Management of type 1 DM

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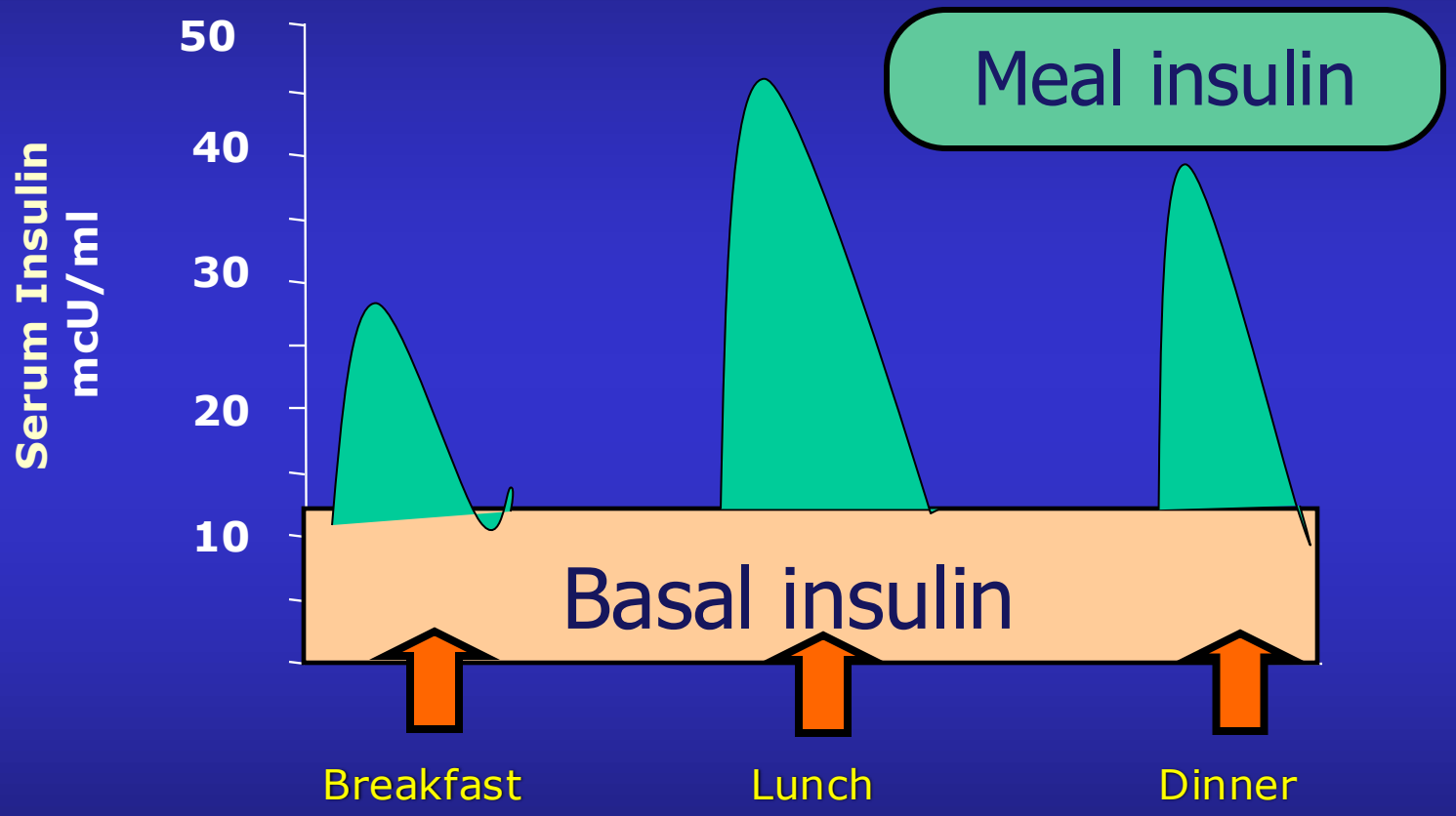
Type 1 diabetes

- Destruction of Beta cells causing insulin deficiency
- Cause is not known:
  - ??Autoimmune, genetic, viral, environmental
- <10% of all cases of diabetes
- Affects usually children & young adults
- Insulin is the main treatment

Normal insulin secretion



Polonsky K et al. New Eng J Med 1988;318:1231

Insulin therapy for DM 1

Basal-meal (basal-bolus) therapy

Basal

Options

1) Glargine, Degludec or Detemir

- Preferred
- Less hypoglycemia

2) NPH

- Low cost
- Less injections (with vials)

Meal

Options:

1) **Rapid-acting**
   - Recommended
   - Less hypoglycemia
   - Better control
2) **Regular**
   - Low cost

Case 1

- An 18-year-old lady with type DM 1 on insulin Aspart 70/30 (Novomix® 30) 28 AM and 20 PM
- A1c is 9.4

Home glucose (mg/dL):

Before breakfast	Before lunch	Before dinner
160	130	320
325	60	280
90	85	405
200	112	310

Insulin for type 1 DM

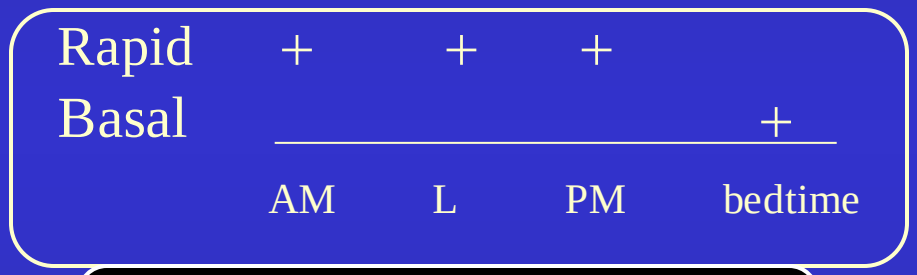
~~Premixed Insulin~~

R	12	8
NPH	16	10
	AM	PM

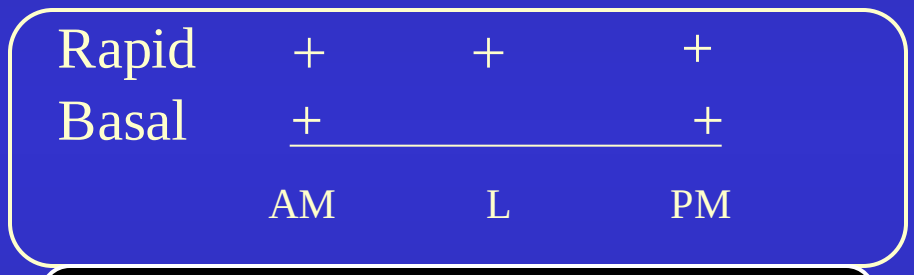
- Premixed Insulin should not be used for type 1 DM
- NPH + regular twice daily is not enough
- These patients need meal insulin with each meal
- Rapid-acting insulin can be used with NPH

Insulin regimens for type 1 DM

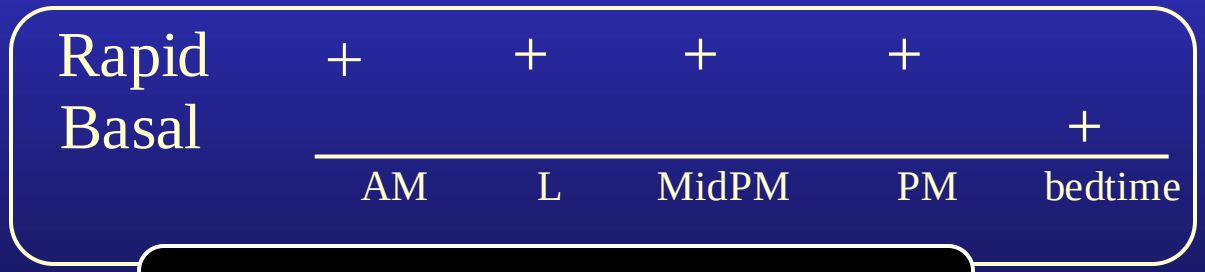
1) Long basal + Rapid:



Is used for most patients



Some need basal twice/day



Some need rapid 4 times/day

Insulin regimens for type 1 DM

2) NPH + Regular:

	AM	L	PM
Regular	+	+	+
NPH	+		+

Is used for most patients

	AM	L	PM	bedtime
Regular	+	+	+	
NPH	+			+

Some need NPH at bedtime

	AM	L	PM
Regular	+	+	+
NPH	+	+	+

Some need NPH tid

	AM	L	PM	bedtime
Regular	+	+	+	
NPH	+	+		+

Some need NPH tid

Case 1

- A 26-year-old man with type 1 DM for 8 years
- Glargine 26 units at bedtime
- Aspart 8 units TID (with each meal)
- A1c 9.1
- Home glucose (mg/dL)

Before Breakfast	Pre-Lunch	Pre-Dinner
152	82	105
250	310	285
205	115	155
160	184	282

Case 1: assessment

- Most of home blood glucose values are high
- There is variability in home sugars
  - Pre-lunch and pre-dinner are very variable
  - This is likely due to variable meals
- A1c is high indicating uncontrolled diabetes
- It is noted that the meal insulin doses are equal
  - This is unusual
  - It is expected that doses would be different depending on the amount of meals
- We need to ask some questions

Case 1: questions?

- Taking insulin on time?
- Following lifestyle changes?
- How many meals daily?
- Taking meals the same time daily?
- What is the main meal?
- Are meals the same amount daily?
- Hypoglycemia (with or without symptoms)?
- Doing carbohydrate counting?
- Using an insulin algorithm to correct high sugars?
- Follow up with educator, dietitian?

Case 1: plan

- Patient advised to check 2-hour after meal sugars
- Aspart adjusted according to post-meal glucose
- **New dose:** Glargine 30 units at bedtime

  Aspart 10 am, 16 lunch, 14 pm

Pre-Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
105	**110**	146	**280**	182	**205**
144	**220**	90	**162**	127	**114**
100	**270**	244	**285**	216	**310**

Case 1: assessment

- Fasting glucose values are fair
  - So, Glargine dose appears to be reasonable
- Post-meal values are very variable
- Also, pre-meal glucose values are variable
- **How to adjust meal insulin here?**
- The variability is due to variable meals
- Taking fixed doses of meal insulin will not always match the amount of food
- Pre-meal glucose will affect post-meal values
- Examples in next slides

Matching insulin to meals
Example: Lunch day 1

Aspart
16 units

2-hour postmeal glucose: 144 mg

Insulin dose is enough

Lunch day 2

Aspart
16 units

2-hour postmeal glucose: 288 mg

Insulin dose is **not** enough because the meal had more carbohydrates

So, we need to match insulin to meals

Give the correct insulin dose that will cover each meal

This is done using:
Carbohydrate counting

We will discuss carbohydrate counting later

Case 1: another observation

Pre-Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
105	110	146	280	182	205
144	220	90	162	127	114
100	270	244	285	216	310

- Note pre & post-meal sugars
- Lunch glucose on day 2: pre is 90; post 162
- Lunch glucose on day 3: pre is 244; post 285
- Starting high means ending high
- So, we should give extra insulin for the extra sugar

How to compensate for the extra high sugar before meals?

Give more insulin

Using **insulin correction algorithm**

How much will 1 unit of insulin lower blood sugar?

This is called

Insulin sensitivity factor

Insulin sensitivity factor (ISF)

This is calculated depending on the type of insulin used

1800 rule

If using **analogs** (long basal + rapid)

1500 rule

If using **conventional** (NPH + regular)

Insulin sensitivity factor (ISF)

1800 rule

1800 ÷ **total** insulin daily dose

1500 rule

1500 ÷ **total** insulin daily dose

Back to our case 1

- Glargine 30 units at bedtime
- Aspart 10 am, 16 lunch, 14 pm

Pre-Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
105	**110**	146	**280**	182	**205**
144	**220**	90	**162**	127	**114**
100	**270**	244	**285**	216	**310**

- Let's calculate the insulin sensitivity factor
- Then do an insulin correction algorithm

Insulin sensitivity factor

1800 ÷ **total** insulin daily dose

Our patient

Total insulin dose:

30 + 10 + 16 + 14 = 70

1800 ÷ 70 = **25**

So, 1 unit of insulin (rapid) will ↓ sugar by **25 mg**

Back to our case 1

- Glargine 30 units at bedtime
- Aspart 10 am, 16 lunch, 14 pm

Pre-Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
105	**110**	146	**280**	182	**205**
144	**220**	90	**162**	127	**114**
100	**270**	244	**285**	216	**310**

- Let's calculate the insulin sensitivity factor
- Then do an insulin correction algorithm

Calculating insulin correction dose

- Example: pre-lunch glucose is 244 mg

1) What is the target glucose?
    - <130 mg
2) How much is the extra glucose?
    - 244 – 130 = 114 mg
3) How much insulin is needed for this extra sugar?
    - 114 ÷ insulin sensitivity factor
    - 114 ÷ 25 = 4.5 units of insulin
    - Round the insulin dose (would give 4 here)
    - This is given + usual dose (so 16 + 4= 20 units)

There is an easier way to do this

By building an insulin correction algorithm

Insulin correction algorithm

- Is used to correct high sugar at any time
- Usually before meals or during sick days
- Set patient's target sugar
- General targets:
  - Premeal: 80-130 mg
  - Random: <150 mg (or 180 mg)
- Starts usually from 131 mg
- Then use intervals by adding insulin sensitivity factor and 1 unit of meal insulin for each interval

Let's form an insulin correction algorithm for our case 1

1) Target pre-meal glucose: <130 mg
2) Insulin sensitivity factor: 25
3) Intervals will be as follows:

    131 + 25 for each 1 unit of meal insulin (Aspart)

4) So: 131 to 156 mg: will need 1 unit insulin
5) 157 to 182 mg: will need 2 units insulin
6) And so on

Insulin correction algorithm for case 1

Use intervals of 25

Sugar level (mg)	Insulin correction dose
80-130	0 (none needed)
131-156	1 unit
157-182	2 units
183-208	3 units
209-234	4 units
235-260	5 units
261-286	6 units
287-312	7 units
313-338	8 units
339-364	9 units
374-399	10 units
400-425	11 units

Important notes on insulin correction algorithm

- The algorithm can change if glucose is not controlled
- Because total insulin dose will be more
- So, insulin sensitivity factor will change (will be less)
- Check sugar 1-2 hours after taking correction insulin dose to assess the response
- Keep in mind factors that can affect response to insulin such as infection, illness, medications

Let's go back to Carbohydrate counting

How can we match insulin to meals?
(Determine insulin doses according to meals)

What is a carbohydrate (Carb)?

- The body's main energy source
- 4 calories per gram
- 100% turns to glucose (sugar)
- Has the most direct effect on blood glucose
- Monitoring carbs remains a key strategy in achieving glycemic control

Carbohydrates (carbs)

- Bread, cereal, rice, pasta, pizza
- Fruits
- Starchy vegetables: corn, potatoes, beans
- Milk, yogurt
- Sugared drinks
- Sweets

How carb counting helps?

- Helps stabilize blood glucose levels
- Gives flexibility to enjoy all foods
- Important for patients with type 1 DM
- Very important for children as insulin can be given after meals (dose is based on carb counting)
- Important for patients on insulin pump
- Can be used for patients with DM 2 on basal/meal insulin who want flexibility with meals

1 serving of carbohydrate (also called 1 carb)

1 carb = 15 grams

How much carbs do we Need?

American Diabetes Association:

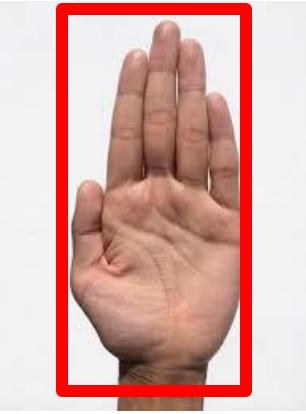
- No set amount
- Determined by patient's eating habits & glucose levels

Canadian & European guidelines:

- 45-60% of calories
- Suggested in this table

	Carbs per Meal	
	services	Grams
Most Women	3 - 4	45 - 60
Most Men	4 - 5	60 - 75

Estimating portions



Full open hand =
1 cup of food

Thumb = tablespoon

Tight fist =
½ cup of food

Tip of thumb =
teaspoon

Estimating portions

1 Cup = 250 ml

Palm size=
100 grams

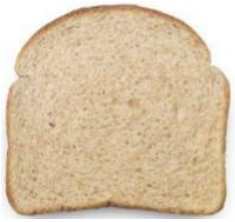
4 tablespoons =
¼ cup

Here are some examples of foods with their content of carbohydrates

Grains:

carbohydrate content

1 slice of toast bread



= 15 grams

1 small Arabic bread

= 30 grams

1 large Arabic bread

= 60 grams

Grains:

carbohydrate content

15 cm bread

= 78 grams

1 slice of bread

= 15 grams

1 burger bread

= 30 grams

Grains:

carbohydrate content

⅓ cup of rice, pasta, or couscous
= 15 grams

1 cup of rice, pasta, couscous
(about ¼ plate = 200 gm weight) = 45 grams

1 slice of a medium size pizza [30 cm (12 inch) diameter] = 30 grams

Grains:

carbohydrate content

1 cup of cereal = 30 grams

1 cup of corn = 5 grams

1 cup of vegetable soup = 15 grams

Starchy vegetables:

carbohydrate content

½ cup (corn, peans, chickpeas or lentils) = 15 gm

1 small potato = 15 gm

15 potato chips = 15 gm

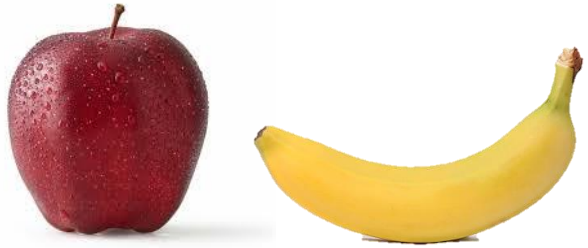
French fries:

12 pieces = 15 gm
Small size order = 30 gm
Medium size order = 45 gm

Fruits:

carbohydrate content

1 Orange, small apple, peach, pear or kiwi = 15 grams



1 Banana, large apple= 15 grams

Fruits:

carbohydrate content

1 Cup of watermelon or melon = 15 grams

3 Dates = 15 grams

1 Cup of strawberry or grapes = 15 grams

Juices:

carbohydrate content

1 Cup orange, apple or mango juice = 30 grams

1 Cup lemon juice = 17 grams

1 Cup carrot juice = 22 grams

Milk products:

carbohydrate content

1 cup of milk or laban (whole, low-fat or no fat) = 12 grams

1 cup of plain yogurt = 12 grams

1 cup of flavored yogurt

= 20-30 grams (depending on contents)

Sweets:

carbohydrate content

1 medium scoop ice cream = ½ cup
= 15 grams

1 piece of basbousa or kunafa
(~ 100 gm) = 45 grams

1 tablespoon sugar or honey= 15 grams

Free food (low or no carbs)

- Fresh vegetables (tomato, cucumbers, carrots, lettuce, spinach):
  - 1 cup = 5 grams
  - Considered free
- Eggs, cheese
- Meat, chicken
- Fish, seafood
- Oils, butter

Another method for counting carbohydrates:

Reading labels on food items

How to read food labels?

- **Look at the following:**

1) Serving size: the amount of food (given usually as cup, or unit).

2) Servings per container: the total number of servings in the whole item.

3) Grams of total carbohydrate per serving: includes all carbs: sugar, starch & fiber.

- Analysis of this label in the next slide

Nutrition Facts

8 servings per container

Serving size 2/3 cup (55g)

Amount per serving

Calories 230

	% Daily Value*
Total Fat 8g	10%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 37g	13%
Dietary Fiber 4g	14%
Total Sugars 12g	
Includes 10g Added Sugars	20%
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Source: U.S. Food and Drug Administration

food label: example

1) **Serving size:** **2/3 cup**
2) **Servings per container:** the item contains **8** servings.
3) **Grams of total carbohydrate:**
   - 37 grams (in 2/3 cup)
   - Total sugars mentioned (including added sugars) & fiber.

♦ **So, 1 cup = 55 grams of carbohydrates**

Nutrition Facts

8 servings per container

Serving size	**2/3 cup (55g)**
Amount per serving	
Calories	**230**
	% Daily Value*
Total Fat 8g	**10%**
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**13%**
Dietary Fiber 4g	**14%**
Total Sugars 12g	
Includes 10g Added Sugars	**20%**
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Source: U.S. Food and Drug Administration

Food label

example: pasta

1) Serving size: 2/3 cup

2) Servings per container: 8

3) Total carbohydrates: 44 gm

per serving

- **So, 1 cup = 66 grams of carbs**

Food label

example: bread roll

1) Serving size: 1/8 loaf of bread

2) Servings per container: 8 (loafs)

3) Total carbohydrates: 30 gm per serving

Nutrition Facts

Serving Size 1/8 loaf (57g/2oz)
Servings Per Container 8

Amount Per Serving

Calories 150	Calories from Fat 5
	% Daily Value*
Total Fat 0.5g	**1%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 350mg	**15%**
Total Carbohydrate 30g	**10%**
Dietary Fiber 1g	**4%**
Sugars 0g	
Protein 5g	

Vitamin A 0% • Vitamin C 0%

Calcium 0% • Iron 10%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Food label

example: white bread

1) Serving size: 1 slice

2) Servings per container: 12

3) Total carbohydrates: 12 gm

per serving

Nutrition Facts

Serving Size 1 slice (33g)
Servings Per Container About 12

Amount Per Serving	
Calories 90	Calories from Fat 30
	% Daily Value*
Total Fat 3.5g	**5%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 110mg	**5%**
Total Carbohydrate 12g	**4%**
Dietary Fiber 2g	**8%**
Sugars 3g	
Protein 1g	

Vitamin A 0%	• Vitamin C 0%
Calcium 0%	• Iron 6%
Thiamin 15%	• Riboflavin 8%
Niacin 8%	• Folate 15%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Food label

example: potato chips

1) Serving size: 17 crisps

2) Servings per container: 6

(total

3) Total carbohydrates: 22 gm

per serving

Nutrition Facts

About 6 servings per container

Serving size **About 17 crisps (28g)**

Amount per serving

Calories **120**

	% Daily Value*
Total Fat 3.5g	**4%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Polyunsaturated Fat 2g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 22g	**8%**
Dietary Fiber 1g	**5%**
Total Sugars 2g	
Includes 2g Added Sugars	**3%**
Protein 2g	
Vitamin D 0mcg	0%
Calcium 10mg	0%
Iron 0.3mg	0%
Potassium 230mg	4%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Food label

example: cookies

1) Serving size: 3 cookies

2) Servings per container: 11

(so, it contains 33 cookies)

3) Total carbohydrates: 22 gm

per serving

Food label

example: fava beans (foul)

1) Serving size: 1/2 cup

2) Servings per container: 3.5

3) Total carbohydrates: 24 grams per serving

Food label

example: orange juice

1) Serving size: 1 bottle

2) Servings per container: 1 bottle

3) Total carbohydrates: 33 grams per serving

Food label

example: fruit juice

1) Serving size: 1 box

2) Servings per container: 1 box

3) Total carbohydrates: 8 grams per serving

38% JUICE BLEND

Nutrition Facts

Serv. Size	1 Drink Box
Amount Per Serving	
Calories	**35**
	% Daily Value
Total Fat 0g	**0%**
15mg	**1%**
Total Carb. 8g	**3%**
Total Sugars 8g	
Incl. 0g Added Sugars	**0%**
0g	
Vit. C 70%	

Not a significant source of sat. fat, *trans* fat, cholest., fiber, vit. D, calcium, iron and potas.

Food label

example: pizza

1) Serving size: 1/8 pizza (a slice)

2) Servings per container: 8 slices

3) Total carbohydrates: 19 gm per serving

Supreme Pizza

Nutrition Facts

Serving Size 1/8 of a Pizza (101g)
Servings Per Container 8

Amount Per Serving	
Calories 270	Calories from Fat 80
	% Daily Value*
Total Fat 9g	**14%**
Saturated Fat 4g	**20%**
Trans Fat 0g	
Polyunsaturated Fat 1g	
Monounsaturated Fat 0.5g	
Cholesterol 20mg	**7%**
Sodium 430mg	**18%**
Total Carbohydrate 19g	**6%**
Dietary Fiber 1g	**4%**
Sugars 1g	
Protein 11g	
Vitamin A 6% • Vitamin C 10%	
Calcium 20% • Iron 2%	

*Percent Daily Values are based on a 2,000 calorie diet.

Food label
different version

- Some countries use different labels
- Here is a fruit juice bottle
- The contents are displayed as per 100 ml (so the serving size is 100 ml)
- It shows carbohydrates: 13 gm
- So, we need to look at the amount in the whole bottle (200 ml)
- Bottle contains 26 gms of carbs

Food labels

don't forget other nutrients

- Healthy tips:
  - Watch calories (if planning weight loss)
  - Less added sugars
  - More fiber
  - Less cholesterol
  - Avoid trans fat
  - Avoid saturated fat
  - Fat to be monounsaturated & polysaturated fat
  - Less sodium

Nutrition Facts

About 6 servings per container

Serving size **About 17 crisps (28g)**

Amount per serving

Calories **120**

	% Daily Value*
Total Fat 3.5g	**4%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Polyunsaturated Fat 2g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 22g	**8%**
Dietary Fiber 1g	**5%**
Total Sugars 2g	
Includes 2g Added Sugars	**3%**
Protein 2g	
Vitamin D 0mcg	0%
Calcium 10mg	0%
Iron 0.3mg	0%
Potassium 230mg	4%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

So after the patients learns how to count carbohydrates, what is next?

We need to know:

How much insulin to give according to the amount of carbs?

Insulin-to-Carbohydrate ratio (I:C ratio)

It is an estimate of the grams of carbohydrates that will be covered by 1 unit of rapid- or short-acting insulin

How to calculate Insulin:Carb ratio?

500 rule

1) Divide 500 on total daily insulin dose
2) This is the initial Insulin:Carb ratio
3) Adjust as per post-meal glucose levels

Case 1: calculating insulin:carb ratio

- Glargine 30 units at bedtime
- Aspart 10 am, 16 lunch, 14 pm
- Total insulin dose = (30+10+16+14) = 70
- Apply 500 rule:
  - 500 ÷ 70 = 7.1
- **Insulin to carb ratio = 7**
- This means that 1 unit of insulin will cover 7 grams of carbohydrates

Lunch: carb counting

Meat	0 grams
Pasta (1 cup)	45 grams
½ corn	15 grams
French fries	30 grams
Vegetable salad	5 gram
Ice cream (2 scoops)	30 grams

Total carbs: 125 grams

120 grams carbs

Insulin: carb ratio
1:7

125 ÷ 7 = 17.8

So, give aspart insulin 18 units

Do not forget to check sugar before meals

Use insulin correction dose if needed

Follow up after starting carb counting

- If post-meal glucose levels are consistently high:
  - Either the patient is not doing carb counting correctly
    or
  - The I:C ratio needs to be adjusted
- If initial glucose is uncontrolled (high A1c), so the patient needs more insulin
  - This means the I:C ratio will change (will be less)
- Review carb counting with the patient
- Make sure insulin correction is used for high premeal glucose

Let’s practice

CASE 2

- Ahmad, 21-year-old student with DM 1 for 7 years
- Glargine 24 u bedtime, Aspart 6 AM, 10 lunch, 8 PM
- A1c 8.8
- His glucose levels have been very variable
- He has no idea about carb counting or insulin correction
- Home blood glucose (mg/dL):

Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
160	260	170	275	184	110
154	118	122	252	215	210
175	115	102	90	260	295

- **How would you set a carb. counting plan?**
- **Outline an insulin correction algorithm**

Plan for carb counting

- The patient was referred to the dietitian (or educator) for teaching on carbohydrates counting

1) Calculate insulin to carbohydrate ratio (I:C ratio)

- 500 ÷ total insulin dose= 500 ÷ 48 = 10.1

So, I:C ratio = **10**

2) Outline an insulin correction algorithm

- calculate insulin sensitivity factor (ISF)
- 1800 ÷ total insulin dose = 1800 ÷ 48= 37.5

so, ISF= **37**

Insulin correction algorithm for case 2

Use intervals of 37

Sugar level (mg)	Insulin correction dose
80-130	0 (none needed)
131-168	1 unit
169-206	2 units
207-244	3 units
245-282	4 units
283-320	5 units
321-358	6 units
359-396	7 units
397-434	8 units
435-472	9 units
473-510	10 units

CASE 2: breakfast

1 bowel of corn flakes cereal

with 1 cup of milk

1 cup of orange juice

1 boiled egg

Piece of cheese

3 olives

1 medium size Arabic bread

- **Let's calculate the amount of carbohydrates**

CASE 2: breakfast counting carbs

1 bowel of corn flakes cereal = 30 grams

with 1 cup of milk = 12 grams

1 cup of orange juice = 30 grams

1 boiled egg = 0 gram

Piece of cheese = 0 gram

3 olives = 0 (has very little carbs)

1 small size Arabic bread = 30 grams

TOTAL carbs = 102 grams

CASE 2: breakfast plan

- The initial insulin : carb ratio is 10
- So, for breakfast, he should take:
  - 102 ÷ 10 = 10 units of aspart insulin
  - Remember to advise using insulin correction algorithm if pre-meal is above target
- But his post-meal glucose = 248 mg

CASE 2: lunch

Half plate of rice with chicken

1 can diet soft drink

1 small plate mixed salad

1 apple

1 medium size snickers chocolate

- **Let's calculate the amount of carbohydrates**

CASE 2: lunch counting carbs

Half plate of rice = 2 cups = 90 grams

Chicken = 0 grams

1 can diet soft drink = 0 grams

1 small plate mixed salad = 0 gram

1 apple = 30 grams

1 medium size snickers chocolate = 30 grams

Total carbs = 150 grams

CASE 2: lunch plan

- The initial insulin : carb ratio is 10
- So, for lunch, he should take:
  - 150 ÷ 10 = 15 units of aspart insulin
  - Remember to advise using insulin correction algorithm if pre-meal is above target
- But his post-meal glucose = 235 mg

CASE 2: assessment

- Post-meal glucose is consistently high
- First step: make sure the patient is counting carbs correctly
- Also, make sure to correct premeal glucose if high
- Then if this is done:
  - The reason is mostly the need for more insulin
  - Particularly the patient has high A1c

CASE 2: plan

- Basal insulin should be adjusted if needed
- Note that some patients need long basal insulin twice daily to control all pre-meal glucose values
- Meal insulin should be increased
- This is done by increasing insulin: carbohydrate ratio to cover more carbs (make carbs number less, so use more insulin)

CASE 2: plan

- I:C ratio was **modified** from 1:10 to 1:8

1) For breakfast (102 gm): dose will be 102÷8= 12.7 (rounded to 13 units) [instead of 10]
2) For lunch (120 gm): dose will be 150÷8= 18.7 (rounded to 19 units) [instead of 15]

- See if the new insulin to carb ratio is working
  - Are post-meal glucose values at target?
- Again, work on controlling pre-meal glucose

CASE 2: follow up

- Glargine 32 units bedtime
- Aspart average doses:
  - 10 to 14 units AM, 16 to 20 units lunch, 12 to 16 units PM
- I:C ratio 1:8
- Initial insulin sensitivity factor = 37
- A1c 8.1 (after 3 months)
- Home blood glucose:

Breakfast	Post-BF	Pre-Lunch	Post-lunch	Pre-Dinner	Post-dinner
102	160	170	142	184	194
74	138	152	150	215	210
92	115	183	110	260	225
68	173	174	148	194	196

- **What is the plan?**

CASE 2: assessment

- Fasting glucose is controlled with hypoglycemia
- Postmeals appear better but still some high numbers
  - It could be that insulin correction doses are not enough
- Prelunch and predinner glucose are high
  - This reflect the action of basal insulin
- Insulin: carb ratio is doing a better job

CASE 2: plan

- Glargine was split into twice daily
  - 16 units am, 16 units pm
- We need to reassess insulin correction dose as his doses of daily insulin are now more:
  - Glargine + average aspart doses (as patient is using carb counting so doses will be variable)
  - Glargine (16+16) + Aspart (12+18+14) = 76
  - Insulin sensitivity factor :1800 ÷ 76 = 23.6 (rounded to 24)
- Let's build a new insulin correction algorithm (note that ISF has changed from 37 to 24)

Updated insulin correction algorithm for case 2

Use intervals with 24

Sugar level (mg)	Insulin correction dose
80-130	0 (none needed)
131-155	1 unit
156-180	2 units
181-205	3 units
206-230	4 units
231-255	5 units
256-280	6 units
281-305	7 units
306-330	8 units
331-355	9 units
356-380	10 units

CASE 2: practice

- **Breakfast**
- Pre-meal glucose: 122 mg
- No need for insulin correction as glucose in target
- Carbs counted: 120 grams
- I:C ratio 1:8
- So Aspart dose: 120 ÷ 8 = 15 units

CASE 2: practice

- **Lunch**
- Pre-meal glucose: 164 mg
- He needs insulin correction
  - Look at insulin correction algorithm
  - He needs 2 units
- Carbs counted: 150 grams
- I:C ratio 1:8
- Aspart : 150 ÷ 8 = 18.7 (round to 19)
- Total dose: 19 + 2 correction = 21

Sugar level (mg)	Insulin correction dose
80-130	0 (none needed)
131-155	1 unit
156-180	2 units
181-205	3 units
206-230	4 units
231-255	5 units
256-280	6 units
281-305	7 units
306-330	8 units
331-355	9 units
356-380	10 units

What if patient does not want carb counting?

- Some find carb counting difficult
- Use fixed meal insulin doses
- Education on ↑ or ↓ doses by estimation
- Check post-meal glucose
- Practice and adjust

Insulin management for children with DM 1

- Education of the family is very important
- Carbohydrate counting is critical
- Rapid acting insulin can be given **after meals**
- Never use premixed insulin
- Regular insulin is difficult to use (have to wait 30 minutes, hypoglycemia)

Education for patients with type 1 DM

- Insulin management
  - Carbohydrate counting
  - Insulin correction algorithm
- SMBG (self monitoring of blood glucose) or CGM (continuous glucose monitoring)
- Hypoglycemia management: with Glucagon kit
- Sick day management
- Diet plan
- Exercise planning
- Family involvement
- Psychological support

Standards of care in DM 1

- Daily SMBG or CGM
- A1c every 3-6 months
- Screening for thyroid disease (hypothyroidism):
  - TSH every 1-2 years
- Investigate for celiac disease if symptoms
  - Abdominal bloating, gases, upset stomach, delayed growth
- Eye exam after 5 years from the diagnosis of DM
- Foot exam after 5 years from the diagnosis of DM
- Urine albumin creatinine ratio (UACR) after 5 years

Type 1 DM: summary

- Use basal/meal (better long basal + rapid)
- Insulin sensitivity factor (1800/total insulin dose)
- Form insulin correction algorithm
- Carbohydrate counting offers flexibility
- Insulin:Carb ratio (500/total insulin dose)
- Education, practice, follow up
- Care should be under a specialist

For talks & educational materials:

www.eledrisi.com

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