Diabetes Mellitus

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Statewide Nursing Coordinator
Course Objectives

• Define/Characterize Diabetes Mellitus (DM)
• Review the incidence of DM
• Examine carbohydrate/glucose digestion, absorption & metabolism
• Analyze the hormones/chemicals involved in glucose digestion, absorption & metabolism
• Examine insulin functions in detail
Course Objectives

• Review DM risk factors
• Consider possible causes of DM
• Examine DM pathology by DM type
• List and study Sx of DM & Tx complications
• Examine DM complications
• Review DM Tx Modalities
Definition

• A complex group of metabolic diseases in which a person has elevated blood sugar concentration (hyperglycemia of ≥ 126 mg/dl or HbA$_{1c}$ ≥ 6.5)
Who, When, What
Prevalence of Diabetes by Country

- Iceland: 1.6%
- Norway: 3.6%
- United Kingdom: 4.2%
- South Africa: 4.5%
- Indonesia: 4.8%
- Japan: 5.0%
- Ireland: 5.2%
- New Zealand: 5.2%
- Netherlands: 5.3%
- Denmark: 5.6%
- Chile: 5.7%
- Australia: 5.7%
- Finland: 5.9%
- Italy: 6.0%
- Greece: 6.4%
- Slovak Republic: 6.4%
- Brazil: 6.5%
- Israel: 6.5%
- OECD: 6.6%
- Spain: 6.7%
- France: 7.7%
- Poland: 7.8%
- Slovenia: 7.9%
- India: 8.0%
- Korea: 8.9%
- Germany: 9.2%
- Canada: 9.7%
- Portugal: 10.3%
- United States: 10.8%
- Mexico: 10.8%
Epidemiology - World

- In 2011, 366 million had DM. Estimated that ½ (183 million) are undiagnosed
- DM caused 4.6 million deaths in 2011
- Prediction: by 2030, 552 million will have DM.
Epidemiology – U.S.  

- 25.8 million = 8.3% of population (2011)
- 18.8 million diagnosed; 7.0 million undiagnosed (2011)
- Prediabetes affects 35% of adults 20+
Epidemiology – U.S.  (2)

- Age (2011)
  - 215,000 < 20 years (2.6%) (about 1 in 400)
  - 10.9 million > 65 (26.9%) (Types 1 & 2)

- Gender
  - Males: 13.0 million or 11.8% of pop. age 20 or older
  - Females: 12.6 million or 10.8% of pop. age 20 or older
Epidemiology – U.S. (4)

- Morbidity/Mortality – 2007
  - 71,382 deaths (6th leading cause of death)
  - Contributed to 160,022 deaths

- Overall death risk ≈ 2x of those without DM

- Life expectancy shorted by 5 - 10 years

- Cost (2007): Total - $174 billion [$116 billion medical direct; $58 billion indirect (disability, work loss, premature mortality)]
Epidemiology – U.S. (5)

  - new blindness 4.2 million (28.5%) with DM 39+ had diabetic retinopathy
  - nontraumatic lower-limb amputation (> 60%)
  - kidney failure (44% of new cases in 2008 & any given year > 50,000 DM on dialysis or transplant)
  - 2 – 12X the risk for heart disease
  - 2 – 4X the risk for stroke
Epidemiology – U.S. (6)

- Developmental Disabilities & DM: No statistics were found but source after source state that the chance of diabetes prevalence, causative conditions, complications and Tx difficulty is higher in those with DD.
BLOOD SUGAR
ANATOMY & PHYSIOLOGY
Balancing [Blood Sugar]
Table 1: Digestive Chemicals & Sources

<table>
<thead>
<tr>
<th>Cell/Hormone</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>α: Glucagon</td>
<td>↑ [blood glucose]</td>
</tr>
<tr>
<td>β: Insulin &amp; Amylin</td>
<td>↓ [blood glucose]</td>
</tr>
<tr>
<td>PP: Pancreatic Polypeptide</td>
<td>↓ [blood glucose]</td>
</tr>
<tr>
<td>ε: Ghrelin</td>
<td>↑ [blood glucose]</td>
</tr>
<tr>
<td>Δ: Somatostatin</td>
<td>↓ [blood glucose]</td>
</tr>
<tr>
<td>Mucosa L cells: GLP-1</td>
<td>↓ [blood glucose]</td>
</tr>
<tr>
<td>Mucosa K cells: GIP</td>
<td>↓ [blood glucose]</td>
</tr>
<tr>
<td>Brush border: α glucosidases</td>
<td>↑ [blood glucose]</td>
</tr>
</tbody>
</table>
Kreb’s/Gluconeogenesis
Facilitated Diffusion
Table 2 - Insulin Functions

- **↓ [blood glucose]**
  - Facilitated diffusion
  - ↑ glucogen synthesis
  - ↑ esterification fatty acids
  - ↓ lipolysis
  - ↓ proteolysis*
  - ↑ amino acid uptake
  - ↓ (inhibits) glucagon release

- **Not [blood glucose] related**
  - ↓ autophagy
  - ↑ K⁺ uptake
  - ↓ in arterial muscle tone
  - ↑ secretion of gastric HCl
  - ↓ blood pressure
  - ↓ renal Na⁺ excretion
  - ↑ K⁺ excretion/↓ blood [K⁺]
RISK FACTORS

**Type 1**
- Family History
- Possible genetic precursors

**Type 2**
- Obesity*
- Adipose tissue distribution
- Inactivity
- Family history of Type 2 DM
- Ethnicity
- Age
- Prediabetes
- Gestational diabetes
- Large baby (> 9 lbs)
ETIOLOGY/CONDITIONS
Etiology/Conditions ➔ DM (1)

• Genetic defects in β cell function
• Exocrine Pancreatic Defects
  – Chronic pancreatitis
  – Pancreatectomy
  – Pancreatic neoplasm
  – Cystic Fibrosis
  – Hemochromatosis
  – Fibrocalculous pancreatopathy
Etiology/Conditions ➔ DM (2)

• Endocrinopathies
  – Cushing Syndrome
  – Hyperthyroidism
  – Growth Hormone excess (acromegaly)
  – Pheochromocytoma
Etiology/Conditions ➔ DM (5)

• Drugs
  – Atypical antipsychotics
  – β-adrenergic agonists
  – Calcium Channel blockers
  – Corticosteroids
  – Niacin
  – Phenothiazines
  – Thiazide diuretics
  – Thyroid hormone
  – Phenytoin
  – Statins
  – Estrogen
TYPE 1 – Insufficient Insulin

• β cells destroyed in antigen-antibody reaction
• DM occurs when 80 – 90% β cells destroyed
TYPE 2 – Resistance/Reduction

(1)

- Insulin resistance
- Contributing Factors:
  - Defective insulin or receptor & post-receptor defects → inability to initiate facilitated diffusion.
  - ↓ intracellular fat & muscle glucose from insulin lack/resistance. Initiates ↑ liver glycogenolysis to ↑ [blood glucose]
  - Insulin resistance → ↑ lipolysis
Types 1 & 2

DM SYMPTOMS
Osmotic Pressure & DM

Fig. 1
Osmotic Pressure

Membrane permeable to water
but not to sugar

Flow of water through
membrane into sugar
solution via osmotic pressure

Sugar Solution

Plain Water
Kidney Nephron

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.
# DM Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Type</th>
<th>Symptom</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>✔</td>
<td>Weight loss</td>
<td>✔</td>
</tr>
<tr>
<td>Glycosuria</td>
<td>✔</td>
<td>Fatigue</td>
<td>✔</td>
</tr>
<tr>
<td>Polydipsia (thirst)</td>
<td>✔</td>
<td>Blurred vision</td>
<td>✔</td>
</tr>
<tr>
<td>Polyuria (frequent urination)</td>
<td>✔</td>
<td>Slow healing/freq infections</td>
<td>✔</td>
</tr>
<tr>
<td>Polyphagia (hunger)</td>
<td>✔</td>
<td>Acanthosis nigricans</td>
<td>✔</td>
</tr>
</tbody>
</table>
## DM Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lethargy</td>
<td>✓</td>
</tr>
<tr>
<td>Stupor</td>
<td>✓</td>
</tr>
<tr>
<td>Ketoacidosis (DKA)</td>
<td>✓, unusual</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>✓</td>
</tr>
<tr>
<td>Nausea/Vomiting</td>
<td>✓</td>
</tr>
<tr>
<td>Hyperosmolar Hyperglycemic Nonketotic State (HHNK)</td>
<td>rare</td>
</tr>
</tbody>
</table>
Diabetic Ketoacidosis Sx

- Kussmaul breathing
  \[ \text{H}_2\text{O} + \text{CO}_2 \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^- \]
- Fruity (alcohol) smelling breath
- Dry skin & mouth
-Flushed face
- Nausea & vomiting
- Stomach pain
HHNK Sx

- Severe hyperglycemia
- Extreme dehydration
- Hyperosmolar plasma
- Altered consciousness, confusion or disorientation to coma without significant ketosis (seizures & death)
Hypoglycemic Symptoms

(1)

- Sweating
- Hunger
- Weakness
- Anxiety
- Dizziness/lightheaded
- Pale skin
- Shakiness
- Rapid or irregular HR
- Fatigue
- Headache
- Blurred vision
- Irritability
Hypoglycemic Symptoms

Later Symptoms (mistaken for intoxication)

- Lethargy
- Confusion
- Behavior Change
- Poor coordination
- Convulsions
Hyerglycemic Symptoms

- Frequent urination
- Increased thirst
- Blurred vision
- Fatigue
- Nausea
- Irritability
- Hunger
- Difficulty concentrating
COMPLICATIONS
Diabetic Vascular Disease
Macroangiopathy

- Stroke & Cerebrovascular Disease
- Coronary artery Disease

(These are large vessel diseases → decreased blood supply (ischemia) from atherosclerosis secondary to vessel endothelial dysfunction plus: procoagulant state and antifibrinolytic state)
Microangiopathy

• Retinopathy

• Nephropathy
Retinopathy

Non-proliferative diabetic retinopathy
- Aneurysm
- Hemorrhage
- Hard exudate

Proliferative diabetic retinopathy
- Growth of abnormal blood vessels
DM Nephropathy
Autonomic Neuropathy

- Gastroparesis
- Diarrhea
- Impotence/Sexual dysfunction
- Orthostatic Hypotension
Peripheral Neuropathy & Microangiopathy

- Light touch, vibratory & temp sensation
- Lost foot proprioception & possible eventual ataxia, gait problems
- Ulceration
- Necrosis
<table>
<thead>
<tr>
<th>Circulatory System (CS)</th>
<th>Change</th>
<th>B/P change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart stroke volume</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Artery volume</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td></td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Blood Volume:</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td></td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>
TREATMENT
DM Diagnosis

• History & Physical

• Diagnostic Tests – [blood sugar]
  – Random blood sugars
  – Fasting blood sugar
  – Glycohemoglobin (HbA$_{1C}$)
  – Fructosamine Assay
  – C-Peptide Assay (Connecting Peptide Assay)
**Education**
All people with diabetes need to learn about their condition in order to make healthy lifestyle choices and manage their diabetes.

**Exercise**
Regular exercise helps your body lower blood sugars, promote weight loss, reduce stress and enhance overall fitness.

**Healthy Weight**
Maintaining a healthy weight is especially important in the control of Type 2 Diabetes.

**Eat a Healthy diet**
What, when and how much you eat plays an important role in regulating how well your body manages blood sugar levels.

**Lifestyle Management**
Learning to reduce stress levels in day-to-day life can help people with diabetes better manage their disease.

**Take Medication if needed**
Type 1 Diabetes always requires daily injections of insulin. Type 2 Diabetes is controlled through exercise and meal planning and may require medications and/or insulin to assist the body in making or using insulin more effectively.
Treatment Approach

• T1DM – Absolute insulin lack
• T2DM – Cellular resistance & relative insulin lack
• Balance insulin production/admin with insulin need
• Treatment modalities:
  – Medications – Insulin and oral antidiabetics (monitored)
  – Diet – monitored & goal directed
  – Exercise – monitored and goal directed
## Insulins - Rapid & Short Acting

<table>
<thead>
<tr>
<th>Name</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid -Acting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humalog/Lispro</td>
<td>15 – 30&quot;</td>
<td>30 – 90&quot;</td>
<td>3 – 5 hours</td>
</tr>
<tr>
<td>Novolog/Aspart</td>
<td>10 – 20&quot;</td>
<td>40 – 50&quot;</td>
<td>3 – 5 hours</td>
</tr>
<tr>
<td>Apidra/Glulisine</td>
<td>20 - 30&quot;</td>
<td>30 – 90&quot;</td>
<td>1 – 1½ hours</td>
</tr>
<tr>
<td><strong>Short -Acting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular/Humulin</td>
<td>30” – 1 hour</td>
<td>2 – 5 hours</td>
<td>5 – 8 hours</td>
</tr>
<tr>
<td>Velsulin (pump)</td>
<td>30” – 1 hour</td>
<td>2 – 3 hours</td>
<td>2 – 3 hours</td>
</tr>
</tbody>
</table>
## Insulins – Intermediate & Long-Acting

<table>
<thead>
<tr>
<th>Name</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intermediate-Acting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPH (N)</td>
<td>1 – 2 hrs</td>
<td>4 – 12 hrs</td>
<td>18 – 24 hrs</td>
</tr>
<tr>
<td>Lente (L)</td>
<td>1 – 2½ hrs</td>
<td>3 – 10 hrs</td>
<td>18 – 24 hrs</td>
</tr>
<tr>
<td><strong>Long-Acting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultralente (U)</td>
<td>30” – 3 hrs</td>
<td>10 – 20 hrs</td>
<td>20 – 36 hrs</td>
</tr>
<tr>
<td>Lantus</td>
<td>1 – 1½ hrs</td>
<td>No peak</td>
<td>20 – 24 hrs</td>
</tr>
<tr>
<td>Levemir/Detemir</td>
<td>1 – 2 hrs</td>
<td>6 – 8 hrs</td>
<td>Up to 24 hrs</td>
</tr>
</tbody>
</table>
# Insulins – Pre-Mixed

<table>
<thead>
<tr>
<th>Name</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humulin 70/30</td>
<td>30&quot;</td>
<td>2 – 4 hrs</td>
<td>14 – 24 hrs</td>
</tr>
<tr>
<td>Novolin 70/30</td>
<td>30&quot;</td>
<td>2 – 12 hrs</td>
<td>Up to 24 hrs</td>
</tr>
<tr>
<td>Novolog 70/30</td>
<td>10 – 20&quot;</td>
<td>1 – 4 hrs</td>
<td>Up to 24 hrs</td>
</tr>
<tr>
<td>Humulin 50/50</td>
<td>30&quot;</td>
<td>2 – 5 hrs</td>
<td>18 – 24 hrs</td>
</tr>
<tr>
<td>Humalog mix 75/25</td>
<td>15&quot;</td>
<td>30” – 2 ½ hrs</td>
<td>16 – 20 hrs</td>
</tr>
</tbody>
</table>
Self Administration

• Injection using 31 gauge, 5/16” long needle @ 90° angle for most; 45° for thin people
• Self injection, rotation of abdomen & thighs
• Tissue damage eventually leads to:
  – Hardened skin with lumps & dimpling
  – Weakened underlying fatty tissue (lipodystrophy)
  – ↓ insulin absorption ➔ difficulty in controlling [blood glucose] levels
Oral Antidiabetic Agents - List

- $\alpha$- glucosidase inhibitors – Acarbose, Miglitol
- Biguanide – Metformin HCl
- Glucagon-Like Peptide (GLP-1) agonists – Exenatide, Liraglutide
- Dipeptidyl peptidase-4 inhibitors - Linagliptin, Sitagliptin, Saxagliptin
- Human Amylin Analogue – Pramlintyde
- Meglitnide/Meglitnide derivative – Repaglinide, Nateglinide
- Sulfonylurea – Glimepiride, Clinizide, Glyburide
Oral Antidiabetic Agents - List

• Combination Medications
  – Metformin HCl & Linagliptin
  – Metformin HCl & Sitagliptin

• Weight Loss Drugs
  – Lorcaserin/Belviq®
  – Phentermine/Topiramate
Diabetes and Obesity

• Does obesity cause DM-Type 2?
• Developed eating habits early in life
• Body Mass Index
• Losing weight is simple, not easy
• Life-style change
Diabetes and Obesity

- **BODY FAT % RANGES FOR MEN**

<table>
<thead>
<tr>
<th>RATING</th>
<th>Age</th>
<th>Age</th>
<th>Age</th>
<th>Age</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20-29</td>
<td>30-39</td>
<td>40-49</td>
<td>50-59</td>
<td>60+</td>
</tr>
<tr>
<td>LOW</td>
<td>&lt;13</td>
<td>&lt;14</td>
<td>&lt;16</td>
<td>&lt;17</td>
<td>&lt;18</td>
</tr>
<tr>
<td>NORMAL</td>
<td>14-20</td>
<td>15-21</td>
<td>17-23</td>
<td>18-24</td>
<td>19-25</td>
</tr>
<tr>
<td>MODERATE</td>
<td>21-23</td>
<td>22-24</td>
<td>24-26</td>
<td>25-27</td>
<td>26-28</td>
</tr>
<tr>
<td>HIGH</td>
<td>&gt;23</td>
<td>&gt;24</td>
<td>&gt;26</td>
<td>&gt;27</td>
<td>&gt;28</td>
</tr>
</tbody>
</table>
# Diabetes and Obesity

## BODY FAT % RANGES FOR WOMEN

<table>
<thead>
<tr>
<th>RATING</th>
<th>AGE 20-29</th>
<th>AGE 30-39</th>
<th>AGE 40-49</th>
<th>AGE 50-59</th>
<th>AGE 60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>&lt;19</td>
<td>&lt;20</td>
<td>&lt;21</td>
<td>&lt;22</td>
<td>&lt;23</td>
</tr>
<tr>
<td>NORMAL</td>
<td>20-28</td>
<td>21-29</td>
<td>22-30</td>
<td>23-31</td>
<td>24-32</td>
</tr>
<tr>
<td>MODERATE</td>
<td>29-31</td>
<td>30-32</td>
<td>31-33</td>
<td>32-33</td>
<td>33-35</td>
</tr>
<tr>
<td>HIGH</td>
<td>&gt;31</td>
<td>&gt;32</td>
<td>&gt;33</td>
<td>&gt;34</td>
<td>&gt;35</td>
</tr>
</tbody>
</table>
“It wasn’t really insulin. You don’t have diabetes yet. It was just a warning shot.”
Diet

DIABETES &
Diet - Sources (1)

• Nutritionist/Dietitian

• Sources:
  – American Diabetics Association: www.diabetics.org
  – Academy of Nutrition and Dietetics (was American Dietetic Association) www.eatright.org
Diet – Intake Amount

• **Recommended caloric intake:**
  - ♂, active ♀ – 15 calories/lb body weight
  - Most ♀, sedentary ♂, & adults ➡️ 55 - 13 cal/lb
  - Sedentary ♀, obese adults – 10 cal/lb
  - Pregnant, lactating ♀ - 15 – 17 cal/lb
  - Example: 200 lb ♂ needs to eat 2000 cal daily to maintain his weight
Diet - Tracking

- Counting calories
- Exchange lists
- Glycemic Index
## Diet – Exchange List

(4)

<table>
<thead>
<tr>
<th>GROUP</th>
<th>CHO</th>
<th>PROTEINS</th>
<th>FAT</th>
<th>CALORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch/Bread</td>
<td>15/0.529</td>
<td>3/0.106</td>
<td>TRACE</td>
<td>80</td>
</tr>
<tr>
<td><strong>Meat</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Lean</td>
<td>7/0.247</td>
<td>0-1/0.035</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Lean</td>
<td>7/0.247</td>
<td>3/0.106</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Med-Fat</td>
<td>7/0.247</td>
<td>5/0.176</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>High-Fat</td>
<td>7/0.247</td>
<td>8/0.282</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
## Diet – Exchange List

(5)

<table>
<thead>
<tr>
<th>GROUP</th>
<th>CHO</th>
<th>PROTEINS</th>
<th>FAT</th>
<th>CALORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable</td>
<td>5/0.176</td>
<td>2</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Fruit</td>
<td>15/0.529</td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Milk</td>
<td>12/0.423</td>
<td>8/0.282</td>
<td>0-3/0.106</td>
<td>90</td>
</tr>
<tr>
<td>Skim</td>
<td>12/0.423</td>
<td>8/0.282</td>
<td>5/0.176</td>
<td>120</td>
</tr>
<tr>
<td>Low-Fat</td>
<td>12/0.423</td>
<td>8/0.282</td>
<td>8/0.282</td>
<td>150</td>
</tr>
<tr>
<td>Whole</td>
<td>12/0.423</td>
<td>8/0.282</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td></td>
<td></td>
<td>5/0.176</td>
<td>45</td>
</tr>
</tbody>
</table>
Diet – Exchange List

- Food exchange lists extensive
- To be determined (dietitian)
  - Caloric intake
  - Amount of CHO, P & F
  - Minimize Na, fats, cholesterol,
  - Appropriate fiber amount
Diet – Glycemic Index

• Glycemic Index – Measure of how quickly blood glucose level rises compared to glucose standard of 100 after eating a particular food. 95 is high GI value; 20 is low
Diet – Glycemic Index (8)

• Index tied to serving size in grams

• GI charts list foods much like exchange lists

• Problems: amt CHO actually consumed; insulin production; variability of foods; person response; impact speed/persistance
Diet - Timing

• Meal timing
  – For diabetics – important
  – Especially important for those using long acting insulin
  – Intensive insulin therapy more flexible
Exercise

DIABETES &
“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”


EXERCISE AND RISK OF DIABETES

Decrease risk of developing diabetes by 50% in those with high risk defined by:

- High blood pressure
- Family history
- Obesity

Relative risk of developing diabetes

<table>
<thead>
<tr>
<th>Kcal of Exercise per week</th>
<th>Relative Risk of Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1.00</td>
</tr>
<tr>
<td>3500</td>
<td>0.52</td>
</tr>
</tbody>
</table>
Exercise & Type 2 Diabetes

Source: Knowler et al., 2002. Randomized clinical trial with average 2.8-year follow-up period.
Exercise Benefits (1)

- Improves body insulin use
- Aerobic exercise can ↓ risk of T2DM
- Aerobic exercise can ↓ complication risk
- May delay/prevent T2DM
- Empties liver glycogen reserves
- ↓ [blood sugar] & fatty acid levels
- ↓ β cell workload/excessive production
Exercise Benefits (2)

• Weight loss and control
• Combats health conditions & diseases
• ↑ energy, muscle strength, endurance partly do to ↑ body efficiency
• Improves mood
• Promotes better sleep
Exercise elements

- **Mode**: walking, swimming, jogging, etc
- **Frequency**: How often exercise occurs
- **Duration**: How long exercise lasts
- **Intensity**: How “hard” exercise is

Intensity can replace duration somewhat but be careful
Easy Exercise

• Walk while talking on phone
• Don’t use TV remote
• Wash car
• Park car at far end of shopping center lot
• Yard work
• Use stairs
Exercise Planning (1)

- SEE PHYSICIAN FIRST!
- Determine best exercise mode
- Schedule food intake, exercise & medication
- Be care of intense exercise
- With regular exercise, medications may have to be reduced. Check with physician
- Learn what exercise does to [blood sugar]
Exercise Planning

• Have CHO-based food available after exercise
• May need to add CHO to meals
• With MD, adjust insulin as necessary
• Track exercise (intensity, duration, frequency)
Exercise Cautions

- Wear medical alert ID (RoadID.com)
- Exercising when medication is @ peak effect
- Exercising when [blood glucose] is very high
- Watch for Symptoms of hypoglycemia (restoring of body balance can take 24 hours)
- Check [blood sugar] before, during, & after (learn how exercise effects body)
Exercise Cautions \(^{(2)}\)

- Carry small CHO snack such as fruit or fruit drink for possible hypoglycemia during exercise
- Too much exercise (intensity/duration) can cause catecholamine production to ↑ [blood glucose]
Exercise Cautions (3)

• Don’t exercise with DM-T1 & positive ketone test & [blood glucose] > 250 mg/dl

• If insulin injection necessary, use abdomen rather than arm or leg to absorb insulin more evenly

• Start hydrated and stay hydrated
## Exercise Measures

### Determining Target Range

<table>
<thead>
<tr>
<th>INTENSITY</th>
<th>% MAX HEART RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very light</td>
<td>&lt; 35</td>
</tr>
<tr>
<td>Light</td>
<td>35 – 54</td>
</tr>
<tr>
<td>Moderate</td>
<td>55 – 70</td>
</tr>
<tr>
<td>Hard</td>
<td>71 – 90</td>
</tr>
<tr>
<td>Very Hard</td>
<td>➢ 90</td>
</tr>
<tr>
<td>Maximal</td>
<td>100</td>
</tr>
</tbody>
</table>

220 – age. Ex: moderate \([220 – age]\) X 0.55 to \([220 – age]\) X 0.70
Bariatric Surgery (1)

- Considered appropriate when BMI is:
  - 30 – 35 with significant comorbidities
  - 35 & up with serious coexisting medical conditions such as diabetes
  - 35 – 40 when no comorbidities are present
Bariatric Surgery (2)

- Bariatric Surgery not 1 specific procedure
  - Gastric band (implanted)
  - Partial gastrectomy (“sleeve” gastrectomy or biliopancreatic diversion with duodenal switch)
  - Resection & re-routing of small intestine to small stomach pouch (gastric bypass)
  - Can ➔ long term significant weight loss
Bariatric Surgery

• Bariatric Surgery can result in:
  – Significant long-term weight loss
  – Diabetic resolution/cure
  – Improved cardiovascular risk
  – Reduction of mortality rates from 23 to 40%

• Study showed no survival benefit among older, severely obese people
DM & Developmental Disabilities (1)

• Incidence of obesity in DD individuals 4x more common than general population

• Problems:
  – Access to healthcare for screening & treatment
  – Inability of those with DD to self manage
  – Inability to understand
  – Flawed view of disease
DM & Developmental Disabilities (2)

- To request copy call (732) 246-2525, ext. 35 or email info@arcnj.org
- February 2012 document
DM & Developmental Disabilities (3)

- This guide is for the individual with DM.
- It used relatively simple language and pictures.
- It talks about DM prevention, warning signs, blood sugar testing, and living with diabetes.
- It is also available in Spanish.