

An Update in Management of Type I Diabetes

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Diabetes Definition

- Fasting blood sugar \geq 126 mg/ dl
- Random glucose in symptomatic patient of \geq 200 mg/dl
- 2 hr OGTT sample \geq 200 mg/dl
- Hemoglobin A1c \geq 6.5 %

Pathophysiology of Type I

- Autoimmune islet cell injury, profound insulin deficiency
- Genetic
 - 5 % FH type I
 - HLA
- Environmental

Epidemiology-Type I

- 2 nd most common chronic disease after asthma
- 1 in 250 children by age 18
- 50-70% present under age 20 and 30-50% over age 20
- Incidence is increasing

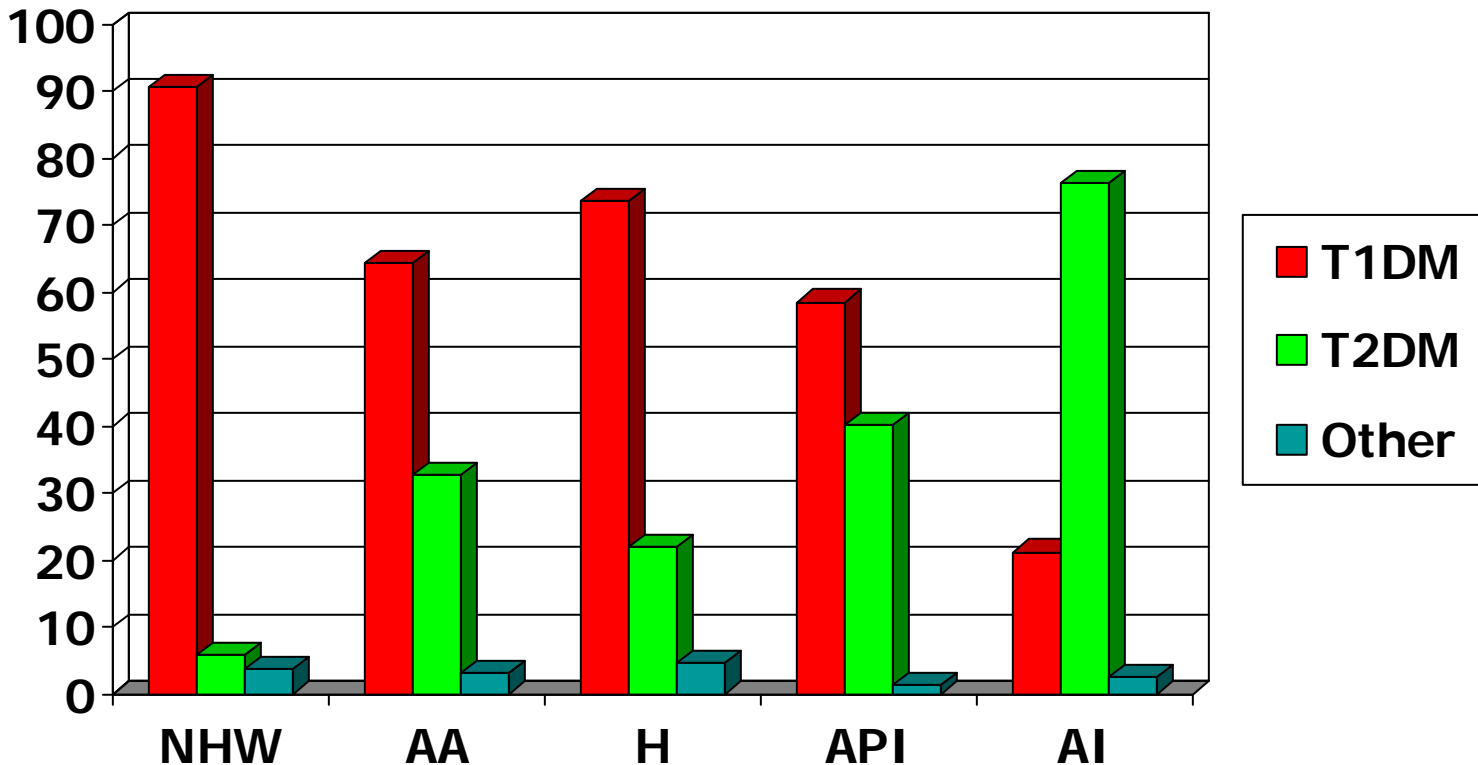
Clinical Presentation

- Polyuria, polydipsia, nocturia
- Weight loss
- Candida perineal infection
- Diabetic ketoacidosis- DKA
 - Fruity odor to breath
 - Nausea, vomiting, abdominal pain
 - Chest pain, difficulty breathing, mental status changes

Differentiation of Type I vs II

	<u>Type I</u>	<u>Type II</u>
Clinical presentation	Usually fairly rapid	Usually indolent
Age/ PE	Any age ≥ 20 % obese	Usually over 10 yrs 80 - 90% obese Acanthosis
Diabetic Ketoacidosis	35-45 %	5-25 %
Ethnicity	More common in Caucasian	More common in African American, Hispanic, American Indian

Type of Diabetes by Ethnicity



Take Home Point

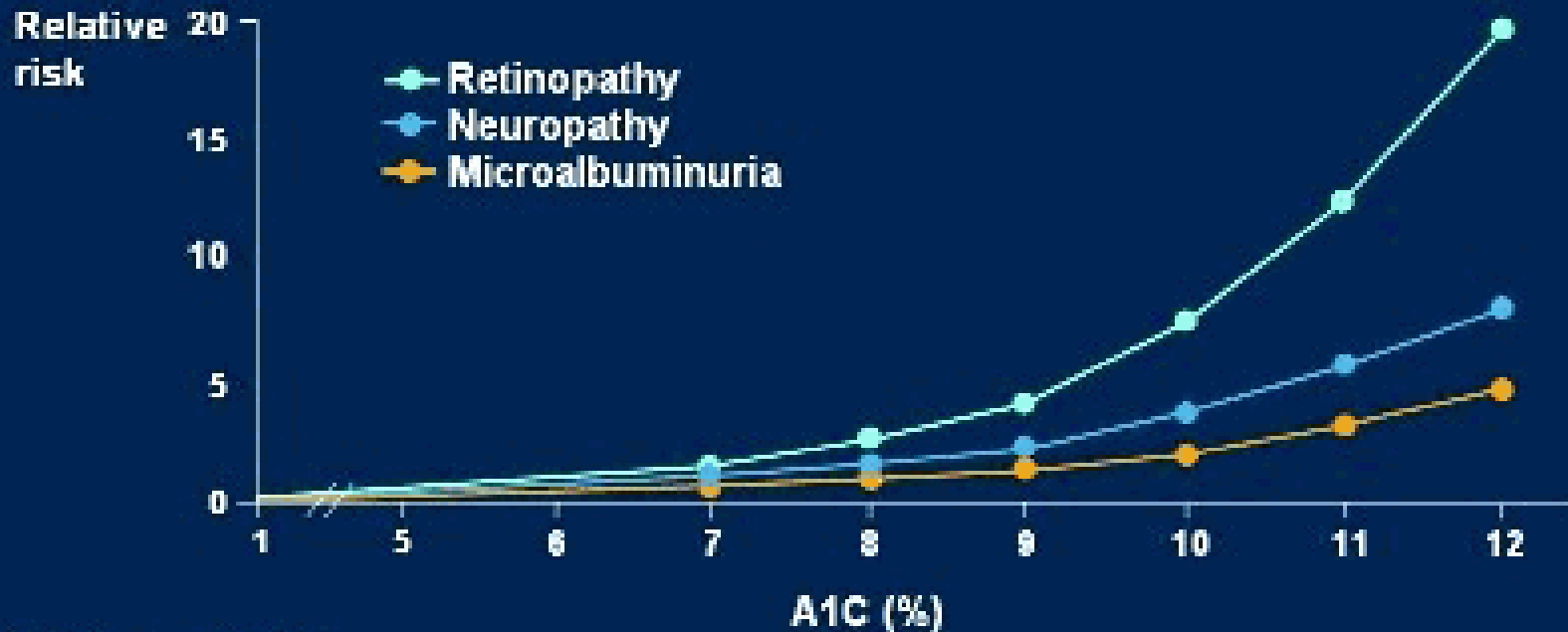
- Half of all Type I diabetics presents after childhood, and with the increasing prevalence of obesity a Type I diabetic may have the phenotype of a Type II diabetic
- All new diabetics should have anti-pancreatic antibodies tested
 - GAD 65, IA-2 and insulin antibodies

Intensive Control Guideline

Age	A1c	Preprandial Blood Sugar
≤ 6	7.5-8.5 %	100-200
6-12	≤ 8 %	80-180
13-19	≤ 7.5 %	70-150
Adult	< 7 %	70- 130

Therapeutic Rationale

Risk of Progression of Microvascular Complications vs A1C DCCT



A1C=hemoglobin A_{1c}

Skyler JS. *Endocrinol Metab Clin North Am.* 1986;25:243-254

CADRE 9

Type I Therapy

- **Exercise** increases glucose transport at the cellular level
- Both sports and daily activities should be encouraged



Nutrition Therapy

- Carbohydrate (CHO) not under 130 grams/d
 - Best sources are fruits , vegetables, whole grains, legumes and low-fat dairy
- Total CHO guided by current age, gender, BMI and physical activity level
- Saturated fat less than 7% , limit trans fats, cholesterol under 200 mg/d
- Protein 15-20 % total energy needs

My Starter Meal Plan – Women

1. Select and Circle Your Activity Level

Sedentary	Sit most of day, do little walking, watch TV/read in evening
Moderately Active	Exercise 20 minutes 2-4 times/week – walking around office, climbing stairs
Active	Exercise 30 minutes 5+ times/week – physical labor, lifting

2. Select and Circle Your Weight Goal

Activity Level	Weight Loss		Weight Maintenance	
	Carb grams	Calories	Carb grams	Calories
Sedentary	140	1400	160	1600
Moderately Active	160	1600	180	1800
Active	180	1800	200	2000

Example of How To Spread Carbs Throughout Meals

Carb Grams	Breakfast	Lunch	Dinner
140	45	45	45
160	45	60	60
180	60	60	60
200	60	60	75

* Remember to include snacks in total daily carbs if you choose to snack.

3. My Starter Meal Plan (Write-In Total Daily Carbs & Carbs At Each Meal)

Total Carb Grams	Breakfast	Lunch	Dinner

* Remember to include snacks in total daily carbs if you choose to snack.

Snack(s)			
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Nutrition Therapy

- CHO nomenclature
 - Most common to calculate grams of total CHO
 - Some use a CHO “serving or choice” description where each serving is equal to 15 grams of CHO

Nutrition Facts	
Serving Size <u>8 fl oz (240 mL)</u>	
Servings Per Container 8	
Amount Per Serving	
Calories 130	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Sodium 0mg	0%
Potassium 450mg	13%
Total Carbohydrate 30g	10%
<u>Sugars 24g</u>	
Protein 2g	
Vitamin C 120%	• Calcium 35%
Thiamin 6%	• Riboflavin 4%
Niacin 2%	• Vitamin B ₆ 6%
Folate 15%	• Magnesium 6%

Not a significant source of saturated fat, cholesterol, dietary fiber, vitamin A and iron.

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

Nutrition Therapy



Nutrition Therapy

- Misleading labels
 - 1 oatmeal raisin cookie = 17 grams CHO
 - 1 sugar-free oatmeal cookie = 16 grams CHO
 - 1 fat free oatmeal raisin cookie = 25 grams CHO

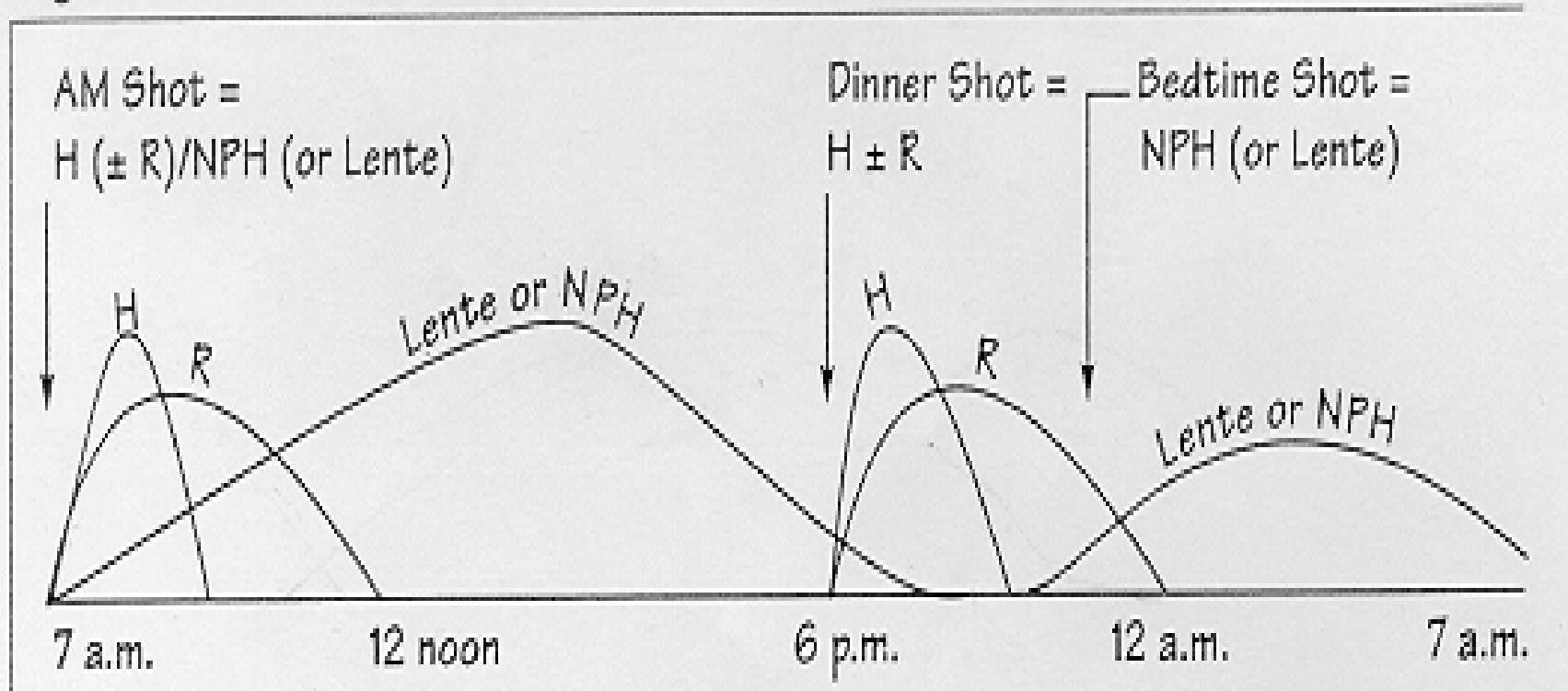
Nutrition Therapy



- Underlying principle of medical nutrition therapy in diabetes is estimating carbohydrate intake and matching this intake to medication

Classic Insulin Regimen

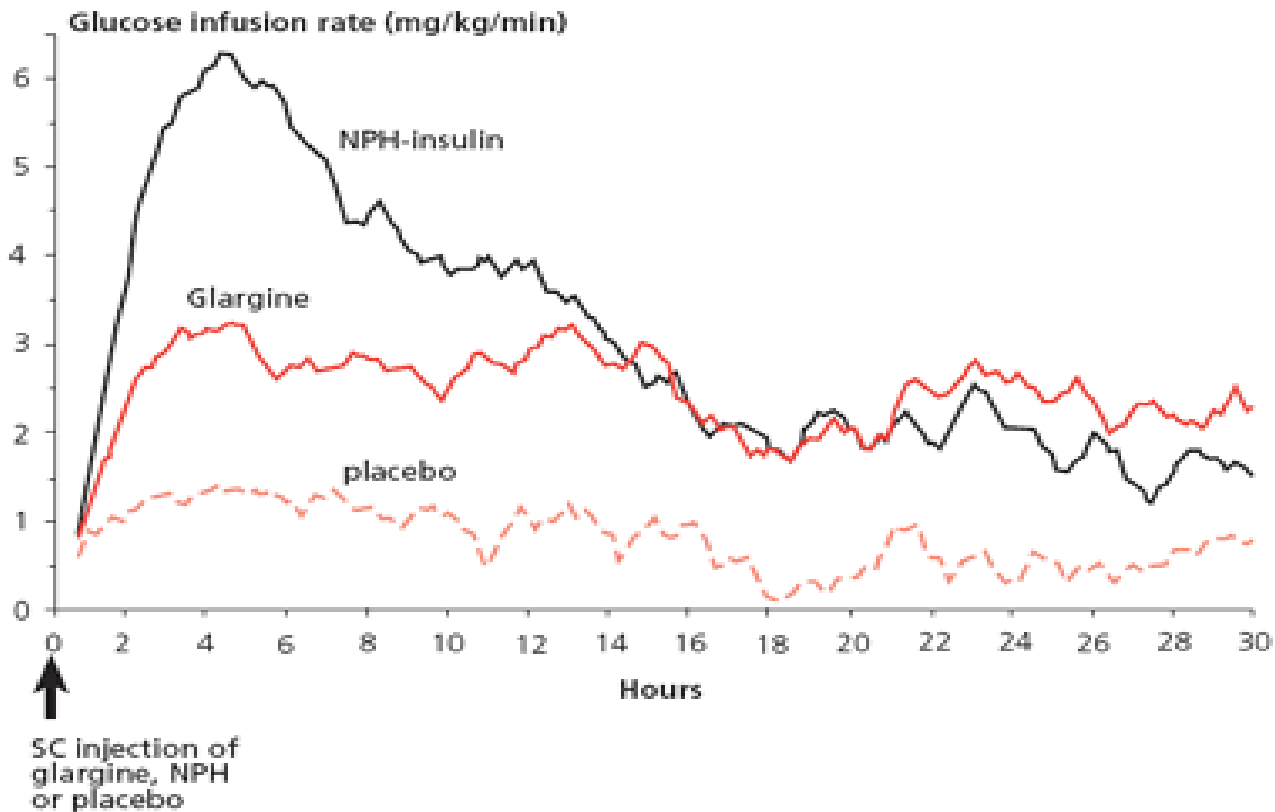
Figure A:



Basal Insulin

Medscape®

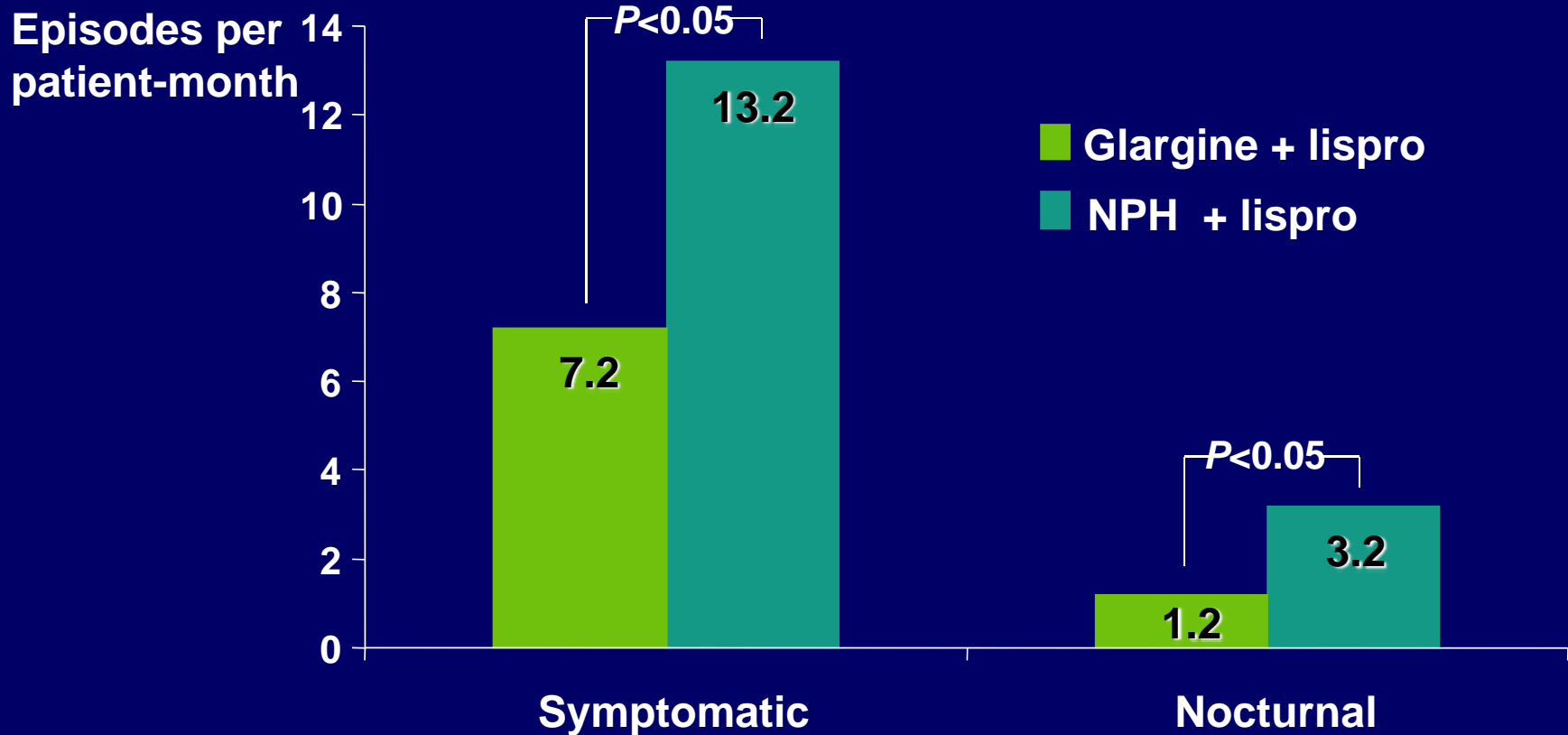
www.medscape.com



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Basal Insulin and Hypoglycemia

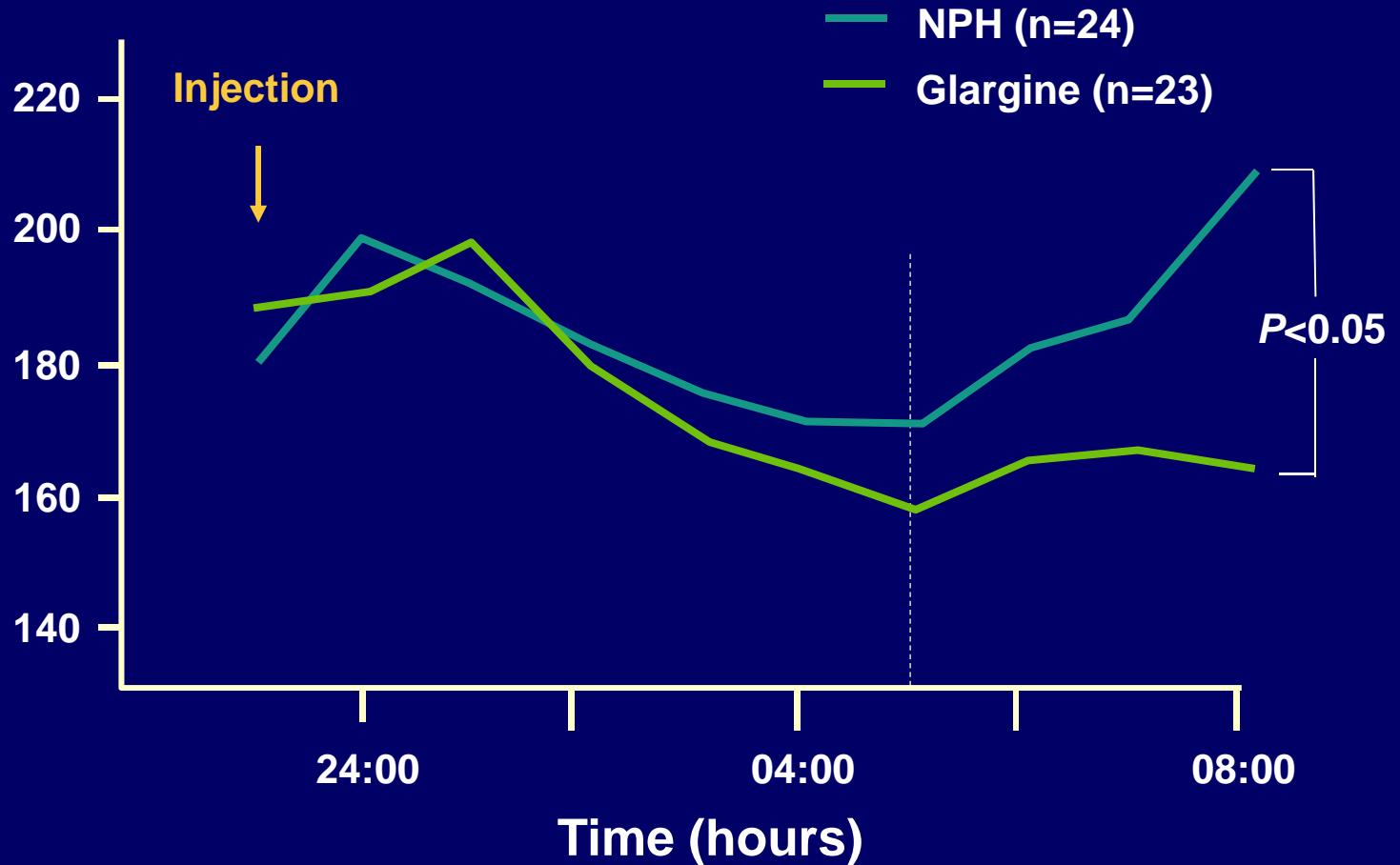
Nocturnal and Symptomatic Hypoglycemia



Glargine vs NPH Insulin Dawn Phenomenon

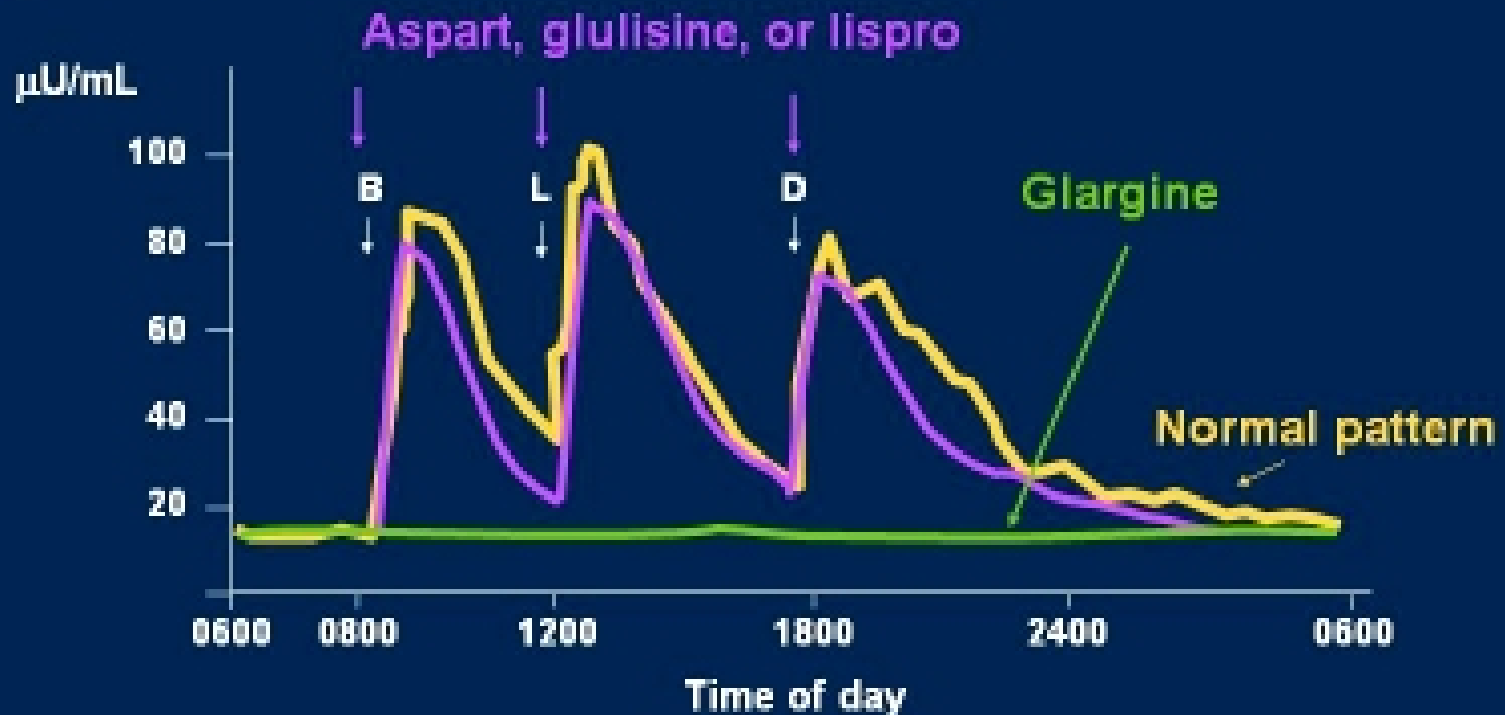
47 Patients With Type 1 Diabetes

Mean
plasma
glucose
(mg/dL)



Basal -Bolus Therapy

Basal-Bolus Insulin Treatment Long- and Rapid-Acting Insulin Analogues



B=breakfast; L=lunch; D=dinner

Basal -Bolus Therapy

TABLE 1: Main characteristics of rapid and long-acting insulin analogues.

Analogue	Trade name/manufacturer	Onset (min)	Peak (hrs)	Duration (hrs)
Long-acting analogues				
Glargine	Lantus/Sanofi-Aventis	4–6 hrs	No peak	>24 hrs
Detemir	Levemir/Novo Nordisk	4–6 hrs	8–10 hrs	~17 hrs
Rapid-acting analogues				
Lispro	Humalog/Eli Lilly	15–30 min	0.5–2.5 hrs	3–6.5 hrs
Aspart	Novorapid/Novo Nordisk	10–20 min	1–3 hrs	3–5 hrs
Glulisine	Apidra/Sanofi-Aventis	10–15 min	1–1.5 hrs	3–5 hrs

Bolus insulin – Sliding scale

Blood Glucose (mg/dl)	Breakfast Bolus	Lunch Bolus	Supper Bolus	Snack Bolus
<70	Treat low blood sugar with 15 grams carbohydrate, recheck in 15 minutes, retreat until above 70, then take insulin in 70-90 row.			
70 - 90	2	2	4	0
91 - 130	4	4	6	1
131 - 150	5	5	7	2
151 - 200	6	6	8	3
201 - 250	7	7	9	4

AM LONG ACTING INSULIN TYPE _____ DOSE _____ TAKE BEFORE BREAKFAST
 PM LONG ACTING INSULIN TYPE Lantus DOSE 16 TAKE BEFORE SUPPER ~~TAKE~~ AT BEDTIME

Bolus Insulin Calculation

Advanced CHO counting

- 1 unit per X grams CHO consumed is estimated based on age, weight, activity level
- Example
 - 1 unit per 30 gram
 - If 90 grams is eaten at the meal
 - Short acting insulin for food is 3 units

Bolus Insulin Calculation- Advanced

- Correction for high blood sugar if necessary
- Example
 - Blood sugar is 300 mg /dl
 - Target blood sugar is 150
 - **Correction factor 50 = 1 unit of insulin will lower blood sugar by 50 mg/dl**
 - 300 actual -150 target , then divided by CF of 50 = 3 units for the high blood sugar

Insulin Pump Therapy

- Only contain short acting insulin
- Programmable basal rate
- Have bolus calculator feature that guides dosage when CHO grams entered and blood sugar entered
- An important safety feature is the insulin on board calculation
 - Factors duration of insulin action into dose calculation to prevent insulin over dosage

Animas Ping

I always feel close to you.



Even when we're 9.84 feet apart.



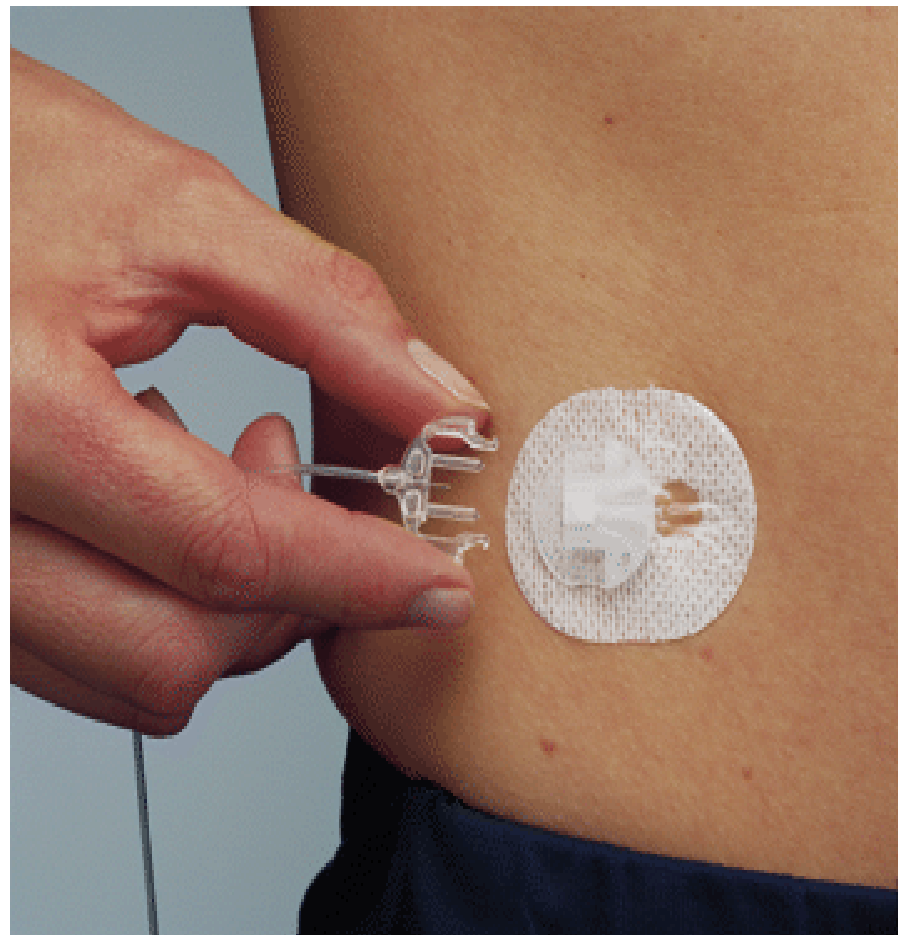
OneTouch® Ping.™
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MiniMed Paradigm



Infusion Sets



OmniPod

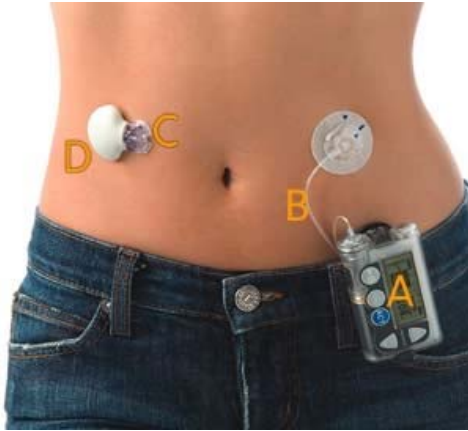


Continuous Glucose Monitoring- CGM

- Measure interstitial glucose each 5 minutes
- Must calibrate with fingerstick blood sugars
- Replace sensor each 3-7 days
- High and Low blood sugar alarms
- Blood sugar trend arrows
- To dose insulin a fingerstick blood sugar is required

CGM Devices

MiniMed REAL-Time Paradigm



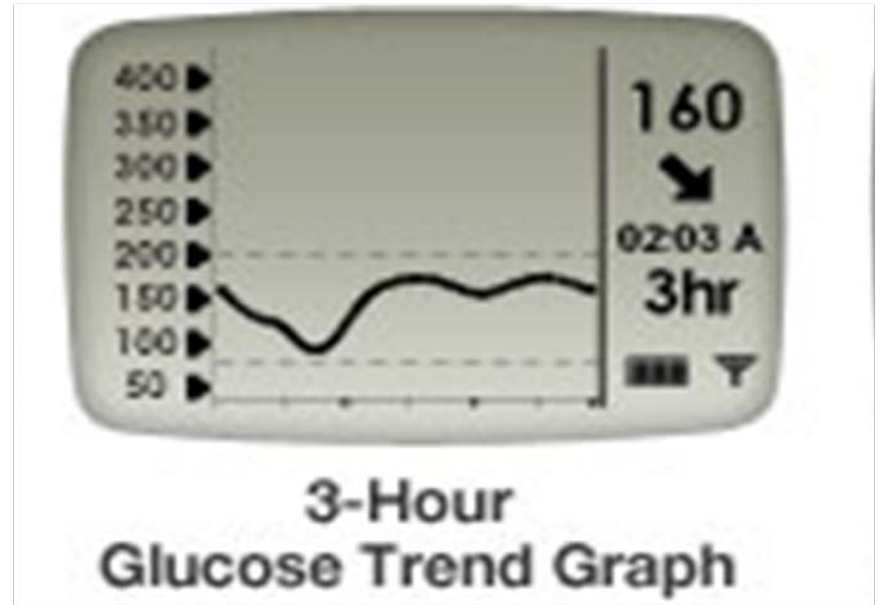
DexCom



MiniMed REAL-Time Guardian

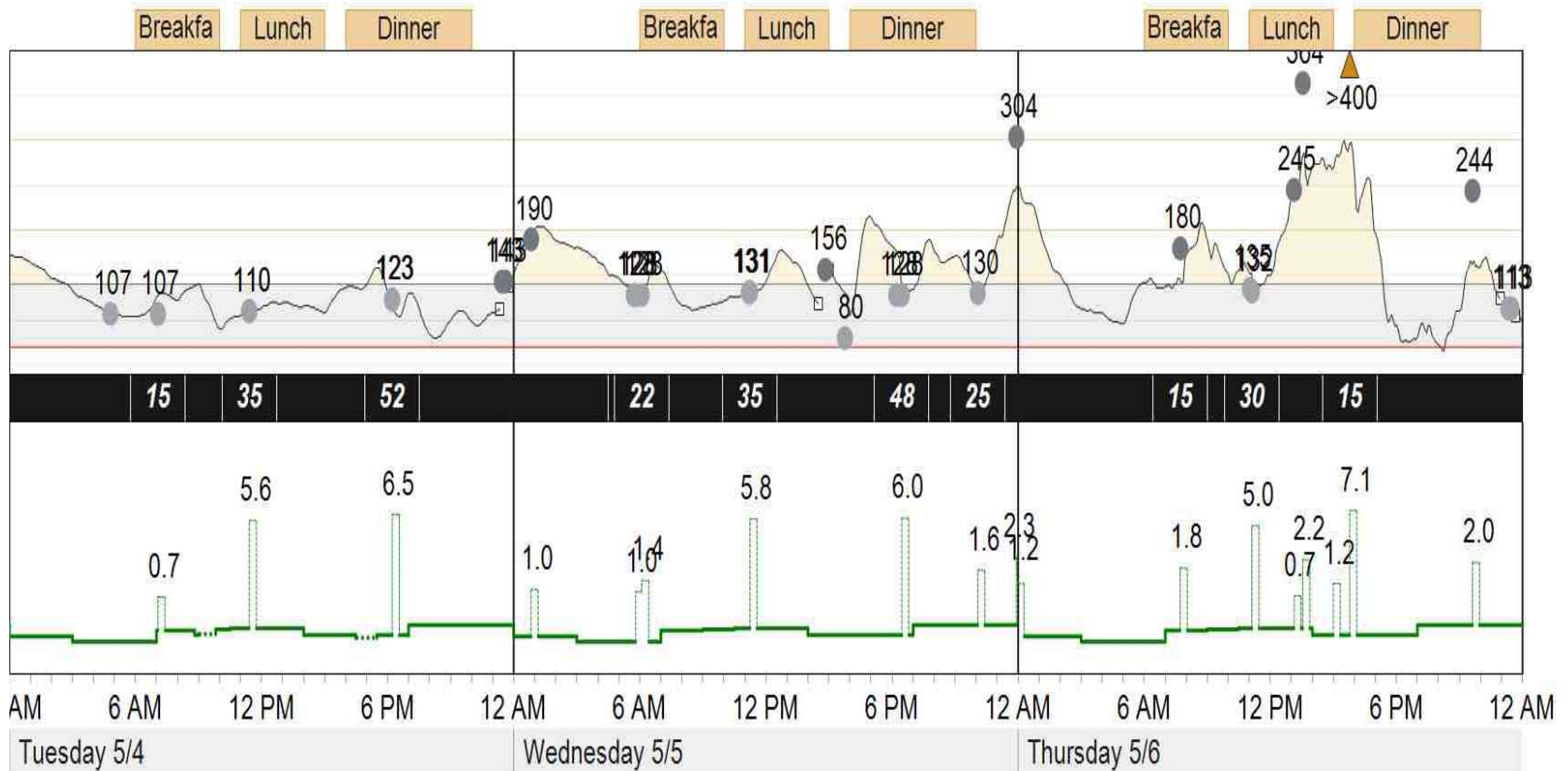


Displays

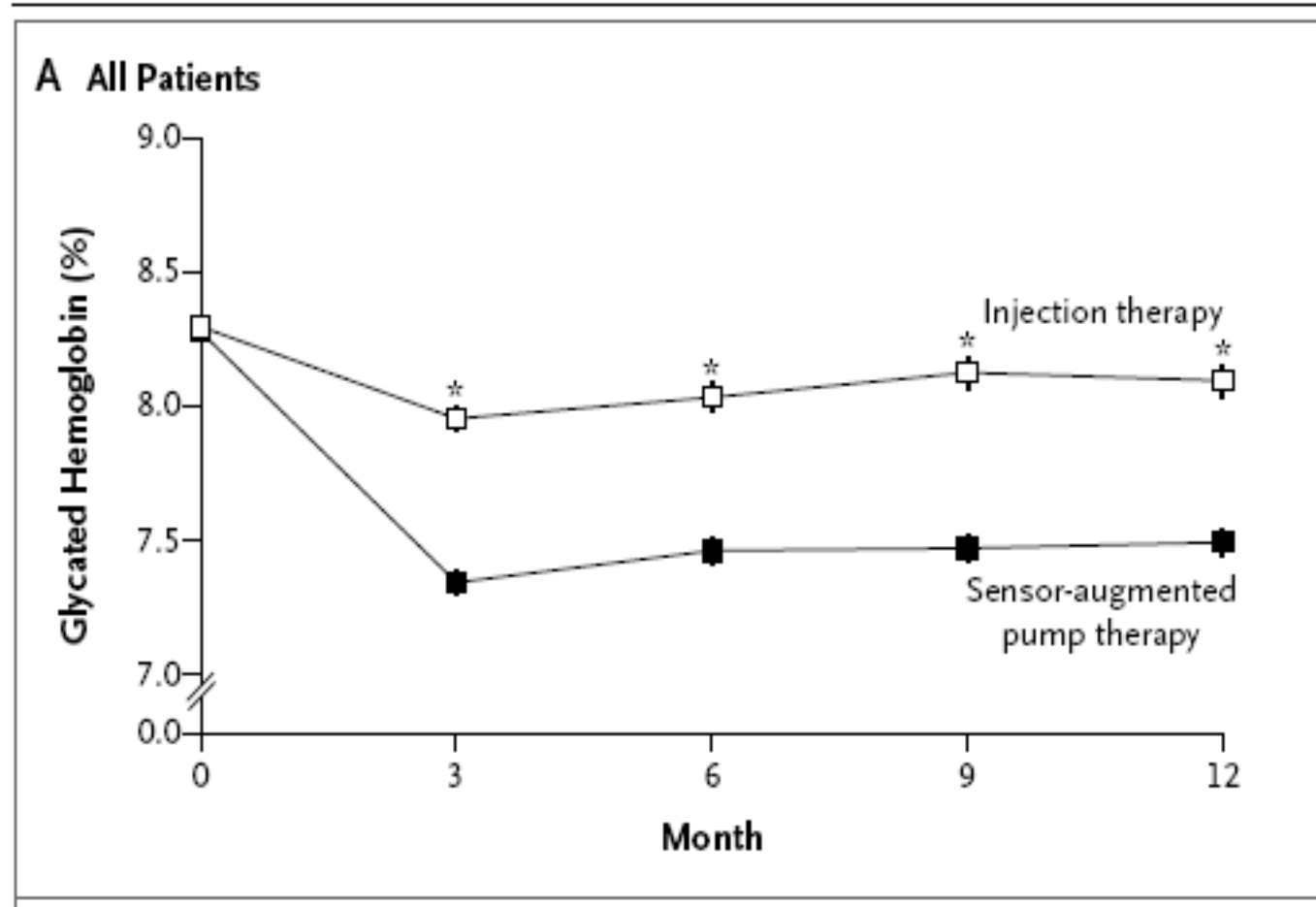


Download Data to review for Blood Sugar Patterns

Sensor & Meter Overview

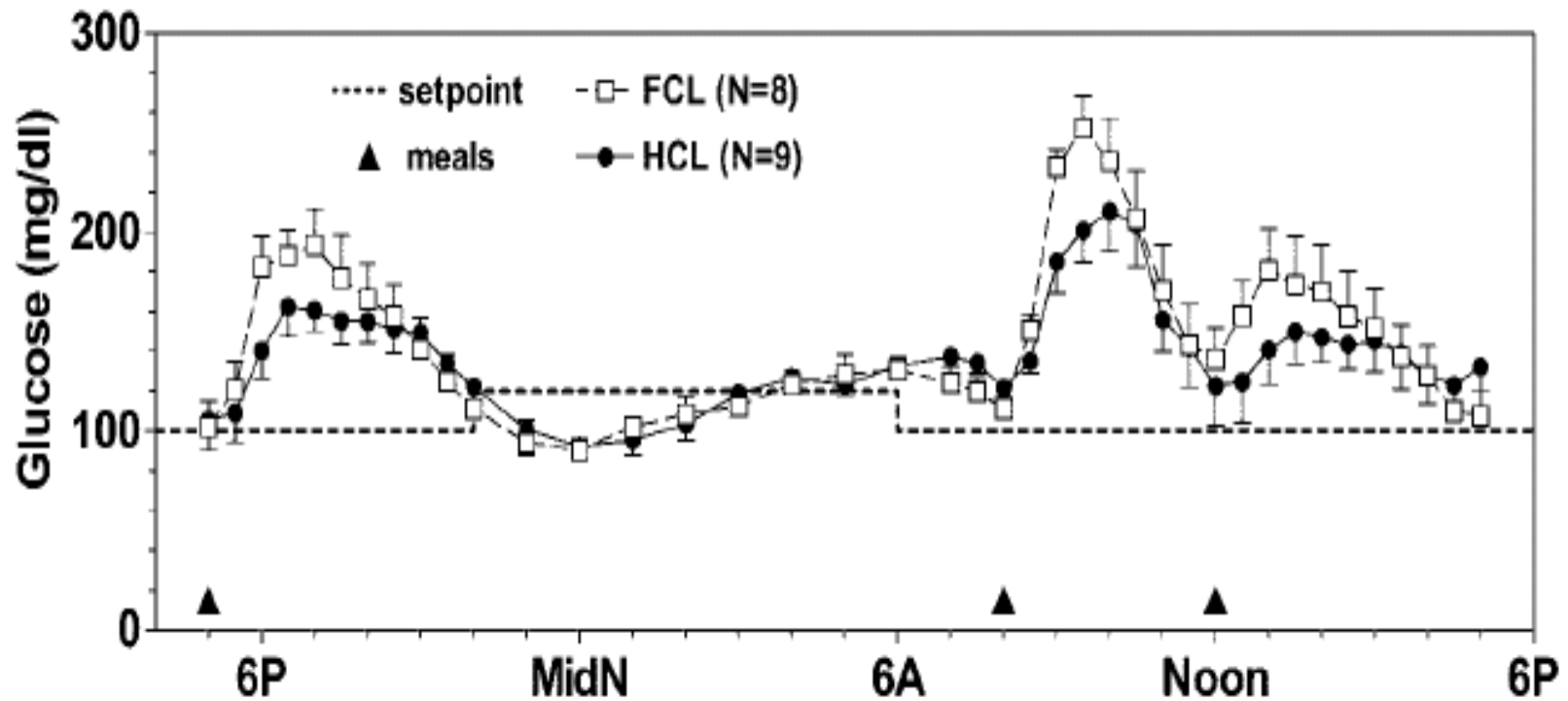


Sensor Augmented Pump Therapy

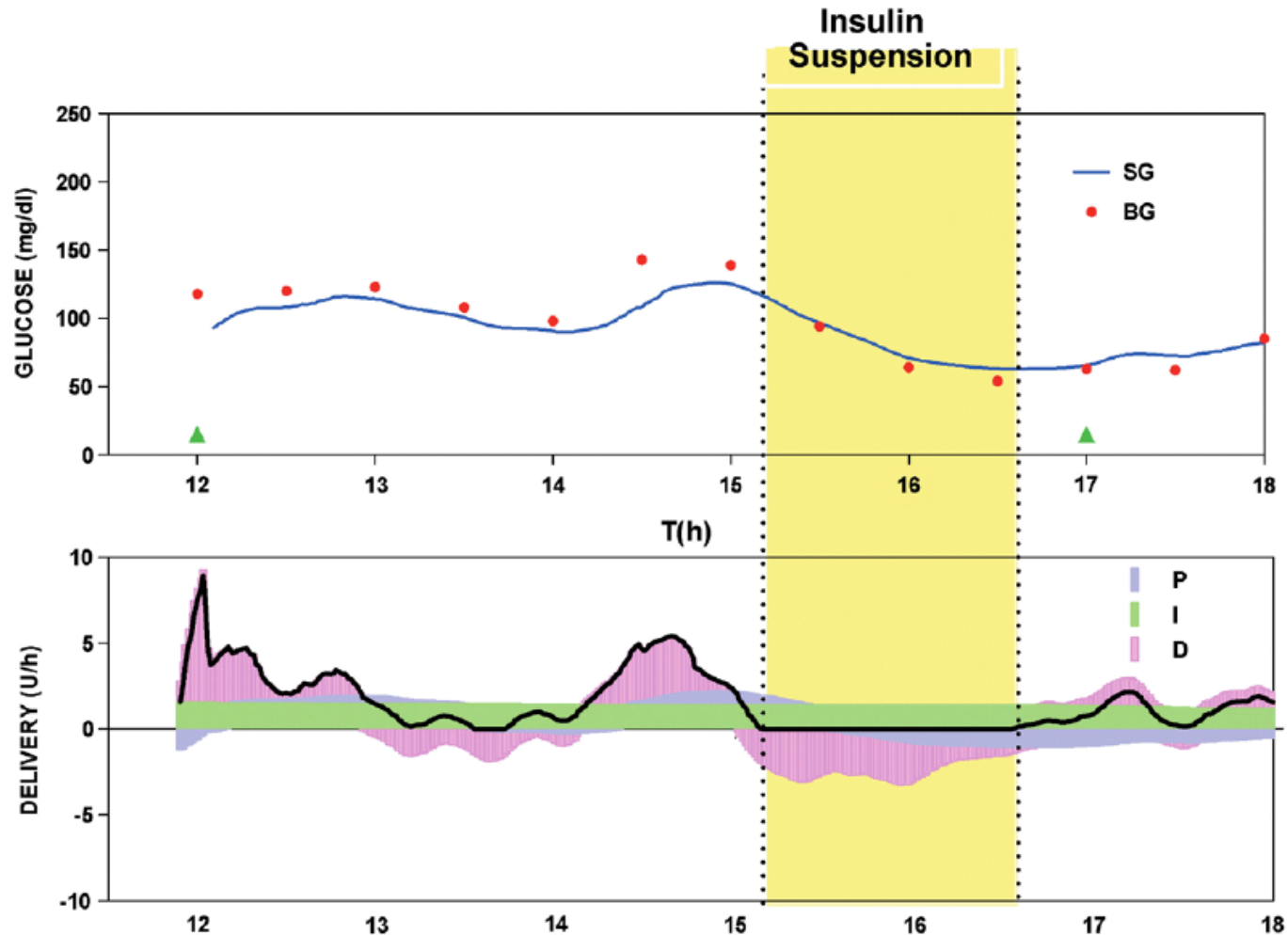


NEJM July 2010

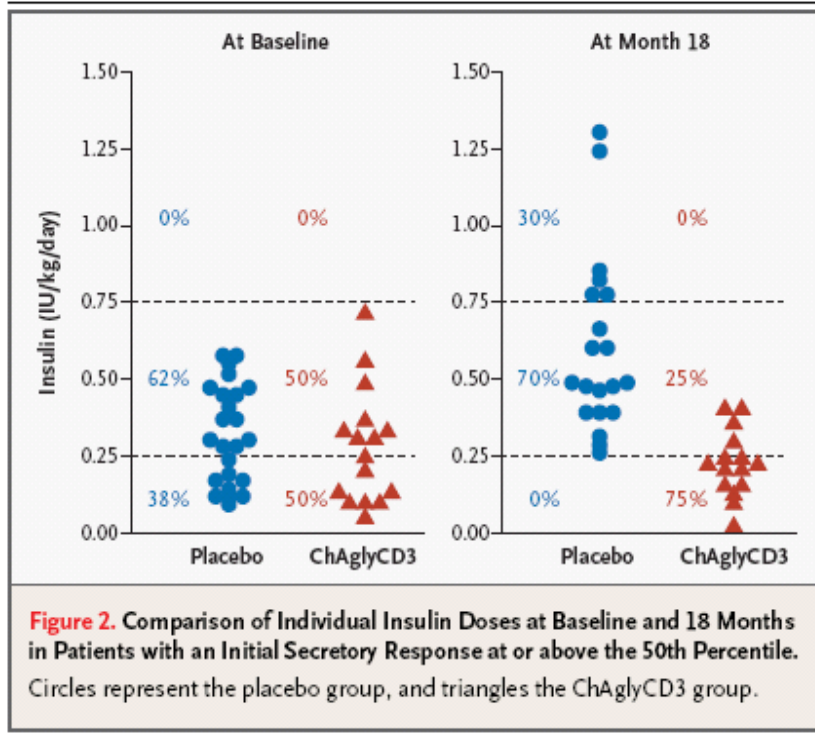
Artificial Pancreas Project- Closed Loop



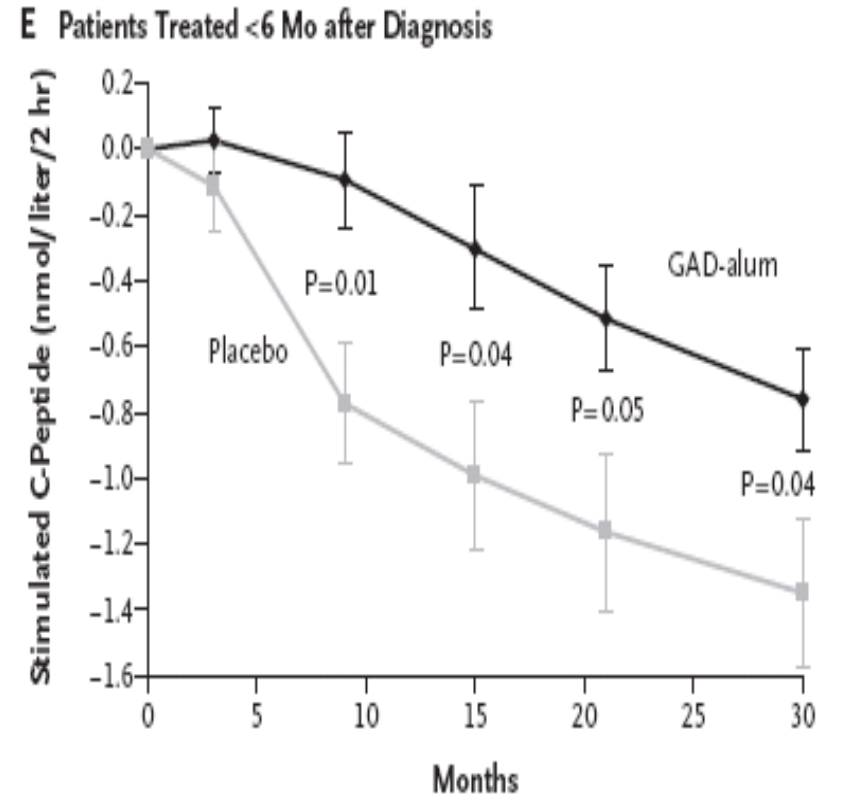
Artificial Pancreas Project- Closed Loop



Type I Diabetes Immunotherapy



NEJM June 2005



NEJM October 2008

Islet cell transplantation

- Initial success to obtain insulin independence with the Edmonton protocol published in 2000
- More than 50 % must restart insulin within 2 years, although residual insulin from transplant did smooth blood sugar control
- Subsequent complete transplant failure
- Limited islet supply
- Immunosuppressive drugs increase cancer risk

Hypoglycemia

- Minidose Glucagon

- To treat hypoglycemia when patient is alert but due to nausea or vomiting cannot take oral fluids
- Less risk of emesis from the Glucagon
- 15 units measured on an insulin syringe and given just like insulin

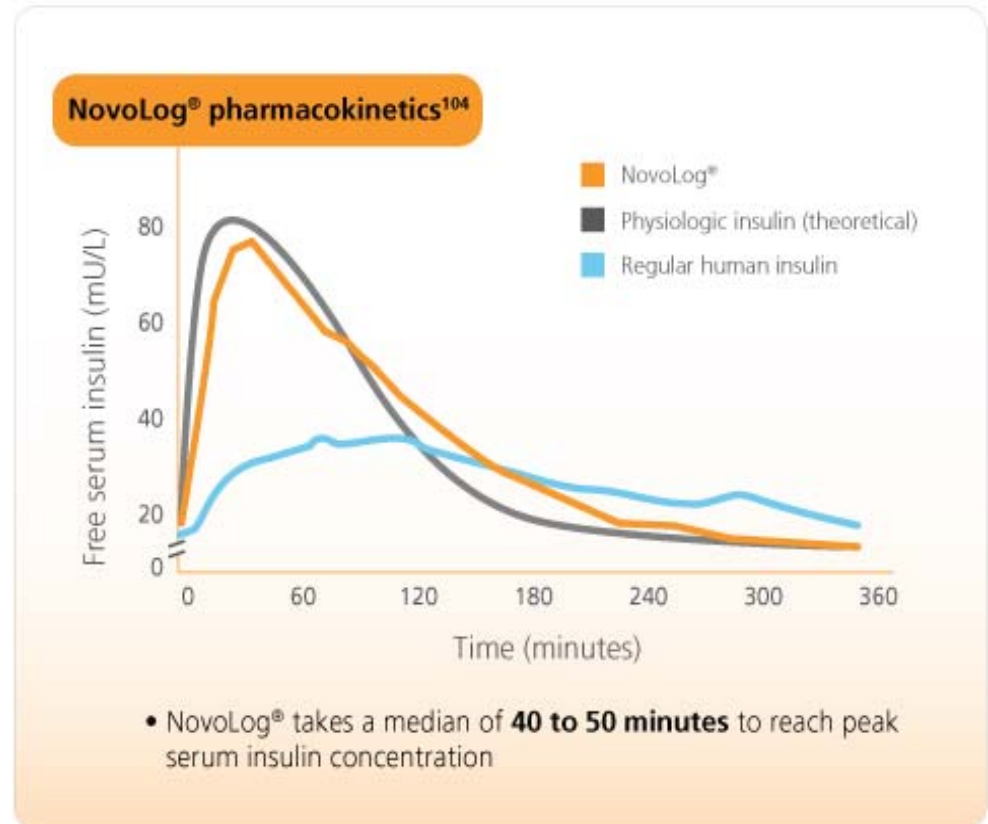
- Alcohol

- Decreases gluconeogenesis

Hyperglycemia

- Causes

- Blood sugar tested **too close** to the last carbohydrate intake and insulin dose
- Insufficient or missed insulin dose



Ketones



Ketones

- Urine ketone test

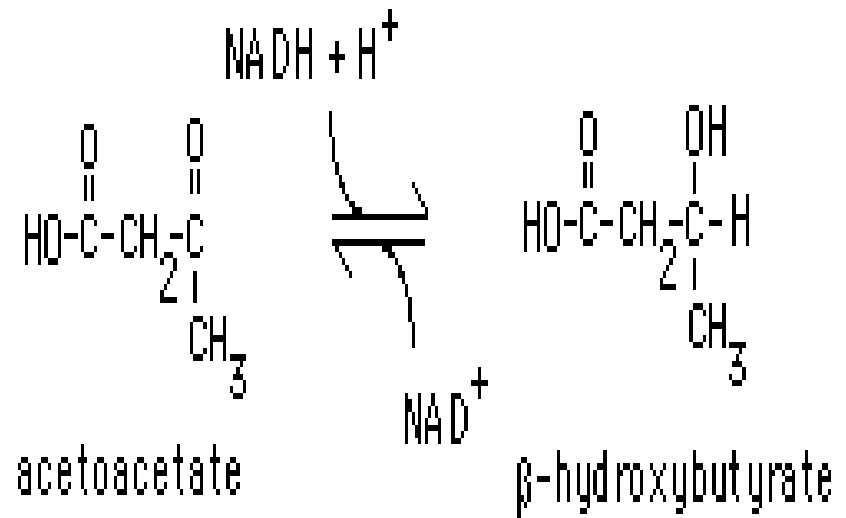
- Inexpensive, 16 cents each
- Measures **acetoacetate**
- May not reflect current status

- Blood ketone test

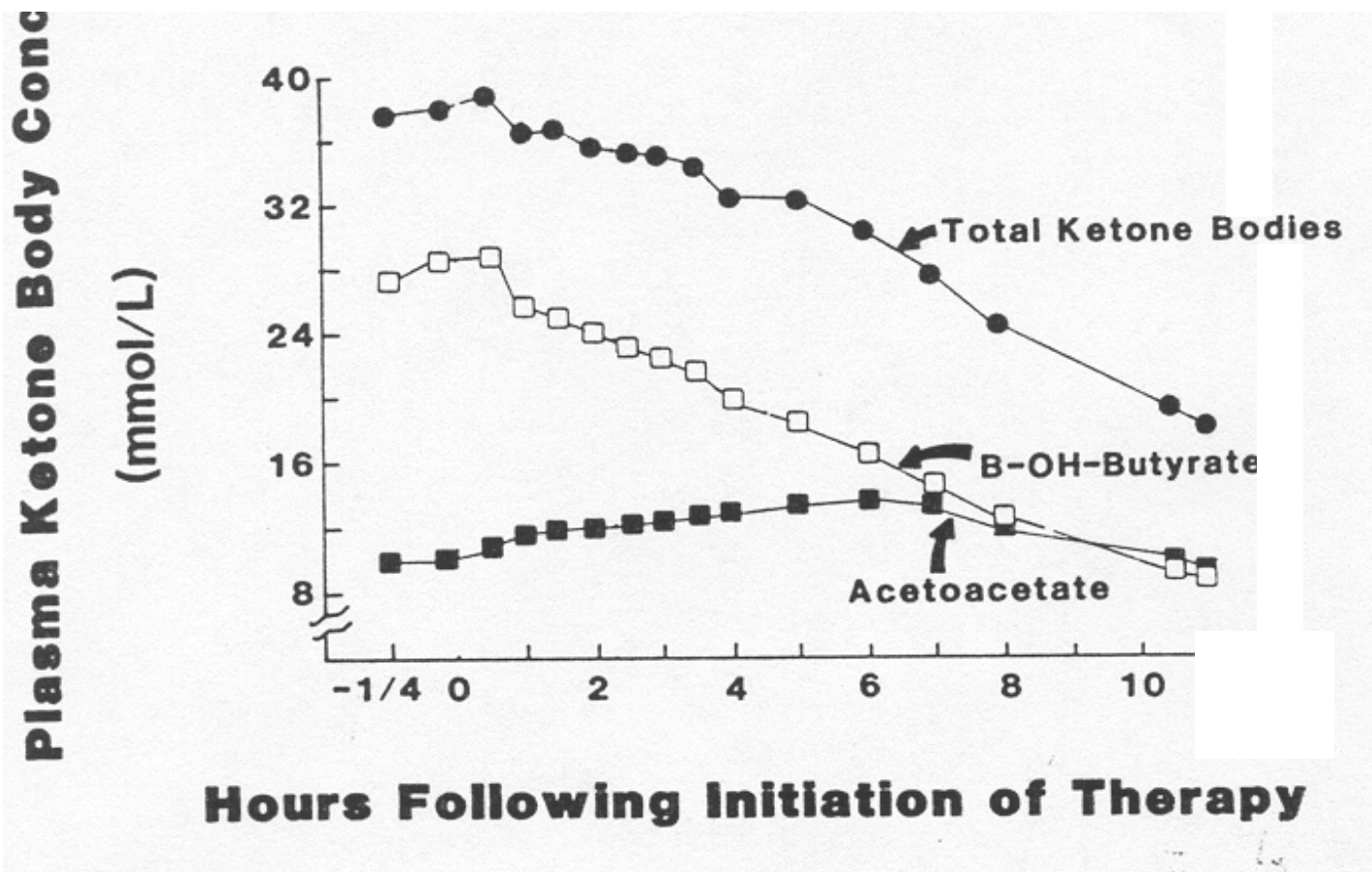
- Expensive, \$ 3.75 each strip
- Measures ***B-hydroxybutyrate (BHB)***
- Reflects current status

Ketones

- When the blood pH is closer to normal Acetoacetate is the major form
- When the blood pH is lower B-hydroxybutyrate is more prevalent
- As blood pH improves B-hydroxybutyrate is converted to acetoacetate



β -hydroxybutyrate is a better indicator of metabolic status when detecting and treating DKA



Comparison of Blood and Urine Ketones

<u>Blood Ketones (mmol/l)</u>	<u>Urine Ketones</u>
< 0.6 mM	Negative
0.6 mM to 0.9 mM	Trace to small
1.0 mM to 1.5 mM	Moderate
1.6 to 3.0 mM	Large
<u>≥ 3.0 mM</u>	Very Large

Diabetic Ketoacidosis Therapy

- Conservative fluid therapy- initial bolus
10 cc/kg normal saline , then IV fluid (NS- first 4-6 hr, then ½ NS) at 1.5 times maintenance
- Electrolyte replacement - Na, K , P
- Continuous Intravenous low dose
(0.1unit /kg /hr) regular insulin therapy
- No insulin bolus recommended
- Bicarbonate therapy rarely used unless ionotropic dysfunction. Use is associated with increased risk of cerebral edema

Type I Diabetes Therapy

- This talk has been glucocentric
- However management of other cardiovascular risk factors is crucial
 - Hyperlipidemia
 - Hypertension
 - Smoking cessation
 - Vitamin D deficiency

Education

- PLANNING FOR COLLEGE:
- A Workshop for High School Students with Diabetes and Their Families
- Learn how to prepare yourself NOW for life at college when you graduate.
- March 3, 2011 at 6pm
- Joslin Diabetes Center
- 3229 East Genesee Street (*across from Nottingham High School*)
- Syracuse, NY 13214 – RSVP: 464-8668