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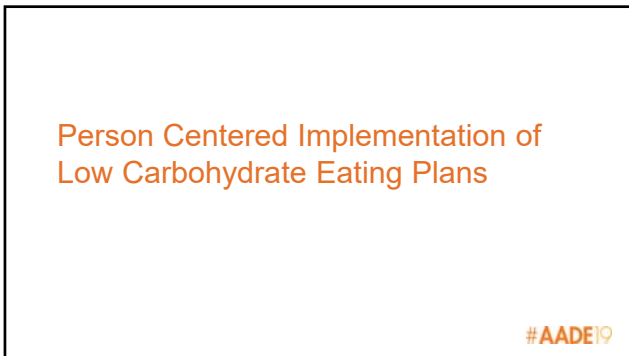
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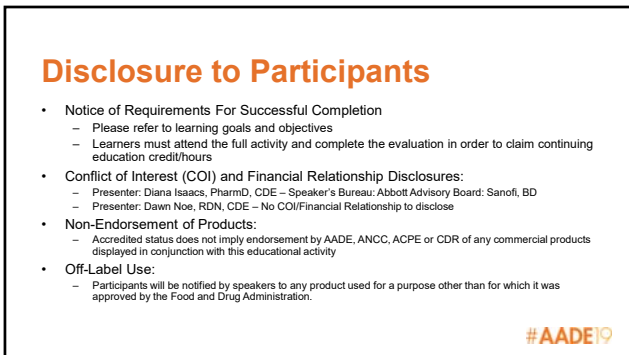
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**Learning Objectives**

- Describe the evidence for low carbohydrate meal plans for people with diabetes.
- Review low carbohydrate eating patterns and how they can be incorporated into diabetes care.
- Discuss cases and medication adjustments for people with diabetes following a low carbohydrate lifestyle.

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**Nutrition Therapy for Adults with Diabetes or Prediabetes: A Consensus Report**

- There is not an ideal percentage of calories from carbohydrate, protein, and fat...macronutrient distribution should be based on individualized assessment of current eating patterns, preferences, and metabolic goals.
- The amount of carbohydrate required for optimal health in humans is unknown.
- For select adults with type 2 diabetes not meeting glycemic targets or where reducing antidiabetic medications is a priority, **reducing overall carbohydrate intake with low or very low carbohydrate eating plans is a viable approach**

Evert AB et al. Diabetes Care 2019;42:731-754

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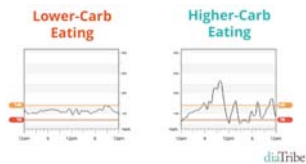
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## The Evidence for Low Carb

- Type 2 Diabetes
  - ↓ A1C/glucose
  - ↓ Blood Pressure
  - ↓ Weight
  - ↑ HDL/ ↓ Trig
  - Long-term outcomes



- Type 1 Diabetes
  - Minimal Data - Clinical Trials Needed
  - Survey of the TYPEONEGRIT Facebook Community
    - Of 316 respondents, 131 (42%) were parents of children with T1DM

Evert AB et al. Diabetes Care 2019;42:731-754  
 Lennerz BS, Barton A, Bernstein RK, et al. Management of Type 1 Diabetes With a Very Low-Carbohydrate Diet. Pediatrics. 2018;141(6):e20173349

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## Defining Low Carb

- Lower carb meal plans
  - Meta-analysis of RCT: ≤ 45% of calories
    - A1C benefits more pronounced in VLC (≤ 26%) at 3-6 months
  - Meta-analysis of RCT: < 40% of calories
  - Ketogenic meal plans are typically 5-10% of calories (~20-50 grams carbs per day)



Table 4

Calories	10%	20%	30%	40%	50%	60%	70%
1,200	30 g	60 g	90 g	120 g	150 g	180 g	210 g
1,500	38 g	75 g	113 g	150 g	188 g	225 g	263 g
2,000	50 g	100 g	150 g	200 g	250 g	300 g	350 g
2,500	63 g	125 g	188 g	250 g	313 g	375 g	438 g

Evert AB et al. Diabetes Care 2019;42:731-754

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## Teaching Low Carb

- Sample menus/grocery lists
- Food Lists
- Carb counting and food label reading
- Plate Method
- Recipes
- Low carb alternatives
- Track Macronutrients
- Eating patterns (vegetarian, gluten free, Mediterranean, Paleo)



Serving size →  
 Total Carbohydrate →

Nutrition Facts	
Serving Size	100 g (1)
Servings per container	1
Amount Per Serving	
Calories	
Calories from Fat	% 100
Total Fat	1.54mg
Saturated Fat	1g
Cholesterol	10mg
Sodium	400mg
Total Carbohydrate	14g
Dietary Fiber	2g

### What are some ideas for healthy carb choices (30-45 grams per meal)?



- Breakfast:
- 1 slice, Greek yogurt
  - 1 cup raspberries
  - 1/2 cup almonds
  - coffee or tea

- Lunch:
- 1/2 cup, feta salad with
  - 2 tbsp, light mayonnaise
  - 1/2 whole, wheat, rice bowl
  - 1/2 cup, cucumber slices, cherry tomatoes
  - 1 light string, chicken
  - 1 apple
  - unsweetened iced tea

- Dinner:
- 2-4 oz, baked turkey cut
  - 1/2 cup, spinach with 1 Tbsp, olive oil almonds
  - 1/2 cup, asparagus
  - 1 cup, fresh strawberries with low fat whipped topping
  - unsweetened green tea



Chick Pea Pasta

Ingredient	Weight	% Daily Value	% Daily Value
Whole Wheat Flour	100g	20%	20%
Water	100g	2%	2%
Salt	1g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%
Whole Wheat Flour	100g	20%	20%

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### Teaching Low Carb

Pasta and Alternatives

<p>Spaghetti (16 oz) 44g (79 kcal) 24g (230 kcal) 7g (51 kcal)</p>	<p>Angel Hair Pasta + Zucchini (17 oz) 19g (79 kcal) 14g (230 kcal) 1g (51 kcal)</p>	<p>Whole-Grain Spaghetti (17 oz) 23g (79 kcal) 24g (230 kcal) 7g (51 kcal)</p>	<p>Linguine made from Chickpeas (2oz) 19g (79 kcal) 24g (230 kcal) 7g (51 kcal)</p>
<p>Spaghetti Squash (16 oz) 14g (79 kcal) 14g (230 kcal) 1g (51 kcal)</p>	<p>Organic Edamame Spaghetti (17 oz) 19g (79 kcal) 14g (230 kcal) 1g (51 kcal)</p>	<p>Zucchini Spaghetti (17 oz) 19g (79 kcal) 14g (230 kcal) 1g (51 kcal)</p>	<p>Tofu Shirataki (17 oz) 19g (79 kcal) 14g (230 kcal) 1g (51 kcal)</p>

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### Teaching Low Carb – Make it Easy!

Breakfast Ideas      Snacks      Lunch/Dinner Ideas

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### Clinical Pearls for Providing Support

- Real food when possible
- Options when convenience needed
- Consider discussing the carb foods that the PWD already eats and find a way to make these a bit less carb/sugar and more whole grain, etc.
  - Ex: flavored sweetened yogurt → plain yogurt, add own vanilla, berries, etc.
- Address and assess for hunger - emphasize protein, fiber, fat for satiety

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## Ketogenic Meal Plan



or better yet...

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## Well Formulated Ketogenic Meal Plans



Source: <https://www.dietdoctor.com/low-carb/keto>

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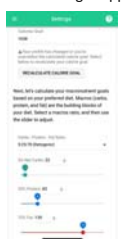
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## Ketogenic Meal Plans

- ~20-50 grams carbs per day
  - 5-10% Carbohydrates
  - 70-85% Fat
  - 10-25% Protein
- Adequate electrolyte supplementation
  - Sodium – 2,000-5,000 mg per day
  - Potassium
  - Magnesium
- Sample plans, food lists, recipes, and pictures, Carb Counting, Tracking Macronutrients

Carb Manager App



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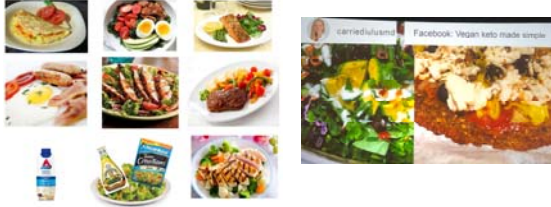
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# Ketogenic Meal Plans

Examples of breakfast, lunch, and dinner:



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# Ketogenic Meal Plans – Keep It Simple

**Vegetables**  
 Vegetables are a good source of fiber, vitamins, and minerals.

Asparagus	Eggplant	Kale
Broccoli	Green Beans	Spinach
Cauliflower	Leeks	Sweet Potato
Cheese	Mushrooms	Tomato
Cucumber	Onions	Turnips
Lettuce	Parsnips	Winter Squash
Peas	Spinach	Zucchini
Spinach	Tomatoes	
Swiss Chard		
Vegetables		

**Protein Foods**  
 Protein foods are the main source of energy and help build muscle.

Chicken	Salmon	Beef
Eggs	Shrimp	Pork
Turkey	Ground Beef	Ham
Ham	Hot Dogs	Hot Wings
Hot Wings	Hot Wings	Hot Wings
Hot Wings	Hot Wings	Hot Wings
Hot Wings	Hot Wings	Hot Wings
Hot Wings	Hot Wings	Hot Wings
Hot Wings	Hot Wings	Hot Wings
Hot Wings	Hot Wings	Hot Wings

**Fats**  
 Fats are a good source of energy and help build muscle.

Avocado	Butter	Coconut Oil
Flaxseed Oil	Grass-fed Butter	Grass-fed Lard
Grass-fed Lard	Grass-fed Tallow	Grass-fed Tallow
Grass-fed Tallow	Grass-fed Tallow	Grass-fed Tallow
Grass-fed Tallow	Grass-fed Tallow	Grass-fed Tallow
Grass-fed Tallow	Grass-fed Tallow	Grass-fed Tallow
Grass-fed Tallow	Grass-fed Tallow	Grass-fed Tallow
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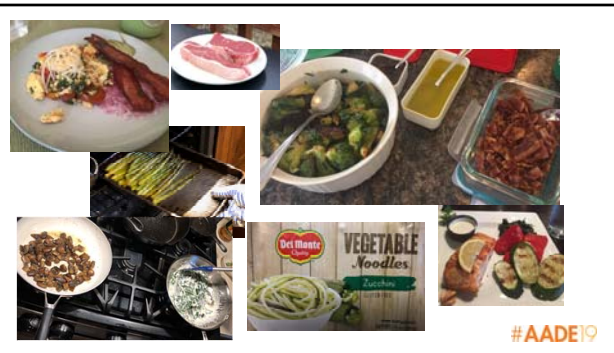
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## Ketogenic Meal Plans Common Side Effects and Clinical Pearls

- Recommend a multivitamin
- Muscle Cramping:
  - Drink 64 ounces of water per day
  - Add Potassium/Magnesium
- "Keto Flu" Dizziness
  - Electrolyte drinks and/or broth for added salt/iodium
- Hunger the first week
  - Enjoy fat/proteins until satiety, especially at the beginning
- How much fat/calories?
  - Eating fat until satisfied and/or limiting fat and total calories for weight management
- Screening for eating disorders prior to starting a ketogenic meal plan and re-assess as needed
- Dry mouth, funny taste in the mouth
  - Normal - You're in ketosis!
- Minimize Risk of Hypoglycemia



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## Transitioning to Low Carb But Not Keto Meal Plan

Sara's Grocery List and Meal Plan

Protein	Carbs	Vegetables
Chicken for grilling Hamburger - no bun or 1/2 bun Cheese Shredded cheese Hard boiled eggs Tuna Fish Salad Scrambled eggs	Oven Fries Baked potato Hash browns for Sunday breakfast 1/2 English Muffin Sesame Pita Bread Spanish rice	No mushrooms, artichokes, olive, green/red pepper (heartburn), tomatoes Cauliflower rice, celery, kale, carrots, broccoli, cauliflower, asparagus, cabbage, green beans, onions, salad greens, summer squash, zucchini, lettuce

**Fats, sauces, gravies, salad dressings, spreads**

Butter  
Mayo  
Olives  
Bacon

**Extras:**  
Lemon Juice  
Wine  
Ketchup/pickles

**Meal Ideas:**

1. Grilled chicken, 1/2 baked potato, butter, broccoll, cauliflower carrot mix
2. Egg, 1/2 English Muffin
3. Tuna salad with lemon juice on 1/2 pita bread
4. Hamburger, no bun, meat fries, vegetable (broccoli mix) or green beans or squash/zucchini
5. Chicken fajita with olives, salsa, shredded cheese, lettuce, Spanish Cauliflower Rice, Low Carb wrap

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## Clinical Pearls for Providing Support

- Real food when possible
- Options when convenience needed
- Options for favorite foods
  - Pizza!
  - Keto dessert ideas
  - Recipes
- Address and assess for hunger - emphasize protein, fiber, fat for satiety
- Emphasize electrolyte needs
- Handling vacations, planning purposeful breaks if needed, emotional/stress eating



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### Medication Adjustments with Low Carb Eating

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### Nutrition Guidelines

- Adopting a VLC eating plan can cause diuresis and swiftly reduce blood glucose;
- Consultation with a knowledgeable practitioner at the onset is necessary to prevent dehydration and reduce insulin and hypoglycemic medications to prevent hypoglycemia.

Evert AB et al. Diabetes Care 2019;42:731-754

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### Medication Adjustments in Type 2

- Limit medications that cause hypoglycemia
  - Insulin
  - Sulfonylureas
  - Meglitinides
- Other medications likely not needed/preferred
  - Alpha glucosidase inhibitors (prevent carbohydrate digestion)
  - TZD (cause weight gain)

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### Ketogenic: Meds to Stop



- Sulfonylurea
- Meglitinide
- Meal time insulin
- Combo insulins: 70/30
- Alpha glucosidase inhibitors

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### Ketogenic: Meds to Use Caution



- SGLT-2 inhibitors
- Long acting insulin
- Insulin U500
- TZD (weight gain)

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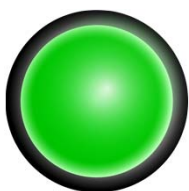
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### Ketogenic: Meds are Ok



- Metformin
- GLP-1 agonist
- DPP-4 inhibitors

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### Medication Adjustments in Type 1

- Basal: 20-50% decrease
- Bolus: may need to intensify carb ratio, bolus for protein?
- Close follow-up
- Monitor ketones
- Avoid SGLT-2 inhibitor
- Caution with hybrid closed-loop pumps

Eiswerth M et al. Endocrinol Diabetes Metab Case Rep. 2018; 18:0002. Krebs JD et al. Asia Pacific Journal of Clinical Nutrition 2016; 25: 78-84. Nielsen JV et al. Upsala Journal of Medical Sciences 2005; 110: 267-273.




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### Blood Pressure Medications

- Initial diuretic effect
- Consider halving or stopping diuretic (ex. HCTZ or chlorthalidone)
- Monitor blood pressure

Hussain TA et al. Nutrition 28 (2012) 1016-1021  
Evert AB et al. Diabetes Care 2019;42:731-754




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### Case: Meet Sally



- Sally is a 52 year old female with type 2 diabetes
- A1C=6.4%, BMI=40kg/m<sup>2</sup>, normal kidney function
- Co-morbidities: hypertension, fatty liver, obesity
- Medications:
  - Insulin glargine 50 units qpm
  - Liraglutide (Victoza) 1.8mg daily
  - Metformin ER 2000mg daily
  - Acarbose 50mg before meals 3 times daily
  - Glimepiride 4mg daily
  - Insulin lispro (Humalog) 15 units at meals 3 times daily




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### Sally's CGM Data

- Sally is now following a ketogenic diet. She reports losing 10lbs over 3 weeks and is in ketosis. She stopped her insulin lispro and continues to take the other meds.




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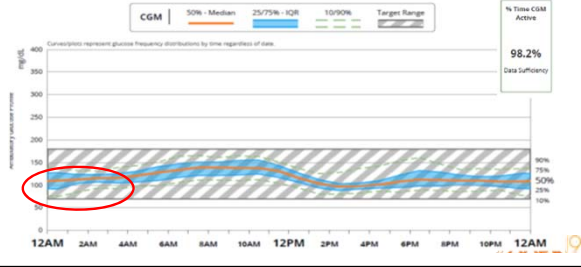
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### Sally's Ambulatory Glucose Profile




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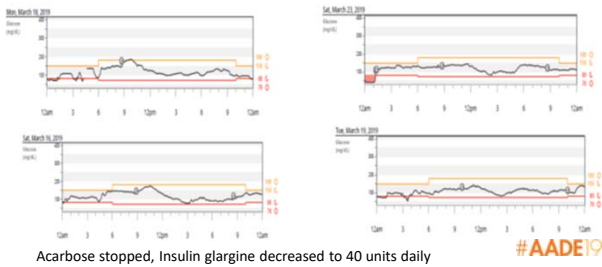
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### Focusing on the Lows




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### After 6 weeks, Sally Has Lost 17 lbs



- Insulin glargine decreased to 20 units
- Metformin, Liraglutide, Glimepiride continued

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### Two Months Later (3.5 months total)

- Working with diabetes educator for bi-weekly nutrition and medication adjustments
- Sally lost 31 lbs
- Meds: metformin, liraglutide
- Stopped insulin glargine and glimepiride
- No hypoglycemia
- A1C=6.2%
- Sally is very happy ☺

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### Summary

- New evidence and guidelines support benefits of low carbohydrate meal plans in diabetes.
- The diabetes educator plays an important role in support the PWD in these plans.
- Medications should be frequently evaluated and adjusted to avoid hypoglycemia.

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