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

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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

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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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

Bowen PG, Mankowski RT, Harper SA, Bulled TW. Exercise is Medicine as a Vital Sign: Challenges and Opportunities. Transl J Am Coll Sports Med. 2019 Jan 1;4(1):1-7. PMID: 30828640; PMCID: PMC6392189.

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Clinical Approaches

How to measure exercise
Glucose patterns & exercise
Adjusting treatment regimens
Minmizing 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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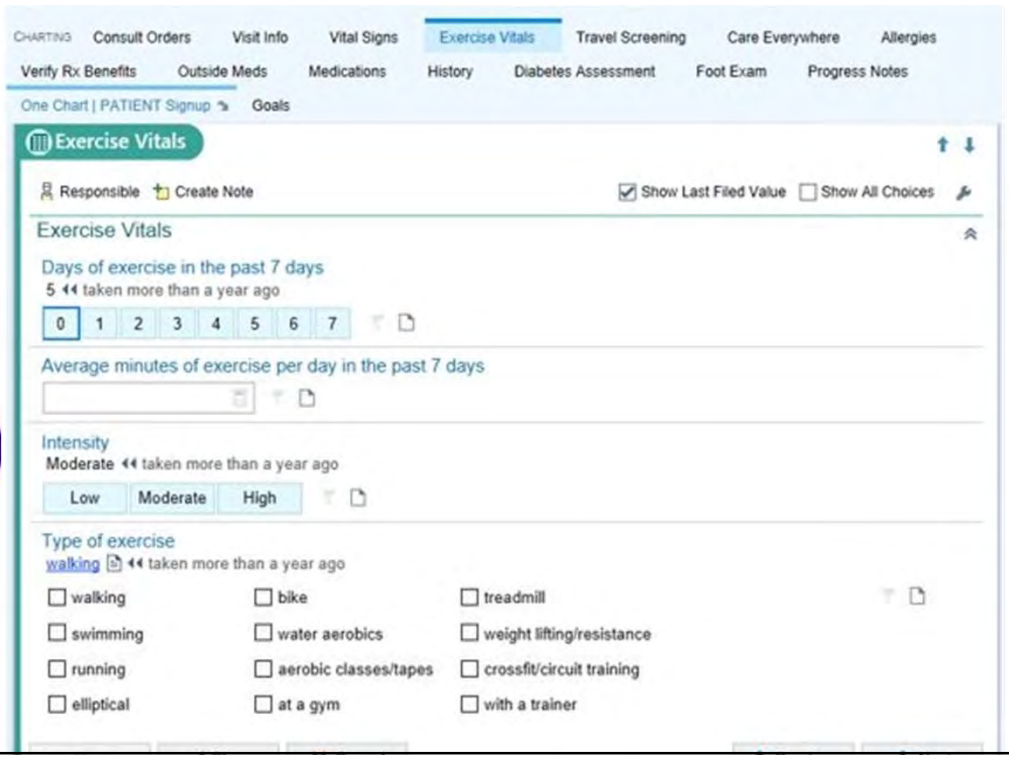
1. Days Per Week?
2. Minutes Per Day?
3. Intensity
4. Activity Type?



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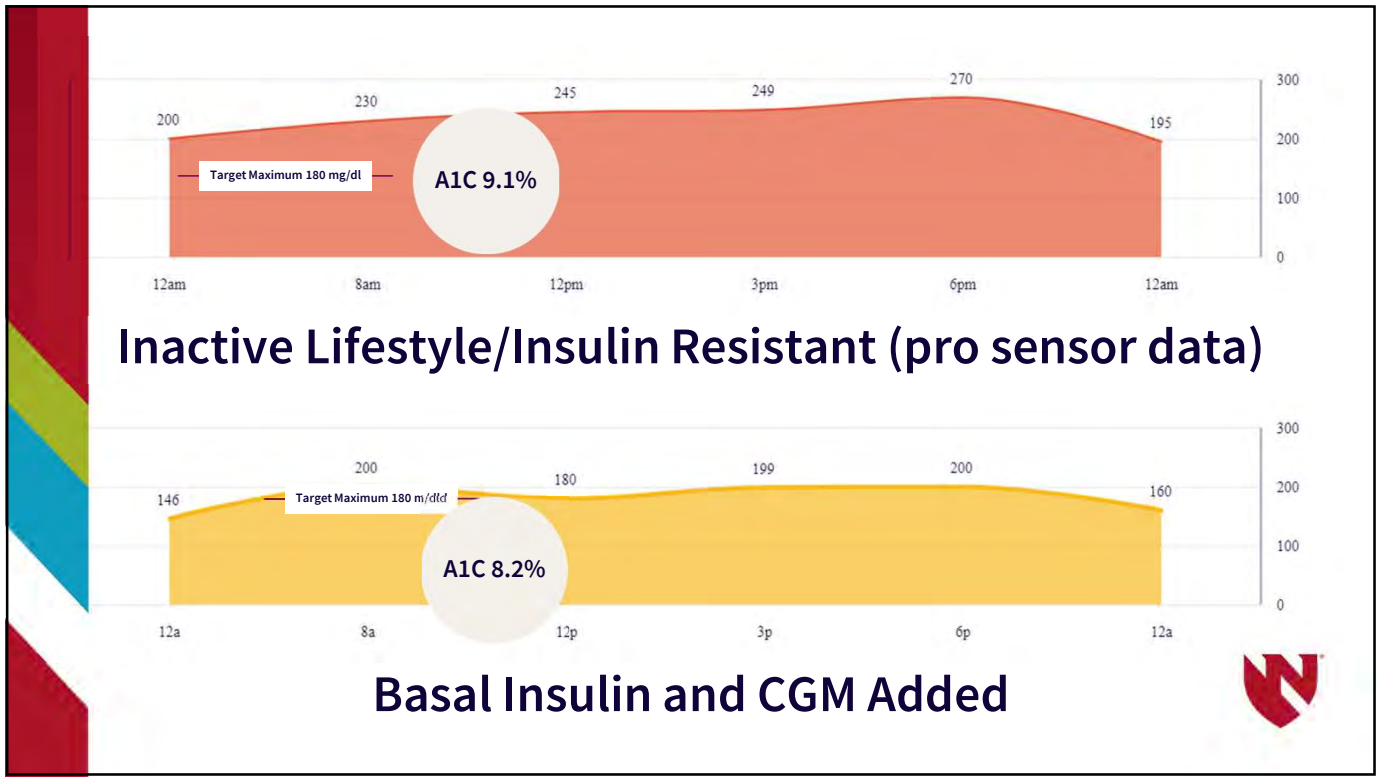

Inactive Lifestyle/Insulin Resistant (pro sensor data)

Basal Insulin and CGM Added

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Stagnant Glucoses -Inactive

Active Day

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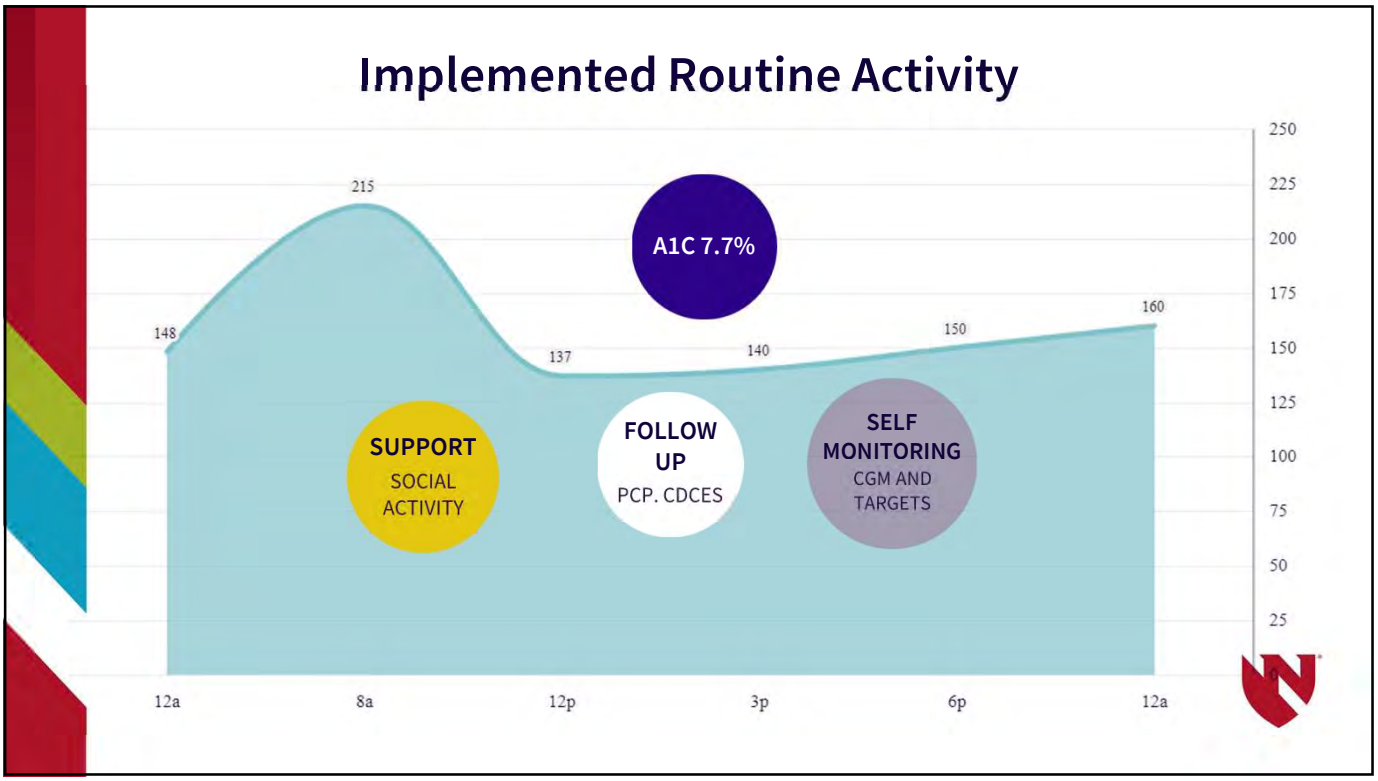

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Considerations based on med class

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

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

GLUCOSEZONE

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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 Website

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

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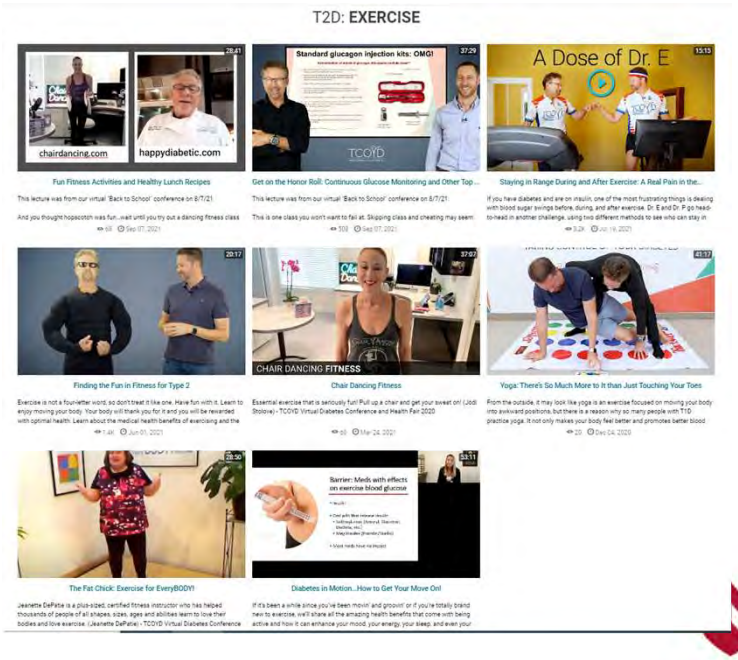
TCOYD Video Vault



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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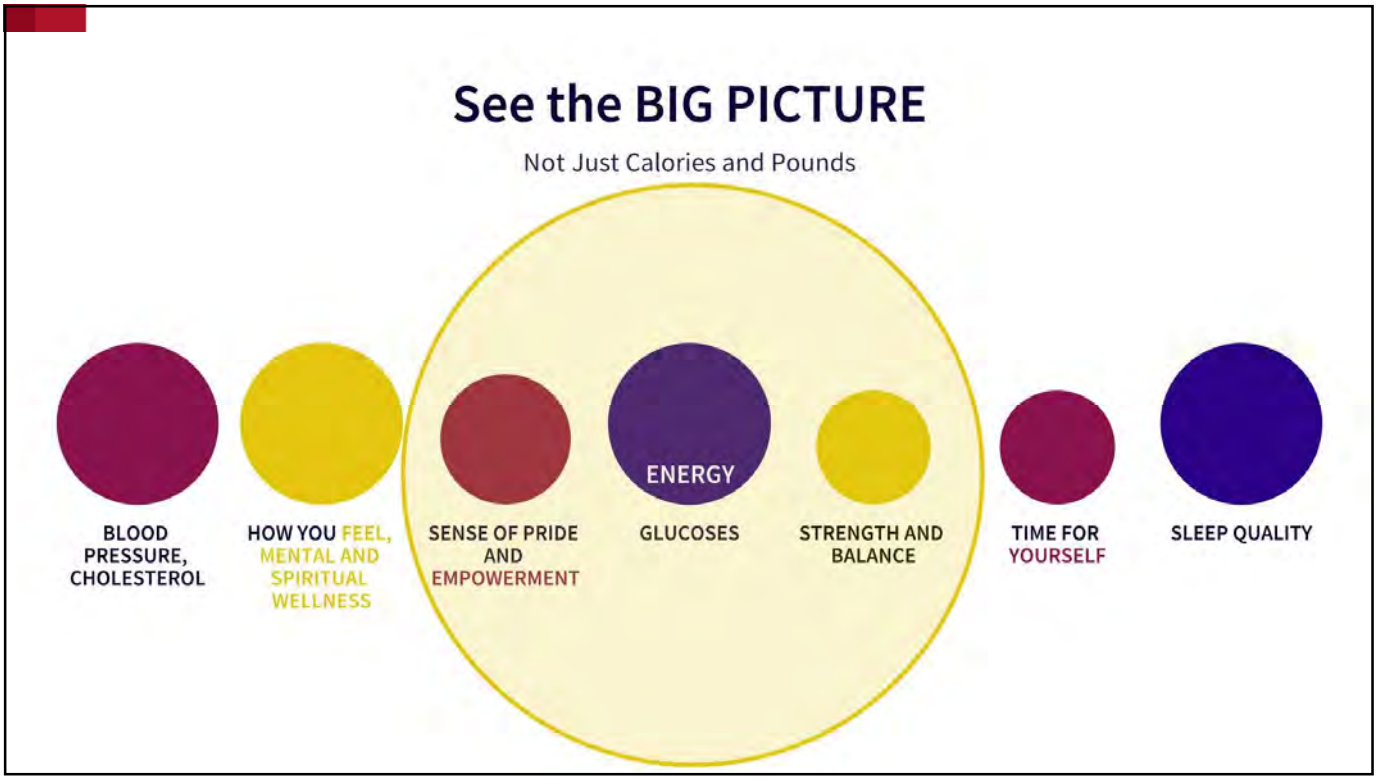

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Thank you!

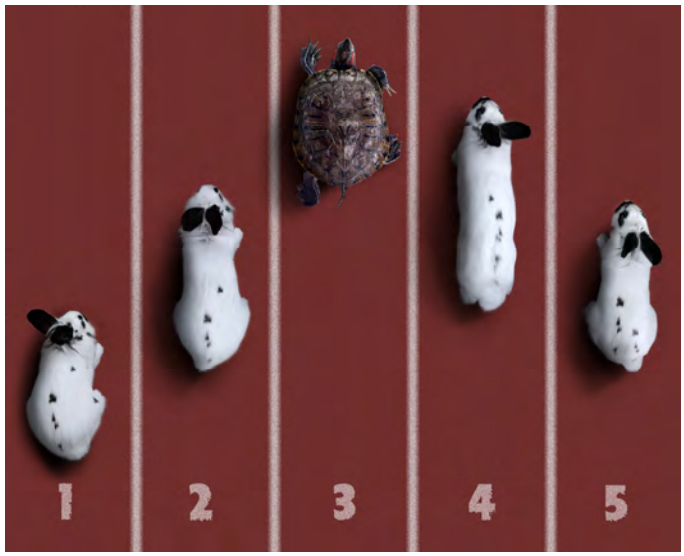

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Table 3—Exercise training recommendations: types of exercise, intensity, duration, frequency, and progression

	Aerobic	Resistance	Flexibility and Balance
Type of exercise	• Prolonged, rhythmic activities using large muscle groups (e.g., walking, cycling, and swimming) • May be done continuously or as HIIT	• Resistance machines, free weights, resistance bands, and/or body weight as resistance exercises	• Stretching: static, dynamic, and other stretching; yoga • Balance (for older adults): practice standing on one leg, exercises using balance equipment, lower-body and core resistance exercises, tai chi
Intensity	• Moderate to vigorous (subjectively experienced as "moderate" to "very hard")	• 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)	• Stretch to the point of tightness or slight discomfort • Balance exercises of light to moderate intensity
Duration	• At least 150 min/week at moderate to vigorous intensity for most adults with diabetes • 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	• 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	• Hold static or do dynamic stretch for 10−30 s; 2−4 repetitions of each exercise • Balance training can be any duration
Frequency	• 3–7 days/week, with no more than 2 consecutive days without exercise	• A minimum of 2 nonconsecutive days/week, but preferably 3	• Flexibility: ≥2−3 days/week • Balance: ≥2−3 days/week
Progression	• A greater emphasis should be placed on vigorous intensity aerobic exercise if fitness is a primary goal of exercise and not contraindicated by complications • Both HIIT and continuous exercise training are appropriate activities for most individuals with diabetes	• 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 • Increase in resistance can be followed by a greater number of sets and finally by increased training frequency	• Continue to work on flexibility and balance training, increasing duration and/or frequency to progress over time

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 duration	
Exercise intensity	30 min	60 min
Mild aerobic (~25% VO_{2max})	−25%*	−50%
Moderate aerobic (~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)	• 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 (<30 min) or at a very high intensity (weight training, interval training, etc.) may not require any additional carbohydrate intake. • 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.
90–150 mg/dL (5.0–8.3 mmol/L)	• 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.
150–250 mg/dL (8.3–13.9 mmol/L)	• Initiate exercise and delay consumption of carbohydrate until blood glucose levels are <150 mg/dL (<8.3 mmol/L).
250–350 mg/dL (13.9–19.4 mmol/L)	• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present. • Initiate mild-to-moderate intensity exercise. Intense exercise should be delayed until glucose levels are <250 mg/dL because intense exercise may exaggerate the hyperglycemia.
≥350 mg/dL (≥19.4 mmol/L)	• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present. • If ketones are negative (or trace), consider conservative insulin correction (e.g., 50% correction) before exercise, depending on active insulin status. • Initiate mild-to-moderate exercise and avoid intense exercise until glucose levels decrease.

Adapted from Zaharieva and Riddell (88).

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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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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