabetes. Pharmacists who opt for this role must meet minimum standards for experience with patient diabetes self-management and after certification must do continuing education specific to diabetes management. Pharmacists interested in becoming a certified diabetes educator or for additional resources on assisting patients with managing diabetes, visit http://www.diabeteseducator.org/. There are also numerous certification programs offered by national and state pharmacy associations that provide education to pharmacists who are interested in creating a diabetes medication therapy management and/or disease management program.

References available on request