

# Type 2 Diabetes & Exercise

## Applying Guidelines to Real-World Scenarios

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## Conflict of Interest

- LE: Clinical advisory boards for Provention Bio, Cecelia Health, Roche & Sanofi
- MM: nothing to disclose
- EC: nothing to disclose



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## Objectives

- Understand current guidelines
- Learn how to apply current guidelines to specific patients
- Review available resources to share with patients and colleagues



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## Outline

- Current recommendations for exercise & physical activity
- Starting out
- Clinical Approaches
- Resources
- *PWD = person/people with diabetes*



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## Background

- Physical activity & exercise should be recommended to **all individuals at risk for or with diabetes** for management of glycemia & overall health.
- Diabetes care teams should understand:
  - This is really hard – most people aren't meeting goals
  - Individualized approaches are needed
- Specific recommendations vary based on:
  - Type of diabetes
  - Age
  - Activity
  - Presence of diabetes-related health complications



American Diabetes Association Professional Practice Committee; 5. Facilitating Behavior Change and Well-being to Improve Health Outcomes: *Standards of Medical Care in Diabetes—2022. Diabetes Care* 1 January 2022; 45 (Supplement\_1): S60–S82. <https://doi.org/10.2337/dc22-S005>

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## Exercise in PWD has been shown to:

- Lower CV and overall mortality risks
- Lower A1C by an average of 0.66% in people with T2D, even without a significant change in BMI
- Slow the decline in mobility among overweight PWD
- Contribute to weight loss
- Improve well-being



American Diabetes Association Professional Practice Committee; 5. Facilitating Behavior Change and Well-being to Improve Health Outcomes: *Standards of Medical Care in Diabetes—2022. Diabetes Care* 1 January 2022; 45 (Supplement\_1): S60–S82. <https://doi.org/10.2337/dc22-S005>

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## Recs for adults with established diabetes

Engage in **≥ 150 min of moderate- to vigorous-intensity aerobic activity per week**

- Spread over at least 3 days/week
- No more than 2 consecutive days without activity

Engage in 2–3 sessions/week of **resistance exercise** on nonconsecutive days

- Free weights or weight machines
- Each session: at least 1 set of 5+ different resistance exercises involving large muscle groups



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## Current guidelines – est. diabetes

**Flexibility training and balance training** are recommended 2–3 times/week for **older adults** with diabetes.

Promote **increase in nonsedentary activities** above baseline for sedentary PWD

- Walking, yoga, housework, gardening, swimming, dancing



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## ADA guidelines – est. diabetes

- All PWD should decrease time spent in sedentary behavior
- Interrupt prolonged sitting with light activity every 30 min
- This is in **additional to (not a replacement for)** increased structured exercise & incidental movement



Colberg, Sheri R., et al. "Physical activity/exercise and diabetes: a position statement of the American Diabetes Association." *Diabetes care* 39.11 (2016): 2065-2079.



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## Pre-exercise Evaluation

- Medical clearance generally unnecessary for asymptomatic individuals prior to beginning low or moderate-intensity activity
- Routine testing is not recommended.
- Perform a careful history, assess CV risk factors
  - Be aware of atypical presentations of CAD (patient-reported or tested decrease in exercise tolerance)
- Consider age & previous physical activity level when customizing a regimen

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## Starting Out

- Check glucose before & after exercise for ~5-10 sessions to learn patterns
  - Repeat when medication changes are made
- Start “low and slow”
- Progress time first, then intensity
- Goal → maintain a given intensity of 30+ min of steady-state exercise
- Foot checks & appropriate footwear
- Make sure modality is appropriate
  - Ex: neuropathy on a treadmill



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## PATIENT PERCEIVED BARRIERS



## “challenges to exercise cited by patients”

loose animals

fast traffic

health problems

not having the proper clothes or enough money

being tired

no partner

insufficient time

competing priorities such as family or work responsibilities

neighborhood walkability

inadequate transportation or facilities to engage in PA

Brown PG, Markowski RT, Harper SA, Bulford TRL. Exercise in Medicine as a Vital Sign: Challenges and Opportunities. Transl J Am Coll Sports Med. 2019 Jan 14;1(1):1-7. PMID: 3082840; PMCID: PMC6392189.

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# Clinical Approaches

How to measure exercise

Glucose patterns & exercise

Adjusting treatment regimens

Minimizing risk



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# EXERCISE VITALS

1. Days Per Week?

2. Minutes Per Day?

3. Intensity

4. Activity Type?

UTILIZING  
EV

REPETITION  
REFLECTION  
RELATIONSHIPS

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1. Days Per Week?

2. Minutes Per Day?

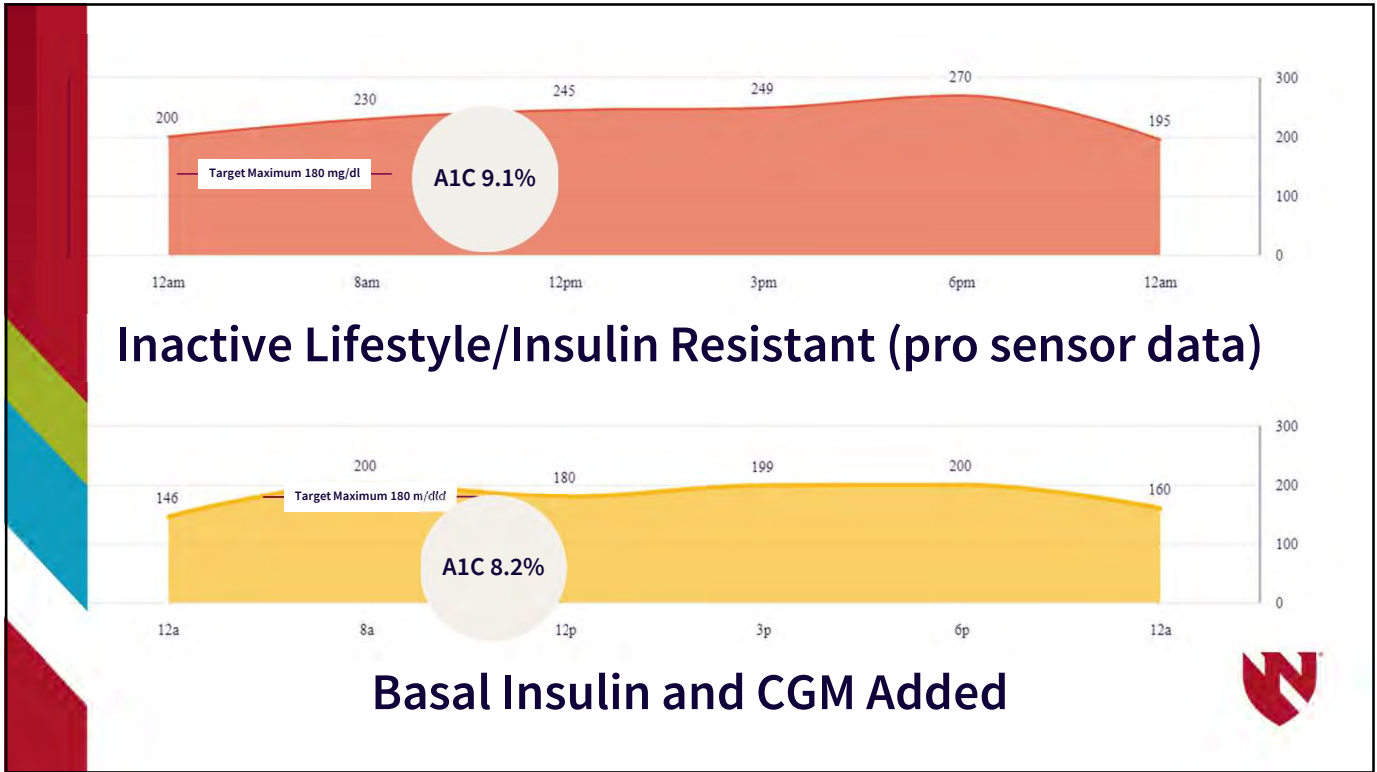
3. Intensity

4. Activity Type?

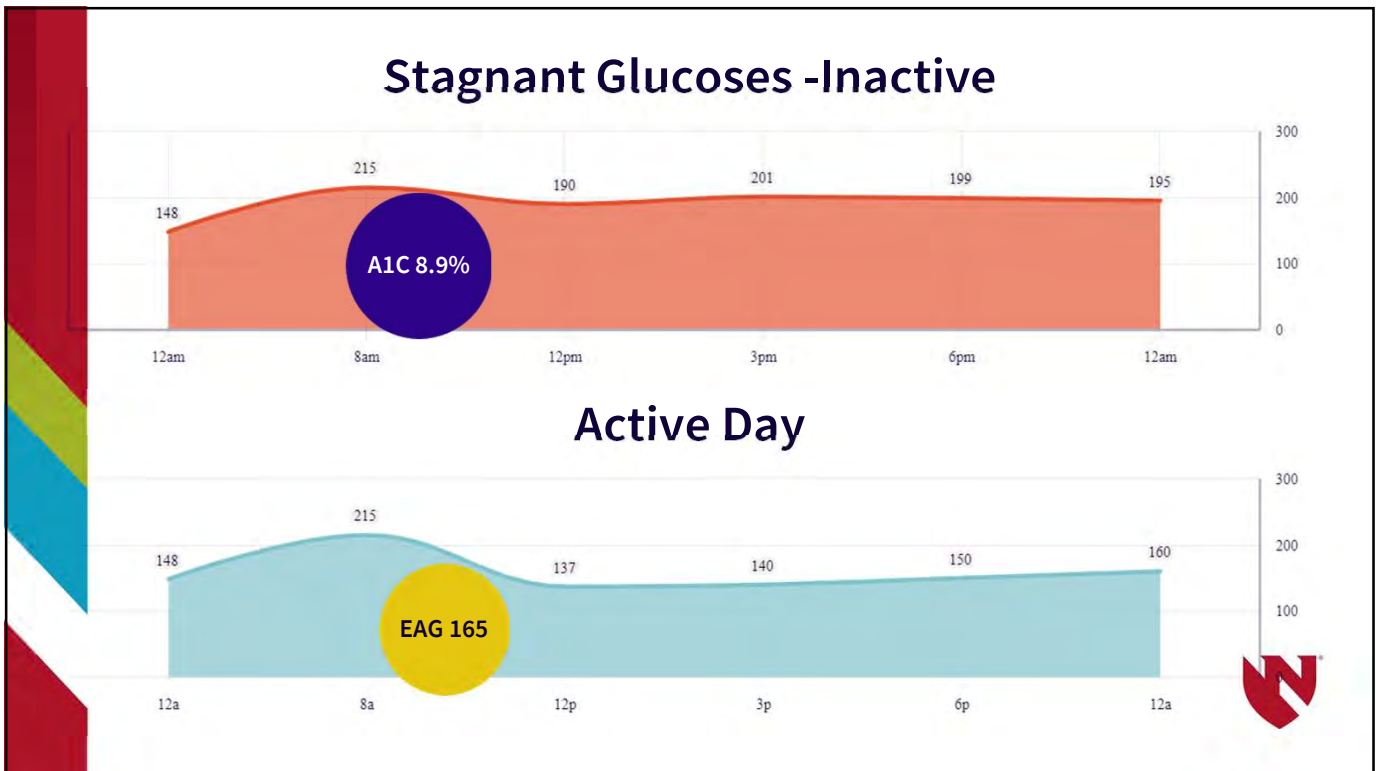
The screenshot shows a digital form for 'Exercise Vitals' within a medical charting application. The form is titled 'Exercise Vitals' and includes several input fields and checkboxes. The 'Days of exercise in the past 7 days' field is set to 5. The 'Average minutes of exercise per day in the past 7 days' field is empty. The 'Intensity' field is set to 'Moderate'. The 'Type of exercise' field has 'walking' selected. The form also includes a 'Responsible' field, a 'Create Note' button, and checkboxes for 'Show Last Filed Value' and 'Show All Choices'. The interface includes navigation tabs for 'Exercise Vitals', 'Vital Signs', 'History', 'Diabetes Assessment', 'Foot Exam', and 'Progress Notes'.

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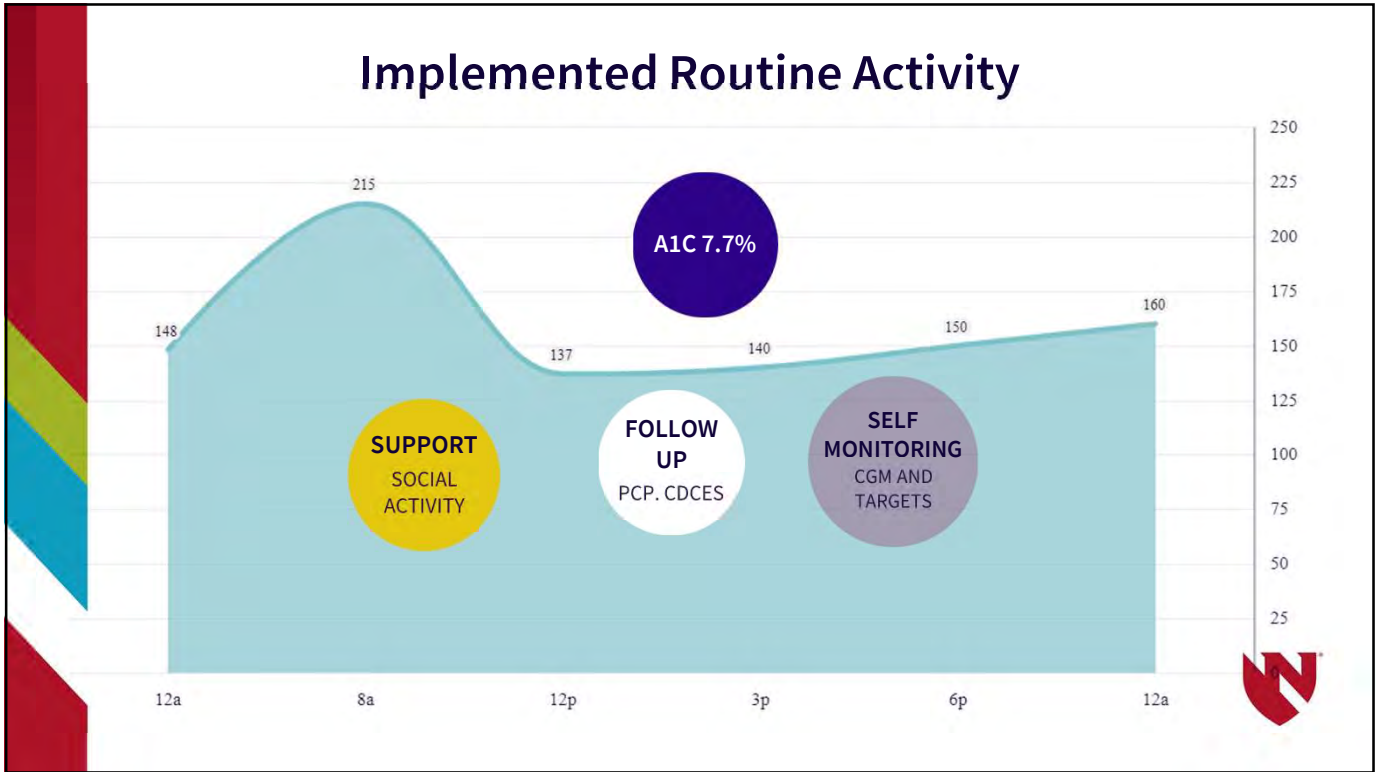




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## Considerations based on med class

**Table 4—Exercise considerations for diabetes, hypertension, and cholesterol medications and recommended safety and dose adjustments**

Type/class of medication	Exercise considerations	Safety/dose adjustments
<b>Diabetes</b>		
Insulin	<ul style="list-style-type: none"> <li>Deficiency: hyperglycemia, ketoacidosis</li> <li>Excess: hypoglycemia during and after exercise</li> </ul>	<ul style="list-style-type: none"> <li>Increase insulin dose pre- and postexercise for deficiency</li> <li>Decrease prandial and/or basal doses for excess insulin</li> </ul>
Insulin secretagogues	<ul style="list-style-type: none"> <li>Exercise-induced hypoglycemia</li> </ul>	<ul style="list-style-type: none"> <li>If exercise-induced hypoglycemia has occurred, decrease dose on exercise days to reduce hypoglycemia risk</li> </ul>
Metformin	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>Generally safe; no dose adjustment for exercise</li> </ul>
Thiazolidinediones	<ul style="list-style-type: none"> <li>Fluid retention</li> </ul>	<ul style="list-style-type: none"> <li>Generally safe; no dose adjustment for exercise</li> </ul>
Dipeptidyl peptidase 4 inhibitors	<ul style="list-style-type: none"> <li>Slight risk of congestive heart failure with saxagliptin and alogliptin</li> </ul>	<ul style="list-style-type: none"> <li>Generally safe; no dose adjustment for exercise</li> </ul>
Glucagon-like peptide 1 receptor agonists	<ul style="list-style-type: none"> <li>May increase risk of hypoglycemia when used with insulin or sulfonylureas but not when used alone</li> </ul>	<ul style="list-style-type: none"> <li>Generally safe; no dose adjustment for exercise but may need to lower insulin or sulfonylurea dose</li> </ul>
Sodium-glucose cotransporter 2 inhibitors	<ul style="list-style-type: none"> <li>May increase risk of hypoglycemia when used with insulin or sulfonylureas but not when used alone</li> </ul>	<ul style="list-style-type: none"> <li>Generally safe; no dose adjustment for exercise</li> </ul>

Colberg, Sheri R., et al. "Physical activity/exercise and diabetes: a position statement of the American Diabetes Association." *Diabetes care* 39.11 (2016): 2065-2079.

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## EXERCISE-GLUCOSE PATTERNS

### AEROBIC WORKOUT <30 MINUTES

EXPECT GRADUAL DECLINE  
IN GLUCOSE LEVELS DURING  
AND UP TO AN HOUR POST  
AVG DECREASE APPROX  
30MG/DL

### WEIGHT LIFTING/RESISTANCE

MAY SEE SLIGHT INCREASE  
INITIALLY, THEN DROP IN  
GLUCOSE 1-6 HOURS POST

### ACTIVE DAY

MAY SEE GRADUAL DROP  
DURING DAY, AND  
ADDITIONAL LOWER  
GLUCOSES LATER IN  
DAY/NEXT DAY

LOOK FOR PATTERNS. FACTOR IN STRESS, SLEEP, MEDICATIONS, FOOD

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## Minimizing Exercise-related Adverse Events in PWD

- Exercising with hyperglycemia and elevated blood ketones is not recommended
- Intense activities may **raise** glucose levels, especially if pre-exercise glucose levels are elevated
- Older PWD or anyone with autonomic neuropathy, CV, or pulmonary disease should avoid outdoor exercise on very hot or humid days to prevent heat-related illnesses



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## Minimizing Exercise-related Adverse Events in PWD

- Consider insulin adjustments, carb intake to prevent exercise-related hypoglycemia.
  - **Frequent** need to supplement with carbs may warrant med changes
- Other strategies to avoid exercise-induced hypoglycemia:
  - Short sprints
  - Resistance exercise before aerobic exercise in the same session
  - Activity timing



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## Hypoglycemia

- In PWD taking insulin and/or insulin secretagogues, physical activity may cause hypoglycemia if the med dose or carb consumption is not adjusted
- PWD on these therapies may need to ingest carbs if pre-exercise glucose is <90 mg/dL
- Adjust insulin dose (pump or pre-exercise)
- Time of day
- Intensity and duration of exercise



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## Hypoglycemia

- In some PWD, hypoglycemia after exercise may last for several hours due to increased insulin sensitivity
- Risk of nocturnal hypoglycemia following physical activity may be mitigated with
  - Reductions in basal insulin dose
  - Inclusion of bedtime snacks
  - Use of CGM



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## NUTRITION AND EXERCISE

### CARB REPLACEMENT: ONLY NEEDED FOR INTENSIVE ACTIVITY

\*If glucose is >90mg/dl prior to workout **no carb** is needed prior

\*Replace small amount every 30 minutes or so via electrolyte beverage if needed (about .25g/kg/hour)

### DON'T FORGET HYDRATION

**WATER** is all that is needed for <30 minute workouts

Electrolyte beverages vary in glucose content! - Generally recommended for **1 hour or longer** workout

LOOK FOR PATTERNS.  
CONSIDER STRESS, SLEEP, MEDICATIONS, FOOD

Dietitian Favorites: G2, body armor lite, coconut water cut with diet lemonade or ice water

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## Resources



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## Recommended resources/equipment

- GlucoseZone
- FitBit workouts
- Youtube body weight exercises
- Peloton app
- Exercise is Medicine handout: Being Active When you Have T2DM



Rx for Health Series

*A series on today's most common chronic conditions and their exercise prescriptions*

Exercise is Medicine® created the Rx for Health series to provide essential guidelines on exercise

RESOURCES

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## Recommended resources/equipment

- Walk down your blood sugar!
- Mall/store walking
- Small equipment
- Library resources
- Used equipment



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UCSF University of California, San Francisco | About UCSF | Search UCSF | UCSF Medical Center

## Diabetes Education Online

Diabetes Teaching Center at the University of California, San Francisco

GLOSSARY Languages: E

Search this website

HOME TYPES OF DIABETES NEWLY DIAGNOSED LIVING WITH DIABETES WORKSHOPS AND CLASSES LEARNING

Home » Living With Diabetes » Activity And Exercise

- ▾ Diet And Nutrition
- ▾ **Activity And Exercise**
  - Benefits of Exercise
  - Exercise Principles
  - Exercise & Blood Sugar
  - Getting started with exercise
  - Exercise Guidelines
  - Coping With Your Emotions
  - Tips For Daily Living
  - Managing Your Weight
  - Complications

### Activity And Exercise

« Heart Health

Being active is an excellent way to stay healthy. When you have diabetes, activity can be especially beneficial, but it has to be done with an emphasis on safety. This section provides general guidelines for activity and exercise; however, you should always ask your medical provider for specific recommendations for your personal activity and exercise regimen.

## UCSF Website

<https://dtc.ucsf.edu/living-with-diabetes/activity-and-exercise/>



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# TCOYD Video Vault

**T2D: EXERCISE**

**Fun Fitness Activities and Healthy Lunch Recipes**  
This lecture was from our virtual 'Back to School' conference on 8/7/21. And you thought hopscotch was fun...and now you try out a dancing fitness class!  
18 | 5/6/21, 2021

**Standard glucagon injection kits: OMO3**  
Get on the Honor Roll: Continuous Glucose Monitoring and Other Top...  
This lecture was from our virtual 'Back to School' conference on 8/7/21.  
10 | 5/6/21, 2021

**A Dose of Dr. E**  
If you have diabetes and are on insulin, one of the most frustrating things is dealing with blood sugar swings before, during, and after exercise. Dr. E and Dr. F go head-to-head in another challenge, using two different methods to see who can stay in...  
3:28 | 2/16, 2021

**Finding the Fun in Fitness for Type 2**  
Exercise is not a four-letter word, so don't dread it like one. Have fun with it. Learn to enjoy moving your body. Your body will thank you for it and you will be rewarded with optimal health. Learn about the medical health benefits of exercising and the...  
18 | Jun 01, 2021

**CHAIR DANCING FITNESS**  
Chair Dancing Fitness  
Essential exercise that is seriously fun! Pull up a chair and get your sweat on! (Jodi Stoen) - TCOYD Virtual Diabetes Conference and Health Fair 2020  
5 | Mar 24, 2021

**Yoga: There's So Much More to It than Just Touching Your Toes**  
From the outside, it may look like yoga is an exercise focused on moving your body into awkward positions, but there is a reason why so many people with T2D practice yoga. It not only makes your body feel better and promotes better blood...  
20 | Dec 04, 2020

**The Fat Check: Exercise for EveryBODY!**  
Jaslene Duffin is a plus-sized, certified fitness instructor who has helped thousands of people of all shapes, sizes, ages and abilities learn to love their bodies and love exercise. (Jaslene Duffin) - TCOYD Virtual Diabetes Conference  
25:00

**Diabetes in Motion...How to Get Your Move On!**  
If it's been a while since you've been motion and groovin' or if you're totally board new to exercise, well there are all the amazing health benefits that come with being active and how it can enhance your mood, your energy, your sleep, and even your...  
45:17

<https://tcoyd.org/vv-t2d-exercise/>

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# Engage Wellness

<https://www.unmc.edu/engage/>



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# Conclusions

Personalized approach is best

- Be mindful of community resources, cost

Don't let people talk themselves out of exercise

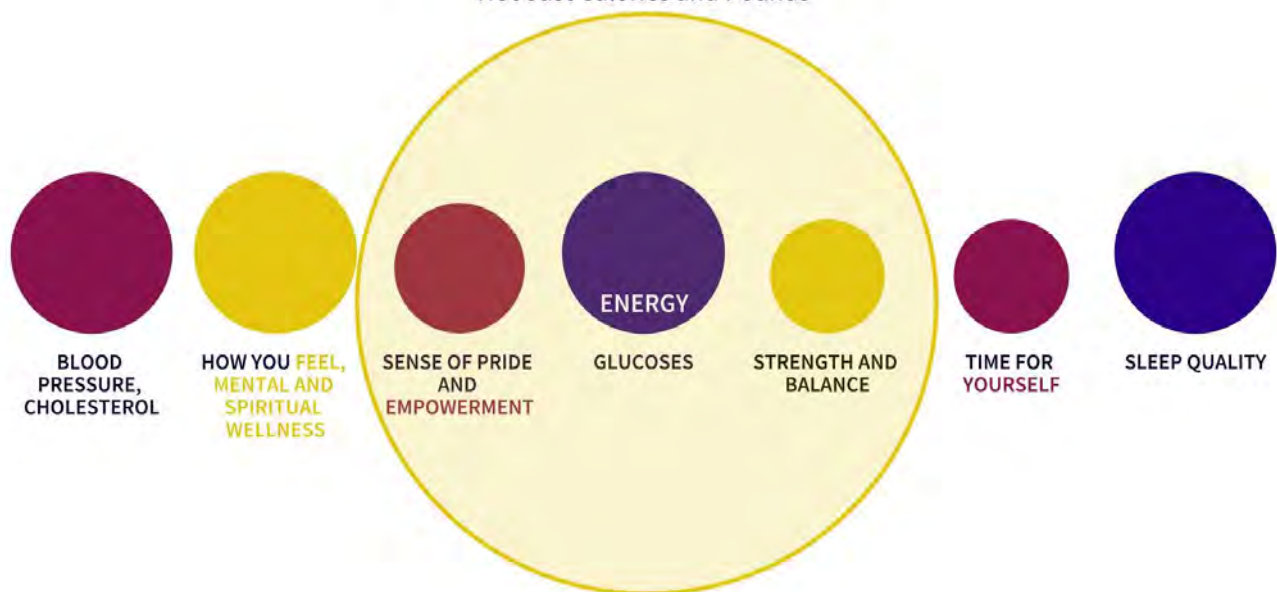
- Perceived risk often higher than true risk
- Try to be proactive about avoiding hypoglycemia
- Many diabetes medications do not cause hypoglycemia



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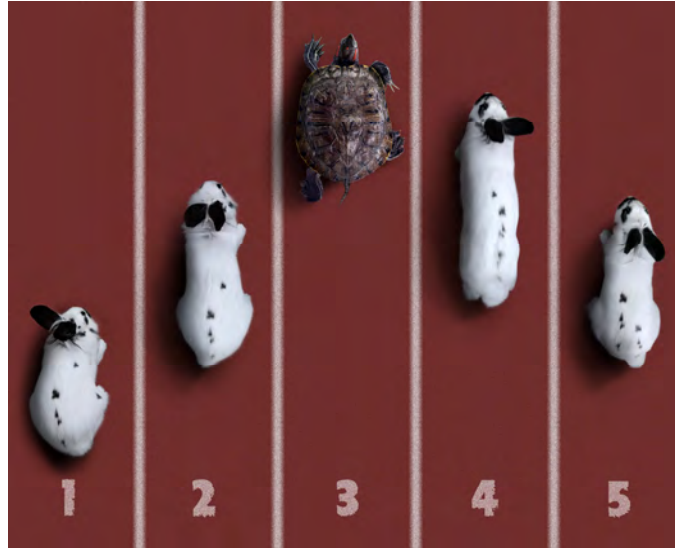
## See the BIG PICTURE

Not Just Calories and Pounds



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# Thank you!



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**Table 3—Exercise training recommendations: types of exercise, intensity, duration, frequency, and progression**

	Aerobic	Resistance	Flexibility and Balance
Type of exercise	<ul style="list-style-type: none"> <li>• Prolonged, rhythmic activities using large muscle groups (e.g., walking, cycling, and swimming)</li> <li>• May be done continuously or as HIIT</li> </ul>	<ul style="list-style-type: none"> <li>• Resistance machines, free weights, resistance bands, and/or body weight as resistance exercises</li> </ul>	<ul style="list-style-type: none"> <li>• Stretching: static, dynamic, and other stretching; yoga</li> <li>• Balance (for older adults): practice standing on one leg, exercises using balance equipment, lower-body and core resistance exercises, tai chi</li> </ul>
Intensity	<ul style="list-style-type: none"> <li>• Moderate to vigorous (subjectively experienced as “moderate” to “very hard”)</li> </ul>	<ul style="list-style-type: none"> <li>• Moderate (e.g., 15 repetitions of an exercise that can be repeated no more than 15 times) to vigorous (e.g., 6–8 repetitions of an exercise that can be repeated no more than 6–8 times)</li> </ul>	<ul style="list-style-type: none"> <li>• Stretch to the point of tightness or slight discomfort</li> <li>• Balance exercises of light to moderate intensity</li> </ul>
Duration	<ul style="list-style-type: none"> <li>• At least 150 min/week at moderate to vigorous intensity for most adults with diabetes</li> <li>• For adults able to run steadily at 6 miles per h (9.7 km/h) for 25 min, 75 min/week of vigorous activity may provide similar cardioprotective and metabolic benefits</li> </ul>	<ul style="list-style-type: none"> <li>• At least 8–10 exercises with completion of 1–3 sets of 10–15 repetitions to near fatigue per set on every exercise early in training</li> </ul>	<ul style="list-style-type: none"> <li>• Hold static or do dynamic stretch for 10–30 s; 2–4 repetitions of each exercise</li> <li>• Balance training can be any duration</li> </ul>
Frequency	<ul style="list-style-type: none"> <li>• 3–7 days/week, with no more than 2 consecutive days without exercise</li> </ul>	<ul style="list-style-type: none"> <li>• A minimum of 2 nonconsecutive days/week, but preferably 3</li> </ul>	<ul style="list-style-type: none"> <li>• Flexibility: <math>\geq 2-3</math> days/week</li> <li>• Balance: <math>\geq 2-3</math> days/week</li> </ul>
Progression	<ul style="list-style-type: none"> <li>• A greater emphasis should be placed on vigorous intensity aerobic exercise if fitness is a primary goal of exercise and not contraindicated by complications</li> <li>• Both HIIT and continuous exercise training are appropriate activities for most individuals with diabetes</li> </ul>	<ul style="list-style-type: none"> <li>• Beginning training intensity should be moderate, involving 10–15 repetitions per set, with increases in weight or resistance undertaken with a lower number of repetitions (8–10) only after the target number of repetitions per set can consistently be exceeded</li> <li>• Increase in resistance can be followed by a greater number of sets and finally by increased training frequency</li> </ul>	<ul style="list-style-type: none"> <li>• Continue to work on flexibility and balance training, increasing duration and/or frequency to progress over time</li> </ul>

Colberg, Sheri R., et al. "Physical activity/exercise and diabetes: a position statement of the American Diabetes Association." *Diabetes care* 39.11 (2016): 2065-2079.



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**Table 2—Suggested initial pre-exercise meal insulin bolus reduction for activity started within 90 min after insulin administration**

Exercise intensity	Exercise duration	
	30 min	60 min
Mild aerobic ( $\sim 25\% VO_{2max}$ )	– 25%*	– 50%
Moderate aerobic ( $\sim 50\% VO_{2max}$ )	– 50%	– 75%
Heavy aerobic ( $70\% - 75\% VO_{2max}$ )	– 75%	N-A
Intense aerobic/anaerobic ( $> 80\% VO_{2max}$ )	No reduction recommended	N-A

Recommendations compiled based on four studies (94–97). N-A, not assessed as exercise intensity is too high to sustain for 60 min. \*Estimated from study (95).



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**Table 1—Suggested carbohydrate intake or other actions based on blood glucose levels at the start of exercise**

Pre-exercise blood glucose	Carbohydrate intake or other action
<90 mg/dL (<5.0 mmol/L)	<ul style="list-style-type: none"> <li>• Ingest 15–30 g of fast-acting carbohydrate prior to the start of exercise, depending on the size of the individual and intended activity; some activities that are brief in duration (&lt;30 min) or at a very high intensity (weight training, interval training, etc.) may not require any additional carbohydrate intake.</li> <li>• For prolonged activities at a moderate intensity, consume additional carbohydrate, as needed (0.5–1.0 g/kg body mass per h of exercise), based on blood glucose testing results.</li> </ul>
90–150 mg/dL (5.0–8.3 mmol/L)	<ul style="list-style-type: none"> <li>• Start consuming carbohydrate at the onset of most exercise (~0.5–1.0 g/kg body mass per h of exercise), depending on the type of exercise and the amount of active insulin.</li> </ul>
150–250 mg/dL (8.3–13.9 mmol/L)	<ul style="list-style-type: none"> <li>• Initiate exercise and delay consumption of carbohydrate until blood glucose levels are &lt;150 mg/dL (&lt;8.3 mmol/L).</li> </ul>
250–350 mg/dL (13.9–19.4 mmol/L)	<ul style="list-style-type: none"> <li>• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present.</li> <li>• Initiate mild-to-moderate intensity exercise. Intense exercise should be delayed until glucose levels are &lt;250 mg/dL because intense exercise may exaggerate the hyperglycemia.</li> </ul>
≥350 mg/dL (≥19.4 mmol/L)	<ul style="list-style-type: none"> <li>• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present.</li> <li>• If ketones are negative (or trace), consider conservative insulin correction (e.g., 50% correction) before exercise, depending on active insulin status.</li> <li>• Initiate mild-to-moderate exercise and avoid intense exercise until glucose levels decrease.</li> </ul>

Adapted from Zaharieva and Riddell (88).

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## Peripheral Neuropathy

- Decreased pain sensation and a higher pain threshold in the extremities can result in an increased risk of skin breakdown, infection, and Charcot joint destruction with some forms of exercise.
- A thorough assessment should be done to ensure that neuropathy does not alter kinesthetic or proprioceptive sensation during physical activity, particularly in those with more severe neuropathy.
- Individuals with peripheral neuropathy should wear proper footwear and examine their feet daily to detect lesions early.
- Anyone with a foot injury or open sore should be restricted to non-weight-bearing activities.
- Moderate intensity walking may not lead to an increased risk of foot ulcers or reulceration in those with peripheral neuropathy who use proper footwear

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## Exercise in the Presence of Microvascular Complications – Retinopathy

- If proliferative diabetic retinopathy or severe nonproliferative diabetic retinopathy is present, then vigorous-intensity aerobic or resistance exercise may be contraindicated because of the risk of triggering vitreous hemorrhage or retinal detachment
- Consultation with an ophthalmologist prior to engaging in an intense exercise regimen may be appropriate.



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