# Hot Topics in Diabetes
# Ketogenic Diets

## What do Health Care Professionals Need to know?

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Waterloo Wellington Diabetes

WaterlooWellington
DIABETES

# Faculty/Presenter Disclosure

- **Faculty/Presenter: Wendy Graham**

- **Relationships with commercial interests:** *(grants/research support, consulting fees, etc.)*
  - sanofi

# Disclosure of Financial Support

***I am not receiving an honorarium for this event***

***No potential conflict of interest***

# Mitigating Potential Bias

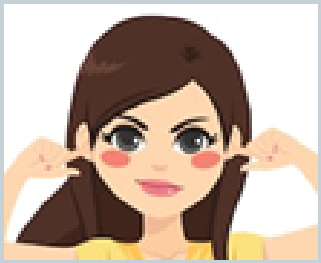
***No known biases.***

# Where are you starting?

## Knowledge

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| None | Limited | Basic | Good | Expert |

# Where are you starting?

1

2

3

4

# Help patients do keto safely

# Objectives

- Recognize the difference between low carbohydrate and ketogenic diet.
- Discuss the current research on the ketogenic diet and diabetes.
- Describe the contraindications and nutrient supplementation required.

# Ketogenic diet is?

A ketogenic diet is:

1) The same as low carbohydrate
2) The addition of butter and bacon to regular intake
3) A  diet high in fat and low in carbohydrate
4) Excludes all vegetables and fruit

# Ketogenic Diet

What is it?

| | | |
|---|---|---|
| Very Low Carbohydrate | 20-50 g/day | (2-10%) |
| High Fat | | (70- 90%) |
| Protein | | (6-20%) |

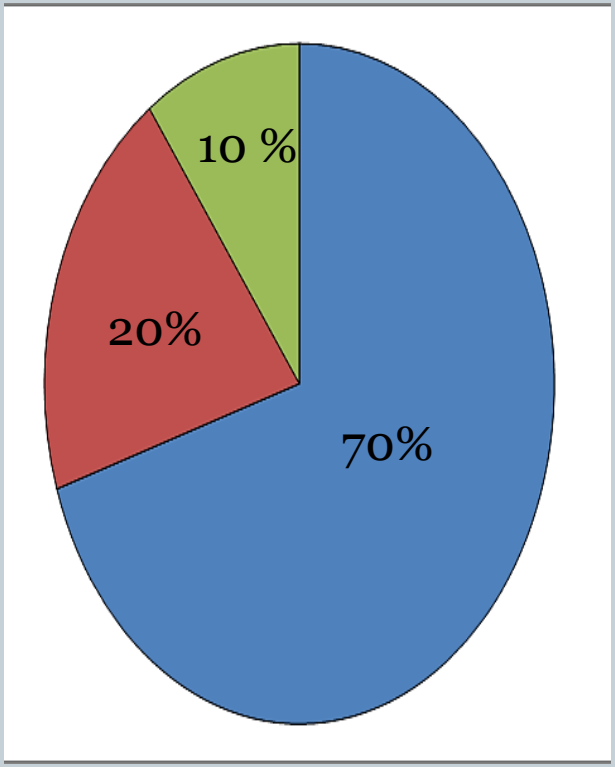
Fat: Carb+Protein

4:1

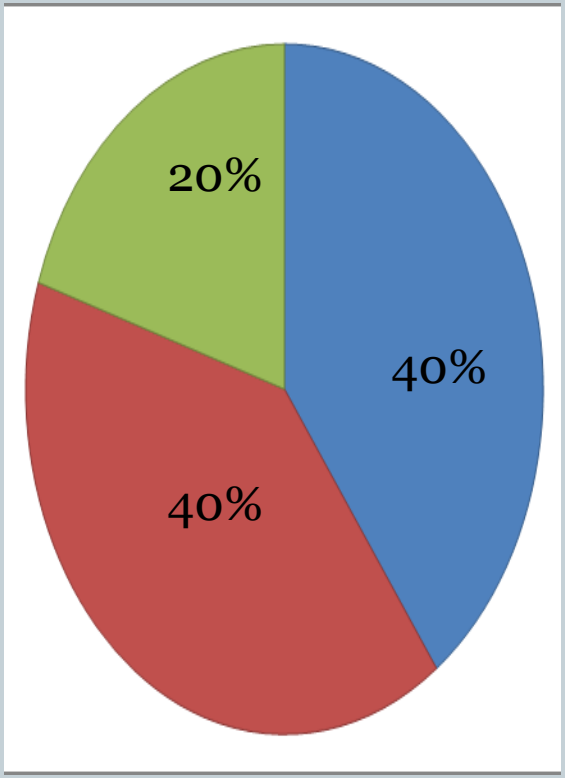
3:1

# Macronutrient Distribution

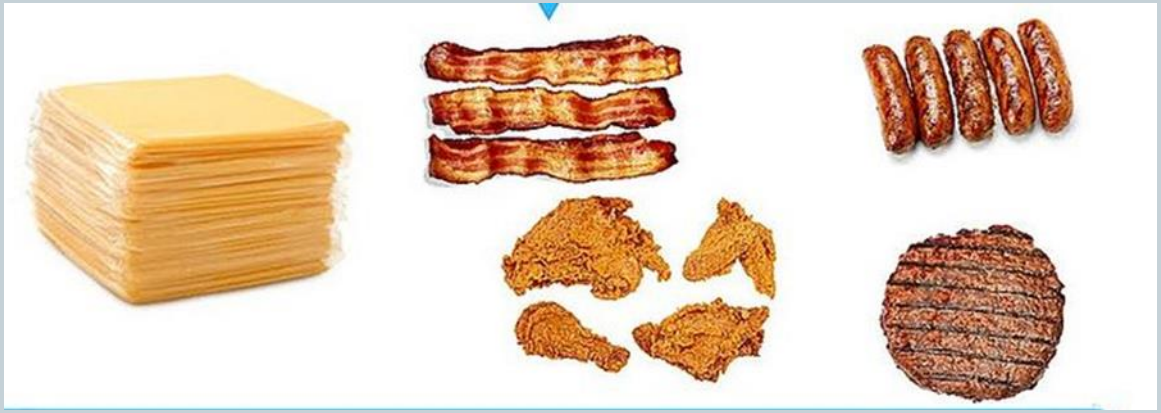
## Ketogenic

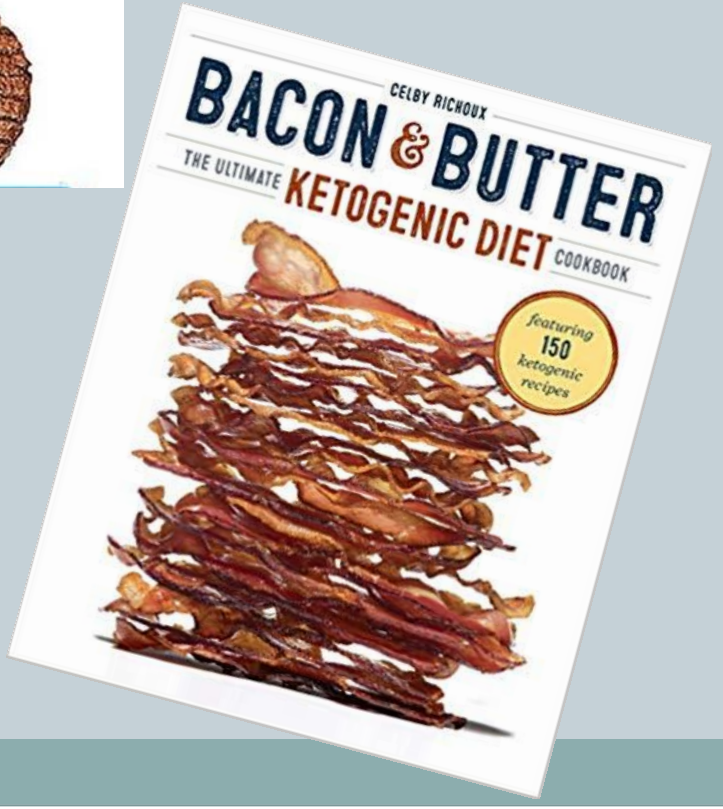



## Low Carbohydrate



# People think Keto is…..





# Keto Diet Sample  Lunch Meals Ratio 3:1

½ tomato
100g cucumber
2 oz cheese
2 oz kolbassa
12 olives
1 ½ large radish
<u>3 Tbsp oil</u>
7.7 g carb
20 g protein
75.6 g fat
791 calories

2 oz tuna oil packed
1 laughing cow cheese
2 c chopped romaine
80 g cucumber
¼ tomato
2 Tbsp mayonnaise
3 Tbsp olive oil
<u>Lemon juice/vinegar</u>
5.8 g carb
12.1 g protein
52.4  g fat
534 calories

# Keto Diet Sample Dinner Menu Ratio 3:1

3 oz BBQ chicken
1 c mashed cauliflower
with 3Tbsp butter
3 Tbsp oil
½ oz macadamia nuts
½ c yellow beans
6.9g carb
23.5g protein
94.5g fat
972 calories

2oz salmon
1 c grated cauliflower
½ portabello mushroom
½ c green beans
1 c almond milk
12 olives
2 Tbsp cream cheese
3 Tbsp olive oil
7.6 g carb
15 g protein
63.3 g fat
660 calories

# Guidelines

American Diabetes Association May 2019

- Reducing overall carbohydrate intake for people with diabetes has “the most evidence” for improving blood sugars.

- *Very low carbohydrate –ketogenic diet can be considered in* *Select* Adults with type 2 diabetes if
  - A1c not at target
  - Priority is reducing medications

Evert et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. Diabetes Care 2019 May; 42(5): 731-54.

# Guidelines

American Diabetes Association May 2019 (cont'd)

- Very low carbohydrate (ketogenic)
  - ↓A1c
  - ↓Weight
  - ↓Blood pressure
  - ↑HDL
  - ↓Triglycerides

Evert et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. Diabetes Care 2019 May; 42(5): 731-54.

# Guidelines

Practice-Based Evidence in Nutrition (PEN)

Ketogenic diet in type 2 diabetes for 3-6 months:

↓A1c

↓BMI, waist circumference

↓Diabetes medications

*Statement conditional on low quality evidence*

Dietitians of Canada.Ketogenic Diet Effects on Glycemic Control in Type 2 Diabetes in Practiced-based Evidence in Nutrition[PEN]; 2019 July. Available from www.pennutrition.com. Access only by subscription.

# Guidelines

## Italian Society of Endocrinology May 2019

Very Low Calorie Ketogenic Diet(VLCKD), recommended in Insulin resistant Type 2 Diabetes (preserved β cell function)

- Early glycemic control in obese, short duration
- Reduce the use of glucose lowering medications

Caprio M et al. Very-low-calorie ketogenic diet (VLCKD) in the management of metabolic diseases: systematic review and consensus statement from Italian Society of Endocrinology. Journal of Endcrinological Investigattion 2019 May 20. doi: 10.1007/s40618-019-01061-2. Downloaded September 2019.

**Italian Society of Endocrinology May 2019**

VLCKD- Three phases

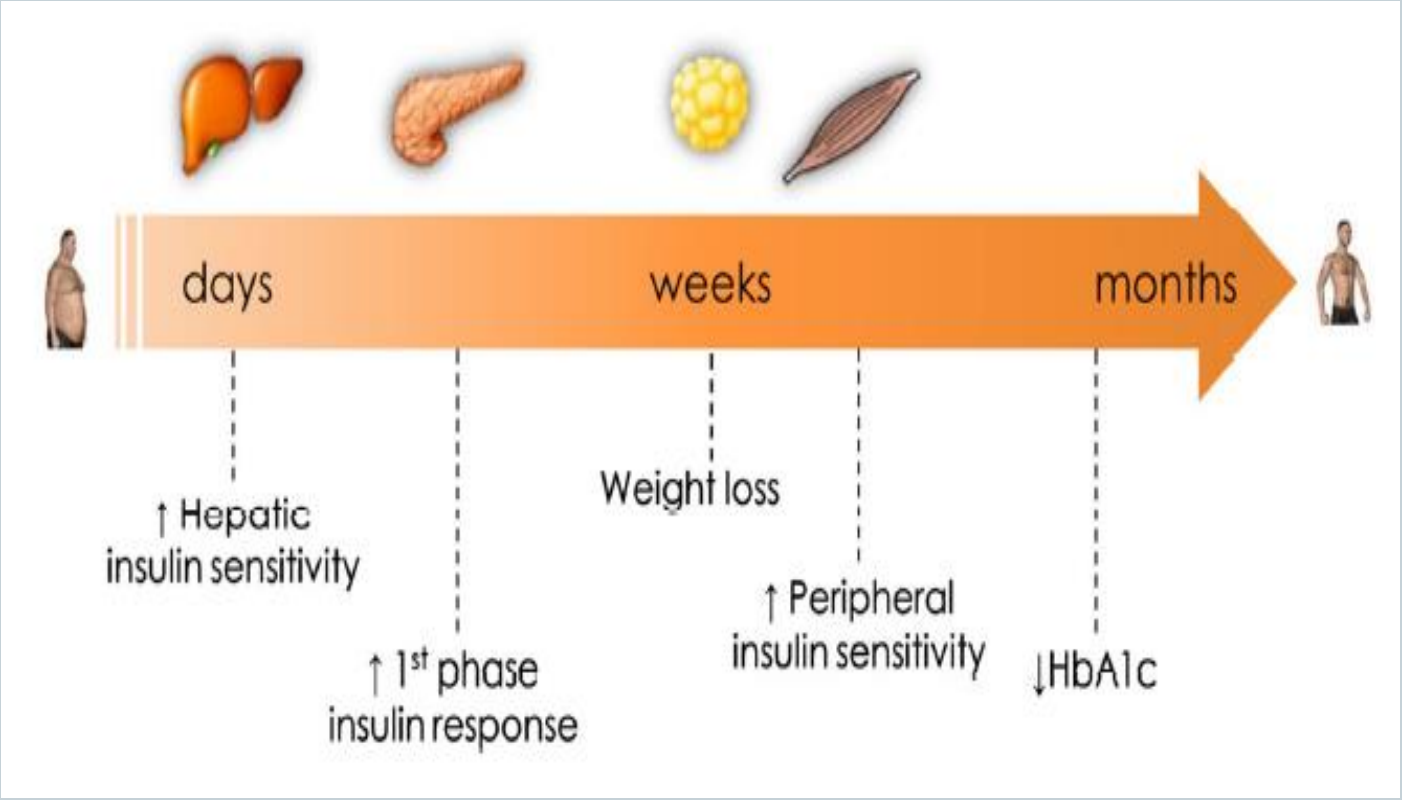
1. Protein preparation and vegetables
2. Protein foods added
3. Protein foods and meals

} 600-800 calories

Duration 8-12 weeks

# Effects of VLCKD on Metabolic Parameters

## Italian Society of Endocrinology May 2019

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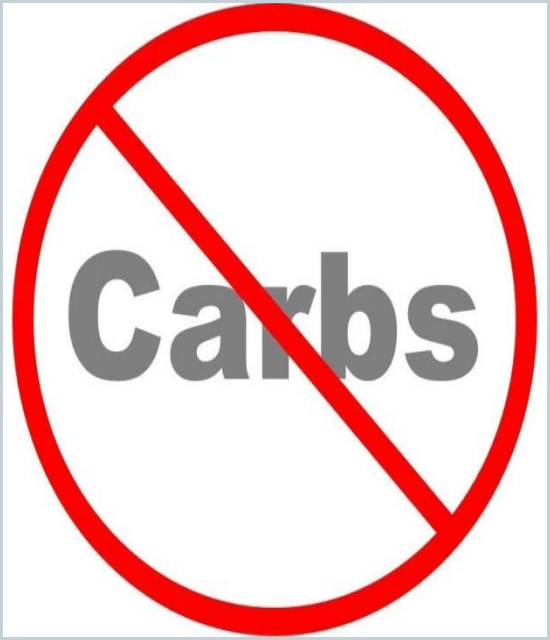
# Physiology




No carbohydrate….no problem

The alternate fuel sources

"Ketone bodies"

3 days
Nutritional
ketosis

# What is the evidence?

# Evidence

research letter

*Diabetes, Obesity and Metabolism* 16: 90–93, 2014.


**Two diets with different haemoglobin A1c and antiglycaemic medication effects despite similar weight loss in type 2 diabetes**

N= 22, 44 weeks

ORIGINAL ARTICLE

Short-term safety, tolerability and efficacy of a very low-calorie-ketogenic diet interventional weight loss program versus hypocaloric diet in patients with type 2 diabetes mellitus

A Goday[1,2,3], D Bellido[4], I Sajoux[5], AB Crujeiras[6,7], B Burguera[8,9], PP García-Luna[10], A Oleaga[11], B Moreno[12] and FF Casanueva[6,7]

RCT, N=45, 16 weeks Retention 64%

ORIGINAL ARTICLE

**Effects of an energy-restricted low-carbohydrate, high unsaturated fat/low saturated fat diet versus a high-carbohydrate, low-fat diet in type 2 diabetes: A 2-year randomized clinical trial**

Jeannie Tay PhD[1,2,6] | Campbell H. Thompson MD[2] | Natalie D. Luscombe-Marsh PhD[1] | Thomas P. Wycherley PhD[3] | Manny Noakes PhD[1] | Jonathan D. Buckley PhD[3] | Gary A. Wittert MD[2] | William S. Yancy Jr MD[4,5] | Grant D. Brinkworth PhD[1]

RCT, N=61, 2 years Retention 53%

# Evidence

**Medication Effect Score(MES)**

- % of medications maximum dose
- Multiplied by adjustment factor

## Results

- ↓A1c ( 0.6-0.7%)
- Medication reduction
  - greater than 50% MES reduction in 70% of patients
- Improvement in lipids
- ↓Weight

Goday et al. Short-term safety, tolerability and efficacy of a very low-calorie-ketogenic diet interventional weight loss program versus hypocaloric diet in patients with type 2 diabetes mellitus. Nutrition and Diabetes 2016 Sep; 6(9):e230. doi: 10.1038/nutd.2016.36
Mayers et al. Two Diets with Different Hemoglobin A1c and Antiglycemic Medication Effects Despite Similar Weight Loss in Type 2 Diabetes. Diabetes Obesity Metab 2014 Jan: 16(1): 10.1111/dom.12191. Accessed February 2019.
Tay, J et al. Effects of an energy-restricted low-carbohydrate, high un saturated fat/low saturated fat versus a high-carbohydrate, low fat diet in type 2 diabetes: A 2 year randomized clinical trial. Diabetes Obesity Metab 2018:20:858-71.

# Evidence ++Intervention

Saslow et al 2017

Online intervention comparing ketogenic diet vs plate method

Inclusion criteria for intervention:

- Willing to give up Carbohydrate foods
- "I see myself as someone who is dependable , self-disciplined (agree or strongly agree)

Saslow et al. An Online Intervention Comparing a Very Low-Carbohydrate Ketogenic diet and Lifestyle Recommendations versus a Plate Method Diet in Overweight Individuals with Type 2 Diabetes: A Randomized Controlled Trial. J Med Internet Res. 2017 Feb; Feb 19(2): e36

# Evidence ++Intervention

Saslow et al 2017

N=12 type 2 diabetes

Initial A1c 7%

32 weeks

Completion 92% vs 54 % plate method

Saslow et al. An Online Intervention Comparing a Very Low-Carbohydrate Ketogenic diet and Lifestyle Recommendations versus a Plate Method Diet in Overweight Individuals with Type 2 Diabetes: A Randomized Controlled Trial. J Med Internet Res. 2017 Feb; Feb 19(2): e36

# Evidence ++Intervention

Saslow et al 2017

Intervention group received:

- **Urine ketone testing kits**
- **Mindfulness training:**
  - Fullness
  - Cravings
  - Taste Satisfaction
  - Triggers for overeating
- **Behavior support:**
  - Physical activity
  - Adequate sleep
  - Developing self compassion
  - Setting Attainable Goals
  - Positive Reappraisal

# Evidence ++Intervention

Saslow et al 2017

Results:

| | 16 weeks | 32 weeks | Plate method |
|---|---|---|---|
| A1c | ↓0.9% | ↓0.8% | ↓0.5/0.4% |
| Weight | | ↓12.7 kg | ↓3 kg |

# Evidence ++Intervention

## Hallberg et al 2018; Athinarayanan et al 2019

**Individualized diet advice**

**Biomarker tracking tools:**

- weight scale, BP cuff (if had HTN),
- BG/ketone meter

**Access to web-based software app:**

- Health coaching & ongoing education
- Weekly f/u x 3 months, biweekly x 3 mos, monthly x 1 month

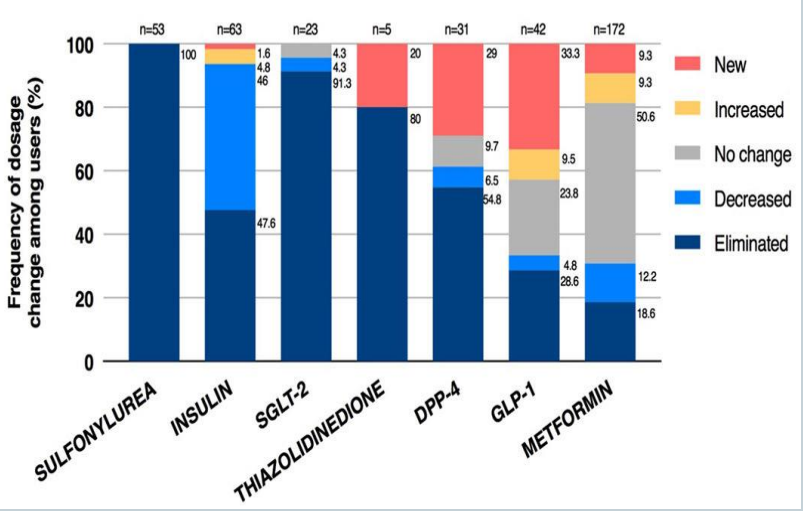
**Social Support via online peer community**


Initial A1c 7.6%

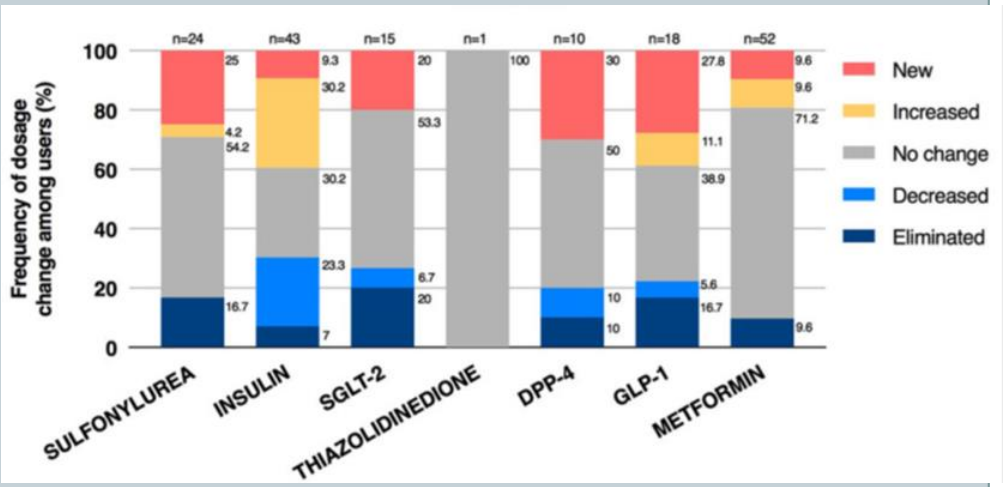
Hallberg S et al. Effectiveness and Safety of a Novel Care Model for the Management of Type 2 Diabetes at 1 year: An Open-Label, Non-Randomized, Controlled Study. Diabetes Therapy. 2018. https://doi.org/10.1007/s13300-018-0373-9
Athinarayanan et al. Long Term Effects of a Novel Continuous Remote Care Intervention Including Nutritional Ketosis for the Management6 of Type 2 Diabetes: A 2 year Non-randomized Clinical Trial. 2019 June 05.l Frontiers in Endocrinology doi 10:3389/fendo.2019.00348. Accessed July 2019.

# Medication Adjustment

## Intervention




## Usual Care




Hallberg S et al. Effectiveness and Safety of a Novel Care Model for the Management of Type 2 Diabetes at 1 year: An Open-Label, Non-Randomized, Controlled Study. Diabetes Therapy. 2018. https://doi.org/10.1007/s13300-018-0373-9

# Evidence ++Intervention

| | 1 year | 2 year |
|---|---|---|
| A1c | ↓1.3%* | ↓0.9%* |
| Weight | ↓13.8 kg | ↓11.9 |
| Diabetes reversal # | 60% | 53.5% |
| Retention | 83% | 74% |

*with medication reduction

#Diabetes reversal ( A1c < 6.5 with no medications other than metformin)

McKenzie A et al. A Novel Intervention including individualized nutritional recommendations Reduces hemoglobin A1c level, Medication Use, and weight in Type 2 Diabetes. JIMR Diabetes. 2017 Mar 7;2(1):e5. doi: 10.2196/diabetes.6981.
Hallberg S et al. Effectiveness and Safety of a Novel Care Model for the Management of Type 2 Diabetes at 1 year: An Open-Label, Non-Randomized, Controlled Study. Diabetes Therapy. 2018. https://doi.org/10.1007/s13300-018-0373-9
Athinarayanan et al. Long-term Effects of a Novel Continuous Remote Care Intervention Including Nutritional Ketosis for the Management of Type 2 Diabetes: A 2 year non-randomized Clinical Trial. Frontiers in Endocrinology.2019.doi:10.3389/fendo.2019.00348

# Limitations in Evidence

- Definitions vary
- Small sample size
- No control group
- High dropout rate
- Short term <3 year

# Summary of Results

- Reduction in A1c
- Reduction in triglycerides
- Improved insulin sensitivity
- Reduction in inflammation (CRP)
- Reduction in insulin resistance (HOMA-IR)
- Reduction in medication
- ?LDL

# Contraindications

- Renal stones
- Severe dyslipidemia
- Liver disease
- Severe esophageal reflux
- Cardiomyopathy
- Chronic metabolic acidosis
- Use of SGLT2 medications


Gupta L et al. Ketogenic diet in endocrine disorders:Currrent perspective. J Postgrad Med. 2017 Oct-Dec 63(4):2423-251.

# Contraindications

- Pregnancy and Breastfeeding
- Type 1 or LADA
- Infections
- Frail elderly
- Eating Disorders
- Recent stroke or MI within last 12 months
- Alcohol or substance abuse

Caprio M et al. Very-low-calorie ketogenic diet (VLCKD) in the management of metabolic diseases: systematic review and consensus statement from Italian Society of Endocrinology. Journal of Endcrinological Investigattion 2019 May 20. doi: 10.1007/s40618-019-01061-2. Downloaded September 2019.

# Contraindications


Potential concerns:

- Cholelithiasis
- Cognitive Impairment
- Disordered Eating
- Erratic Lifestyle
- Lack of Family Support
- Lack of Numeracy/Literacy
- Psychological Disorders
- Religious Fasting

# Initial Bloodwork/ Tests

- Albumin
- BUN
- Carnitine free/total
- Creatinine
- Electrolytes
- Glucose
- Lipid Profile
- Total Protein
- TSH*
- C peptide*

Kossoff E et al. Optimal clinical management of children receiving dietary therpies for epilepsy:Updated recommendations of the International Ketogenic Diet Study Group.Epilesia Open. 2018: 3(2):175-192.

- ECG

- Calcium
- Iron
- Selenium
- Vitamin D
- Zinc

- Acylcarnitine
- Urine organic acids
- Plasma amino acids

*Westman et al Implementing a low carbohydrate, ketogenic diet to manage type 2 diabetes mellitus. Expert Review of Endocrinology & Metabolism.2018:13(5):263-272.

# What about the Medications

- Insulin
- Sulfonylurea
- Antihypertensive agents
- Alpha-glucosidase inhibitors

Westman et al Implementing a low carbohydrate, ketogenic diet to manage type 2 diabetes mellitus. Expert Review of Endocrinology & Metabolism.2018:13(5):263-272.

# Nutritional Deficiencies

Supplement:

Vitamin D

Calcium

Thiamine

Vitamin C

Selenium

Fibre

Folate

# Pros

- Weight loss
- Decreased insulin resistance
- Anti inflammatory effect
- Improved blood glucose and insulin sensitivity
- Lower medications

# Side Effects- Mild

- “Keto Flu”
- Constipation
- Insomnia
- Backache
- Diarrhea & vomiting
- Halitosis

# Cons

- Potential for loss of body protein and skeletal muscle
- Increased oxidative stress
- Increased risk of lower GI disorders
- Increased acid load leading to bone loss
- Lipid profile changes?
- Nutritional deficiency diseases
- Ketoacidosis
- Decreased glycogen stores
  - Compromised physical activity
  - Recovery from hypoglycemia

# What do I do with my Patient?

- Assessment
  - What is Keto to them
  - Why Keto
- Contraindications
- Pros/Cons
- Referral to RD familiar with keto
- Blood work at initiation and every 3 months
- Medical tests at 1 year

# Resources

Websites

Matthew's friends

- https://www.matthewsfriends.org/

Charlie foundation

- https://charliefoundation.org/

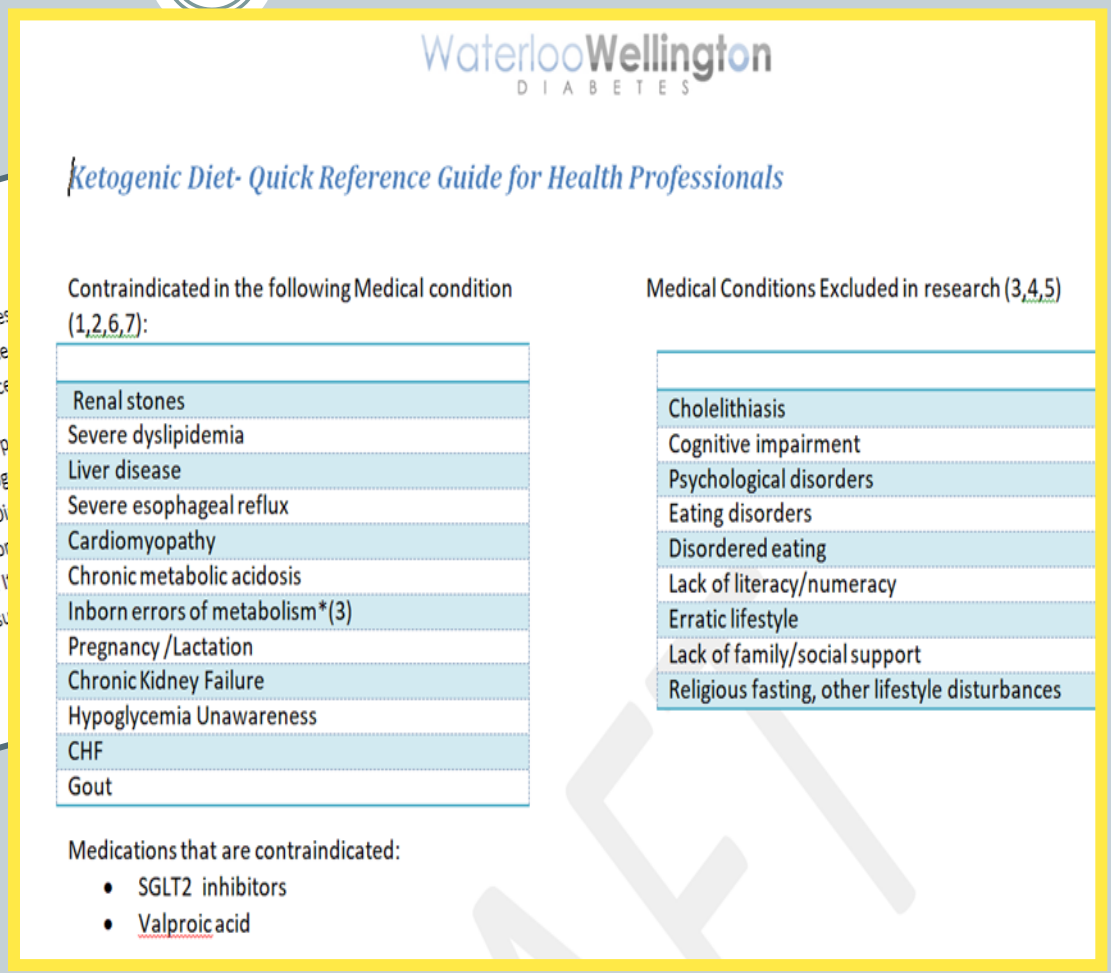
# Upcoming Resources

## Ketogenic Diet Overview

In recent years the ketogenic diet has gained popularity, being promoted by celebrities, popular pres
It promises weight loss, improved blood glucose and in some cases improved physical performance
diabetes are interested in this type of diet and are looking to their health care providers for advice

This document has been prepared to provide health care professionals with a summary of the p
contraindications and approaches to care. There is limited information on the use of the ketog
diabetes. Of the studies that do exist, none go beyond three years duration. The American Di
only organization to include very low carbohydrate (ketogenic) diet in their consensus repor
selected patients where the goal is A1c reduction and reducing anti-glycemic medication. I
for screening or specify follow-up required. The following information is provided to ensu
diet based on information from epilepsy research and guidelines.

What is a Ketogenic Diet?



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*Ketogenic Diet- Quick Reference Guide for Health Professionals*

Contraindicated in the following Medical condition (1,2,6,7):

| |
|---|
| Renal stones |
| Severe dyslipidemia |
| Liver disease |
| Severe esophageal reflux |
| Cardiomyopathy |
| Chronic metabolic acidosis |
| Inborn errors of metabolism*(3) |
| Pregnancy /Lactation |
| Chronic Kidney Failure |
| Hypoglycemia Unawareness |
| CHF |
| Gout |

Medical Conditions Excluded in research (3,4,5)

| |
|---|
| Cholelithiasis |
| Cognitive impairment |
| Psychological disorders |
| Eating disorders |
| Disordered eating |
| Lack of literacy/numeracy |
| Erratic lifestyle |
| Lack of family/social support |
| Religious fasting, other lifestyle disturbances |

Medications that are contraindicated:

- SGLT2 inhibitors
- Valproic acid

# Summary

- Evidence is limited, but evolving
- Food Pattern is difficult to maintain
- Requires adequate planning and medical monitoring
- Benefit in *Highly Motivated patients*
  - improved blood glucose
  - decreased medication
  - decreased weight
  - improved triglycerides, HDL*
- Respect the patient's choice and provide support

# Thank you ……

Working Group Waterloo Wellington Diabetes

- Tiffany Krahn RD CDE
- Amy Waugh RD CDE
- Laura Wilson RD CDE

Hamilton Health Sciences

- Jennifer Fabe MSc RD

Food Photos

- Gwyn Xagoraris RD CDE

# Comments or Questions

**Wendy Graham RD CDE**
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