OBJECTIVES

• REVIEW DIABETES DIAGNOSTIC CRITERIA
• REVIEW GOALS FOR GLUCOSE CONTROL
• HIGHLIGHT WHEN NEW DIABETES MEDS ARE APPROPRIATE AND WHEN OLDER ONES MAY BE NEEDED
• REVIEW DIABETES TECHNOLOGIES INCLUDING INSULIN PUMPS AND CONTINUOUS GLUCOSE MONITORS-WHO IS A CANDIDATE
Diabetes Numbers

- **Prevalence:** In 2015, 30.3 million Americans, or 9.4% of the population, had diabetes.
  - Approximately 1.25 million American children and adults have type 1 diabetes.
- **Undiagnosed:** Of the 30.3 million adults with diabetes, 23.1 million were diagnosed, and 7.2 million were undiagnosed.
- **Prevalence in Seniors:** The percentage of Americans age 65 and older remains high, at 25.2%, or 12.0 million seniors (diagnosed and undiagnosed).
- **New Cases:** 1.5 million Americans are diagnosed with diabetes every year.
- **Deaths:** Diabetes remains the 7th leading cause of death in the United States in 2015, with 79,535 death certificates listing it as the underlying cause of death, and a total of 252,806 death certificates listing diabetes as an underlying or contributing cause of death.

Prediabetes Numbers

- Eighty-six million people aged 20 years and older
- 1 in 3 American adults
- The percentage of U.S. adults with prediabetes is similar for non-Hispanic whites (35%), non-Hispanic blacks (39%), and Hispanics (38%)
- Without weight loss and moderate physical activity, 15-30% of people with prediabetes will develop type 2 diabetes within 5 years
COST OF DIABETES

- Updated March 22, 2018
- $327 billion: Total costs of diagnosed diabetes in the United States in 2017
- $237 billion for direct medical costs
- $90 billion in reduced productivity
- After adjusting for population age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes.
- Difficult to measure cost in relation to quality of life

DIAGNOSTIC CRITERIA FOR DM AND PREDIABETES

<table>
<thead>
<tr>
<th></th>
<th>Fasting Glucose</th>
<th>Random BG</th>
<th>A1c</th>
<th>GTT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 99 mg/dl</td>
<td>3.5-5.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prediabetes</td>
<td>100-125 mg/dl</td>
<td>5.7-6.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>&gt; 126 mg/dl</td>
<td>&gt; 200 mg/dl</td>
<td>&gt;6.5%</td>
<td></td>
</tr>
<tr>
<td>Gestational</td>
<td>50 gm non-fasting 1 hour ≥ 140 mg/dl</td>
<td>100 gm OGTT Fastig ≥ 95 mg/dl 1 hr ≥ 180 mg/dl 2 hr ≥ 155 mg/dl 3 hr ≥ 140 mg/dl</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SCREENING RECOMMENDED

- All adults at 45, earlier if
  - BMI ≥ 25
  - First degree relative
  - Physical inactivity
  - High risk race/ethnicity
  - Women delivered > 9# baby or PCOS
  - HDL < 35
  - A1c > 5.7%
  - Hypertension
  - CVD
- Gestational Diabetes
  - Screen for undiagnosed DM at first prenatal visit based on DM risk criteria
  - Screen all women at 24-28 weeks for those not previously known to have diabetes
  - 6 to 12 weeks postpartum, rescreen for diabetes
CHILDREN AT RISK

• Screening to begin age 10 or puberty onset if
  – Weight is >120% ideal body weight
  – Plus any two risk factors
    • Family history of type 2 dm
    • Race/ethnicity (Native American, African American, Latino, Asian American, Pacific Islander
    • Signs of insulin resistance: acanthosis nigricans, hypertension, dyslipidemia, PCOS, small for gestational age
    • Maternal history of DM or GDM during gestation

Staging of Type 1 Diabetes

<table>
<thead>
<tr>
<th>Stage</th>
<th>Type 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Autoimmune</td>
<td>Autoimmune</td>
<td>Non-insulin-dependent</td>
</tr>
<tr>
<td>Stage</td>
<td>Neuropathy</td>
<td>Neuropathy</td>
<td>Neuropathy</td>
</tr>
<tr>
<td>Stage</td>
<td>Fatty liver</td>
<td>Fatty liver</td>
<td>Fatty liver</td>
</tr>
<tr>
<td>Stage</td>
<td>Insulin resistance</td>
<td>Insulin resistance</td>
<td>Insulin resistance</td>
</tr>
</tbody>
</table>

Table 1: Staging of type 1 diabetes (A6)

ADA/AACE GLUCOSE GOALS

<table>
<thead>
<tr>
<th>Glycemic control &amp; A1c Target</th>
<th>ADA</th>
<th>AACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1c (%)</td>
<td>&lt;7</td>
<td>&lt;6.5</td>
</tr>
<tr>
<td>Preprandial (mg/dl)</td>
<td>80-120</td>
<td>&lt;110</td>
</tr>
<tr>
<td>Postprandial (mg/dl)</td>
<td>140-180</td>
<td>&lt;140</td>
</tr>
<tr>
<td>Bedtime (mg/dl)</td>
<td>100-140</td>
<td>100-140</td>
</tr>
</tbody>
</table>

ADA: American Diabetes Association
AACE: American Association of Clinical Endocrinologists
INDIVIDUALIZATION OF GOALS

- More stringent targets if able to achieve without significant hypoglycemia
- Less stringent targets for those with history of severe hypoglycemia, limited life expectancy, advanced micro or macrovascular disease, limited life expectancy
- Standard goal for children -7.5% or less.
WHAT IS HIS A1C GOAL?

a. 8.0%
b. 8.5%
c. 7.5%
d. None of the above
<table>
<thead>
<tr>
<th>Class</th>
<th>Mechanism</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPP-4 inhibitors</td>
<td>Inhibits DPP-4, Promotes GLP-1, GIP</td>
<td>• No hypoglycemia</td>
<td>• Melody &amp; A1c, Prandiasis, Urticaria</td>
<td>High</td>
</tr>
<tr>
<td>Glucagon agonists</td>
<td>Activates GLP-1 R, Insulin, Glucagon, Gastric emptying, Fatality</td>
<td>• Weight loss, No hypoglycemia, Beta cells mass, T2D protection</td>
<td>• GI, Future, Medulla, cv, Hypertable</td>
<td>High</td>
</tr>
<tr>
<td>GLI</td>
<td>Inhibits or gluconidase, Inhibits carbohydrate absorption</td>
<td>• No hypoglycemia, Hypoglycemia, GLP, Propranolol, Glucagon, T3D events</td>
<td>• Gastrinominal, Dosing frequency, Melody &amp; A1c</td>
<td>Medium</td>
</tr>
<tr>
<td>GLIC</td>
<td>Activates aldolase, Mutates glucose production</td>
<td>• No hypoglycemia, Hypoglycemia, Non-prandial glucose, T3D events</td>
<td>• GI, Melody &amp; A1c, Dosing frequency</td>
<td>High</td>
</tr>
<tr>
<td>GLP</td>
<td>Activates Glucagon, Sensitivity, Fatality</td>
<td>• No hypoglycemia, Hypoglycemia, T3D events</td>
<td>• GI, Medulla, cv, Hypertable</td>
<td>High</td>
</tr>
<tr>
<td>Alpha glucosidases</td>
<td>Activates alpha-glucosidase, Enhances glucose transport, Fatality</td>
<td>• No hypoglycemia, Hypoglycemia, Glucagon, T3D events</td>
<td>• GI, Melody &amp; A1c, Dosing frequency</td>
<td>High</td>
</tr>
</tbody>
</table>
| Antihyperglycemic Therapy in T2DM

Table 1. Properties of anti-hyperglycemic agents (adapted)

<table>
<thead>
<tr>
<th>Class</th>
<th>Mechanism</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin</td>
<td>Activates insulin receptor, Enhances peripheral glucose uptake</td>
<td>• Universally effective, Reduced efficiency, OGTT, Metabolic risk</td>
<td>• Hypoglycemia, Weight gain, Hypoglycemia, Insulin, Training requirements, T3D</td>
<td>Variable</td>
</tr>
<tr>
<td>Alpha glucosidases</td>
<td>Activates alpha-glucosidase, Enhances glucose transport, Fatality</td>
<td>• No hypoglycemia, Hypoglycemia, Glucagon, T3D events</td>
<td>• GI, Melody &amp; A1c, Hypertable, Hepatitis, Dosing frequency</td>
<td>High</td>
</tr>
</tbody>
</table>

Table 1. Properties of anti-hyperglycemic agents (adapted)
Combination Injectable Therapy in T2DM

Insulin Therapy in T2DM

- The progressive nature of T2DM should be regularly & objectively explained to T2DM patients.
- Avoid using insulin as a threat, describing it as a failure or punishment.
- Give patients a self-titration algorithm.
MIMICKING NATURE WITH INSULIN THERAPY

BASAL/BOLUS CONCEPT

Physiologic insulin secretion

- Suppresses glucose production between meals and overnight
- Nearly constant levels
- 50% of daily needs

![Graph showing 24-hour profile of basal insulin levels](image)


HELPING PATIENTS UNDERSTAND INSULIN REPLACEMENT

![Graph showing plasma insulin levels](image)

CURRENTLY AVAILABLE SHORT-ACTING PRANDIAL INSULINS

<table>
<thead>
<tr>
<th>Insulin Type</th>
<th>Human, short-acting</th>
<th>Analogue, rapid-acting</th>
<th>Analogue, rapid-acting</th>
<th>Analogue, rapid-acting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset, hr</td>
<td>0.5 - 1</td>
<td>&lt; 0.3 - 0.5</td>
<td>&lt; 0.25</td>
<td>&lt; 0.25</td>
</tr>
<tr>
<td>Peak, hr</td>
<td>2 - 3</td>
<td>0.5 - 2.5</td>
<td>1 - 1.5</td>
<td>1 - 1.5</td>
</tr>
<tr>
<td>Effective duration, hr</td>
<td>3 - 6</td>
<td>3 - 6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Injection, meal timing, min</td>
<td>-30 to -45</td>
<td>-15 to immediately after</td>
<td>0 to -10</td>
<td>-15 to -20</td>
</tr>
</tbody>
</table>

SA word doc: I know this is the conventional slide but neither detemir nor U100 Lantus last 24 hours in most people – the Lantus people now admit this as they market U300 and we add a point below

Julia Sawyers, 6/6/2018
**CURRENTLY AVAILABLE BASAL INSULINS**

<table>
<thead>
<tr>
<th>Insulin Type</th>
<th>NPH Insulin</th>
<th>Insulin Glargine U-100 &amp; U-300</th>
<th>Insulin Detemir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>4-10 hours</td>
<td>No pronounced peak</td>
<td>Relatively flat</td>
</tr>
<tr>
<td>Onset</td>
<td>U-100: Up to 24 hrs</td>
<td>U-300: Beyond 24 hrs (peak only)</td>
<td>U-100: N/A</td>
</tr>
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<td>Peak</td>
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</tr>
</tbody>
</table>

**INHALED INSULIN - AFREZZA**

**INSULIN REPLACEMENT WITH BASAL-BOLUS (INJECTIONS OR PUMP)**

Risk of hypoglycaemia

**Spirometry prior to starting, at 6 months, and then annually.**
Absortive period

Time of day

8 1 0 1 2 1 4 1 6 1 8 2 0 2 2 4 2 4 6

Relative concentration plasma insulin

11

Risk of hypoglycaemia


INSULIN REPLACEMENT WITH INTERMEDIATE- AND SHORT-ACTING INSULINS

CLASSIFICATION OF HYPOGLYCEMIA

Pharmacologic Therapy for Type 1 Diabetes Management

ADA 2015 Guidelines

INSULIN REPLACEMENT WITH INTERMEDIATE- AND SHORT-ACTING INSULINS

CLASSIFICATION OF HYPOGLYCEMIA

<table>
<thead>
<tr>
<th>Level</th>
<th>Glucose alert value (mmol/L)</th>
<th>Measured criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe hypoglycaemia (level 3)</td>
<td>≤ 3.1 mmol/L (56 mg/dL)</td>
<td>Sufficiently low for treatment with fast-acting insulins and diet adjustment of glucose-lowering therapy</td>
<td>Severe hypoglycaemia, significant hypoglycaemia associated with severe mental impairment, requiring external assistance for recovery</td>
</tr>
<tr>
<td>Severe hypoglycaemia (level 2)</td>
<td>3.2-4.9 mmol/L (58-90 mg/dL)</td>
<td>Sufficiently low for treatment with fast-acting insulins and diet adjustment of glucose-lowering therapy</td>
<td>Severe hypoglycaemia, significant hypoglycaemia associated with severe mental impairment, requiring external assistance for recovery</td>
</tr>
<tr>
<td>Severe hypoglycaemia (level 1)</td>
<td>5.0-6.0 mmol/L (90-108 mg/dL)</td>
<td>Sufficiently low for treatment with fast-acting insulins and diet adjustment of glucose-lowering therapy</td>
<td>Severe hypoglycaemia, significant hypoglycaemia associated with severe mental impairment, requiring external assistance for recovery</td>
</tr>
<tr>
<td>Severe hypoglycaemia (level 0)</td>
<td>6.1-7.0 mmol/L (110-126 mg/dL)</td>
<td>Sufficiently low for treatment with fast-acting insulins and diet adjustment of glucose-lowering therapy</td>
<td>Severe hypoglycaemia, significant hypoglycaemia associated with severe mental impairment, requiring external assistance for recovery</td>
</tr>
</tbody>
</table>
RISK FACTORS FOR HYPOGLYCAEMIA IN THE OLDER ADULT

- Use of insulin or insulin secretagogues
- Erratic meals
- Duration of diabetes
- Antecedent hypoglycaemia
- Hospital discharge within the preceding 30 days
- Comorbidities such as renal insufficiency
- Poly-pharmacy (≥ 5 concurrent medications)
- Cognitive decline, depression

NOCTURNAL HYPOGLYCAEMIA

- During sleep, the neuroendocrine response against hypoglycaemia is markedly blunted (the response threshold is shifted to lower glucose levels)

- While symptoms of hypoglycaemia trigger awakening in healthy subjects, individuals with type 1 diabetes frequently fail to respond to symptoms during sleep

RISK FACTORS FOR NOCTURNAL HYPOGLYCAEMIA

- Intensive Insulin Management
- Exercise
- Baseline blood glucose level
- Diet or hypoglycaemia
- Premixed insulin twice daily/NPH insulin
- Alcohol
- Impaired sympathoadrenal response during sleep
- Children who go to bed early
- Use of sulfonylureas (type 2 diabetes)
g310  Suggest adding one more slide dealing with elderly issues
gbauer, 6/11/2018

Slide 36

BC243  where did these come from? reference? children who go to bed early.
Belinda Childs, 6/10/2018

BC244  If we are adding these, we need references and to discuss
Belinda Childs, 6/10/2018

JS75  During the last member review Simon had provided feedback to include this information. References have been added
Julia Sawyers, 6/11/2018
HYPOGLYCEMIA

• Individuals at risk for hypoglycemia should be asked about symptomatic and asymptomatic hypoglycemia at each visit
  – At what number do you feel your low blood glucose
  – Have you had any hypoglycemia that required the assistance of another person or glucagon
  – Not limited to only those on insulin
INSULIN INFUSION PUMP OPTIONS

INSULIN PUMP-HOW IT WORKS

Dosing instructions are entered into the pump's visual component. A calculated amount of insulin is then injected into the body in a controlled, continuous manner.

MEDTRONIC 670 G

Insulin pump with hybrid closed-loop technology
Recommendations: Glucose Monitoring (2)

- Most patients on multiple-dose insulin (MDI) or insulin pump therapy should do SMBG:
  - Prior to meals and snacks
  - At bedtime
  - Prior to exercise
  - When they suspect low blood glucose
  - After treating low blood glucose until they are normoglycemic
  - Prior to critical tasks such as driving
  - Occasionally postprandially

American Diabetes Association Standards of Medical Care in Diabetes. Glycemic targets. Diabetes Care 2017; 40 (Suppl. 1): S48-S56

Recommendations: Glucose Monitoring (3)

- When used properly, CGM in conjunction with intensive insulin regimens is a useful tool to lower A1C in selected adults (aged ≥ 25 years) with type 1 diabetes. A
- Although the evidence for A1C lowering is less strong in children, teens, and younger adults, CGM may be helpful in these groups. Success correlates with adherence to ongoing use of the device. B
- CGM may be a supplemental tool to SMBG in those with hypoglycemia unawareness and/or frequent hypoglycemic episodes. C

American Diabetes Association Standards of Medical Care in Diabetes. Glycemic targets. Diabetes Care 2017; 40 (Suppl. 1): S48-S56

Recommendations: Glucose Monitoring (4)

- Given variable adherence to CGM, assess individual readiness for continuing use of CGM prior to prescribing. E
- When prescribing CGM, robust diabetes education, training, and support are required for optimal CGM implementation and ongoing use. E
- People who have been successfully using CGM should have continued access after they turn 65 years of age. E

American Diabetes Association Standards of Medical Care in Diabetes. Glycemic targets. Diabetes Care 2017; 40 (Suppl. 1): S48-S56
Continuous Glucose Monitoring (CGM)

- May be useful among children, teens, and younger adults
- Success related to adherence to ongoing use
- Hypoglycemia unawareness and/or frequent hypoglycemic episodes
- Assess individual readiness for continuing prior to prescribing
- Robust diabetes education, training, support critical for optimal CGM implementation
BIBLIOGRAPHY

Type 1 Diabetes Through the Life Span: A Position Statement of the American Diabetes Association Diabetes Care July 2014 37:7 2034- 2054. doi: 10.2337/dc14-1140

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