Instructions on Completing the Module
Screening for Diabetes in Older Adults

*The results of the assessments and evaluations are confidential, and the data is used to meet requirements of our federally funded grant.

Please make sure to turn in Pre-Test, Post-Test, and Module Evaluation.

1. **Before** reading the module, and without looking at it, complete the Pre-Test.
   
   Record your answers on the examination form marked Pre-Test. *(Found at the start of the module.)* Keep the completed answer form to turn in at the completion of the module.

2. Complete the module as outlined.

3. **After** reading the module, please complete the Post-Test.
   
   Use the questions in Appendix C and record your answers on the examination form marked Post-Test. *(Found at the end of Appendix C.)* Keep the completed answer form to return with the pre-test at the completion of the module.

   Complete the Module Evaluation. *(Found after the post-test.)* Keep the completed module evaluation form to return with the pre-test and post-test at the completion of the module.

4. To obtain credit for the module you must:
   
   b. Turn in the Pre-Test, Post-Test, and Module Evaluation
   c. Obtain a score of 70% or better on the Post-Test

MTGEC/IPHARM
Skaggs Building Room 318
University of Montana
32 Campus Drive
Missoula MT, 59812-1522

Email: IPHARM@umontana.edu
Phone (406) 243-2339 & Fax (406) 243-4353
Pre-test: Screening for Diabetes in Older Adults
Record responses on examination form.

1. All of the following conditions are types of microvascular complications that can result from diabetes EXCEPT:
   a. Nephropathy
   b. Myocardial infarction (heart attack)
   c. Retinopathy
   d. Erectile dysfunction

2. Which of the following diseases is the leading cause of death among patients with diabetes?
   a. Kidney failure
   b. Cancer
   c. Heart disease
   d. Pneumonia

3. Native Americans are how many times more likely to be diagnosed with diabetes compared to Caucasians of similar age?
   a. Similar diagnosis rate to Caucasians
   b. Over twice as likely
   c. Three times as likely
   d. Four times as likely

4. Diabetes is associated with chronic kidney disease in what percentage of patients?
   a. 35%
   b. 40%
   c. 45%
   d. 50%

5. Which of the following characteristics is NOT commonly associated with type 2 diabetes?
   a. Obesity
   b. Insulin resistance
   c. Onset before age 40
   d. Varying degrees of endogenous insulin production

6. The American Diabetes Association recommends daily low dose aspirin therapy to prevent thrombosis in which subset of patients:
   a. Men and women over age 50 with diabetes plus one additional risk factor.
   b. All adults over 30 years of age with type 2 diabetes.
   c. ONLY adults with type 2 diabetes who have already had a heart attack or stroke
   d. ONLY adults with type 2 diabetes who have an allergy to clopidogrel.
7. Which of the following statements is TRUE regarding screening recommendations for diabetes in the general population?
   a. All adults should be tested annually after the age of 35.
   b. All adults who are overweight (BMI >25 kg/m² or ≥ 23 kg/m² if Asian American) and have one or more risk factors.
   c. All adults should be screened annually starting at age 45.
   d. All children who are overweight and have a sedentary lifestyle should be screened annually.

8. Patients with glucose values higher than normal but less than the diagnostic cut-off for diabetes are said to have:
   a. Gestational diabetes
   b. Prediabetes
   c. Adult onset diabetes
   d. Insulin resistance

9. Which of the following interventions is the most cost-effective at preventing onset of Type 2 diabetes in those with high risk of developing diabetes?
   a. Acarbose
   b. Metformin
   c. Pioglitazone
   d. Life-style modifications (weight loss and exercise)

10. The HbA1c test for screening for diabetes may be preferred over other tests because:
    a. It has good reliability when National Glycohemoglobin Standardization Program (NGSP)-certified methods are used.
    b. It is available as a point-of-care test.
    c. It does not require participants to be in a fasting state.
    d. All of the above statements are true.

11. According to 2013 medical expenditures, diabetes is:
    a. the most costly disease in the United States.
    b. the 2nd most costly disease in the United States.
    c. the 3rd most costly disease in the United States.
    d. the 5th most costly disease in the United States.

12. Which of the following geriatric conditions would NOT be exacerbated by diabetes?
    a. Depression
    b. Cancer
    c. Persistent pain
    d. Polypharmacy

13. Which of the following statements is TRUE regarding diabetic retinopathy?
    a. Diabetes is the second leading cause of blindness among American adults.
b. Diabetic retinopathy is broken down into dominant and non-dominant forms of the disease.
c. The majority of people with diabetic retinopathy are diagnosed early so that therapy is effective.
d. All type 2 diabetic patients should receive an ophthalmologic dilated eye examination at the time of diagnosis.

14. Which of the following neuropathies would NOT be considered to be autonomic in origin?
   a. Neurogenic bladder
   b. Erectile dysfunction
   c. Inability to detect cold or heat
   d. Gastroparesis

15. Diabetes is the leading cause of non-traumatic lower-limb amputations in the United States. Which of the following risk factors would NOT increase the likelihood of incurring an amputation?
   a. Peripheral neuropathy
   b. Peripheral vascular disease
   c. Severe nail deformity
   d. Well controlled blood sugars

16. A 67 year old female, American Indian patient who is obese and taking antihypertensive medications is being screened for diabetes using the Afinion™ HbA1c test. Her HbA1c result is 5.7%. What action would you recommend?
   a. This patient clearly has diabetes and should be referred for follow-up care.
   b. This patient has a normal HbA1c and doesn’t require referral for follow-up care.
   c. This patient has multiple risk factors for diabetes, and given the A1c result, should be referred to her primary care provider at the patient’s earliest convenience to discuss the results.
   d. Counsel the patient to watch how much sugar she is eating.

17. A 72 year old male patient, who appears to be in good health, is screened for diabetes using the Afinion™ test. His HbA1c result is 7.5%. What action would you recommend?
   a. This patient has very few risk factors and should not be referred for follow-up care.
   b. This patient should be referred to his primary care provider for follow-up care, as the HbA1c result suggests chronic hyperglycemia.
   c. Counsel this patient on the importance of risk factor reduction.
   d. Both b & c

18. Which of the following non-pharmacologic therapies is NOT recommended by the American Diabetes Association?
   a. Weight loss if indicated
   b. Sucrose (e.g. table sugar) should be removed from the diet
c. Moderate exercise for 30 minutes for 5 days per week
d. Stop smoking

19. The American Diabetes Association recommends strongly that adults over age 65 with diabetes should receive all of the following vaccinations EXCEPT:
   a. Annual influenza vaccine
   b. Hepatitis B vaccine
   c. Pneumococcal polysaccharide vaccine 23 (PPSV23)
   d. Pneumococcal conjugate vaccine 13 (PCV13)

20. Which of the following is NOT considered to be a risk factor for developing type 2 diabetes?
   a. Body mass index ≥ 25 kg/m2
   b. Chronic physical inactivity
   c. Female sex
   d. Hypertension (≥140/90 mmHg)
### Participant Information

1. Name: ________________________________
2. Mailing address: ______________________
   ______________________________________
   ______________________________________
   ______________________________________
3. Date exam completed: __________________

### Questions: (Please circle one response per question)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Screening for Diabetes in Older Adults

By Kim Madson, PharmD
Skaggs School of Pharmacy
University of Montana
Missoula, MT

Updated by Rose Macklin, PharmD, BCPS
Partners in Home Care
Missoula, MT

A 2-hour Geriatric Health Screening Module from the

Montana Geriatric Workforce Enhancement Program

A Consortium of:
University of Montana, Missoula
Mountain Pacific Health, Helena
RiverStone Health, Billings
St. Vincent Healthcare, Billings

Montana Geriatric Education Center Website

Copyright November 2017
Montana Geriatric Education Center
Disclosures

Montana Geriatric Workforce Enhancement Program Goals/Purpose
Improve health outcomes for older adults in rural Montana via increased knowledge of older adult care and treatment of health problems by health professionals.

Successful completion of this continuing education activity includes:
- Completion of the Pre-Test
- Reading of text
- Viewing two embedded videos in the module
- Completion of the Post-Test with at least 70% accuracy
- Completion of the module evaluation

Contact Hours: 2, including 2 Rx Hours for Nurses

Montana Nurses Association (MNA)
The Montana Geriatric Education Center is an approved provider of continuing nursing education by the Montana Nurses Association, an accredited approver by the American Nurses Credentialing Center’s Commission on Accreditation.
MNA Continuing Nursing Education Expiration Date: November 10, 2019

Conflicts of Interest
The planners and presenters of the CE activity have disclosed no relevant financial relationship with any commercial companies pertaining to this activity.

The Montana Geriatric Workforce Enhancement Program is supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) under grant number U1QHP28733, Geriatric Workforce Enhancement Program (GWEP); the total award is $2,143,140 and supports the program 100%. This information or content and conclusions are those of the author and should not be construed as the official position or policy of, nor should any endorsements be inferred by HRSA, HHS or the U.S. Government.
Description of Module

Content:

This module provides an overview of diabetes, including the impact of diabetes on the nation. Risk factors and complications of diabetes are discussed and characteristics of older adults who should be screened are identified. Both written and video instructions are used to teach the correct use of the Afinion™ Analyzer. A role play video models referral and counseling strategies that can be used with older adults who are at risk for developing diabetes. Pharmacologic therapies and important life style changes are briefly addressed.

In addition to providing continuing education for health care professionals, the ImProving Health Among Rural Montanans (IPHARM) program uses this module to train health professions students to perform diabetes screening at geriatric health screening events throughout the state.

Module Purpose:

The purpose of this module is to enable learners to apply knowledge gained about diabetes and issues surrounding screening for diabetes to improve diabetes related care for older adults in the learners’ professional settings.

Learning Objectives:

Specifically, the learner will be able to:

1. Summarize the impact of diabetes on the nation, particularly on older adults and Native Americans.
2. Identify and compare the classifications of diabetes.
3. Discuss the causes, risk factors, complications, and prevention of diabetes.
4. Identify patients who are good candidates for diabetes screening.
5. Describe how to perform a glycated hemoglobin (HbA1c) test using the Afinion™ HBA1c test.
6. Identify which screened patients should be referred for follow up.
Table of Contents

SCREENING FOR DIABETES ................................................................................................................. 12

I. INTRODUCTION .............................................................................................................................. 12

II. IMPACT OF DIABETES ON HEALTH .......................................................................................... 13
   A. PREVALENCE OF DISEASE ........................................................................................................ 13
   B. RELATION TO OBESITY ............................................................................................................. 15
   C. SPECIAL POPULATIONS ............................................................................................................ 16
      1. Older Adults ............................................................................................................................ 16
      2. Native Americans ................................................................................................................... 16

III. OVERVIEW OF DIABETES ............................................................................................................. 17
   A. DEFINITION OF DIABETES MELLITUS ..................................................................................... 17
   B. CLASSIFICATIONS OF DIABETES .............................................................................................. 17
   C. ROLE OF INSULIN IN DIABETES .............................................................................................. 18
   D. CONTRIBUTING PATHOLOGIES ................................................................................................. 19
   E. DIAGNOSTIC CRITERIA FOR DIABETES .................................................................................... 20
      1. Methods of Diagnosis ............................................................................................................ 20
   F. RISK FACTORS .......................................................................................................................... 21
   G. COMPLICATIONS ........................................................................................................................ 22
      1. Macrovascular ........................................................................................................................ 25
      2. Microvascular ........................................................................................................................ 29
      3. Infections ................................................................................................................................ 37
      4. Lower Extremity Complications ............................................................................................. 38
   H. PREVENTION OF DIABETES ....................................................................................................... 39

IV. SCREENING FOR DIABETES ......................................................................................................... 42
   A. WHO SHOULD BE SCREENED? .................................................................................................. 42
   B. USE OF HbA1C FOR SCREENING ............................................................................................ 44
   C. USE OF THE AFINION™ HbA1C TEST .................................................................................... 45
      1. The Afinion™ HbA1c test (55) ............................................................................................... 45
      2. Performing a finger stick for blood collection ....................................................................... 46
      3. Interpretation of Results ........................................................................................................ 48

V. VIDEOS OF A GERIATRIC HEALTH SCREENING EVENT .......................................................... 48

VI. THERAPIES FOR DIABETES ......................................................................................................... 49
   A. DIET AND EXERCISE ................................................................................................................ 50
   B. DRUG THERAPY ........................................................................................................................ 52

VII. USEFUL DIABETES WEBSITES .................................................................................................. 55

VIII. REFERENCES .............................................................................................................................. 56

APPENDIX A: (IPHARM) AUTHORIZATION TO TEST FORM .......................................................... 59

APPENDIX B: PROTECTION OF STAFF & PUBLIC FROM BLOOD-BORNE PATHOGENS .................. 60

APPENDIX C: AFINION™ HbA1C QUICK GUIDE .......................................................................... 61

APPENDIX D: BODY MASS INDEX CHART ...................................................................................... 65

APPENDIX E: IPHARM PATIENT BROCHURE: UNDERSTANDING YOUR BLOOD SUGARS ............. 66

APPENDIX F: POST-TEST: SCREENING FOR DIABETES IN OLDER ADULTS ................................... 67

APPENDIX G: EVALUATION: SCREENING FOR DIABETES IN OLDER ADULTS ............................... 73
Screening for Diabetes

I. Introduction

Diabetes mellitus represents a major health concern in the United States. Diabetes mellitus is the 7th leading cause of death in the country and is the 3rd costliest disease. In 2013, of the estimated $245 billion in total costs of diagnosed diabetes, $176 billion dollars was spent on direct medical expenditures and $69 billion was spent in lost productivity.\(^1\) \textit{(Diabetes mellitus will be referred to only as diabetes from this point on.)}

Diabetes, which is a group of metabolic disorders, is characterized as a disease in which chronic high blood sugars (hyperglycemia) result from inadequate insulin secretion by the pancreas, improper action of insulin on tissues, or a combination of both. Detrimental effects on tissues, due to chronic exposure to hyperglycemia, may result in vision loss from retinopathy, renal failure from kidney disease, and nerve damage from neuropathy.\(^2\) Additionally, hyperglycemia plays havoc with the vascular system resulting in diabetic patients being 2 to 4 times more likely to have a heart attack or stroke compared to other patients of the same age and sex without diabetes.\(^3\)

Therefore, identifying patients with diabetes allows for aggressive treatment of their hyperglycemia, as well as initiation of therapies to ultimately prevent the long-term complications associated with this disease.

\textit{The scope of this module is to:}

A. Describe the impact diabetes has on health, particularly on the health of older adults and Native Americans.
B. Provide an overview of diabetes, its classification, causes, risk factors, complications and prevention.
C. Describe how diabetes can be screened for in specific populations.
D. Describe how to use the Afinion™ Analyzer.
E. Briefly describe non-pharmacologic and pharmacologic therapies available for treatment of diabetes.
F. Identify which screened patients should be referred for follow-up.

II. Impact of Diabetes on Health

A. Prevalence of Disease

In 2015, the total prevalence of diabetes in the United States was estimated to be 30.3 million people or roughly 9.4% of the population. Approximately 23 million individuals had a diagnosis of diabetes in 2015, which left roughly 23% of the patients not yet diagnosed and at risk for hyperglycemic-related effects on the body. Among U. S. residents aged 65 years and older, 25% have diabetes.\(^{(3)}\) Since 1990, the age group with the greatest growth rate in diabetes is the 45 to 64 year old group.\(^{(3)}\) By the year 2050, the prevalence rate of diabetes in the United States could be as high as 33% of the adult population if rates continue to climb and those already diagnosed with diabetes live with their disease burden.\(^{(4)}\)

Type 2 diabetes, which accounts for 90 to 95% of all diabetes diagnoses, was previously referred to as adult-onset diabetes, as most of the people who are diagnosed are well into their adult years.\(^{(3)}\) Trends towards increasing obesity and lack of exercise in the American population over the last 20 years have led to an increasing prevalence of type 2 diabetes diagnoses among all age groups (Figure 1).\(^{(5, 6)}\)
While age is a risk factor for developing diabetes, sex is not a strong predictor with comparable incidence rates between men and women. Non-Hispanic blacks and American Indians/Alaska natives do have higher incidence rates of diabetes than whites (see Table 1).

**Table 1: Percentage of People ≥18 years with Diabetes, United States, 2015**

<table>
<thead>
<tr>
<th>Group</th>
<th>Percentage who have diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 18-44 years</td>
<td>4%</td>
</tr>
<tr>
<td>Age 45-64 years</td>
<td>17%</td>
</tr>
<tr>
<td>Age ≥65 years</td>
<td>25.2%</td>
</tr>
<tr>
<td>Men</td>
<td>12.7%</td>
</tr>
<tr>
<td>Women</td>
<td>11.7%</td>
</tr>
<tr>
<td>Non-Hispanic whites</td>
<td>7.4%</td>
</tr>
<tr>
<td>Non-Hispanic blacks</td>
<td>12.7%</td>
</tr>
<tr>
<td>American Indian/Alaska natives</td>
<td>15.1%</td>
</tr>
</tbody>
</table>
“Prediabetes” is defined as having blood glucose levels higher than normal but less than needed to diagnose diabetes. More than 1 out of 3 adults in the United States or 84.1 million individuals have prediabetes. Unfortunately, 9 out of 10 of these individuals are unaware of their status. Nearly half of seniors (≥65 years) have prediabetes. Without weight loss and moderate physical activity, 15 to 30% with prediabetes will develop Type 2 diabetes within 5 years. Screening and identifying those at risk for diabetes is a critical first step in impacting long-term diabetes prevalence rates in our country.\(^{(1,3)}\)

The substantial cost of diabetes is not only a burden on the individual patients and their families but on society as a whole. As far as diseases, Americans spend the most on diabetes care. Spending on diabetes is growing 36 times faster than spending on heart disease, which is the number one cause of death in the United States.\(^{(7)}\)

More than 1 in 10 health care dollars in the U.S. are spent directly on diabetes and its complications, and more than 1 in 5 health care dollars in the U.S. goes to the care of people with diagnosed diabetes. With $245 billion healthcare dollars spent on patients with diabetes in 2013, 72% were for direct costs and 28% were for indirect costs such as lost productivity and disability.\(^{(1,3)}\) People with diabetes have medical expenditures that are approximately 2.3 times higher on average than those without diabetes. Because the prevalence of diabetes increases with age, it is not surprising to find that our elderly incur a greater degree of the health expenditures for diabetes than younger working people with diabetes. In 2015, 252,806 deaths were attributed to diabetes which is likely an underestimate since diabetes is often listed as a secondary cause of death.\(^{(1,3)}\)

B. **Relation to Obesity**

Considerable evidence exists which correlates increasing body weight with the increased risk of developing type 2 diabetes.\(^{(8)}\) Results from the 2013-2014 National Health and Nutrition Examination Survey (NHANES) show that 78% of the U.S. adult population weighs more than recommended. The survey estimated 32.7% of U.S. adults aged 20 and over are overweight (BMI 25.0–29.9), 37.9% are obese (BMI ≥30), and 7.7% are extremely obese (BMI ≥ 40 kg/m\(^2\)).\(^{(9)}\)
Given these statistics, the correlation between body weight and type 2 diabetes will likely continue. Data suggest that for every kilogram increase in body weight, the risk for developing diabetes increases 4.5 to 9%.\(^\text{[10]}\)

**C. Special Populations**

1. **Older Adults**
   Older patients typically have multiple health problems which reinforces the need to properly identify patients at risk for diabetes to help prevent or slow diabetic complications. And as would be expected, older patients with diabetes have higher rates of premature death as well as greater functional disability. Older adults with diabetes have the highest rates of major lower extremity amputations, heart attacks, and end stage renal disease of any age group. They also have higher rates of complications from diabetes treatment including emergency room visits for hypoglycemia episodes. Common geriatric conditions that may be exacerbated by diabetes include polypharmacy, depression, cognitive impairments, urinary incontinence, injurious falls, and persistent pain. Older patients with diabetes will have special needs not found in younger patients; thus, specific treatment recommendations have been developed by the American Diabetes Association (ADA) and the American Geriatrics Society (AGS).\(^\text{[11,12]}\)

2. **Native Americans**
   Diabetes is one of the greatest health concerns facing Native Americans today. Native Americans and Alaska Native adults are over twice as likely as white adults to be diagnosed with diabetes. They are 1.6 times more likely than the general population to die from diabetes.\(^\text{[13]}\)

   Native Americans make up 6% of Montana’s population (versus 91% Caucasian).\(^\text{[14]}\)
   Most Native Americans on the seven reservations located throughout the state receive their healthcare from the Indian Health Service (IHS)\(^\text{[15]}\), which continues to be chronically and severely underfunded.\(^\text{[16,17]}\) Nationally, the IHS has estimated the prevalence of diabetes within their adult population to be approximately 15%. The
percent population with diabetes varies by region from 6% among Alaska Native adults to 22% among Native American adults in southern Arizona. \(^3\)

Awareness of the issues surrounding diabetes in Native Americans is important to provide supportive care and counseling to these individuals, because not only do Native Americans acquire diabetes at a higher rate, they are also at greater risk for complications.

- Native Americans are nearly twice as likely to develop end-stage renal disease.\(^{13}\)
- Native American adults with diabetes may be 3 to 8 times more likely to have cardiovascular disease compared to those without diabetes.\(^{13}\)

III. Overview of Diabetes

A. Definition of Diabetes Mellitus

As mentioned previously, diabetes is a chronic disorder caused by insufficient insulin secretion, improper action of insulin on tissues, or a combination of both which leads to impaired metabolism of carbohydrates, proteins, and lipids.

B. Classifications of Diabetes

The ADA has four general classifications for diabetes mellitus:\(^2\)

1. Type 1
2. Type 2
3. Other (caused by genetics, infections, endocrine disorders, etc.)
4. Gestational (occurs in 7% of all pregnant women; these women are at greater risk of developing type 2 diabetes)

Only type 2 diabetes will be discussed further in greater detail, as this type pertains to most of the diagnosed cases and is the most receptive to lifestyle and dietary changes. But as a brief review, Table 2 will describe some of the distinguishing characteristics between type 1 and type 2 diabetes.
Table 2: Comparison between Type 1 and Type 2 Diabetes

<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical age of onset</td>
<td>Generally in childhood or adolescence</td>
<td>Usually &gt; 40 years old</td>
</tr>
<tr>
<td>Synonyms</td>
<td>Juvenile-onset Insulin-dependent diabetes mellitus (IDDM)</td>
<td>Adult-onset Non-insulin dependent diabetes mellitus (NIDDM)</td>
</tr>
<tr>
<td>Etiology</td>
<td>Immune-mediated and idiopathic (unknown)</td>
<td>Insulin resistance and secretory deficiencies</td>
</tr>
<tr>
<td>Body weight</td>
<td>Non-obese</td>
<td>Obese (80%)</td>
</tr>
<tr>
<td>Endogenous insulin secretion</td>
<td>Minimal secretion</td>
<td>Varying degrees of secretion</td>
</tr>
<tr>
<td>Insulin resistance</td>
<td>Not usually</td>
<td>Common</td>
</tr>
</tbody>
</table>

C. Role of Insulin in Diabetes

Insulin is a peptide hormone which is synthesized by β-cells within the pancreas. After the ingestion of food, the plasma glucose rises stimulating the release of insulin from the pancreas which then facilitates the process of glucose transport into the cells. Figure 2 summarizes the normal actions of insulin on glucose metabolism.

It is not fully understood what causes type 2 diabetes, but insulin resistance is a major contributing factor. Insulin resistance occurs when tissues, which normally respond to the actions of insulin (i.e., muscle, liver and fat), become less susceptible to the actions of insulin. This results in the decreased clearance of glucose from the plasma which in turn stimulates the pancreas to secrete more insulin. The pancreas can only continue this compensatory response of over producing insulin for a limited time, because eventually the β-cells will no longer be able to produce enough insulin to overcome the insulin resistance. This leads to the subsequent development of high
plasma glucose or hyperglycemia.\(^{(20, 21)}\) Rising insulin levels normally turn off liver production of glucose. Because of insulin resistance, the liver overproduces glucose overnight, resulting in fasting hyperglycemia by morning.\(^{(22)}\)

Insulin resistance is not only associated with type 2 diabetes. It has also been linked to other disorders such as cardiovascular disease, hypertension, dyslipidemia, atherosclerosis, and polycystic ovary disease. The association between insulin resistance and type 2 diabetes is felt to involve both genetic and environmental factors, and there is great interest in how obesity plays into this relationship.\(^{(20)}\)

**D. Contributing Pathologies**

Besides impaired insulin secretion and tissue insulin resistance, other factors contribute to the pathology of type 2 diabetes. Two gut hormones, glucagon-like peptide 1 (GLP-1) and glucose-dependent insulinoctropic polypeptide (GIP), are significantly reduced in diabetes. These gut hormones are normally secreted in response to a meal. They stimulate a bolus release of insulin to match the glucose load, suppress glucagon secretion (which normally increases blood glucose levels), slow gastric emptying, and cause satiety to reduce food intake. This is referred to as the incretin effect. With GLP-1 and GIP deficiencies, patients with diabetes experience post-prandial hyperglycemia and increased caloric intake. Patients with type 1 diabetes and patients with long-standing type 2 diabetes also develop a significant amylin deficiency. Amylin is a glucoregulatory hormone secreted with insulin that helps lower blood glucose by slowing gastric emptying, suppressing glucagon output, and increasing satiety.\(^{(22)}\)

Visceral adipose tissue (VAT) refers to fat cells in and around body organs and in the abdominal cavity. VAT is more insulin resistant and more atherogenic than peripheral subcutaneous fat. There are direct correlations among weight gain, VAT and insulin resistance. Furthermore, fat cells can produce adiponectin, which improves insulin resistance. Adiponectin is made in decreasing amounts as an individual becomes more overweight.\(^{(22)}\)
E. Diagnostic Criteria for Diabetes

While the purpose of screening patients is not to diagnose the disease, it is important to understand the criteria required to diagnose a patient and the types of tests involved.

1. Methods of Diagnosis

Currently there are four diagnostic methods approved by the ADA which are summarized in Table 3. Only one of the four methods needs to be performed, but a confirmatory test MUST be performed to make a diagnosis. (2, 22)

Some patients have glucose levels that are higher than normal but less than the diagnostic criteria for diabetes. Patients who fall into this category are classified as having prediabetes or borderline diabetes. Patients with prediabetes are at risk of developing type 2 diabetes within the next five to ten years. With moderate weight loss (5-10% of total body weight), exercise (150 minutes/week), and the use of certain pharmacological agents (e.g., metformin), the development of type 2 diabetes may be delayed or prevented. (2, 22)
### Table 3: Diagnostic Criteria for Diabetes (2, 12, 22, 23)

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Diabetes</th>
<th>Prediabetes</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HbA1c performed in a laboratory using a method that is National Glycohemoglobin Standardization Program (NGSP) certified and standardized to the DCCT assay.</td>
<td>≥6.5%</td>
<td>5.7-6.4%</td>
</tr>
<tr>
<td>2</td>
<td>Casual* plasma glucose with diabetes symptoms (i.e., polyuria, polydipsia, and unexplained weight loss.)</td>
<td>≥ 200 mg/dL</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fasting plasma glucose (no caloric intake ≥ 8 hours).</td>
<td>≥ 126 mg/dL</td>
<td>≥ 100 mg/dL but &lt; 126 mg/dL (Referred to as impaired fasting glucose or IFG)</td>
</tr>
<tr>
<td>4</td>
<td>Two-hour postprandial plasma glucose during an oral glucose tolerance test (OGTT). Patient should be fasted for ≥ 8 hours and then given 75 gm anhydrous glucose orally dissolved in water.</td>
<td>≥ 200 mg/dL</td>
<td>≥ 140 mg/dL but &lt; 200 mg/dL (Referred to as impaired glucose tolerance or IGT)</td>
</tr>
</tbody>
</table>

* Casual is defined as any time of day without regard to time since last meal.

#### F. Risk Factors

Certain factors have been identified with an increased risk of developing type 2 diabetes (Table 4). Properly identifying patients with these risk factors is an important step to initiate intervention therapies as well as to address lifestyle changes related to modifiable risk factors. The ultimate goal is to prevent or delay the onset of diabetes.
Table 4: Risk Factors for Type 2 Diabetes\textsuperscript{(12, 24)}

<table>
<thead>
<tr>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥ 45 years old</td>
</tr>
<tr>
<td>Overweight (Body mass index ≥ 25 kg/m(^2) or ≥ 23 kg/m(^2) if Asian American; See Appendix D)</td>
</tr>
<tr>
<td>Acanthosis nigricans or nonalcoholic fatty liver disease</td>
</tr>
<tr>
<td>First degree relative with diabetes</td>
</tr>
<tr>
<td>Physical inactivity</td>
</tr>
<tr>
<td>Race/ethnicity (African-American, Native Americans, Latinos, Asian Americans, and Pacific Islanders)</td>
</tr>
<tr>
<td>Previously identified prediabetes (e.g., impaired fasting glucose (IFG), impaired glucose tolerance (IGT), or HbA1c &gt;5.7%)</td>
</tr>
<tr>
<td>History of gestational diabetes</td>
</tr>
<tr>
<td>Hypertension (≥ 140/90 mmHg in adults or on antihypertensive therapy)</td>
</tr>
<tr>
<td>HDL cholesterol &lt;35 mg/dL and/or a triglyceride level &gt;250 mg/dL</td>
</tr>
<tr>
<td>Polycystic ovary syndrome</td>
</tr>
<tr>
<td>History of cardiovascular disease</td>
</tr>
<tr>
<td>Anti-psychotic therapy for schizophrenia and/or severe bipolar disease</td>
</tr>
<tr>
<td>Sleep disorders (obstructive sleep disorders, chronic sleep deprivation) in the presence of glucose intolerance</td>
</tr>
<tr>
<td>Chronic glucocorticoid exposure</td>
</tr>
</tbody>
</table>

G. Complications

As a result of the insidious nature of type 2 diabetes, complications are often present by the time diabetes is diagnosed. Once complications are present, they may be slowed but not reversed. In support of tight glycemic control, a 10-year study [the United Kingdom Prospective Diabetes Study (UKPDS 33)] in newly diagnosed type 2 diabetic patients found better managed blood glucose, by use of an intensive treatment regimen, resulted in significant reductions in microvascular complications (e.g., diabetic kidney disease, retinopathy, and neuropathy) compared to conventional therapy. The goal set for fasting blood glucose for the intensive regimen was <108 mg/dL and the conventional group goal was set at <270 mg/dL, which resulted in median HbA1c values of 7% (intensive group) versus 7.9% (conventional group) – a relative reduction of 11%. A seemingly small difference in the HbA1c test, which is a measure of long-term glycemic control, resulted in significant reductions in all diabetes-related complications by 12%, microvascular endpoints by 25%, retinal photocoagulation (a treatment for retinopathy) by 29%, and a borderline reduction in myocardial infarction by 16%.\textsuperscript{(25)}
In a similarly named study, the United Kingdom Prospective Diabetes Study 35 (UKPDS 35) compared the relationship of glycemic control (HbA1c test) to the incidence of micro- and macrovascular complications in 3,600 newly diagnosed type 2 diabetic patients. No therapeutic interventions were implemented, but rather patients were observed for approximately 10 years (7.5-12.5 years). Results strongly suggest a direct relationship between the risk of diabetic complications and glycemic control (Figures 3 & 4). Every 1% reduction in HbA1c resulted in a 37% (median) decreased risk of microvascular complications and a 21% decrease in either a macro- or microvascular event or diabetes-related death.

*Figure 3: Relationship between Glycemic Control and Diabetes-Related Complications* (26)
Although the UKPDS 35 study showed the above beneficial effects of reducing macrovascular complications (e.g., heart attack and stroke) with tight blood glucose control, other large trials since then have not yielded similar results. The Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation (ADVANCE) trial compared standard therapy (HbA1c goal of 7.3%) to intensive therapy (HbA1c goal of 6.5% or less) for over 11,000 patients with type 2 diabetes who were followed for complications over 5 years. Although tight blood glucose control did lower diabetic kidney disease risk, it did not reduce the risk of major cardiovascular events or deaths from cardiovascular disease. Rates of hypoglycemia were higher in the intensive treatment group.\textsuperscript{(27)}

In the Action to Control Cardiovascular Risk in Diabetes Study Group (ACCORD) trial, over 10,000 patients (with a mean age of 62 years) with a median HbA1c level of 8.1% were assigned to intensive therapy (goal HbA1c of 6.0%) or standard therapy (goal HbA1c of 7-7.9%). Of these patients, 35% already had cardiovascular disease. After 3.5 years, the intensive therapy arm was stopped because of an increased mortality rate without reducing risk of major cardiovascular events compared to the standard
treatment group. Severe hypoglycemia and weight gain of more than 10 kg were more frequent in the intensive therapy group.\textsuperscript{(28)} Lowering blood glucose levels to the normal range in older patients, especially those with preexisting cardiovascular disease, appears harmful. The ADA has adjusted HbA1c goals based on the results of these landmark trials.

To summarize, controlling blood glucose levels alone does reduce the risk of microvascular diabetic complications. However, reducing the risk of macrovascular complications is more complex and requires attention to other cardiovascular risk factors (e.g., blood pressure, lipid levels, weight control, and smoking), not just blood glucose control, to affect outcomes. A brief discussion will follow on the detrimental effects diabetes has on the body, which may be helpful when counseling patients regarding the importance of proper glycemic control. Furthermore, people with diabetes are also more susceptible to infections and peripheral complications, primarily in the lower extremities.

1. **Macrovascular**

Macrovascular complications involve the large blood vessels such as the coronary, cerebral, and some peripheral arteries, and are primarily a result of atherosclerosis.\textsuperscript{(18)} As mentioned previously, people with diabetes are 2 to 4 times more likely to have a heart attack or stroke compared to people of the same age and sex without diabetes. In addition, cardiovascular disease is the leading cause of death in diabetic patients.\textsuperscript{(1)} Diabetic patients are at increased risk of atherosclerosis for three primary reasons:\textsuperscript{(18)}

1. The incidence of other cardiac risk factors is increased in diabetes, such as hypertension, high cholesterol, and obesity.
2. Diabetes is itself a risk factor for cardiovascular disease (CVD). Both the American College of Cardiology (ACC) and the American Heart Association (AHA) consider diabetes to be equivalent to having coronary heart disease.\textsuperscript{(29)}
3. Diabetes may act synergistically with other risk factors by increasing atherogenicity (i.e., altering lipid particles, modifying the blood vessel wall, or by promoting a prothrombotic environment).

Therefore, patients with diabetes need intensive treatment for coexisting risk factors. An overview of the recommended treatment guidelines for diabetic patients may be found in Section V: Therapies for Diabetes.

**a) Dyslipidemia**

Lipid abnormalities are common in patients with diabetes. The typical abnormalities include:\(^{(30)}\)

- Decreased high-density lipoproteins (HDL) cholesterol
- Elevated triglycerides
- Average low-density lipoproteins (LDL) cholesterol, but these particles tend to be smaller, denser, and potentially more atherogenic.

In 2009–2012, of adults with diagnosed diabetes, 65% had blood LDL cholesterol >100 mg/dl or used cholesterol-lowering medications.\(^{(3)}\) Life style changes are recommended for all patients with diabetes such as reducing saturated fat, trans fat, and cholesterol intake; increasing intake of omega-3 fatty acids, viscous fiber, and plant stanols/sterols; weight loss (if indicated); and increasing physical activity (30 minutes of moderate intensity physical activity five times weekly).\(^{(29,31)}\)

2013 practice guidelines from the ACC/AHA have changed how providers treat dyslipidemias. Instead of determining treatment by the actual lipid numbers such as LDL, HDL, triglycerides and total cholesterol levels, providers now consider cardiovascular disease status, risk factors and age to stratify treatment options. Since statin medications (e.g., atorvastatin, simvastatin, pravastatin) are the primary class shown to prevent cardiovascular events, they are the mainstay of treatment, in either moderate or high intensity doses (Table 5). For patients with atherosclerotic cardiovascular disease who can’t tolerate high
dose statin therapy, moderate dose statin therapy combined with ezetimibe may be considered.\textsuperscript{(29,31)}

| Table 5: Recommendations for Lipid Treatment & Monitoring in Patients with Diabetes\textsuperscript{(32)} |
|---|---|---|
| Age | Risk factors | Recommended statin dose intensity\* | Monitoring with lipid panel |
| <40 years | None | None | Annually or as needed to monitor for adherence |
| | CVD risk factor(s)\textsuperscript{**} | Moderate or high | |
| | Overt CVD\textsuperscript{***} | High | |
| 40–75 years | None | Moderate | As needed to monitor adherence |
| | CVD risk factors | High | |
| | Overt CVD | High | |
| >75 years | None | Moderate | As needed to monitor adherence |
| | CVD risk factors | Moderate or high | |
| | Overt CVD | High | |

* In addition to lifestyle therapy. \textsuperscript{**} CVD risk factors include LDL cholesterol \(\geq100\) mg/dL (2.6 mmol/L), high blood pressure, smoking, and overweight and obesity. \textsuperscript{***} Overt CVD includes those with previous cardiovascular events or acute coronary syndromes.

The American Association of Clinical Endocrinologists (AACE) and the American College of Endocrinology (ACE) published dyslipidemia guidelines in 2017 which are in line with the ACC/AHA guidelines but do specify LDL goals based on risk status. Those with diabetes are considered in the high-risk category with a LDL goal of less than 100 mg/dL. Persons with established cardiovascular disease, diabetes or chronic kidney disease (stage 3 or 4) with one other risk factor have a LDL goal of \(<70\) mg/dL. Persons with extreme risk of cardiovascular events may benefit from a LDL goal of less than 55 mg/dL.\textsuperscript{(32)}

\textbf{b) Hypertension}

Hypertension affects the majority of patients with diabetes and contributes to cardiovascular disease, strokes, retinopathy, and kidney disease. The prevalence of hypertension depends on the type of diabetes, age, obesity and ethnicity.\textsuperscript{(11)} In 2009–2012, of adults with diagnosed diabetes, 71% had blood
pressure >140/90 mmHg or used prescription medications to lower high blood pressure.\(^{(3)}\)

**Monitoring:** Blood pressure check at every office visit

**Blood Pressure Goals for Diabetic Patients**\(^{(31, 33)}\)
- Blood pressure <140/<90 mmHg
- Blood pressure <130/80 mmHg for certain individuals (younger patients) if can achieve without undue treatment burden.
- The National Kidney Foundation recommends <125/<75 mmHg in patients with kidney disease.

**Treatment Recommendations:** Lifestyle changes with antihypertensives. Any medication shown to reduce CV outcomes may be used (ACE inhibitors, angiotensin receptor blockers (ARBs), thiazide-like diuretics, or dihydropyridine calcium channel blockers). ACE inhibitors (e.g., lisinopril) or ARBs (e.g., losartan) are drugs of choice if albuminuria present. Two or more antihypertensive drugs are typically needed.\(^{(11,12, 31)}\)

c) **Smoking**

It is not clear if a direct relationship exists between smoking and diabetes, but there is substantial evidence concerning the relationship of smoking with increased risk of coronary heart disease, autonomic diabetic neuropathies, peripheral arterial disease, lower leg amputations and albuminuria. Therefore, it is strongly advised to urge patients who smoke to stop.\(^{(11, 42)}\)

d) **Thrombosis or Blood Clots**

Patients with diabetes have at least double the risk of stroke or heart attack compared to people without diabetes. Furthermore, heart disease is the number one cause of death in diabetics.\(^{(11)}\) It is no wonder many patients with diabetes are placed on antiplatelet therapy by their physicians. However, we have learned over time that the bleeding risk, including intestinal bleeds and hemorrhagic strokes, associated with long-term aspirin therapy may outweigh the benefit of preventing strokes and heart attacks, especially if used for primary prevention (preventing a first heart attack or stroke). There is some evidence of a difference in aspirin’s effect by sex. Aspirin tends to reduce the
risk of cardiovascular events (heart attacks) in men and reduce the risk of strokes in women. Major risk factors for CV events include diabetes, family history of premature CV events, hypertension, dyslipidemia, smoking and albuminuria. The American Diabetes Association has revised their general recommendation for antiplatelet therapy to selective use of aspirin or clopidogrel (Plavix®).

**Aspirin Therapy in Diabetic Patients** (11, 31)
- Consider aspirin (75-162 mg/day) as primary prevention in adults >50 years with diabetes + one major additional risk factor, if not at increased bleeding risk.
- Secondary prevention: All adults with diabetes who have already had a CV event.
- Aspirin should not be used by those with low CV risk due to bleeding risk outweighing potential benefit.
- For patients with CVD and documented aspirin allergy, clopidogrel (75mg/day) should be used.
- Dual antiplatelet therapy is reasonable for up to a year after an acute coronary syndrome.

2. **Microvascular**

The true mechanism for the development of microvascular complications is unclear, but three distinct metabolic pathways appear to be involved.

I. Excess glucose in the blood can interact and bind (glycate) proteins causing irreversible changes in the protein structure and potentially the function of the protein. This newly formed glycated protein is referred to as an advanced glycation end (AGE) product. AGE products have been linked to detrimental effects in the extracellular matrix as well as within the cell (intracellular). (18, 34)

II. High levels of intracellular glucose can cause the premature activation of enzymatic processes (i.e., protein kinase C) which can lead to increased neovascularization in the eye, increased pro-inflammatory responses, and potentially prothrombotic states. (34)

III. Some tissues such as nerves, retina, kidney and blood vessels do not require insulin to transport glucose intracellularly. In hyperglycemic
conditions, increased intracellular glucose can be converted by the enzyme, aldose reductase, to sorbitol. This enzymatic reaction requires the cofactor NADPH, which results in the depletion of this cofactor. NADPH is also used to form glutathione which is one of the body’s more potent antioxidants. Therefore, elevated glucose levels indirectly lower our defense mechanisms against oxidative stress and damage.\(^\text{18,34}\)

Irregularities found in the arterioles and capillaries result in microvascular complications. The three main microvascular complications are diabetic kidney disease, retinopathy and neuropathy.

\textit{a) Diabetic kidney disease (nephropathy)}

Kidney disease is a common complication of diabetes. In the United States, people with chronic kidney disease (CKD) have associated conditions of diabetes (40%), hypertension (32%), and self-reported CV disease (40%).\(^\text{35}\)

And just as the prevalence of diabetes has increased at national and state levels, so, too, has the incidence of CKD which increased steadily until 2006 and has now leveled off, with higher incidence in the elderly and those with diabetes. In 2012, the prevalence of chronic kidney disease (stages 1–4) in U.S. adults was 36.5%. In 2014, a total of 52,159 people developed end-stage renal disease with diabetes as the primary cause.\(^\text{3}\) Figure 5 shows the prevalence of chronic kidney disease by age and risk factor in the United States.\(^\text{35}\)
The progression of diabetic kidney disease usually starts with a dysfunction in the glomerulus. In normal physiology, the glomerulus is comprised of a vascular capillary bed which filters the blood, generating a filtrate which progresses further down the nephron, the filtering unit of the kidney. Early in diabetes, changes in the glomerulus, i.e., thickening of the capillary vessels, cause a decrease in the volume of filtrate produced, which specialized cells within the kidney sense as low blood flow or pressure. This triggers the renin-angiotensin system, and often subsequent hypertension, to increase blood pressure to maintain adequate blood flow through the kidney. This hypertensive state also leads to progressive damage within the glomerulus. As the glomerular function deteriorates, so does its ability to discriminate which types of molecules are being filtered. Albumin, a serum protein, is generally not filtered through the kidney, but with decreased glomerular function, small amounts of albumin are found in the urine. The detection of small amounts of albuminuria is often the first sign of diabetic kidney disease.
disease, and as the nephropathy progresses, larger amounts of albumin are found in the urine. Having 30 mg/24 hours of albumin or more in the urine is considered abnormal and requires further testing to confirm the results. Historically, ratios between 30 and 299 mg/24 hours were called “microalbuminuria” and those >300 mg/24 hours were called “macroalbuminuria” (Figure 6)\(^{(22,36,37)}\)

**Figure 6: Disease Progression of Diabetic Kidney Disease with Corresponding Decreases in Renal Function\(^{(36)}\)**

<table>
<thead>
<tr>
<th>Renal Function</th>
<th>GFR (ml/min)</th>
<th>SCr (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microalbuminuria</td>
<td>120</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Macroalbuminuria</td>
<td>&gt;120</td>
<td>&gt;1.0</td>
</tr>
</tbody>
</table>

GFR = glomerular filtration rate; SCr = serum creatinine

**Monitoring:** All type 2 diabetic patients should be tested for urinary albumin and estimated glomerular filtration rate (eGFR) at the time of diagnosis (type 1 diabetics after 5 years of disease) and annually thereafter.

**Goals:**
Optimized blood glucose control and blood pressure control to reduce the risk of or slow the development of diabetic kidney disease.

**Treatment of Diabetic Kidney Disease:**
Nonpregnant patients with albuminuria should receive either an ACE inhibitor or an angiotensin blocker.

Avoid nephrotoxic medications such as nonsteroidal anti-inflammatory drugs (e.g., ibuprofen, naproxen) and aminoglycosides (e.g., gentamicin).\(^{(12,13,37)}\)
For people with diabetic kidney disease not yet requiring dialysis, keeping the amount of dietary protein to the recommended daily allowance of 0.8 g/kg/day is suggested.\textsuperscript{(11,37)}

b) Retinopathy

In the United States, diabetes is the leading cause of blindness among adults between the ages of 20 to 74 years old. Roughly 4 million Americans have diabetic retinopathy, and 899,000 Americans have vision-threatening retinopathy.\textsuperscript{(38)} Approximately 29% of adults with type 2 diabetes have some degree of diabetic retinopathy.\textsuperscript{(1)} Furthermore, patients with diabetes have a higher prevalence of other visual impairments including cataracts and glaucoma (Figure 7).\textsuperscript{(37, 39)}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure7.png}
\caption{Prevalence of Eye Disorders Among Persons >50 Years Old With and Without a Diagnosis of Diabetes\textsuperscript{[39]}}
\end{figure}

Diabetic retinopathy, which usually affects both eyes, is a progressive disease characterized by two stages: non-proliferative and proliferative diabetic retinopathy.

\textbf{(1) Non-proliferative diabetic retinopathy}\textsuperscript{(18,36)}
Non-proliferative diabetic retinopathy usually occurs early in the disease. Initially, microaneurysms occur in retinal capillaries which increase the permeability of the vessel walls to fats, leading to hard, yellow exudates in the retinal vessel wall. Exudates in the area of the macula (point of central vision) can lead to macular edema. The progression of this stage eventually leads to decreased vascular flow in the retina or retinal ischemia. Figure 8 compares a normal retina to one with advanced retinopathy.

(2) **Proliferative diabetic retinopathy**\(^{(18,36)}\)

Secondary to the ischemic changes in the retina, new blood vessels are formed (neovascularization) to restore blood flow, but unfortunately, these blood vessels, which often appear near the optic nerve or macular region, are weaker and more susceptible to rupture. Retinal detachment and blindness can be the final stages if not treated.

*Figure 8: Pictures of a Normal Retina (left) and an Abnormal Retina (right) Showing Scattered Hemorrhages and Yellow Exudates*
Preventing retinopathy is the goal. Optimizing blood glucose, cholesterol, and blood pressure control helps reduce the risk of retinopathy. Early diagnosis of diabetic retinopathy and timely treatment reduce the risk of vision loss. Unfortunately, up to 50% of patients are not getting their eyes examined or are diagnosed too late for treatment to be effective. Of note, low dose daily aspirin therapy does not appear to increase the risk of retinal bleeding and is allowable if indicated for cardiovascular event protection.

Once a patient does develop diabetic retinopathy, they should be referred to an experienced ophthalmologist. Laser photocoagulation therapy can be used to treat proliferative diabetic retinopathy and severe non-proliferative disease. Antivascular endothelial growth factor (VEGF) injection therapy is indicated for treating diabetic macular edema.

Retinopathy: Monitoring Recommendations (12, 37)

All type 2 diabetic patients should receive an ophthalmologic dilated eye examination at the time of diagnosis (Type 1 diabetics after 5 years of disease).

Women with diabetes should get an eye exam prior to becoming pregnant and be counseled on the risk of development or progression of retinopathy during pregnancy, with eye exams performed during each trimester.

If no retinopathy present, then recheck every 2 years.
If retinopathy present, then recheck annually or more often if progressive.
c) Neuropathy

Neuropathies, which are functional disturbances of the peripheral nervous system, affect approximately 60 to 70% of all diabetic patients in some form.\(^\text{36, 40}\) Four broad categories of neuropathies affect diabetic patients: sensory, gastrointestinal autonomic, cardiovascular autonomic, and motor.

(1) Sensory\(^\text{36, 40}\)

Loss of sensory nerve input (i.e., hot and cold), due to demyelination of peripheral nerves, results in symmetric distal polyneuropathies. Early symptoms include numbness or tingling sensations in the extremities (usually the feet and sometimes the hands) typically followed by painful neuropathies, and eventually the permanent loss of sensation in the affected areas.

(2) Gastrointestinal/Miscellaneous Autonomic Neuropathies\(^\text{19, 36, 40}\)

Autonomic nerves support the involuntary activities of the body, such as actions of the stomach, bladder and intestines. Dysfunction of the autonomic nerves may lead to debilitating complications summarized in Table 6.

<table>
<thead>
<tr>
<th>Neuropathy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gastroparesis</strong></td>
<td>A paralysis of the stomach causing delayed gastric emptying and impaired absorption of food. Symptoms include a bloated feeling after eating, nausea and sometimes emesis.</td>
</tr>
<tr>
<td><strong>Diabetic diarrhea</strong></td>
<td>Erratic functioning of the intestine resulting in episodic, voluminous, and watery stools which may be passed without warning. Periods of constipation may also occur, which may increase the risk of an impacted bowel.</td>
</tr>
<tr>
<td><strong>Neurogenic bladder</strong></td>
<td>The bladder fails to respond to normal nerve stimulation resulting in incomplete emptying of the bladder leading to urinary retention. The holding of residual urine in the bladder puts patients at increased risk of urinary tract and kidney infections.</td>
</tr>
</tbody>
</table>
3. Erectile dysfunction (ED)

The ability to attain and maintain an erection may be impaired in diabetic men, and ED may often be a presenting problem leading to a type 2 diabetes diagnosis.

(3) Cardiovascular Autonomic Neuropathies (CAN)\(^{(37)}\)

CAN is the most studied and clinically important form of diabetic autonomic neuropathy because of its independent association with cardiovascular death. In early stages, CAN often lacks symptoms. Advanced disease may be expressed by resting tachycardia (>100 bpm) and orthostatic hypotension without a compensatory heart rate response.

(4) Motor Neuropathies\(^{(18, 36)}\)

Motor neuropathies, the rarest of the diabetic neuropathies, affect the nerves which cause movement, primarily in the extremities, and may result in decreased motor function and gait disturbances. People with diabetes are more likely to have falls than adults without diabetes. When a fall does occur, approximately 46% of people with diabetes reported being injured compared to 33% of people without diabetes in Montana.\(^{(41)}\)

Because the types and presentations of diabetic neuropathies are so diverse, a general recommendation is an annual screening for the above neuropathies by a health care provider. People with diabetes should be educated about the types and typical presentation of the various neuropathies. If signs or symptoms appear, patients should notify their provider for prompt further evaluation.

3. Infections

Diabetic patients are more susceptible to pneumonia, urinary tract infections, and skin and soft tissue infections. They often have a worse prognosis compared to patients without diabetes. The increased risk of infection may be related to an impaired cell-mediated immunity and phagocytic function, a decrease in peripheral circulation, or the increased growth of organisms under hyperglycemic conditions.
Furthermore, hyperglycemia prevents adequate wound healing; therefore, glycemic control is paramount to speed wound healing.\footnote{36} Because diabetic patients are at greater risk of pneumonia, the ADA recommends vaccinations be kept up-to-date for this patient population.

---

**American Diabetes Association Recommendation: Vaccinations**\footnote{42}

- All diabetic patients should receive an annual influenza vaccine.
- All diabetic patients should receive pneumococcal polysaccharide vaccine 23 (PPSV23) if \( \geq 2 \) years of age.
- Adults \( \geq 65 \) years of age, if not previously vaccinated, should receive pneumococcal conjugate vaccine 13 (PCV13), followed by PPSV23 6–12 months after initial vaccination.
- Adults \( \geq 65 \) years of age, if previously vaccinated with PPSV23, should receive a follow-up \( \geq 12 \) months with PCV13.
- Administer hepatitis B vaccination to unvaccinated adults with diabetes who are aged 19–59 years.
- Unvaccinated diabetic patients \( \geq 60 \) years of age may consider receiving the Hepatitis B vaccine.

### 4. Lower Extremity Complications

Diabetes is the leading cause of non-traumatic lower-limb amputations in the United States, causing approximately 108,000 amputations annually. About 60% of non-traumatic lower-limb amputations occur in adults with diabetes.\footnote{3} Patients with diabetes are predisposed to lower extremity complications due to neuropathies, poor peripheral circulation, and impaired wound healing. People
with diabetes often cannot feel painful warnings of blister formation or an ingrown toenail. Therefore, it is essential to educate patients to inspect their feet daily for signs of skin damage and infection.\(^{(32)}\) Risk factors which have been identified with increasing likelihood of an amputation are:\(^{(37)}\)

- Peripheral neuropathy with loss of protective sensation
- Evidence of increased pressure (erythema, hemorrhage under a callus)
- Bony or foot deformity
- Peripheral vascular disease (decreased or absent pedal pulses)
- A history of ulcers or amputations
- Severe nail pathology
- Poorly controlled blood glucose
- Advanced diabetic kidney disease
- Visual impairment (so can’t self-monitor feet)
- Smoking

The best defense is once again good screening and detection of early signs of foot and lower extremity problems. Patients with diabetes should have at least an annual comprehensive foot examination which includes inspection, palpation of dorsal and tibial pulses, reflex checks, and sensation, vibration, and monofilament testing.\(^{(11,12)}\) People with diabetes should inspect their feet daily for signs of inflammation or wounds. Wearing cotton socks, good-fitting shoes, trimming nails straight across to avoid ingrown toenails, and keeping the skin in good condition are advised. Diabetics should avoid going barefoot, using abrasive treatments (corn removers), and should stop smoking to help prevent lower extremity complications.

**H. Prevention of Diabetes**

Preventing type 2 diabetes has been a “hot topic” in diabetes research. Several randomized, controlled trials have demonstrated the ability to prevent this devastating disease. Table 7 summarizes the most significant type 2 diabetes prevention trials.\(^{(43-47)}\) Intensive lifestyle changes (5-10% weight loss and moderate physical activity of 30 minutes/day) can reduce the onset of diabetes by 58% in those patients at high risk for developing type 2 diabetes and is the most cost-effective option. Metformin, acarbose, orlistat and pioglitazone can also decrease the incidence of diabetes. The ADA Consensus Development Panel recommends that all persons with prediabetes (IFG, IGT,
or HbA1c 5.7-6.4%) should be referred to an intensive behavioral counseling program targeting loss of 7% of body weight and increasing moderate-intensity physical activity (such as brisk walking) to at least 150 minutes/week. Periods of prolonged sitting should be interrupted every 30 minutes with short bursts of physical activity. Metformin should be considered for patients with prediabetes, especially if they also have BMI ≥35 kg/m², are less than 60 years old, have a history of gestational diabetes, or have rising HbA1c levels despite lifestyle changes.\(^{(11,12,51)}\)
### Table 7: Summary of Clinical Trials for Diabetes Prevention (43-47)

<table>
<thead>
<tr>
<th>Study Descriptor</th>
<th>Patient Population</th>
<th>Treatment Groups</th>
<th>Primary Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finnish Diabetes Prevention Study Group 2001 (43)</td>
<td># of pts = 522 Sexes = male &amp; female Ave. age = 55 y.o. Ave. BMI = 31 kg/m² Pre-diabetic pts (+ IGT) Years of follow-up = 3.2</td>
<td>1. Brief diet &amp; exercise counseling 2. Intense, individualized diet &amp; exercise counseling</td>
<td>Intensely counseled group had a 58% relative reduction in incidence of type 2 diabetes compared to brief counseling.</td>
</tr>
<tr>
<td>Diabetes Prevention Program 2002 (44)</td>
<td># of pts = 3,234 Sexes = male &amp; female Ave. age = 51 y.o. Ave. BMI = 34 kg/m² Pre-diabetic pts (+ IGT) Years of follow-up = 2.8</td>
<td>1. Lifestyle group: counseled on better nutrition &amp; exercise 2. Metformin 3. Placebo</td>
<td>Both the lifestyle and metformin groups had a 58% and 31% relative reduction, respectively, in the incidence of type 2 diabetes compared to placebo.</td>
</tr>
<tr>
<td>STOP-NIDDM 2002 (45)</td>
<td># of pts = 1,429 Sexes = male &amp; female Ave. age = 55 y.o. Ave. BMI = 31 kg/m² Pre-diabetic pts (+ IGT) Years of follow-up = 2.8</td>
<td>1. Acarbose (drug to slow carbohydrate absorption) 2. Placebo</td>
<td>The acarbose-treated group had a 36% relative reduction in the incidence of developing type 2 diabetes compared to placebo.</td>
</tr>
<tr>
<td>XENDOS 2004 (46)</td>
<td># of pts = 3,277 Sexes = male &amp; female Ave. age = 43 y.o. BMI &gt; 30 kg/m² Normal BG or IGT Duration = 4 years</td>
<td>1. Lifestyle changes + orlistat 120 mg TID 2. Lifestyle changes + placebo</td>
<td>The orlistat-treated group had a 37% risk reduction in incidence of type 2 diabetes compared to control. Orlistat group lost more weight.</td>
</tr>
<tr>
<td>ACT NOW 2011 (47)</td>
<td># of pts = 602 Sexes = male &amp; female Ave. age = 52 y.o. IGT Duration = 2.4 years</td>
<td>1. Pioglitazone 45 mg per day 2. Placebo</td>
<td>The pioglitazone-treated group had a 72% reduction in incidence of type 2 diabetes.</td>
</tr>
</tbody>
</table>

Key: BMI: body mass index, IGT: impaired glucose tolerance

The RISE Study is currently recruiting people ages 20 to 60 years who have either prediabetes or early type 2 diabetes for a yearlong therapy trial with monitoring for up to a year after. They estimate enrollment to be 255 and hope to complete the study by March 2019. Patients will be randomized into 4 trial groups: placebo, metformin, insulin glargine followed by metformin, or liraglutide with metformin. The study will assess trends of insulin resistance and glucose tolerance. (48)
IV. Screening for Diabetes

A. Who should be screened?

While there is considerable evidence that intensive treatment of cardiovascular risk factors can reduce mortality in patients with established diabetes, there have been limited clinical trials to address the effectiveness of diabetes screening on decreasing mortality or morbidity, or on the cost-effectiveness of early detection.

There are two approaches to prevention of disease: population-wide or mass testing and prevention strategies or screening of high-risk patients and treatment of the identified subset. The United States and the United Kingdom use the screen and treat approach to manage diabetes. Because current screening practices for diabetes have a low sensitivity for detecting prediabetes, screening practices alone are unlikely to have a major impact on diabetes outcomes. Low sensitivity of screening tests results in a high number of false negatives where people are incorrectly identified as not having prediabetes. Because of this, participants in screening events should be encouraged to have repeat screening conducted periodically and still institute healthy lifestyle changes. More work is needed to determine effective screening strategies for those with prediabetes.

A randomized trial of the effect and cost-effectiveness of early intensive multifactorial therapy on 5-year cardiovascular outcomes in individuals with screening-detected type 2 diabetes, the Anglo-Danish-Dutch Study of Intensive Treatment in People with Screen-Detected Diabetes in Primary Care (ADDITION-Europe) study, was conducted in Europe to answer these questions. Over 3000 participants (mean age of 60 years) were randomized to screening plus routine care (RC) or intensive treatment (IT) comprising screening and promotion of target-driven intensive management (medication and promotion of healthy lifestyles) of hyperglycemia, blood pressure and cholesterol. The primary end-point was a composite of first cardiovascular event with a second end-point of all-cause mortality. Data was extrapolated to 30 years using the UK Prospective Diabetes Study outcomes model. Prescription costs increased in both groups, more so
in the IT group than in the RC group. There were clinically important improvements in cardiovascular risk factors in both study groups. Modest but statistically significant differences between groups in reduction in HbA1c levels, blood pressure and cholesterol favored the IT group. The incidence of first cardiovascular event (IT 7.2%, RC 8.5%) and all-cause mortality (IT 6.2%, RC 6.7%) did not differ between groups. The intensive treatment group was not cost effective compared to routine care group. The lower than expected event rates and differences in medical delivery between centers may have limited the outcome results.\(^{(50)}\)

The ADA currently recommends diabetes screening only be performed in patients at higher risk of developing diabetes.\(^{(11, 12)}\)

### ADA Criteria for Testing for Diabetes\(^{(2, 12)}\)

- The HbA1c, fasting plasma glucose (8 hr fast), or 75-g 2-hr Oral Glucose Tolerance Test may be used.

- Testing should be considered in all adults who are overweight (BMI \(\geq 25\) kg/m\(^2\) or \(\geq 23\) kg/m\(^2\) if Asian American and have one or more risk factor (see Table 4 for risk factors)

- In the absence of the above criteria, testing for diabetes should begin at age 45 years.

- Repeat adult testing at least every 3 years, except those with prediabetes who should be tested yearly.

- In children,
  - Test if high risk: weight > 120% of weight ideal for height + 2 risk factors
B. Use of HbA1c for Screening

Hemoglobin, which is found in red blood cells, is a protein which delivers oxygen to cells. Like most proteins, it has the ability to be glycated or linked with sugars found in the blood, such as glucose. Therefore, the amount or percentage of glycated hemoglobin in the blood is a measurement of how much glucose the hemoglobin has been exposed to in the preceding weeks. Since hemoglobin is only found within red blood cells, which typically have a lifespan of 120 days, the percent of glycated hemoglobin is a measure of glycemic control over the past 8 to 12 weeks. A person without diabetes usually has about 5% of the hemoglobin glycated, but for patients with chronic hyperglycemia, the percentage of glycated hemoglobin is considerably higher.\textsuperscript{52, 53}

The HbA1c test, which is a measurement of glycated hemoglobin, is routinely recommended for use at least twice a year as a monitoring tool for patients diagnosed with diabetes to assess how well the patients are managing their diabetes.\textsuperscript{12, 13, 53} The HbA1c test is currently used as a screening device, as studies have evaluated the HbA1c test in this capacity and have found good reliability when National Glycohemoglobin Standardization Program (NGSP)-certified methods are used.\textsuperscript{12, 23}

The ImProving Health Among Rural Montanans (IPHARM) screening program chose to utilize the HbA1c test as a screening device for three main reasons.

1. Analyses suggest that the HbA1c test has the best combination of sensitivity and specificity at a cut point of 5.7%, which can be used to identify cases of impaired fasting glucose. Among the non-diabetic population, an HbA1c of 5.6% corresponds to an FPG of 110mg/dL and an HbA1c of 5.4% corresponds to an FPG of 100mg/dL. Table 8 demonstrates further correlations of HbA1c and average plasma glucose. Clinical judgment is necessary to evaluate patients whose values fall between 5.7 - 6.4%, with considerable emphasis placed on co-existing risk factors. The HbA1c test can help identify individuals with high risk for future diabetes.\textsuperscript{12}

\begin{table}[h]
\centering
\caption{Correlation of Hemoglobin A1c with average plasma glucose\textsuperscript{12}}
\end{table}
2. The test is easy to administer and only takes about five minutes to perform, requiring minimal blood sample collection.

3. The test does NOT have to be performed in a fasted state. This is important as it is not practical for patients to attend screening events in the afternoon without eating a meal since the previous night.

Finally, it should be emphasized that the use of the HbA1c test for screening purposes is not a diagnostic procedure. Multiple factors, including hemoglobinopathies (e.g., sickle cell trait) can interfere with test results, and results have to be confirmed. Conditions associated with increased red cell turnover, such as pregnancy (second and third trimesters), recent blood loss or transfusion, erythropoietin therapy, or hemolysis can affect HbA1c results. An updated list of interferences is available at Harmonizing Hemoglobin A1c Testing. Follow-up care by a health care professional will be necessary to confirm a diagnosis of diabetes.

### C. Use of the Afinion™ HbA1c test

1. **The Afinion™ HbA1c test**

   The Afinion™ HbA1c test is a Clinical Laboratory Improvement Amendments (CLIA) waived, single-use, point-of-care test read by the fully automated Afinion™ Analyzer. The device uses a boronate affinity method unlike the more commonly used DCA immunoassay method. The HbA1c test cartridge contains all reagents necessary for the measurement of glycated hemoglobin. It utilizes 1.5 µL of blood.
to provide HbA1c results (measuring range of HbA1c of 4-15%) in about three minutes.

The Afinion™ HbA1c test has demonstrated 98% accuracy when compared to a central laboratory high-performance liquid chromatography (HPLC) method. In CLIA waived labs, it is recommended to analyze controls with each new lot of HbA1c kits, at least every 30 days, when training new users, and anytime an unexpected test result is obtained.

A quick guide for use of the Afinion™ HbA1c test is found in Appendix C and provides information on the Afinion™ Analyzer, how to set up the testing device, and how to run a sample and controls.

There are several similar devices on the market. We are focusing on the Afinion™ model because this is the device we use in the MT Geriatric Education Center’s geriatric health screening program, also known as IPHARM.

2. Performing a finger stick for blood collection

Obtaining an adequate quantity of blood from a finger stick is sometimes the most challenging component of diabetic screening.

Among the following steps are some suggestions to assist with minimizing collection difficulties.

a. Patients with thick calluses or poor peripheral circulation may be the most difficult. Warming the hands under warm water or holding onto hand warmers can substantially help with getting adequate blood supply down to the finger tips. For patients with thick calluses, try to look for a finger with the least amount of callus.

b. It is generally a better idea to obtain the blood sample from the non-dominant hand, as a bandage will be placed on the finger utilized for the blood sample, and the non-dominant hand may be less callused.

c. Inspect the patient’s fingers and gently press on the tips of the fingers to assess which fingertip has good blood return. (The tip should become a rosy-red color compared to the other finger areas.)
middle (3rd) finger or the ring (4th) finger is generally a good choice to perform the finger stick.

d. Cleaning of the finger area with an alcohol swab prepares the site for penetration with the lancet. The fingertip needs to be completely dry prior to performing the finger stick.

e. The recommended placement of the lancet on the finger is on the outside edge of the fingertip. (About the 2 o’clock position when looking at the fingertip.) Place the lancet firmly on the tip, push downward, AND hold in place for two seconds. Holding the lancet in place prevents the reflexive impulse to pull the lancet away from the skin before it has fully penetrated.

f. When trying to get the area which was pricked to bleed, keep in mind the lancet provides a slit-like cut which responds better to gently opening the cut as opposed to squeezing the cut (which pushes the cut edges together.) A drop of blood should appear with gentle massaging. Try to avoid “milking” the finger (which is squeezing along the finger towards the tip), as this may lead to blood cell lysis and an inaccurate result.

   NOTE: If a patient will not bleed after two different attempts, ask the patient to drink about 2 cups of water and return in an hour as the patient may be dehydrated. If the patient still cannot provide a sufficient sample, inform the patient that no further attempts will be made, and rescheduling for another day will be necessary.

g. Placing the collection capillary at a slight downward angle to the blood droplet and gently touching the side of the droplet with the capillary should result in the gentle sucking action of the blood. Blood will wick and completely fill the capillary (1.5 microliters), avoiding air bubbles.
Once the blood fills the capillary, provide the patient with a tissue or gauze pad to press against the bleeding finger. Place a bandage on the finger if needed.

3. **Interpretation of Results**

As mentioned previously, IPHARM utilizes the Afinion™ HbA1c test to screen patients who may be at higher risk of diabetes. Table 9 may be used as a general guideline for the interpretation of the results. Patients with an HbA1c ≥ 5.7% should be referred to a health care provider for follow-up, but it should be emphasized to the patient that this abnormal value does NOT diagnose them with diabetes.

<table>
<thead>
<tr>
<th>HbA1c value</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5.7%</td>
<td>No follow-up recommended, but general counseling on risk factor reduction is advised.</td>
</tr>
<tr>
<td>≥ 5.7%</td>
<td>Follow-up with a health care provider recommended; provide general counseling on risk factor reduction.</td>
</tr>
</tbody>
</table>

**Table 9: IPHARM Recommended Actions for Afinion™ Analyzer HbA1c Test Results**

V. **Videos of a Geriatric Health Screening Event**

The MTGEC/IPHARM program provides wellness screening to people throughout Montana that might otherwise be unable to access this service. Additionally, the program provides patient care experience for students in their last professional year in the study of pharmacy, physical therapy, nursing and other health care fields.

The following videos illustrate a typical screening for HbA1c using the Afinion™ Analyzer. The first video shows how to set up the screening device. The second video is a sample of a typical patient consultation session. Watching the videos is a component of the contact hours for this module and should be completed at this time.

**Setting up the Afinion™ Analyzer**
VI. Therapies for Diabetes

A multidisciplinary approach to address the diverse needs of a diabetic patient may include expert involvement of physicians, physician assistants, nurse practitioners, nurses, pharmacists, diabetes educators, dieticians, physical therapists, mental health professionals and social workers. An individualized treatment plan with patient-specific goals, in conjunction with patient education, is essential to achieving successful therapeutic outcomes.

Table 10 describes the glycemic goals which have been established by the two main professional diabetes organizations: American Diabetes Association (ADA) and the American Association of Clinical Endocrinologists (AACE). \(^{(11, 24)}\)

<table>
<thead>
<tr>
<th>Glycemic Parameter</th>
<th>Expert Group</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c</td>
<td>ADA</td>
<td>&lt; 7%*</td>
</tr>
<tr>
<td></td>
<td>AACE</td>
<td>≤ 6.5%*</td>
</tr>
<tr>
<td>Pre-prandial plasma glucose</td>
<td>ADA</td>
<td>80-130 mg/dL</td>
</tr>
<tr>
<td></td>
<td>AACE</td>
<td>&lt; 110 mg/dL</td>
</tr>
<tr>
<td>Post-prandial plasma glucose (generally 1-2 hours after the beginning of a meal)</td>
<td>ADA</td>
<td>&lt; 180 mg/dL</td>
</tr>
<tr>
<td></td>
<td>AACE</td>
<td>&lt; 140 mg/dL</td>
</tr>
</tbody>
</table>

*HbA1c targets should be individualized.

Lowering HbA1c to below 7% has been shown to reduce microvascular complications of diabetes, and if implemented soon after the diagnosis of diabetes, is associated with long-term reduction in macrovascular disease. Therefore, a reasonable HbA1c goal for many non-pregnant adults is less than 7%. More stringent HbA1c goals (such as <6.5%) are reasonable for selected individual patients, if this can be achieved without significant hypoglycemia or other adverse effects. Appropriate patients might include those with
short duration of diabetes, long life expectancy, and no significant cardiovascular disease. Less stringent HbA1c goals (such as less than 8%) should be considered for people with a history of severe hypoglycemia, limited life expectancy, advanced complications, extensive comorbid conditions, and those with long-standing diabetes. Many elderly patients with diabetes fall into this latter category. For these patients, the risks of therapy (death or events associated with hypoglycemia) may not outweigh the benefits of tight blood glucose control that take years to fully appreciate. Goals should be individualized (Figure 9) and patients should know their glycemic goals.\textsuperscript{(12, 24, 57)}

\textbf{Figure 9: Patient & Disease Factors that Affect Individual HbA1c Optimal Goal}\textsuperscript{(58)}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure9}
\caption{Patient & Disease Factors that Affect Individual HbA1c Optimal Goal}
\end{figure}

\textbf{A. Diet and Exercise}

Diet and exercise are essential therapies for all patients with diabetes. Additionally, it has been shown that patients at risk for diabetes can prevent or delay diabetes onset with modifications in diet and weight control.\textsuperscript{(12, 42)}

The following nutritional goals apply to patients with diabetes, but their application may be appropriate for patients at risk for diabetes.\textsuperscript{(12)}
- Attain and maintain recommended metabolic outcomes, including glucose and HbA1c levels, cholesterol levels, blood pressure, and body weight.
- Prevent and treat the chronic complications and comorbidities of diabetes. Modify nutrient intake and lifestyle as appropriate for the prevention and treatment of obesity, dyslipidemia, cardiovascular disease, hypertension and kidney disease.
- Improve health through healthy food choices and physical activity.
- Address individual nutritional needs, taking into consideration personal and cultural preferences and lifestyle, while respecting the individual’s wishes and willingness to change.

Any of the lifestyle interventions listed in Table 11 may be appropriate for patients at risk for diabetes. There are no ideal percentages of calories from carbohydrate, protein, and fat for all people with diabetes. Therefore, macronutrient portion amounts should be based on individual eating patterns, preferences, and metabolic goals. Increasing dietary fiber (14 g fiber/1,000 kcal), including eating whole grains, and limiting sugary drinks are also recommended. Before any patient initiates a physical activity program, it is advised that the patient be assessed by a healthcare provider.\(^{(12,42)}\)

Table 11: Lifestyle Modifications for Diabetic Patients\(^{(12,42)}\)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Comment/Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lose weight if BMI &gt;25 kg/m(^2)</td>
<td>Mediterranean, Dietary Approach to Stop Hypertension (DASH), vegetarian, low-fat or low-carb diets may be effective for short-term weight loss.</td>
</tr>
<tr>
<td>Smoking</td>
<td>Stop smoking</td>
</tr>
<tr>
<td>Exercise appropriately</td>
<td>30 minutes of moderate exercise 5 days a week (150 min/week). Exercise should include adequate warm-up and cool-down periods (about 5-10 minutes each). Use proper</td>
</tr>
</tbody>
</table>
B. Drug Therapy

Most patients will require pharmacologic assistance to achieve glycemic goals. Implementing drug therapy is beyond the scope of diabetes screening and will not be discussed in detail in this module, but Table 12 briefly describes the commonly prescribed agents used in the treatment of type 2 diabetes. Metformin is considered first line therapy for treating Type 2 diabetes, unless contraindicated, since it has been shown to reduce mortality in overweight patients with diabetes, targets insulin resistance and is a cost-effective option.\(^{(59)}\) Recently, two more anti-diabetic medications have outcome study data showing that they can lower risk of mortality in patients with existing cardiovascular disease: liraglutide\(^{(60)}\) (a GLP-1 incretin mimic) and empagliflozin\(^{(61)}\) (SGLT2 inhibitor). The choice of antidiabetic medication is still individualized, considering desired HbA1c reduction, efficacy, co-morbid conditions, side effects, cost and patient preference. Since the majority of patients with type 2 diabetes are not using insulin, insulin products are not included in Table 12.\(^{(11)}\)
### Table 12: Commonly Prescribed Medications for Patients with Type 2 Diabetes (22,59)

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>Mechanism Of Action</th>
<th>Major Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfonylureas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolbutamide (Orinase®)</td>
<td>Primarily stimulates insulin release from the pancreas. Also decreases glucose output by the liver.</td>
<td>Hypoglycemia, weight gain, nausea, &amp; headache (Note: The first generation medications are rarely used due to increased toxicity.)</td>
</tr>
<tr>
<td>Tolazamide (Tolinase®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorpropamide (Diabinese®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyburide (DiaBeta®, Micronase, Glynase®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glipizide (Glucotrol®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glimepiride (Amaryl®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Biguanides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metformin (Glucophage®, Fortamet®, Riomet®)</td>
<td>Decreases liver glucose production. Improves insulin sensitivity in peripheral tissues. Decreases intestinal absorption of glucose.</td>
<td>Metallic taste, diarrhea, nausea, weight loss. Renal function must be monitored. Stop drug if eGFR is less than 30 ml/min. Periodically check Vitamin B12 levels &amp; supplement if needed. Contraindicated in patients with CHF, alcohol abuse, metabolic acidosis, liver or kidney disease, and ≥ 80 years old.</td>
</tr>
<tr>
<td><strong>Alpha-Glucosidase Inhibitors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acarbose (Precose®)</td>
<td>Delays intestinal absorption of carbohydrates resulting in decreased post-prandial glycemia.</td>
<td>Flatulence, diarrhea, and abdominal pain.</td>
</tr>
<tr>
<td>Miglitol (Glyset®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thiazolidinediones (glitazones)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosiglitazone (Avandia®)</td>
<td>Increases insulin sensitivity.</td>
<td></td>
</tr>
<tr>
<td>Pioglitazone (Actos®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Meglitinides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repaglinide (Prandin®)</td>
<td>Increases insulin secretion from the pancreas.</td>
<td>Headache, weight gain, and hypoglycemia</td>
</tr>
<tr>
<td>Nateglinide (Starlix®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DDP-IV Enzyme Inhibitors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saxagliptin (Onglyza®)</td>
<td>Prolongs active incretin levels in gut, reducing</td>
<td>Headache, nausea, diarrhea, and nasopharyngitis.</td>
</tr>
<tr>
<td>Sitagliptin (Januvia®)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug Class</td>
<td>Mechanism Of Action</td>
<td>Major Side Effects</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Linagliptin (Tradjenta*)  
Alogliptin (Nesina*) | fasting and postprandial glucose levels                                              |                                                                                    |
| GLP-1 Incretin Mimetics  
- Exenatide (Byetta, Bydureon*)  
- Liraglutide (Victoza*)  
- Dulaglutide (Trulicity*)  
- Albiglutide (Tanzeum*)  
(57)                                                                 | Nausea, vomiting, diarrhea, headache, dizziness, and hypoglycemia |
| Amylin Analog  
- Pramlintide (SymlinPen ®) | Modulates gastric emptying. Prevents postprandial rise in plasma glucagon. Produces satiety leading to decreased caloric intake. | Nausea, dizziness, headache, abdominal pain, anorexia, vomiting, weight loss & hypoglycemia |
| Dopamine Agonist  
- Bromocriptine (Cycloset*) | Resets dopaminergic mediation of circadian rhythms that play a role in insulin resistance/obesity | Hypotension, drowsiness, hypoglycemia, stomach upset, nasal congestion, lazy eye |
| Bile Acid Sequestrant  
- Colesevelam (WelChol*) | Bile acid sequestrant                                                                  | Constipation, dyspepsia, & increased triglycerides                                 |
| SGLT2 Inhibitors  
- Canagliflozin (Invokana*)  
- Dapagliflozin (Farxiga*)  
- Empagliflozin (Jardiance*) | Promotes glucose excretion by the kidneys into the urine. Empagliflozin reduces risk of mortality if established CV disease.  
(61)                                                                 | Urinary tract infections, yeast infections, increased potassium, weight loss |

Key: DDP-IV is dipeptidyl-peptidase IV, GLP-1 is glucagon-like peptide-1, SGLT2 is sodium-glucose cotransporter-2, eGFR is estimated glomerular filtration rate.
VII. Useful Diabetes Websites

🌟 Highly recommended websites for further understanding of key concepts related to geriatric screening.

(1) Governmental

(a) National Diabetes Education Program (NDEP) 🟢

(b) National Institute of Diabetes & Digestive & Kidney Diseases 🟢

(c) Indian Health Service, Division of Diabetic Treatment & Prevention 🟢

(d) The Montana Diabetes Resource Center

(2) Diabetes Organizations

(a) American Diabetes Association 🟢

(b) American Association of Diabetes Educators

(c) National Diabetes Education Initiative

(d) Defeat Diabetes Foundation, Inc.
VIII. References

APPENDIX A: (IPHARM) AUTHORIZATION TO TEST FORM

IMPROVING HEALTH AMONG RURAL MONTANAS (IPHARM) AUTHORIZATION TO TEST FORM

IPHARM will provide SCREENING test(s) to you today at your request and for the specific purpose of providing you with information that may relate to your health. An explanation of the results and how they may relate to your health will be provided by IPHARM personnel.

What will happen today?
IPHARM personnel will conduct the test(s) you have requested, obtain the results, and explain the results to you. You will receive the original and only copy of your complete test results. IPHARM personnel will record your results for statistical purposes on a data sheet that does NOT include your name. The results will be used in IPHARM reports compiled with all other test results and your results will never be individually identified or connected to you without your written permission. IPHARM will keep your agreement to be tested and the results sheets confidential, separated, and secure. IPHARM further agrees to use personnel trained to provide these tests and to follow general methods approved for these tests. IPHARM agrees to exercise due caution in those areas associated with the tests provided.

What do I agree to when I sign below?
By signing below, you indicate you have read and understand this form. You agree that IPHARM has no responsibility to contact your health care provider. You agree to receive testing from IPHARM for the test(s) you have requested. Finally, you agree to hold harmless IPHARM personnel for acts beyond their control or outside their responsibility in providing you these tests.
*A copy of this form is available upon request.*

Do I need to give these results to my health care provider?
IPHARM strongly encourages you to take your results to your provider when you next schedule an appointment. In some cases, IPHARM may suggest you schedule an appointment with your provider. IPHARM reminds you that a single screening test result whether abnormal or normal does not provide you or your provider enough information on which to make therapeutic decisions about your health. However, the tests may indicate that you should have further tests done or undertake changes in your life that could improve your health.

____________________________________________  ____________________
Client Signature                                Date

____________________________________________  ____________________
Printed name of client                          Daytime phone number

_____ Initial here if you will allow IPHARM to take a picture of you during testing to be used for publicity of the IPHARM program.

____________________ Client record number (record on results sheet also)
Appendix B: Protection of Staff & Public from Blood-Borne Pathogens

IPHARM will follow the procedures outlined below in order to protect individuals administering finger-stick tests and individuals exposed to finger-stick test waste that might cause injury. In all cases, IPHARM’s intent is to protect staff and the public from potential injury.

Procedure 1
All IPHARM workers will be instructed by an IPHARM Clinical Pharmacist Specialist (CPS), Principal Investigator (PI), or Project Coordinator (PC) before any tests are completed.

Procedure 2
All IPHARM workers administering finger-sticks must wear non-latex gloves on both hands prior to administering any finger-stick.

Procedure 3
All IPHARM workers will administer finger-stick tests only after training on the proper method for doing this procedure and only after observation of an instructor (PI, CPS, or PC) administering this test.

Procedure 4
The following items must be placed in a “Sharps” container after use:

- Lancets (closed, open, or retractable), pipettes or other collection tubes, any other devices or potentially sharp objects that are used and come into contact with blood or body fluids.
- Items that may be discarded in a plastic garbage bag include the following: alcohol swabs, tissues including tissue with blood, used Band-Aids, and gloves that are properly removed and folded inside out into one another (gloves with blood may be handled in this manner also).

Procedure 5
After a person has a finger-stick test, they should be told to compress the site for at least 3-5 minutes with gentle but firm pressure. The IPHARM staff member working the station should inspect the site after this in order to determine if the person’s lancet wound has stopped bleeding. If not, a Band-aid shall be applied.

Procedure 6
In the event any worker believes they have come into contact with blood or body fluid and such contact has consisted of contact with an open sore or mucous membrane, the worker should immediately contact the IPHARM Clinical Pharmacist Specialist at the event.
Appendix C: Afinion™ HbA1c Quick Guide

Afinion™ HbA1c • Quick Guide

CLIA statement
This is a CLIA-waived test. A CLIA Certificate of Waiver is needed to perform testing in waived labs. If the laboratory modifies the test instructions, including quality control, the test will no longer meet the requirements for waived categorization. A modified test is regarded as highly complex and is subject to all applicable CLIA requirements.

Important!
- Read the entire Afinion™ HbA1c Quick Guide before testing patient samples or controls.
- See the Afinion™ AS100 Analyzer User Manual for more information about the operation of the Analyzer and Test Cartridge.
- See the Afinion™ HbA1c Package Insert for more information about the HbA1c assay.
- Use quality control materials to confirm that the Analyzer and test kit are working properly.

1 GETTING STARTED
Take time to familiarize yourself with the Analyzer and the test kit.

Afinion™ AS100 Analyzer

1 ON/OFF button
2 Light emitting diodes
3 Touch screen
4 The lid
5 Connectors

Cleaning the Analyzer
Clean the Analyzer every 30 days. Follow the procedure in the User Manual. See section “Cleaning and Maintenance”.

Important touch buttons
- Patient sample mode
- Control mode
- Patient ID
- Control ID
- Enter
- Accept

Important information codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>Hemoglobin below 6.0 g/dL</td>
</tr>
<tr>
<td>104</td>
<td>Hemoglobin above 20.0 g/dL</td>
</tr>
<tr>
<td>105</td>
<td>HbA1c below 4.0%</td>
</tr>
<tr>
<td>106</td>
<td>HbA1c above 15.0%</td>
</tr>
<tr>
<td>202</td>
<td>Excess sample on the sampling device exterior</td>
</tr>
</tbody>
</table>
| 204  | - Hemolyzed or coagulated sample  
    | - Analyzer failure            |

Afinion™ HbA1c Test Cartridge

Sampling device
Barcode
Capillary
ID area
2 PREPARE FOR TESTING

- Switch the Analyzer on.
- Allow 15 minutes for the Test Cartridge to reach operating temperature (64-86°F) before use.
- Open the pouch just before use. Hold the Test Cartridge by the handle.
- Label the Test Cartridge with sample ID. Use the ID area.
- Analyze Afinion™ HbA1c Control before analyzing patient samples.

3 PROCEDURE FOR COLLECTING THE SAMPLE

Sampling from a control vial
Follow the procedure described below.
See page 4 for control testing recommendations.

Sampling from finger
- Always use gloves.
- Cleanse the finger using alcohol. Allow the area to air dry.
- Use a lancet and firmly prick the finger (a). Properly dispose the lancet.
- Allow a good drop of blood to form before sampling (b).
- Apply direct pressure to the wound site with a clean gauze pad.

Specimen collection using the Afinion™ HbA1c Test Cartridge

1. Pull up the sampling device.
2. Touch the surface of the blood drop (a), or control (b).
3. Fill the capillary to the end. It is not possible to overfill.
4. Avoid air bubbles and incomplete filling (a). Avoid sample on the outside of the capillary (b). Do not wipe off.
5. Insert the sampling device immediately.
6. Within 1 minute place the Test Cartridge in the Analyzer.
4 RUNNING SAMPLES ON THE ANALYZER

1. **Patient sample:**
   Touch ( ) for patient samples.

2. **Control:**
   Touch ( ) for controls.

3. The lid opens automatically.
   Insert the Test Cartridge.
   The barcode should face left.

4. **Patient sample:**
   Touch ( ) for patient samples.

5. **Control:**
   Touch ( ) to accept.

6. The lid opens automatically.
   Remove and discard the cartridge.

Close the lid manually.

Information codes
Important information codes are listed on page 1. Consult the Analyzer User Manual for information codes not listed on page 1. Follow the actions listed in the User Manual to correct the error.

Verification of test results
Consult the HbA1c Package Insert. See section “Test result reporting”.

Verification of Control results
Compare the results with the values listed on the front of the Afinion™ HbA1c Control Package Insert.

Technical Support?
Call 1-877-4-Afinion or 1-877-423-4646. This is a toll free number. Available for use only in the United States of America. US Technical Support can also be reached by E-mail. Send your request to: techsupport@us.axis-shield.com
CONTROL TESTING
Read the entire Afinion™ HbA1c Control Package Insert before use.

How often do I have to run controls?
In CLIA waived labs, it is recommended analyzing controls:
- With each new shipment of HbA1c kits.
- With each new lot of HbA1c kits.
- At least every 30 days.
- When training new users.
- Anytime an unexpected test result is obtained.

How should I use the Afinion™ HbA1c controls?
- Allow the control to reach room temperature before use. This takes about 30 minutes.
- Mix the control well by thoroughly shaking the vial for 30 seconds.
- Inspect the vial to ensure that the control solution is homogeneous.
- Analyze the control using the procedures described on page 2 (Specimen collection) and page 3 (Running samples on the Analyzer).
- Compare the test results with the values listed on the front page of the Afinion™ HbA1c Control Package Insert.

What do I do if Afinion™ HbA1c Control results are not within the acceptable range?
- Do not analyze any patient samples.
- Check the control vial label to make sure it is not expired.
- Ensure that the control has not been used for more than 60 days.
- Verify that the controls and test cartridges have been stored correctly.
- Verify that there is no visual sign of bacterial or fungal growth in the control vial.

Correct any procedural error. Re-test the control.

If the control values are still not within acceptable range, repeat the test using a new vial of control. If the control results are still not acceptable, call Afinion™ Technical Support.

Technical Support?
Call 1-877-4-Afinion or 1-877-423-4646. This is a toll free number. Available for use only in the United States of America.
US Technical Support can also be reached by E-mail. Send your request to: techsupport@us.axis-shield.com
## Body Mass Index Table

<table>
<thead>
<tr>
<th>Height (inches)</th>
<th>Normal</th>
<th>Overweight</th>
<th>Obese</th>
<th>Extreme Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>91</td>
<td>96</td>
<td>105</td>
<td>110</td>
</tr>
<tr>
<td>59</td>
<td>94</td>
<td>99</td>
<td>104</td>
<td>109</td>
</tr>
<tr>
<td>60</td>
<td>97</td>
<td>102</td>
<td>107</td>
<td>112</td>
</tr>
<tr>
<td>61</td>
<td>100</td>
<td>106</td>
<td>111</td>
<td>116</td>
</tr>
<tr>
<td>62</td>
<td>104</td>
<td>109</td>
<td>115</td>
<td>120</td>
</tr>
<tr>
<td>63</td>
<td>107</td>
<td>113</td>
<td>118</td>
<td>124</td>
</tr>
<tr>
<td>64</td>
<td>110</td>
<td>116</td>
<td>122</td>
<td>128</td>
</tr>
<tr>
<td>65</td>
<td>114</td>
<td>120</td>
<td>126</td>
<td>132</td>
</tr>
<tr>
<td>66</td>
<td>118</td>
<td>124</td>
<td>130</td>
<td>136</td>
</tr>
<tr>
<td>67</td>
<td>121</td>
<td>127</td>
<td>134</td>
<td>140</td>
</tr>
<tr>
<td>68</td>
<td>125</td>
<td>131</td>
<td>138</td>
<td>144</td>
</tr>
<tr>
<td>69</td>
<td>128</td>
<td>135</td>
<td>142</td>
<td>149</td>
</tr>
<tr>
<td>70</td>
<td>132</td>
<td>139</td>
<td>146</td>
<td>153</td>
</tr>
<tr>
<td>71</td>
<td>136</td>
<td>143</td>
<td>150</td>
<td>157</td>
</tr>
<tr>
<td>72</td>
<td>140</td>
<td>147</td>
<td>154</td>
<td>162</td>
</tr>
<tr>
<td>73</td>
<td>144</td>
<td>151</td>
<td>159</td>
<td>166</td>
</tr>
<tr>
<td>74</td>
<td>148</td>
<td>155</td>
<td>163</td>
<td>171</td>
</tr>
<tr>
<td>75</td>
<td>152</td>
<td>160</td>
<td>168</td>
<td>176</td>
</tr>
<tr>
<td>76</td>
<td>156</td>
<td>164</td>
<td>172</td>
<td>180</td>
</tr>
</tbody>
</table>

Appendix E: IPHARM Patient Brochure: Understanding Your Blood Sugars

Prevention and Treatment

- Good news! Lifestyle changes are very effective at reversing prediabetes and preventing its progression to diabetes.
  - Reduce weight by 5-10%.
  - Exercise 30-60 minutes per day at least 5 days per week.
  - Eat a healthy diet (See list on last page).
  - Stop smoking and avoid excess alcohol.

- Control blood pressure and cholesterol levels. The American Diabetes Association recommends the same guidelines for prediabetes that apply to diabetes.
  - Blood Pressure: A goal of less than 140/90 is recommended by the American Diabetes Association. Some health care providers may advise a lower goal for certain individuals.
  - Cholesterol: Check fasting cholesterol levels at least once a year.

- If lifestyle changes alone are unsuccessful, patients can talk to their provider about medications that can help control prediabetes.

What if I have prediabetes?

- Several tests should be performed at least once per year:
  - Fasting glucose should be checked with the FPG or OGTT test.
  - Hemoglobin A1c (HbA1c) test (measure of blood glucose control over 2-3 months).
  - Cholesterol levels.
  - Urinalysis to test for presence of protein in urine.

- Blood pressure should be monitored regularly.

How to choose fruit...

One serving of fruit should contain 15 grams of carbohydrates.

The following fruit servings contain about 15 grams of carbohydrates:

- 1 medium banana
- 1 small apple
- 1 1/2 cup cubed watermelon
- 1 1/2 cup whole strawberries
- 1 small orange
- 1/2 large grapefruit

What are carbohydrates?

- Carbohydrates are a source of energy for your body.
- Foods with carbohydrates raise your blood sugar (glucose).
- Keeping track of carbohydrates can help keep your blood sugar in range.
- The three main types of carbohydrates include the following:
  - Starches - e.g., oats, rice, peas, and potatoes.
  - Sugars - naturally occurring (e.g., milk and fruit) and added sugar (e.g., soda).
  - Fiber - the indigestible parts of plants, including fruits, vegetables, whole grains, nuts, and legumes.

- All carbohydrates have a glycemic index (GI), which is a number that helps classify carbohydrates based on how quickly and how high they boost blood sugar compared to pure glucose (sugar).

- In general, you want to choose foods with a low GI (scores <55).
- Also, the more a food is processed the higher its GI.
- Foods with a low GI are foods such as whole grains, beans, fruits, and vegetables.

Diabetes Super Foods!

These foods have a low GI and provide important nutrients.

<table>
<thead>
<tr>
<th>Food</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans</td>
<td>Kidney, pinto, navy or black beans</td>
</tr>
<tr>
<td>Dark green leafy vegetables</td>
<td>Spinach, kale, collard</td>
</tr>
<tr>
<td>Citrus fruit</td>
<td>Oranges, grapefruits</td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>Full of fiber</td>
</tr>
<tr>
<td>Berries</td>
<td>Strawberries, blueberries, raspberries</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>Untreated and full of fiber, vitamin A and C</td>
</tr>
<tr>
<td>Fish high in omega-3 fatty acids</td>
<td>Salmon</td>
</tr>
<tr>
<td>Whole grains</td>
<td>Puffed barley, oatmeal</td>
</tr>
<tr>
<td>Nuts</td>
<td>Almonds, walnuts, flax seeds</td>
</tr>
<tr>
<td>Dairy</td>
<td>Fat-free milk and yogurt</td>
</tr>
</tbody>
</table>
APPENDIX F: Post-test: Screening for Diabetes in Older Adults

Record responses on examination form.

1. All of the following conditions are types of microvascular complications that can result from diabetes EXCEPT:
   a. Nephropathy
   b. Myocardial infarction (heart attack)
   c. Retinopathy
   d. Erectile dysfunction

2. Which of the following diseases is the leading cause of death among patients with diabetes?
   a. Kidney failure
   b. Cancer
   c. Heart disease
   d. Pneumonia

3. Native Americans are how many times more likely to be diagnosed with diabetes compared to Caucasians of similar age?
   a. Similar diagnosis rate to Caucasians
   b. Over twice as likely
   c. Three times as likely
   d. Four times as likely

4. Diabetes is associated with chronic kidney disease in what percentage of patients?
   a. 35%
   b. 40%
   c. 45%
   d. 50%

5. Which of the following characteristics is NOT commonly associated with type 2 diabetes?
   a. Obesity
   b. Insulin resistance
   c. Onset before age 40
   d. Varying degrees of endogenous insulin production

6. The American Diabetes Association recommends daily low dose aspirin therapy to prevent thrombosis in which subset of patients:
   a. Men and women over age 50 with diabetes plus one additional risk factor.
   b. All adults over 30 years of age with type 2 diabetes.
   c. ONLY adults with type 2 diabetes who have already had a heart attack or stroke
   d. ONLY adults with type 2 diabetes who have an allergy to clopidogrel.
7. Which of the following statements is TRUE regarding screening recommendations for diabetes in the general population?
   a. All adults should be tested annually after the age of 35.
   b. All adults who are overweight (BMI >25 kg/m2 or ≥ 23 kg/m2 if Asian American) and have one or more risk factors.
   c. All adults should be screened annually starting at age 45.
   d. All children who are overweight and have a sedentary lifestyle should be screened annually.

8. Patients with glucose values higher than normal but less than the diagnostic cut-off for diabetes are said to have:
   a. Gestational diabetes
   b. Prediabetes
   c. Adult onset diabetes
   d. Insulin resistance

9. Which of the following interventions is the most cost-effective at preventing onset of Type 2 diabetes in those with high risk of developing diabetes?
   a. Acarbose
   b. Metformin
   c. Pioglitazone
   d. Life-style modifications (weight loss and exercise)

10. The HbA1c test for screening for diabetes may be preferred over other tests because:
    a. It has good reliability when National Glycohemoglobin Standardization Program (NGSP)-certified methods are used.
    b. It is available as a point-of-care test.
    c. It does not require participants to be in a fasting state.
    d. All of the above statements are true.

11. According to 2013 medical expenditures, diabetes is:
    a. the most costly disease in the United States.
    b. the 2nd most costly disease in the United States.
    c. the 3rd most costly disease in the United States.
    d. the 5th most costly disease in the United States.

12. Which of the following geriatric conditions would NOT be exacerbated by diabetes?
    a. Depression
    b. Cancer
    c. Persistent pain
    d. Polypharmacy
13. Which of the following statements is TRUE regarding diabetic retinopathy?
   a. Diabetes is the second leading cause of blindness among American adults.
   b. Diabetic retinopathy is broken down into dominant and non-dominant forms of the disease.
   c. The majority of people with diabetic retinopathy are diagnosed early so that therapy is effective.
   d. All type 2 diabetic patients should receive an ophthalmologic dilated eye examination at the time of diagnosis.

14. Which of the following neuropathies would NOT be considered to be autonomic in origin?
   e. Neurogenic bladder
   f. Erectile dysfunction
   g. Inability to detect cold or heat
   h. Gastroparesis

15. Diabetes is the leading cause of non-traumatic lower-limb amputations in the United States. Which of the following risk factors would NOT increase the likelihood of incurring an amputation?
   e. Peripheral neuropathy
   f. Peripheral vascular disease
   g. Severe nail deformity
   h. Well controlled blood sugars

16. A 67 year old female, American Indian patient who is obese and taking antihypertensive medications is being screened for diabetes using the Afinion™ HbA1c test. Her HbA1c result is 5.7%. What action would you recommend?
   e. This patient clearly has diabetes and should be referred for follow-up care.
   f. This patient has a normal HbA1c and doesn’t require referral for follow-up care.
   g. This patient has multiple risk factors for diabetes, and given the A1c result, should be referred to her primary care provider at the patient’s earliest convenience to discuss the results.
   h. Counsel the patient to watch how much sugar she is eating.

17. A 72 year old male patient, who appears to be in good health, is screened for diabetes using the Afinion™ test. His HbA1c result is 7.5%. What action would you recommend?
   e. This patient has very few risk factors and should not be referred for follow-up care.
   f. This patient should be referred to his primary care provider for follow-up care, as the HbA1c result suggests chronic hyperglycemia.
   g. Counsel this patient on the importance of risk factor reduction.
   h. Both b & c
18. Which of the following non-pharmacologic therapies is NOT recommended by the American Diabetes Association?
   e. Weight loss if indicated
   f. Sucrose (e.g. table sugar) should be removed from the diet
   g. Moderate exercise for 30 minutes for 5 days per week
   h. Stop smoking

19. The American Diabetes Association recommends strongly that adults over age 65 with diabetes should receive all of the following vaccinations EXCEPT:
   e. Annual influenza vaccine
   f. Hepatitis B vaccine
   g. Pneumococcal polysaccharide vaccine 23 (PPSV23)
   h. Pneumococcal conjugate vaccine 13 (PCV13)

20. Which of the following is NOT considered to be a risk factor for developing type 2 diabetes?
   e. Body mass index ≥ 25 kg/m2
   f. Chronic physical inactivity
   g. Female sex
   h. Hypertension (≥140/90 mmHg)
## POST-TEST: Examination Form

*Screening for Diabetes in Older Adults*

### Participant Information

1. Name: ______________________________
2. Mailing address: ____________________
   ____________________________________
   ____________________________________
   ____________________________________
3. Date exam completed __________________

### Questions: (Please circle one response per question)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For credit, please return this completed page to:

MTGEC/IPHARM
Skaggs Building Room 318
University of Montana
32 Campus Drive
Missoula MT, 59812-1522
Phone# (406) 243-2339 & Fax# (406) 243-4353
### APPENDIX G: Evaluation: Screening for Diabetes in Older Adults

**Please indicate your major**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

1. Based on the module description and stated objectives, this module met my expectations of the content it would deliver.

2. How effective were the following in helping you understand the material?

   - **Very Effective**
   - **Effective**
   - **Neutral**
   - **Somewhat Effective**
   - **Not Effective**
   - **Not Applicable**

   **Pre-test**

   **Written Text**

   **Videos/Photos**

   **Websites/Web Links**

   **References**

   **Case Studies**

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Don't Know</th>
</tr>
</thead>
</table>

3. I learned something I can use in my practice/employment or personal setting.

   - **Provide new information to patients/clients**
   - **Adjust practices with geriatric patients/clients**
   - **New program development or program enhancement**
   - **Provide new information to family/friends/co-workers**
   - **Train staff or provider**
   - **Other implementation**

---

MTGEC Screening for Diabetes in Older Adults
Page 73 of 74
MNA CE expiration Date: November 10, 2019
4. How do you plan to implement the information from this module to strengthen your practice, employment or personal goals? (check any that apply)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

* Describe 'other' implementation plan here:

5. How long did it take you to complete the module? (including pre-test, module review, post-test and evaluation)

<table>
<thead>
<tr>
<th></th>
<th>&lt;1 hour</th>
<th>1-2 hours</th>
<th>2-3 hours</th>
<th>3-4 hours</th>
<th>4-5 hours</th>
<th>&gt;5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

6. The test questions were relevant to the module content.

7. Please provide suggestions to improve the online learning experience to meet your needs.

8. Please offer ideas or suggestions for new modules.

For credit, please return this completed page to:

MTGEC/IPHARM
Skaggs Building Room 318
University of Montana
32 Campus Drive
Missoula MT, 59812-1522
Phone# (406) 243-2339 & Fax# (406) 243-4353