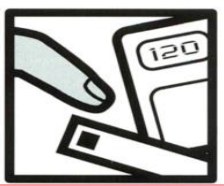


Carbohydrate Counting in Type 1 Diabetes: A case Scenario



DIABETES & DIET

- A primary goal in the management of diabetes is the regulation of blood glucose to achieve near normal blood glucose using insulin and appropriate diet.
- The results of the Diabetes Control and Complications Trial (DCCT)*, published in 1993, proved conclusively what many already knew intuitively: Better blood sugar control reduces the risk of complications from diabetes, including nerve damage, damage to the eyes, and kidney disease
- **Blood glucose concentration following a meal is determined by the rate of appearance of glucose into the blood stream (absorption) and its clearance/disappearance from the circulation. The rate of disappearance of glucose is largely influenced by insulin secretion.** *(Shenk et al, 2003)*

*NIDDK, *The effect of intensive treatment of diabetes on the development and progression of long term complication in insulin dependent diabetes mellitus, New England Journal of Medicine, 1993.*

Case Scenario

A 10-year-old female patient was transferred from a Siliguri hospital to our institution for tertiary care under our paediatric endocrinologist. She presented to the emergency department with hyperglycaemia, vomiting and abdominal pain. She had a history of polyuria and polydipsia, and weight loss over past two months.

On admission parameters:

Parameters	Values	Units
CBG	400	mg/dl
Hb	10.5	%gm
Urea	36	mg/dl
Creatinine	0.8	mg/dl
T3	0.9	mg/ml
T4	7.6	Ug/dl
TSH	14.9	uIU/ml
Potassium	2.0	mEq/L

Urine ketones was positive 2++

Nutritional screening on admission

Anthropometric		As per growth chart
Ht	136cm	Just below 25 th percentile
Weight	24kgs	Below 5 th percentile

Impression: Acute Wasting secondary to New onset T1DM in DKA

Her initial treatment was rehydration, correction of hyperglycaemia and ketosis with insulin, correction of hypokalemia with potassium infusion and 'survival skills education'.

Diabetes & Diet education:

Started on 2000 Calorie Diet with 3 meals and 3 snacks
CHO counting and education on insulins and insulin therapy

CBG and insulin dose during the hospital stay

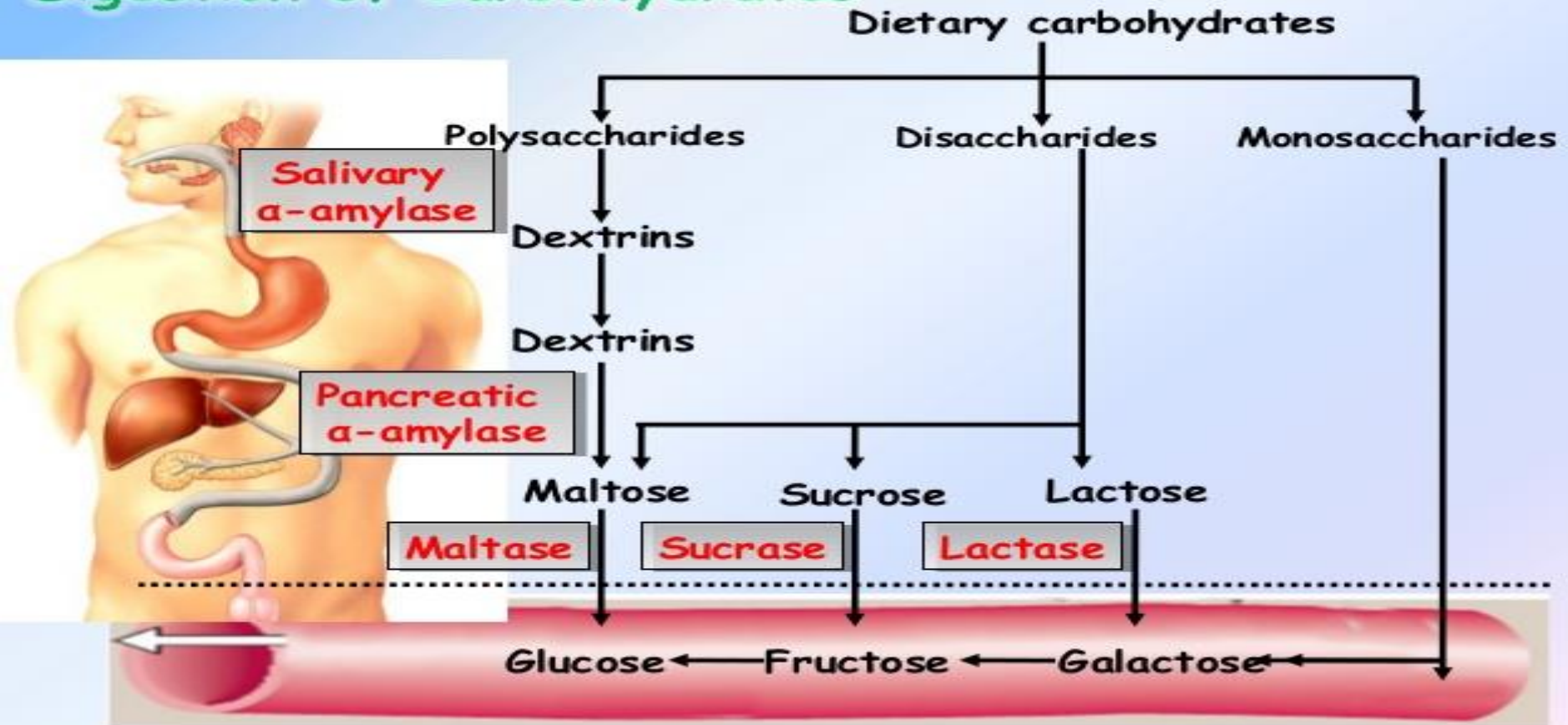
Days	Before BF <i>Plasma</i> Glucose	Insulin dose	Before Lunch <i>Plasma</i> Glucose	Insulin dose	Before Dinner <i>Plasma</i> Glucose	Insulin dose	12 MN <i>Plasma</i> Glucose	Insulin dose	3am <i>Plasma</i> Glucose	Insulin dose
1	On admission				400	15				
2	241	16	187	6	140	12	65	Sugar given	50	Sugar given
3	100	10	269	10	133	8	328	-	372	3 HA
4	112	12	60	4	316	10	265	-	264	3HA
5	101	15	128	8	230	15	264	-	224	-
6	277	15	213	10	169	15	190		130	-
7	124	15	156	8	Discharged					

Medications:

- 1.Humalog Mix 50 s/c as per CBG
- 2.HA {Human Atrapid} as per CBG
- 3.Syrup potklor 7.5ml orally 8th hourly till day 3 to correct hypokalaemia

What happens when carbohydrates is eaten

Digestion of Carbohydrates



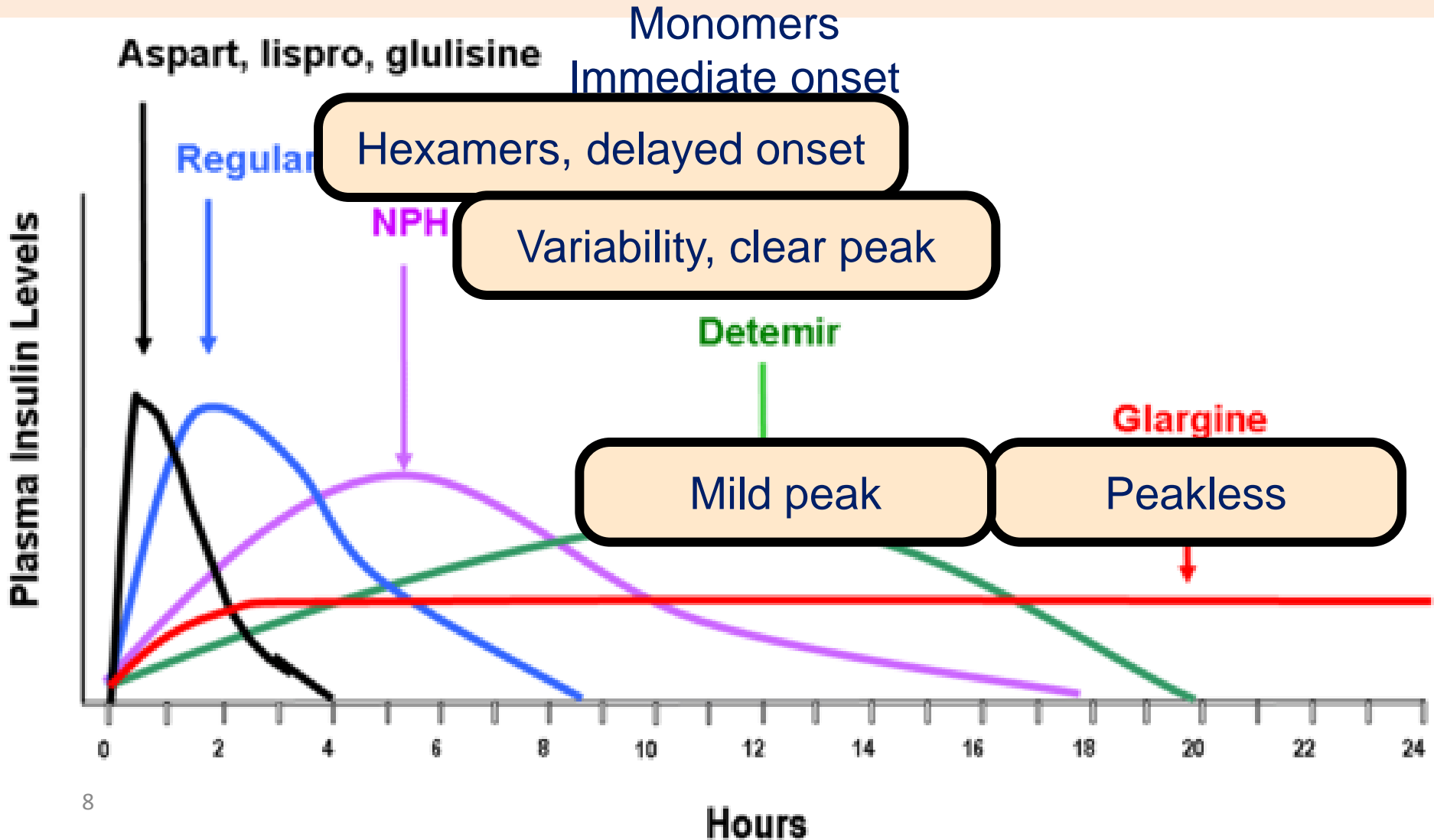
The body breaks down or converts most carbs into glucose, which is absorbed into the bloodstream. As the glucose level rises in the blood, the pancreas releases the hormone insulin. Insulin is needed to move glucose from the blood into the cells, where it's used as an energy source

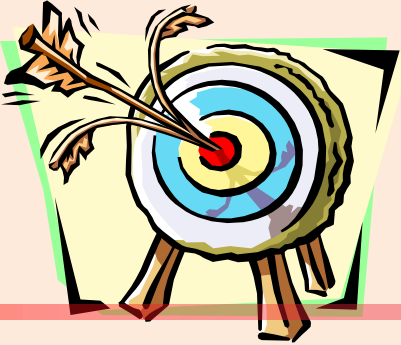
Insulin

Main types of insulin preparations

Type	Onset	Peak	Duration	Comments
Rapid-acting insulin analogue	5-15 min	30-60 min	2-5 hr	Can be injected at the start of a meal
Short-acting (soluble/regular insulin)	30 min	1-3 hr	4-8 hr	Usually injected 15-30 minutes before a meal. Clear solution
Intermediate or long-acting insulin (isophane or zinc insulin)	1-2 hr (NPH, Lente)	4-8 hr	8-12 hr (NPH)	Used to control glucose levels between meals. May be combined with short-acting insulin
	2-3 hr (Ultralente)	4-8 hr	8-24 hr (Ultralente)	
Long-acting insulin analogue	30-60 min	No peak	16-24 hr	Usually taken once daily

Action of Insulin isomers





Hitting The Bull's Eye

Once you know where you want to reach, the road becomes clear

Know your targets:

TIME	NORMAL	GOAL	POOR
Fasting	70-100	90-130	>150 <90
Post-Prandial	<140	140-160	>180
Avg. Bed time	<120	110-150	>180 <110

Many people believe that a diabetes meal plan means that you just have to cut back on sugar.

This is not true!

1. Carbohydrates (carbs) have the greatest effect on your blood sugar
2. 90 to 100 percent of the carbs you eat appear in your bloodstream as blood glucose within minutes to hours after you have eaten.

The carbs you will need to count are both:

- starches that break down slowly into sugar
- simple sugars that break down into blood glucose almost right away

Foods Without Carbohydrate:

- Meat, fish, poultry, cheese, eggs, cottage cheese, tofu
- Butter, oils, margarine, mayonnaise, salad dressings

To count carbohydrates, you'll need to know which foods contain carbohydrates and learn to estimate the number of grams of carbohydrate in the foods you eat.

All of these foods contain starches:

Cereals and products made from grains like bread, biscuits, noodles, vermicelli, pasta and pizzas



Legumes
Dried beans and peas



Starchy vegetables like potatoes, tapioca, colocasia, yam, corn, and peas



Milk and milk products



All of these foods contain sugars:

Fruit and fruit juices
jams,
jellies, and fruit
smoothies



Sweet bakery
products
like cake with icing,
pie, donuts, candy,
and cookies



Sugary drinks
such as regular
soda and fruit
drinks



Sweet condiments
such as barbeque
sauce, relish and
ketchup



CARBOHYDRATES NEEDS

- The total amount of carbohydrate needed daily is based on calorie needs of each person.
- Carbohydrate should comprise around 50-55% of the day's calorie intake.
- The amount of carbohydrate eaten should be spread throughout the day
- The total number of meals and snacks can differ based on BMI and nutritional needs, lifestyle, and the action and the timing of medication and insulin

Estimated total calorie intake from Carbs

Carbohydrate should provide 50-55% of total calories

Complex carbohydrate should account for 2/3 of total Carbs

For a 2000 k calorie diet:

55% of 2000 =1,100 kcals from carbs

At 4 kcals per gram=275 grams of carbs

50% of 2000 =1000 kcals from carbs

At 4 kcals per gram=250 grams of carbs



Definition of Carb Counting

Definition

A method of teaching people how to “eat consistent amounts of carbohydrate at meals and snacks at similar times each day, with the end goal of achieving glycaemic control and other diabetes and metabolic nutrition goals.”¹ It offers a little more freedom than exchange list. The reason why this way of eating is so popular is that it is simple. Have to count carbs per meal or snack.

1. Hope S. Warshaw and Karen M. Bolderrman, *Practical Carbohydrate Counting: A How-to-Teach Guide for Health Professionals*, American Diabetes Association 2008

Advantages:

Effectiveness²

Flexibility³

Ease of implementation⁴

- 2,3,4. *Practical Carbohydrate Counting*, American Diabetes Association, 2001

Why Count Carbohydrate?

**Carbohydrate is the
nutrient in food that raises
blood glucose the most**

Principles of Carbohydrate Counting

- Carbohydrate counting is a meal planning method for people with diabetes
- It is a way to count carbohydrate (grams or serving) in meals and snacks
- By evenly spacing carbohydrates through out the day and by eating the same amount at each meal or snack you get better blood sugar control so you can stay within target blood sugar.

- With carbohydrate counting food choices can vary from day to day as long as the total amount of carbohydrate is the same at each meal or snack. This consistency can help keeping blood sugar in target range
- For diabetic following flexible insulin therapy insulin doses are matches to the amount of carbohydrates they choose to eat to get a better blood glucose control

Carb Counting: A Continuum

- **Basic Carb Counting:**

Learn the foods that contain carb Choose and eat these foods in the proper proportions/servings at meals

- **Intermediate Carb Counting:**

Actual counting of carbs at meals

Example: 45 grams of carbs per meal

- **Advanced Carb Counting:**


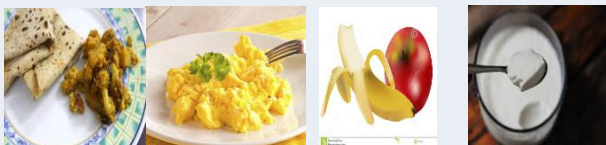

Coordinating the amount of diabetes medication taken with the amount of carbs consumed

Basic Carb Counting Using Grams

Your meal plan may call for you to eat a specified amount of carbohydrate at each meal or snack. You do not have to eat the same foods everyday. Your food choices can change from day to day as long as the total carbs specified for each meal and snack stay about the same.

Being consistent is the key to successful carb counting.

For example, if you need to eat around 55 grams of carb for breakfast, here are three different breakfasts that each total around 55 grams of carb:

Breakfast 1# Continental Around 55 grams of carb:	Breakfast 2# Indian Around 55 grams of carb:	Breakfast 3# Chinese Around 55 grams of carb:
3 slices of toast 30 gm	2 chapattis(45 gm raw wt) 30gm	Noodles 45 gms(45 gms) 30gms
1 tsp Jam 5gm	1 cup mixed veg 5gms	1 cup saute veg 5gms
1 orange/ 1 med apple 14 gm	1 orange/ 1 med apple 14 gm	1 orange/ 1 med apple 14 gms
1 egg /white to order 0 gm	1 egg /white to order 0gm	1 egg /white to order 0 gms
1 cup Milk for coffee/tea 7gm	1 cup Curd (150ml) 7gm	1 cup Milk for coffee/tea 7gm
		

Carbohydrate counting

- Carbohydrate serving/choice:
A carbohydrate serving or choice is a portion of food that has 15 g of carbohydrates.
1 carbohydrate choice=15 g carbohydrates
- Carbohydrate counting by gram:
Another way is to count carbohydrates by gram in the portion you eat and add those amount for a meal or a snack total



Tools for Carbohydrate Counting

Nutrition Labels

Nutrition Facts	
Serving Size 1 cup (4 oz)	
Serving Per Container 3	
Amount Per Serving	
Calories 75 Calories from Fat 27	
	% Daily Value*
Total Fat 3 g	5%
Saturated Fat 0 g	0%
Cholesterol 0 mg	0%
Sodium 300 mg	4%
Total Carbohydrate 10 g	3%
Dietary Fiber 5 g	20%
Sugars 3 g	
Protein 2 g	
Vitamin A 80% - Vitamin C 60% - Calcium 4% - Iron 4%	
* 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
Sat 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	

The serving size for the food is 1 cup.

There are 3 servings or 3 cups in this container.

The total carbohydrate tells how many grams of carbohydrate are in 1 serving.

Sugar is already included in the total carbohydrate amount. This value shows the amount of natural or added sugar.

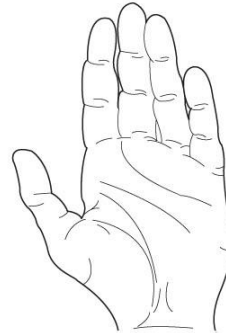
Measuring Tools



Carbohydrate Counting Hand Guide



Fist = 8 fluid oz or 1 cup



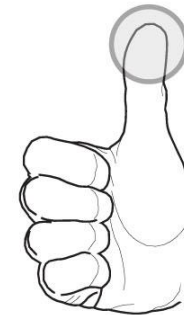
Palm = 3 oz.



Thumb = 1 oz.



Handful = 1/2 cup



Thumb tip = 1 tsp.

For carbohydrate counting, you need to:

1. Be motivated and able to take the time required to improve diabetes management
2. Do simple arithmetic (add, subtract, multiply and divide)
3. Understand insulin action
4. Read food labels
5. Count carbohydrates
6. Understand the relationship between carbohydrate and insulin
7. Adjust insulin based on food intake, exercise and blood glucose level

Carb Counting

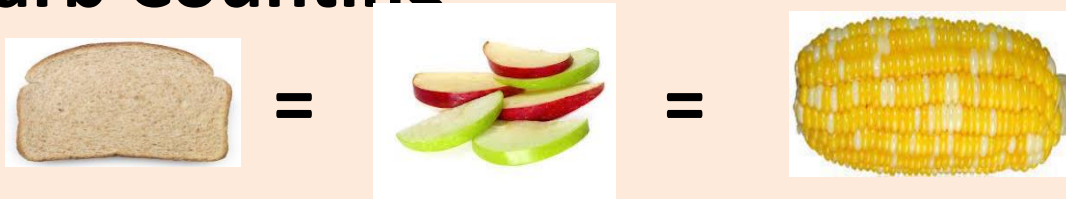
One serving of carbohydrate is measured as 15 grams.

A food that contains 15 grams of carbohydrate is called “one carb serving”.

One slice of bread, a small piece of fruit, or a ear of corn each have around 15 grams of carb.

Each of these equals one carb serving.

Carb Counting



All foods once looked like this...



...but now many foods look like this.



Counting carbohydrates from food labels

- Check the product serving size
- See the total amount of carbohydrate/serving
- Find the dietary fiber amount/serving
(if the food you are planning to eat has more 5 g of fiber per serving ,subtract the grams of fiber from the total carbohydrates grams)
- Compare the serving size listed to your portion
- Calculate the amount of carbohydrate in your portion.

Nutrition Facts			
Serving Size ½ cup (114g)			
Servings Per Container 4			
Amount Per Serving			
Calories 90	Calories from Fat 30		
			% Daily Value*
Total Fat 3g			5%
Saturated Fat 0g			0%
Cholesterol 0mg			0%
Sodium 300mg			13%
Total Carbohydrate 13g			4%
Dietary Fiber 3g			12%
Sugars 3g			
Protein 3g			
Vitamin A 80%	•	Vitamin C 60%	
Calcium 4%	•	Iron 4%	
* 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
Sat 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			

“Sugar-free” and “no sugar added” foods still contain a large amount of carbs.



Sugar-free apple pie has carbohydrates from the apples and the pie crust.



This sugar-free pudding contains 8 grams of carb per ½ cup serving:

Sugar-free pudding has carbohydrates from the milk.

Nutrition Facts

Serving Size: 1/2 cup • 11g

Amount Per Serving

Calories 80	Calories from Fat 0	% DV
Total Fat 0g		0%
Saturated Fat 0g		0%
Trans Fat 0g		
Cholesterol 0mg		0%
Sodium 300mg		12%
Total Carbohydrate 8g		3%
Dietary Fiber <1g		0%
Sugars 0g		
Protein <1g		0%
Vitamin A 4%	Vitamin C 0%	
Calcium 15%	Iron 4%	

Unofficial Pts: 2

@DietFacts.com

Percent of Calories from:

Fat-0% **Carb-40%** **Protein-0%**

(Total may not equate 100% due to rounding.)

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

Nutrient		2,000 Calories	2,500 Calories
Total Fat	less than	65 g	80 g
Saturated Fat	less than	20 g	25 g
Cholesterol	less than	300 mg	300 mg
Sodium	less than	2400 mg	2400 mg
Total Carbohydrates		300 g	375 g
Fiber		25 g	30 g

1 g Fat = 9 calories **1 g Carbohydrate = 4 calories**
1 g Protein = 4 calories **1 g Alcohol = 7 calories**

Advanced carbohydrate counting

- Diabetic patient treated with insulin should match their insulin (time and dose) with their meal times and carbohydrate amounts
- Patient following a flexible insulin therapy or on insulin pump can make adjustment in their bolus insulin based on the amount carbohydrate and type of food they choose to eat
- To do this, you need to know your carbohydrate-to-insulin ratio.
 - Example: Ratio of 15:1 means that 1 unit of insulin needed for every 15 grams carbohydrate



What Is An Insulin-to-Carb Ratio?

- An insulin-to-carb ratio helps you dose how much rapid-acting insulin you need to “cover” the carbohydrate you will eat at a meal or snack.
- For example, an insulin-to-carb ratio of **1:20 means that 1 unit of rapid-acting insulin “covers” 20 grams of carbohydrate.**
- Estimated amount of carbohydrate in the meal, amount of insulin taken, and what was the blood glucose before and two hours after eating will help to decide if the ratio is correct, or if it should be adjusted.
- Different people have different insulin-to-carb ratios depending upon age, sex, nutritional status and even time of the day
- The insulin-to-carb ratio will depend on the total daily dose of insulin and/or on how much insulin currently take with meals.

The 450/500 Rule

450 Rule for Users of Regular Insulin

Divide 450 by the total daily dose of insulin. The result is the grams of carbohydrate that are approximately covered by 1 unit of insulin.

Example: If 30 units a day of Regular insulin then the carb-to-insulin ratio is 1:15

450 divided by 30 (total dose) = 15 (grams of carb covered by 1 unit of insulin).

500 Rule for Users of Humalog and Novo log

Divide 500 by the total daily dose of insulin. The result is the grams of carbohydrate that are approximately covered by 1 unit of insulin.

Example: If 40 units a day of Humalog then carb-to-insulin ratio is 1:12.5

500 divided by 40 (total dose) = 12.5 (grams of carb covered by 1 unit of insulin).

Generally, one unit of rapid-acting insulin will dispose of 12-15 grams of carbohydrate. This range can vary from 4-30 grams or more of carbohydrate depending on an individual's sensitivity to insulin. Insulin sensitivity can vary according to the time of day, from person to person, and is affected by physical activity and stress

How to use the insulin to carb ratio?

Step 1: Count up the total amount of carbohydrate in your meal or snack.

Example using an insulin-to-carb ratio of 1:15:

- **Step 1:** (count up the total grams of carbohydrate)
- 1 1/2 cup rice ----- 32 g carb
- 1 cup dal----- 18 g carb
- 60 gms non veg ----- 0 g carb
- 1 cup mixed veg----- 5g carb
- 1 cup curd(150ml)----- 7 g carb
- = **62 g of total carbohydrate**

Step 2: Divide the total amount of carbohydrate eaten by your insulin-to-carb ratio to determine your insulin dose (divide by the **insulin-to-carb ratio**)

$62 \text{ g} \div 15 = 4.1$ units of insulin (those on multiple daily injections can round up to 5 units)

Healthy eating guidelines

- Calories to promote healthy body weight
- Total fat < 35%
- Saturated fat < 10% (< 7% for some)
- Dietary cholesterol < 300 mg (< 200 mg for some)
- Protein 15-20% of total calories
- Fiber 25-30 g /day
- Use fat sparingly in cooking
- Bake, steam, grill food instead of frying
- Choose lean cut of meat
- Choose low fat milk and dairy product
- Allow sweet only occasionally

Take Home Messages

- Recommended caloric intake should be a mixture of Carbohydrates (55%), Fats (30%) and Proteins (15%)
- Carbohydrates – in the form of complex carbs
- Food divided into 3 main meals
 - Breakfast (20%), Lunch (20%), Dinner (30%)
 - and 2-3 snacks(10%) each.
- Carbohydrate Exchanges should be taught to the family
- Maintain normal growth and development
 - Evaluate using growth charts every 3-6 months
- All family members should eat the same meal prepared for the child
- A snack should be taken before any unusual sport activity or physical exercise

So, enjoy the increased variety and flexibility with Carbohydrate Counting...



..but watch the fat and calories! THANK YOU

Acknowledgement

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