Disclosure to Participants

- Notice of Requirements For Successful Completion
  - Please refer to learning goals and objectives
  - Learners must attend the full activity and complete the evaluation in order to claim continuing education credit/hours
- Conflict of Interest (COI) and Financial Relationship Disclosures:
  - No COI/Financial Relationship to disclose
- Non-Endorsement of Products:
  - Accredited status does not imply endorsement by AADE, ANCC, ACPE or CDR of any commercial products displayed in conjunction with this educational activity
- Off-Label Use:
  - Participants will be notified by speakers to any product used for a purpose other than for which it was approved by the Food and Drug Administration.

Objectives:

- Explain the ACSM guidelines for aerobic and strength training for all adults
- State physical activity guidelines for snacking
- State adjustments for insulin and other medications
- Create a physical activity plan for person with diabetes with or without complications
General Outline For Today

• Background clinical studies
• Physical activity recommendations
• Blood glucose guidelines during physical activity
• Medication adjustments
• Precautions/Complications

Benefits for Person with Diabetes

• Improved insulin sensitivity
• Lower blood glucose levels
• Improved glucose uptake
• Improved A1c
• Reduced CV risk factors
• Prevention/delay development of T2

Diabetes Care 2016;39:2065–2079 | DOI: 10.2337/dc16‐1728

Physical Inactivity in the U.S. in 2017

CDC: Nutrition, Physical Activity, and Obesity: Data, Trends and Maps
Relationship of Moderate to Vigorous Physical Activity to All Cause Mortality

DPP Review

Look AHEAD Lifestyle Benefits:
- More significant weight loss & improvements in fitness
- Improved glycemic control
- Significantly more people reach 3 ADA goals for A1c, BP and lipids
- Improved BP & lipid levels
- Less sleep apnea, depression & liver fat

Diabetes Spectrum 2017 Aug; 30(3): 166-170

*Goal: 7% reduction in baseline body weight through low-calorie, low-fat diet and ≥150 min/week moderate intensity exercise.
IGT, impaired glucose tolerance; T2D, type 2 diabetes.
How much exercise is recommended (regardless of having diabetes)?

Physical Activity Recommendations:

Exercise
- Biking/Spinning
- Walking/Running
- Swimming
- Weight training
- Zumba

Physical Activity
- Gardening
- Cleaning
- Mowing the lawn
- Shoveling snow
- Construction work
- Manual labor

What is The Difference?
2019 ADA Lifestyle Management: Standards of Medical Care in Diabetes

- Children and adolescents with T1, T2, or Pre-DM should do 60 min/day of moderate or vigorous aerobic activity AND
  - Strengthening activities 3x/week

AND

T1 & T2 Adults: Should do aerobic activity of moderate to vigorous intensity 150 min or more/week over at least 3 days. OR
  - Vigorous-intensity or interval training of 75 min/week AND
  - 8-10 strength training exercises, 8-12 repetitions, twice (2-3x) a week

AND

- Decrease sedentary behavior
- Flexibility & balance training 2-3x/week
**Sedentary Behavior**

- All adults (esp. type 2) should decrease the amount of time spent in daily sedentary behavior
- Prolonged sitting should be interrupted with light activity every 30 min
- The above two recommendations are additional to, and not a replacement for, increased structured exercise and incidental movement

**Components of Fitness/Exercise Program**

1. Cardio-respiratory function
2. Musculoskeletal fitness
3. Flexibility
4. Balance
5. Speed

**Progression of Fitness/Exercise Program (FITT Principle)**

1. Frequency
2. Intensity
3. Time (duration)
4. Type of exercise
5. Progression
Exercise Programming: Individualization is Key

How Often? How Long?

<table>
<thead>
<tr>
<th>Activity</th>
<th>How Often</th>
<th>How Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health/ Improve Blood Glucose</td>
<td>3-4x/week</td>
<td>20-30 Min</td>
</tr>
<tr>
<td>Weight Loss</td>
<td>4-6x/week</td>
<td>40-60 Min</td>
</tr>
</tbody>
</table>

Review: What is The Definition of Hypoglycemia (NO PA)?

• Blood Glucose less than 70 mg/dL
• Treat with the rule of 15
  ➢ 15 grams of carb every 15 min, re-check BG

Diabetes Care 2019;42(Suppl. 1):S61–S70

Review: What are Some of the Signs of Hypoglycemia?

- Headache
- Sweating
- Weakness
- Shakiness
- Tachycardia
- Dizziness
- Confusion
- Hunger
- Paleness

Diabetes Care 2019;42(Suppl. 1):S61–S70
Who is NOT at Risk for Exercise Induced Hypoglycemia? People Who take:

- GLP1/Incretin Mimetic
- DPP-4s
- SGLT2 Inhibitors
- Biguanides
- Thiazolidinediones
- Alpha-glucosidase Inhibitors

Who IS at Risk for Exercise Induced Hypoglycemia? Those who:

- Have T1
- Use insulin:
  - Rapid/Short acting
  - Intermediate
  - Long acting
- Use Sulfonylureas
- Use Meglitinides

Potential Risk of Hypoglycemia:

- Autonomic neuropathy – requires careful supervision and progression of fitness program (blunted HR, BP, and hypoglycemia awareness)
- Gastroparesis – erratic impact on BG which may be exacerbated by exertion
- Beta blockers – may “mask” the symptoms of hypoglycemia
Nocturnal Hypoglycemia/Lag Effect

- More common in type 1 DM
- Usually between 6-15 hours (48 hours potential)
- Treatment Suggestions
  - Decrease insulin dose
  - Check BG overnight
  - Use CGM

Diabetes Care 2016;39:2065–2079

Blood Glucose Guidelines During Physical Activity

Pre-Exercise BG Guidelines

- General Target: 90-250 mg/dL or 126-180 mg/dL
  - What is the starting BG?
  - What is the intensity?
  - What is the duration?
  - What is the type of activity?

Diabetes Care 2016;39:2065–2079
The Lancet Review Jan 23 2017;1-14
Pre-Exercise Hyperglycemia Guidelines

- **Type 1**: Caution BG values >250 mg/dL
  - Unexplained hyperglycemia: **NO EXERCISE**
  - Check for ketones
    - Positive ketones (blood>1.5mmol/L) = **NO**
    - Positive ketones (urine>2+ - 4.0mmol/L) = **NO**
  - BG 250-350 mg/dL (trace-mild ketones) **Proceed with caution**
- **Type 2**: BG values > 400 mg/dL = **NO EXERCISE**

Post-Exercise BG Guidelines

- Individualize For Each Person:
  - OA: Above 90 mg/dL (**)
  - Insulin: Above 110 mg/dL (**)
  - High BG after EX....

**General suggestions to be individualized**

www.joslin.org
Exercise & Insulin

Inject Less!
- Individualize
- Think about the peak action
  - Rapid/Short acting insulin (adjust 90 min within mealtime)
  - Intermediate/Long acting insulin
- Should person inject into the working muscle?
- What about adjusting oral agents for type 2?
- Start slowly

Insulin Pump Options
- Individualize!
- Temporary Basal (pre, during, post)
- Reduce pre-meal bolus
  - Mild intensity aerobic, 30-60 min (25-50% decrease)
  - Moderate intensity aerobic, 30-60 min (50-75% decrease)
  - Heavy intensity aerobic (75%)
  - Intense aerobic/anaerobic (no reduction)
- Disconnect

Snacking Suggestions (Individualize):

30 Min: 15-30 grams of CHO

60 Min: 15-30 grams of CHO
  + 7-8 grams of PRO

60+ Min: 15-30 grams of CHO
  + Adjust the Insulin
Snacking Suggestions (Individualize):

<table>
<thead>
<tr>
<th>Pre-Ex Blood Glucose</th>
<th>CHO Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;90 mg/dL</td>
<td>15-30 g of fast-acting CHO PRIOR to starting PA</td>
</tr>
<tr>
<td>90-150 mg/dL</td>
<td>CHO at start of PA</td>
</tr>
<tr>
<td>150-250 mg/dL</td>
<td>Delay CHO until BG &lt;150mg/dL</td>
</tr>
</tbody>
</table>

Adjust Insulin or Snack?

Insulin
- Planned
- To Lose/Maintain weight
- To improve control

Snacks
- Long duration activity
- Unplanned

Precautions/Complications
Precautions

- Scope of Practice
- Complications (Neuropathies)
- Exercise tolerance test (stress test)

Refer to MD/DO When Person Has:

- Erratic glycemic control
- Not been appropriately evaluated
- Severe complications (acute or chronic)

Exercise & Retinopathy:

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild to Moderate</td>
<td>-Limited/No Risk</td>
</tr>
<tr>
<td>Non-proliferative</td>
<td>-Annual eye exam</td>
</tr>
<tr>
<td></td>
<td>-Moderate: avoid increasing BP</td>
</tr>
</tbody>
</table>

Diabetes Care 2016;39:2065–207
### Exercise & Retinopathy:

<table>
<thead>
<tr>
<th>Considerations</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe NPDR and Unstable NPDR</td>
<td>• Avoid raising BP</td>
</tr>
<tr>
<td>• Risk vitreous hemorrhage</td>
<td>• Avoid PA with impact</td>
</tr>
<tr>
<td>• Risk retinal detachment</td>
<td>• Avoid Valsalva</td>
</tr>
<tr>
<td></td>
<td>• Avoid head below waist</td>
</tr>
</tbody>
</table>

*Diabetes Care 2016;39:2065–2079*  
#AADE

### Exercise & Peripheral Neuropathy

- **Recommendations:**
  - Proper foot care
  - Consider non-weight bearing w/ local foot issues
  - Ulcer/Charcot Foot: No weight bearing

*Diabetes Care 2016;39:2065–2079*  
#AADE

### Exercise & Autonomic Neuropathy

- **Risks & Recommendations:**
  - Postural hypotension: avoid quick postural changes
  - Altered thermoregulation: avoid overheating, stay hydrated
  - Cardiac autonomic neuropathy: MD clearance/ETT, RPE
  - Gastroparesis: hypoglycemia harder to treat

*Diabetes Care 2016;39:2065–2079*  
#AADE
**Exercise & Nephropathy**

- **Microalbuminuria:**
  - PA does not accelerate
  - More PA may moderate progression
- **Albuminuria or nephropathy:**
  - Start at low intensity & volume

Diabetes Care 2016;39:2065–2079

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**Exercise & Nephropathy**

- **End Stage:**
  - Start low intensity & volume
  - Monitor electrolytes if PA during dialysis

Diabetes Care 2016;39:2065–2079

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**Incidence of Myocardial Infarction In People with Type 2 Diabetes**

- No prior MI
- Prior MI

2015 ACSM Pre-Exercise Health Screening & Evaluation

- No more risk-factor assessment
- Recommend anyone with DM who is sedentary should obtain medical clearance (even low intensity)
- Adopted three factor review:
  1. The Individual's current physical activity level
  2. Presence of signs or symptoms CVD, metabolic, renal disease
  3. Desired exercise intensity

Take Home Messages

- Individualize
- Move more!
- Interrupt sedentary behavior

Most Importantly...Have Fun!
**Thank You!**

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617-329-1950

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**Energy Sources During Exercise**

<table>
<thead>
<tr>
<th>Source:</th>
<th>Muscle</th>
<th>Glucose</th>
<th>Fat</th>
<th>Blood Glucose</th>
</tr>
</thead>
</table>

---

**CVD Risk Factors:**

- **Age**
- **Gender**
- **Heredity**
  - Race; MI prior to age 55
- **High blood pressure** (>140/90 mmHg)
- **High cholesterol** (>200 mg/dl)
  - LDL >160 mg/dl
  - HDL <35 mg/dl
- **Physical inactivity**
- **Obesity**
  - >30% of body weight
  - BMI >30 kg/m²
- **Diabetes**
- **Smoking**
- **Fibrinogen** (clotting factor)
- **C-reactive protein**
- **Left Ventricular Hypertrophy (LVH)**
- **Cocaine use**
**Typical Activities Intensity Levels**

<table>
<thead>
<tr>
<th>Intensity Level</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.0 METs or &lt;4 kcal/min</td>
<td>Walking 1-2mph, Biking &lt;50W</td>
</tr>
<tr>
<td>3.0-6 METs or 4-7 kcal/min</td>
<td>Walking 3-4 mph, Biking &lt;10mph</td>
</tr>
<tr>
<td>&gt;6 METs or &gt;7 kcal/min</td>
<td>Fast Walking, Biking &gt;10mph</td>
</tr>
</tbody>
</table>

**Pregnancy**

**Benefits:**
- Reduce risk of preeclampsia
- C-section
- Excessive weight gain
- Improve CV health

**Recommendations:**
- Pre-Existing DM: Any type of PA prior to and during pregnancy
- At risk for gestational: 20-30 min of moderate-intensity on most or all days of week

**The word on avoiding “active sites” for injecting...**

Michael Berger, MD:

“this recommendation turned out to be quite useless and, in fact, potentially dangerous: exercise-induced hypoglycemia cannot be avoided by simply changing the insulin injection site.”

(ADA, Handbook of Exercise in Diabetes)