Author(s): Arno Kumagai, M.D., 2009

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DIABETES MELLITUS

Part 3:

MANAGEMENT

M2 -Endocrine Sequence

A. Kumagai

Winter 2009

University of Michigan
Medical School

Diabetes Mellitus: Chronic Complications

"Too much sugar is bad for you."

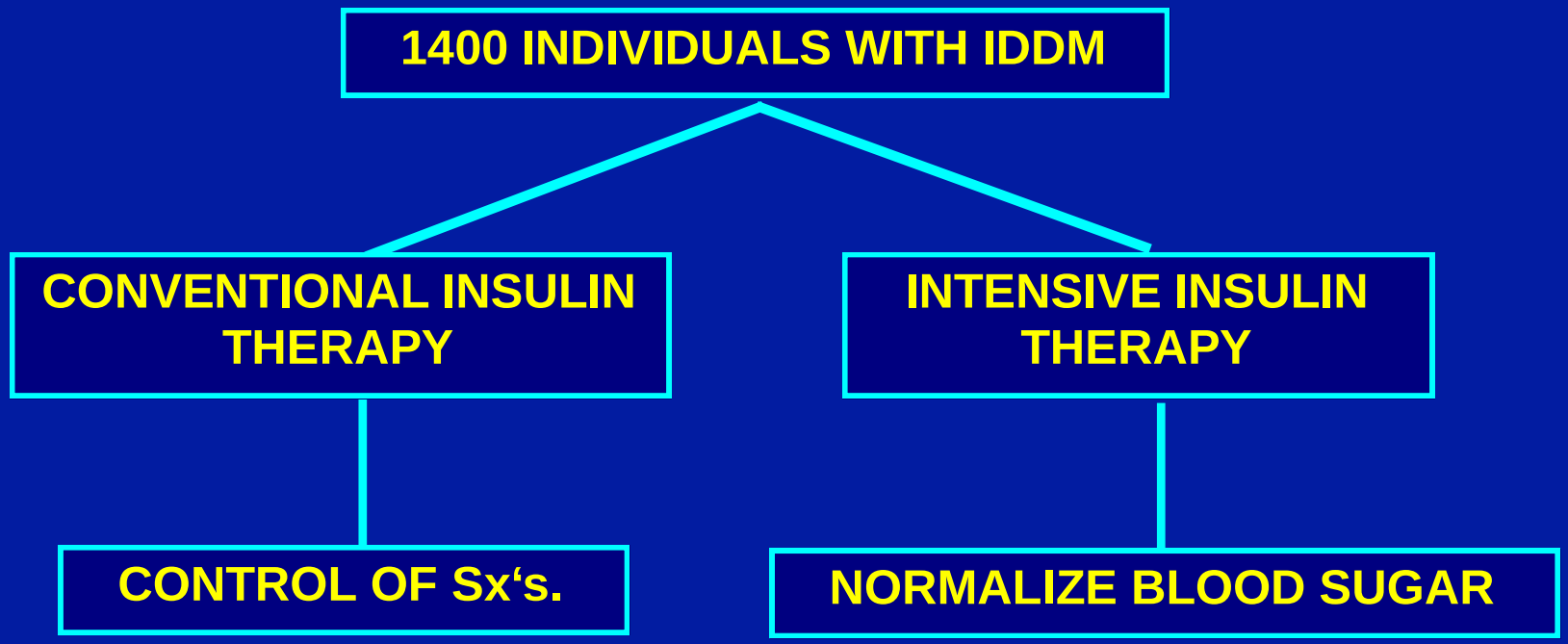
-- My mother

Diabetes Mellitus: Treatment

THE GLUCOSE HYPOTHESIS

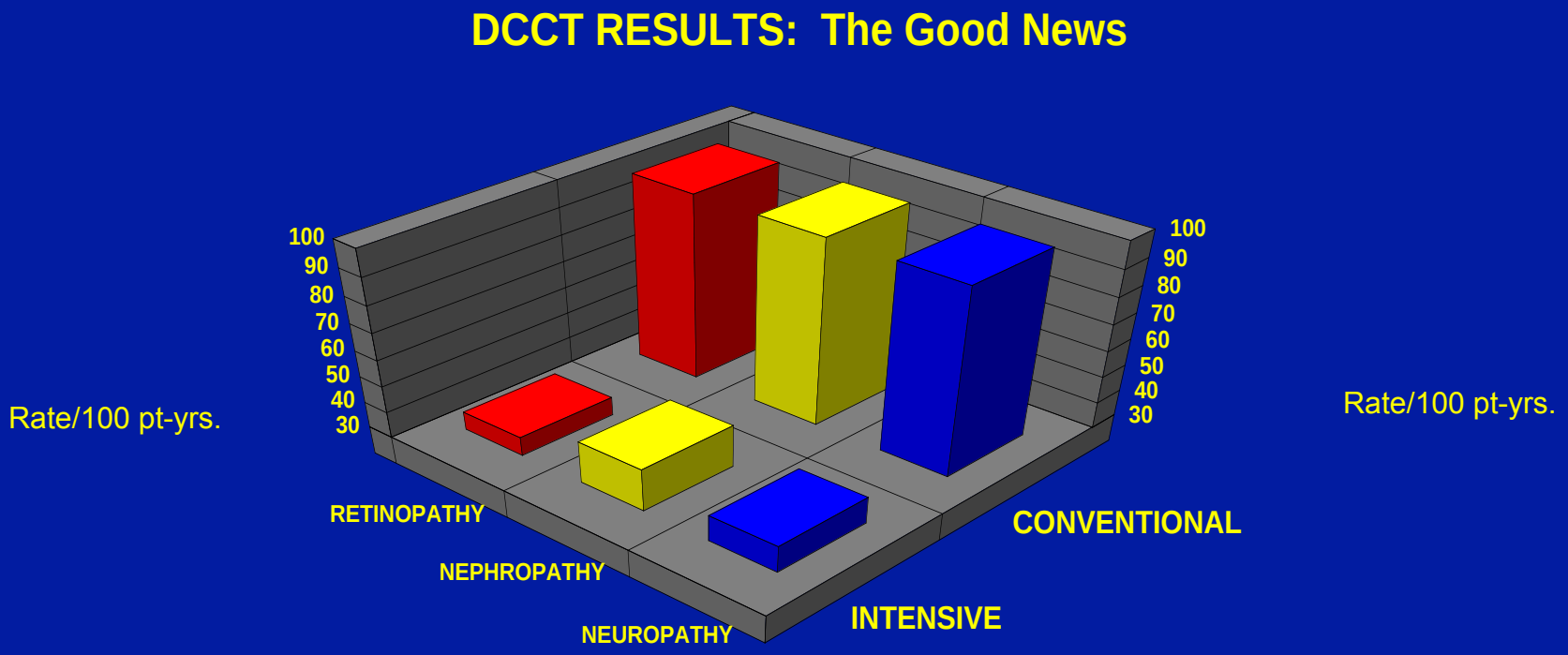
Normalization of blood glucose levels in individuals with diabetes will prevent or delay chronic complications.

THE DIABETES CONTROL AND COMPLICATIONS TRIAL (DCCT), 1993



Does long-term normalization of blood glucose levels in type 1 diabetes reduce the risk of development or progression of microvascular complications?

The Benefits of "Tight Control": The DCCT



Intensive metabolic control dramatically reduced the risk of developing or worsening microvascular complications in type 1 diabetes.

A more recent trial, the **United Kingdom Prospective Diabetes Study** (**UKPDS**), demonstrated very similar results in individuals with type 2 diabetes.

PD-INEL DCCT, 1993

Message from the DCCT and UKPDS:

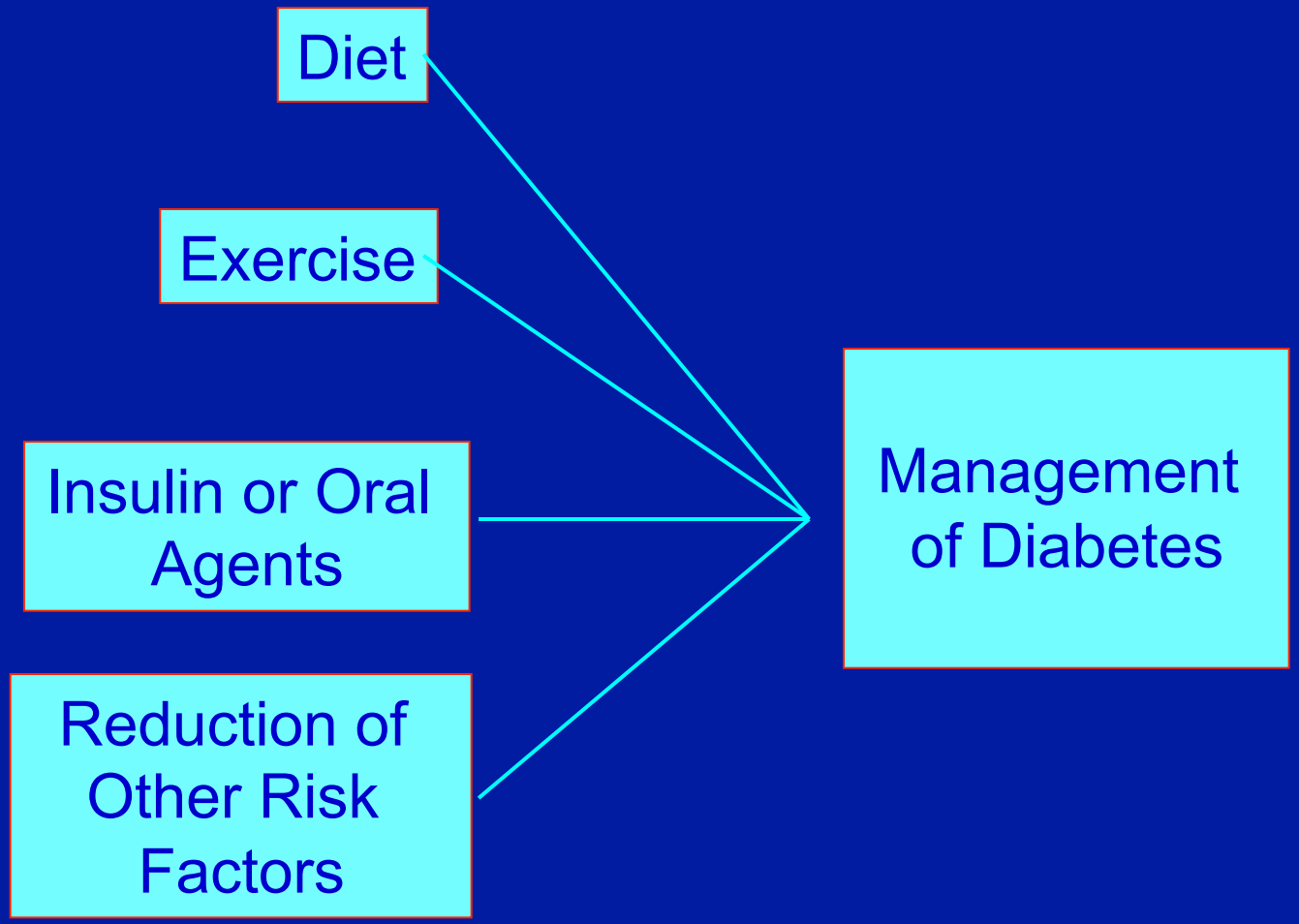
“Metabolic control matters.”

Management of Diabetes Mellitus: Goals of Therapy

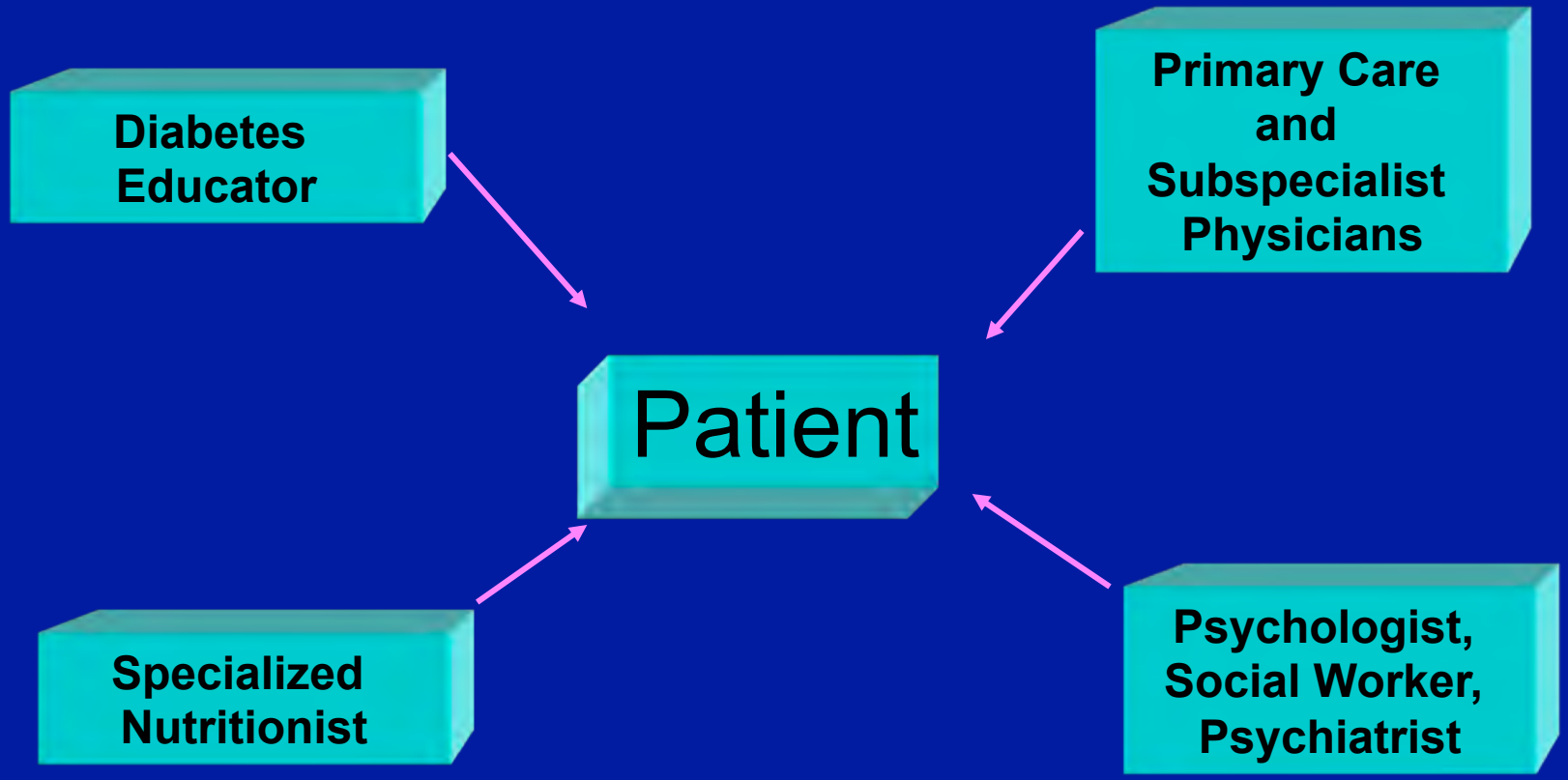
MANAGEMENT MUST BE INDIVIDUALIZED!

- **Normal fasting blood glucose levels.**
- **Prevention of postprandial hyperglycemia.**
- **Reduction of hypoglycemic episodes to a bare minimum.**
- **Psychosocial: Helping the patient to live a productive, enjoyable life with diabetes and NOT ruled by diabetes**

Management of Diabetes Mellitus: Components of Therapy



The Diabetes Care Team



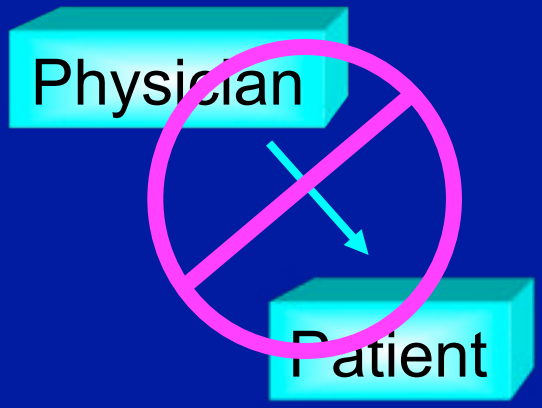
Diabetes Care From the Patient's Perspective

To deliver effective diabetes care, perspective is EVERYTHING

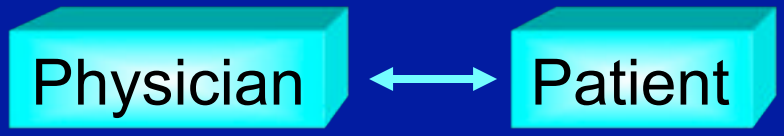
- Goals and ambitions
- Lifestyle and personal preferences
- Concerns and fears

Since over 95% of diabetes care is SELF CARE, one must understand "where the patient is coming from" to deliver meaningful advice and care.

“Diabetes Care is Self Care”



The concept of “patient compliance” is neither appropriate nor effective in diabetes care.



The “doctor-knows-best” approach is replaced by shared responsibilities and alliances between the physician and the patient in diabetes care.

The Role of the Diabetes Care Provider

"Knowledge speaks but wisdom listens."

-- Jimi Hendrix

Management of Diabetes Mellitus

INSULIN THERAPY

Treatment of Diabetes: Pre-Insulin Era

1870 Siege of Paris:

- Apollinaire Bouchardat notices that famine actually improves control in his diabetic patients.
- "Mangez le moins possible." ("Eat the least possible.")

1914-17 New York:
"Under-nutrition Therapy"

- Frederick Allen imposes severe caloric restriction (<500 Cal/d) on Diabetic Ward, alternating with periods of total fasting .
- Most died of starvation, but were spared death from ketoacidosis.

Child with Type 1 Diabetes, 1922

PD-EXP Schade et al, 1983

The Advent of Insulin

January 11, 1922 University of Toronto

- Frederick Banting and his graduate student, Charles Best, administer a crude preparation of insulin to Leonard Thompson, a 14-year-old boy with type 1 diabetes.
- **The results were modest, with side effects (sterile abscesses). Banting & Best go back to the drawing board….**

January 23, 1922: Repeat attempt with new preparation from J.B. Collip's laboratory. This time, preparation results in significant decreases in blood sugars and minimal side effects. Leonard Thompson begins life-long insulin therapy.

1923: Banting & McCleod share Nobel Prize in Medicine

Dr. Frederick Allen closes his clinic and declares bankruptcy.

The Advent of Insulin

PD-EXP Shade, et al, Intensive Insulin Therapy, 1983

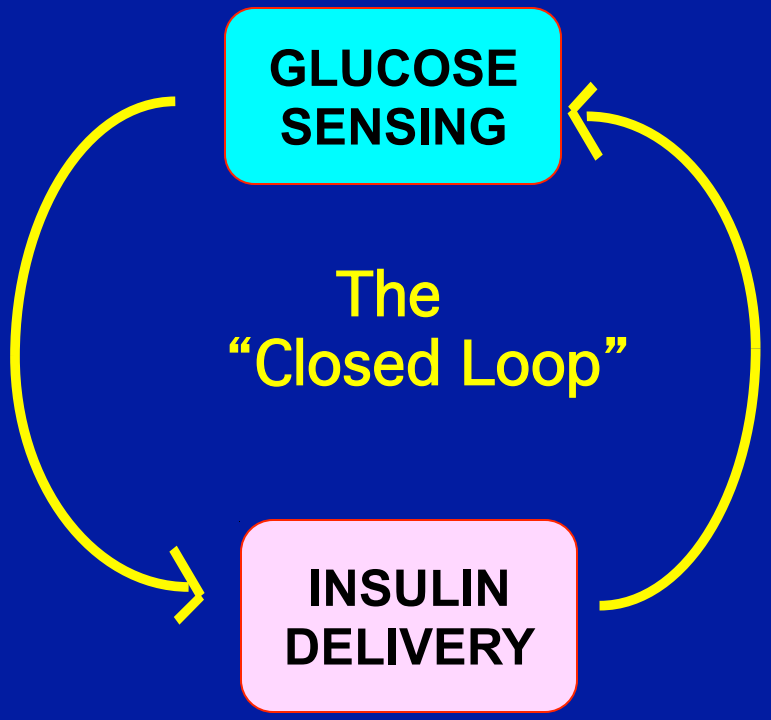
With the advent of insulin therapy, the challenge in diabetes care shifted from mere survival to avoiding chronic complications.

Insulin

Pickup & Williams, 1991

51 amino acids, MW 6,000 Daltons
Secreted as a prohormone consisting of an A-chain, a B-chain and a connecting, or C-peptide.

The Dream of Intensive Insulin Therapy



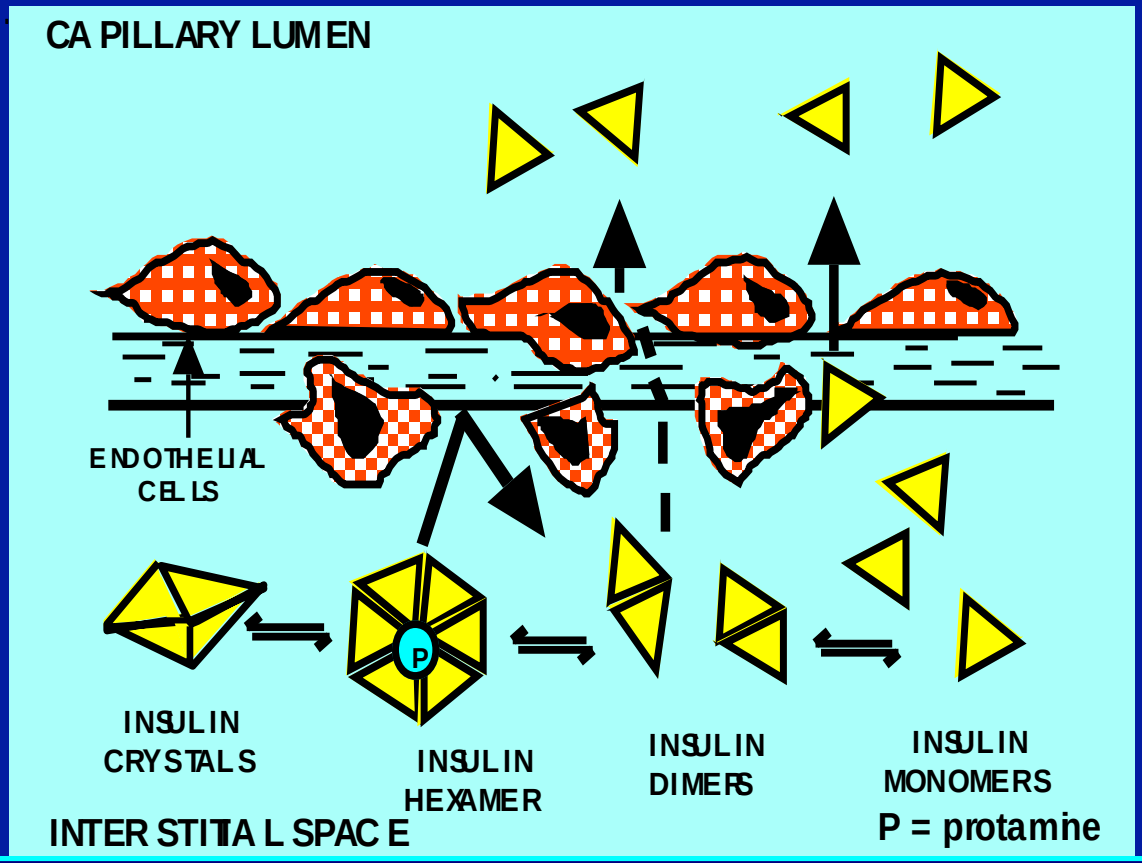
Insulin Therapy

GOAL

To most closely match insulin delivery with insulin needs

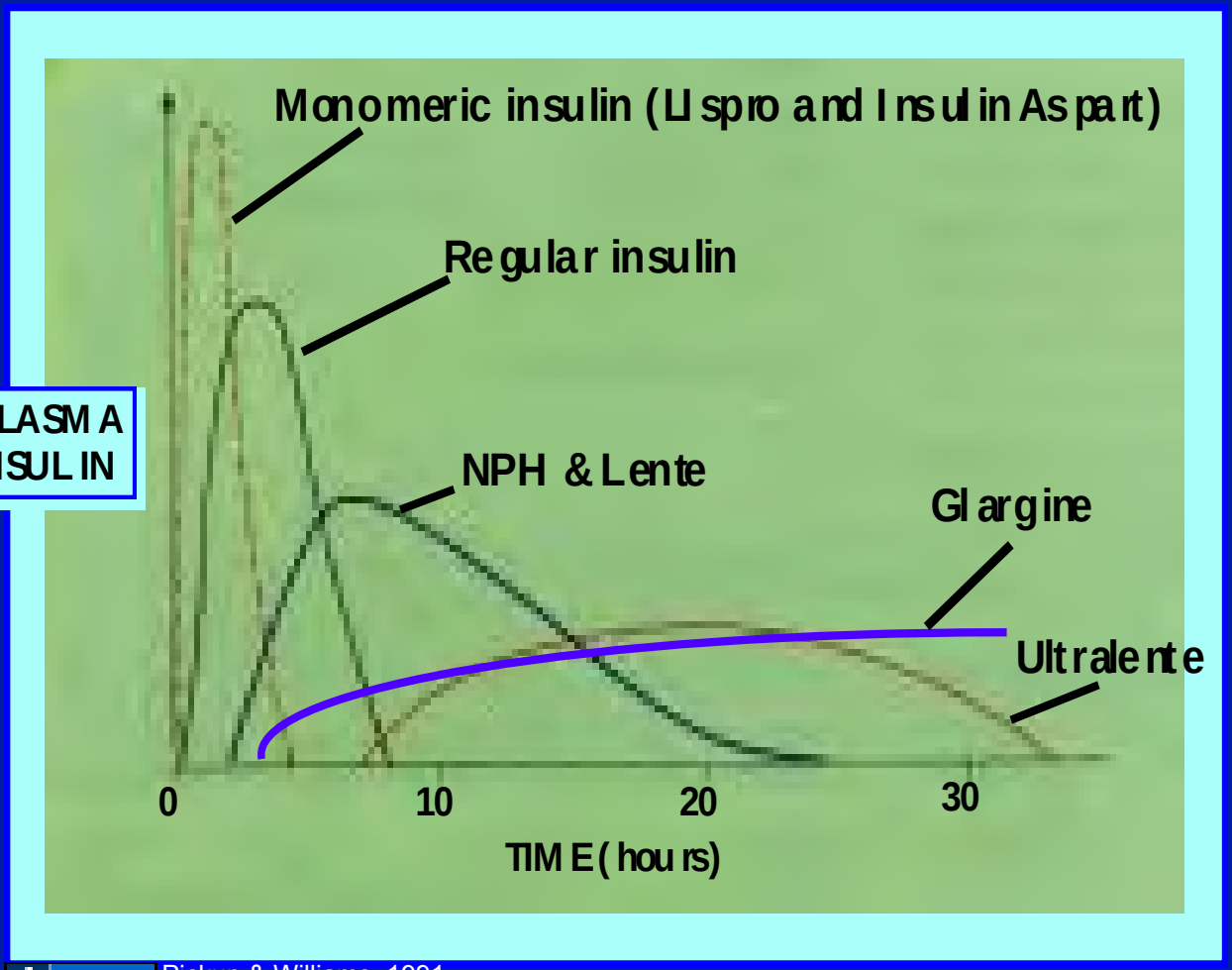
INSULIN

INSULIN ABSORPTION



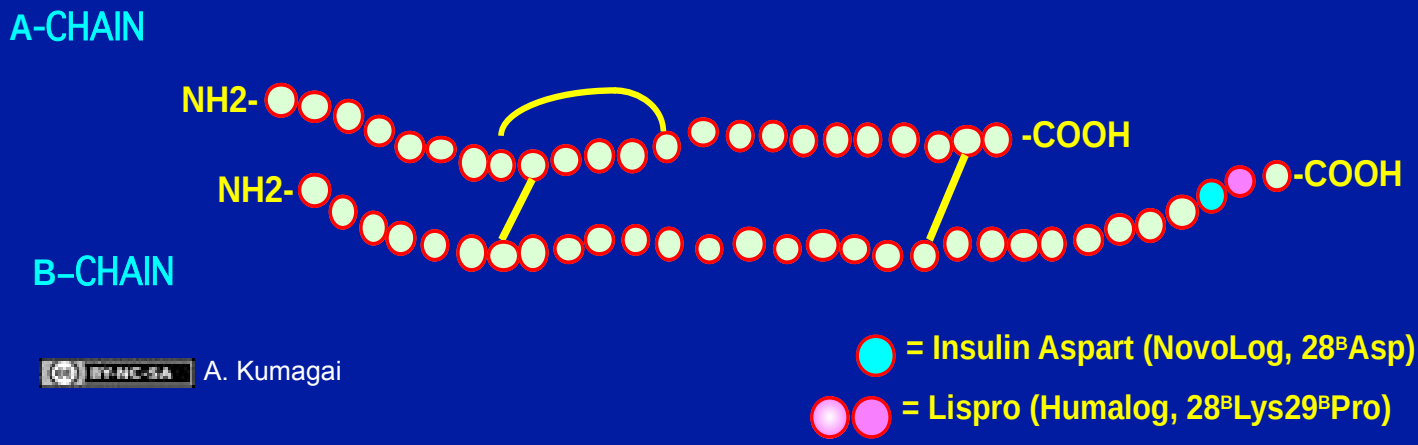
Insulin absorption and entry into the systemic circulation depends chiefly on its dissociation from hexamers and crystals, which in turn depends on tissue pH. Blood flow plays only a minor role.

Insulin Preparations



Pickup & Williams, 1991

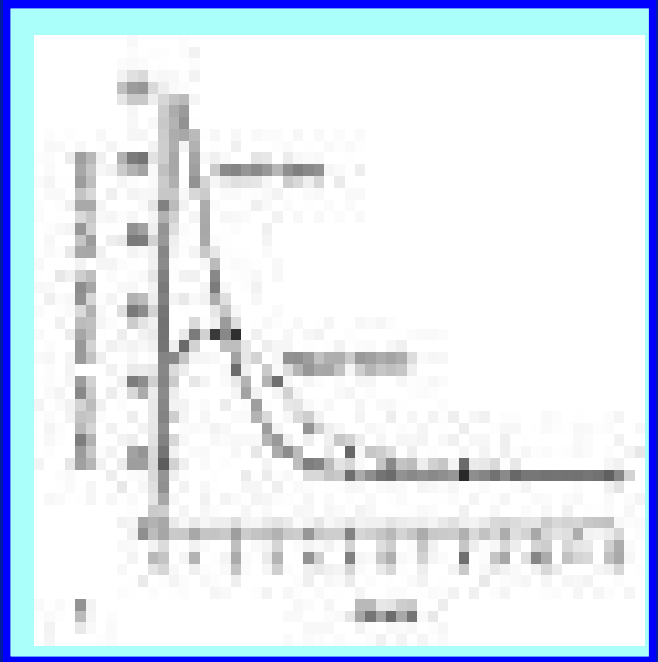
Rapid-Acting Insulins:
Lispro (Humalog) and Insulin Aspart (Novalog)

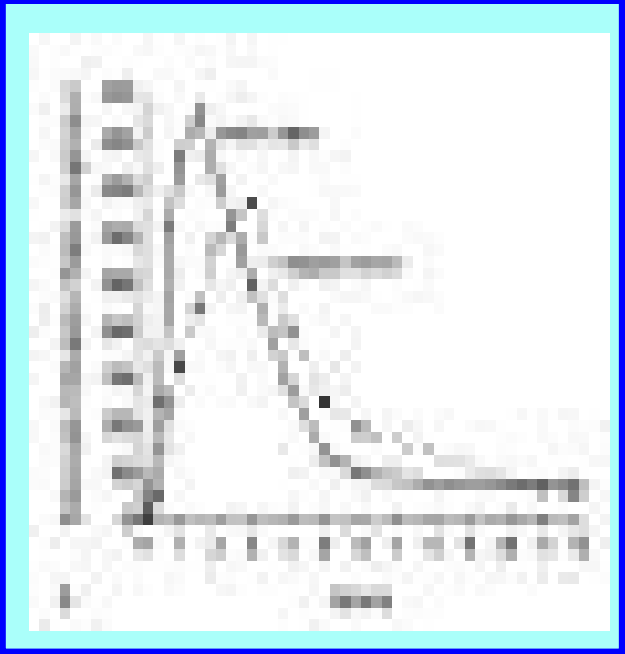


 A. Kumagai

 Source Undetermined

Rapid-Acting Insulins: Regular vs. Lispro (or Aspart)

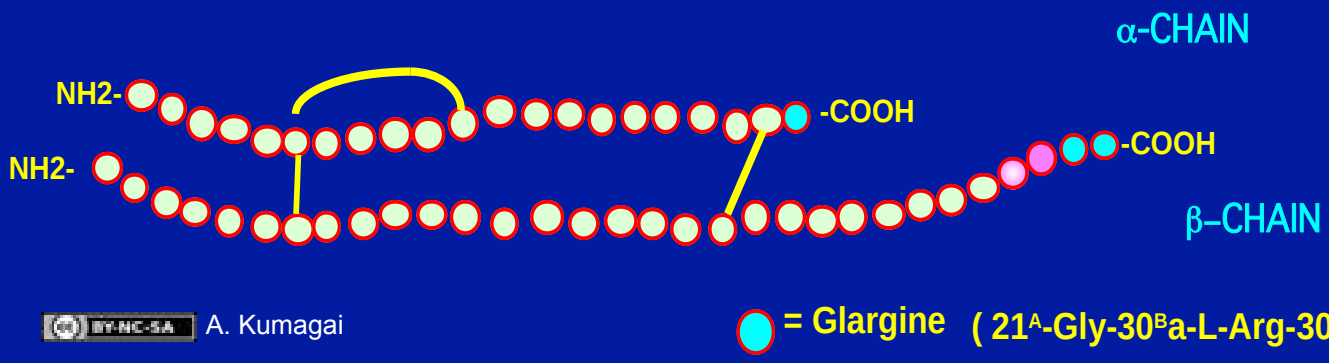




Insulin	Onset	Peak	Duration
Regular	20-30'	1.5-2.0 hrs	~5-6 hrs
Lispro	5-6'	40-60'	~3 hrs

Holleman & Hoekstra, 1997

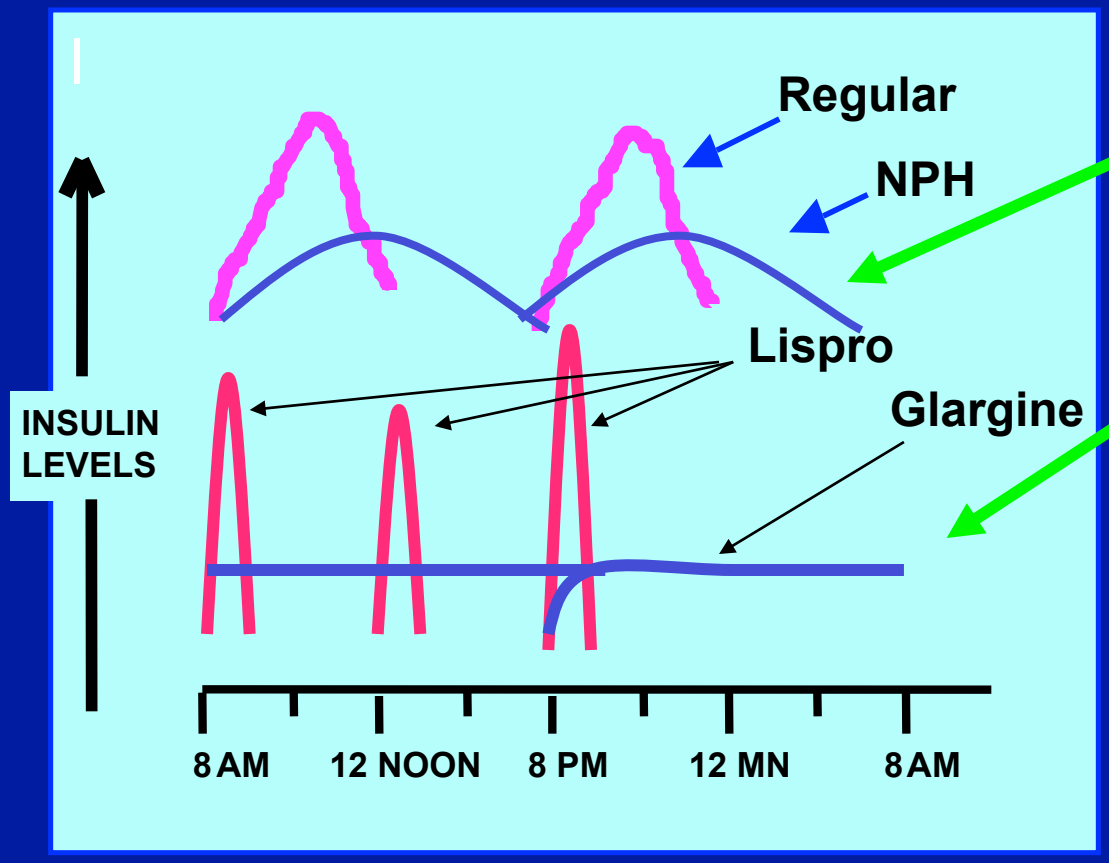
Long-Acting Insulins: Insulin Glargine (Lantus)



Insulin Glargine (Lantus)

- Substitution of amino acids alters isoelectric point and decreases solubility at physiologic pH.
- Very long-acting, “peakless” insulin.
- Often taken once a day at bedtime.
- Because of acidic buffer, cannot be mixed with other types of insulin in same syringe.

Insulin Regimens

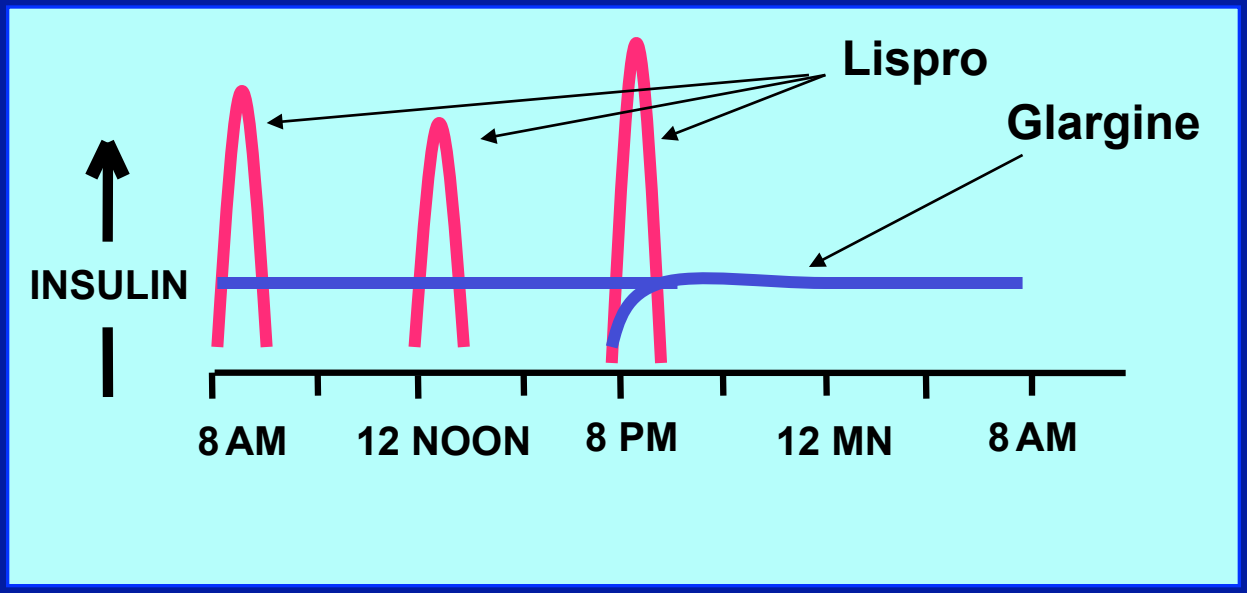


CONVENTIONAL THERAPY= NPH ± Regular once-twice daily

INTENSIVE THERAPY = Rapid with each meal and Long in AM and/or at bedtime.

Multiple-Daily Insulin Regimens

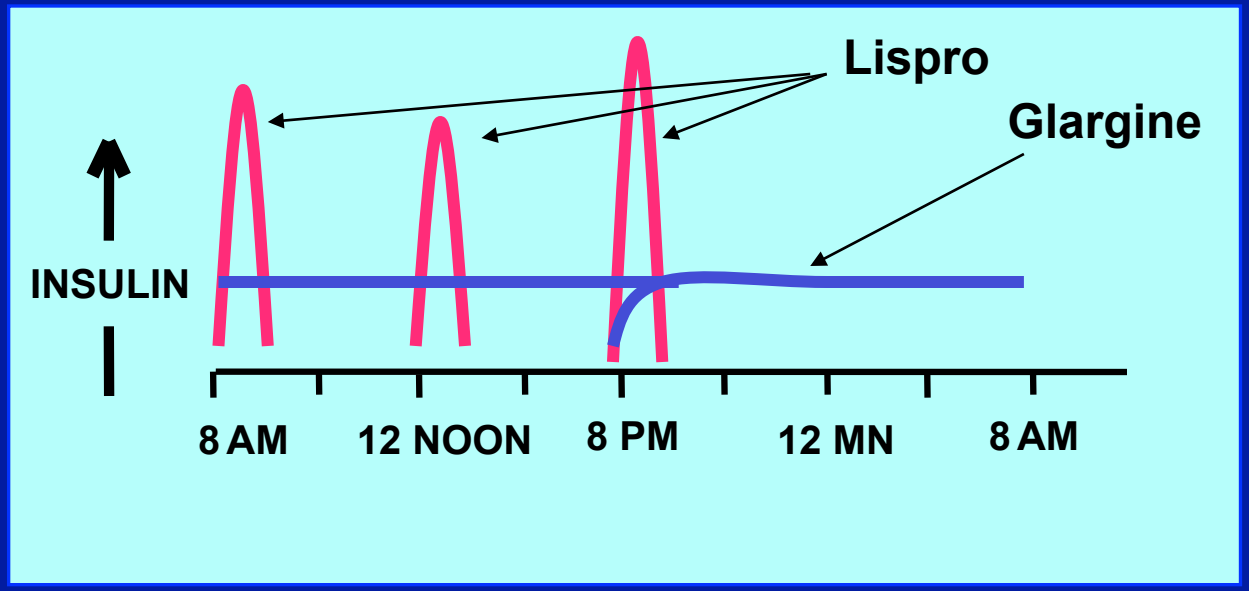
General Principle:



Normal insulin secretion from the pancreas is split into approximately 50% continuous basal infusion and 50% meal-associated boluses

Multiple-Daily Insulin Regimens

FLEXIBILITY is derived from a sliding scale of the rapid-acting insulin, e.g.,



The rapid-acting insulin may be dosed according to amount of carbohydrates (e.g., 1 unit per 15 g CHO) and the pre-meal blood sugar (e.g., 1 unit per 50 > 100 mg/dL).

Continuous Subcutaneous Insulin Infusion Therapy (CSII)

Insulin Pumps

PD-SELF Insulin Pump by David-i98, Wikipedia

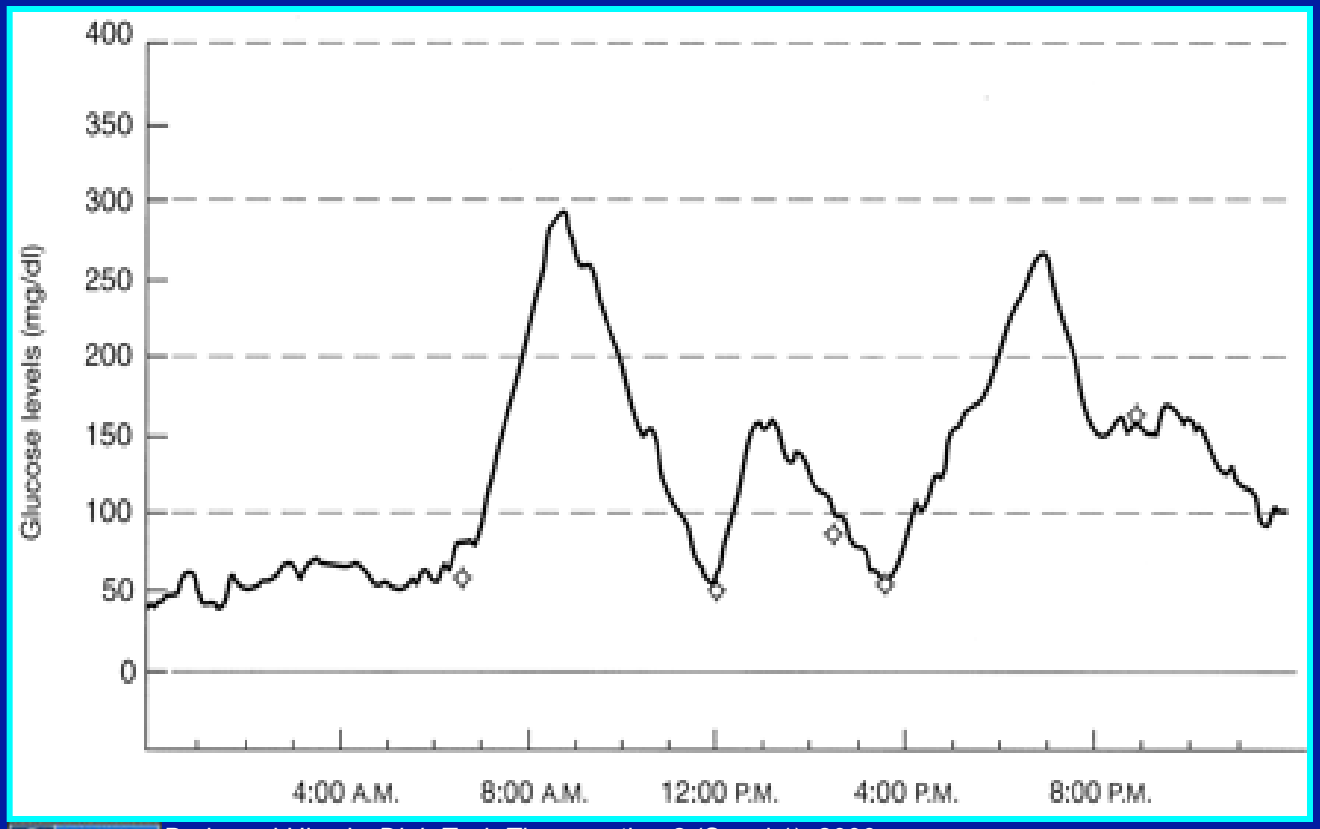
PD-SELF Insulin Pump With Infusion by mbbradford, Wikipedia

INSULIN THERAPY

The cornerstone of insulin therapy is SELF MONITORING OF BLOOD GLUCOSE LEVELS.

Continuous Glucose Monitoring

Continuous Glucose Monitoring System (CGMS) Medtronic MiniMed

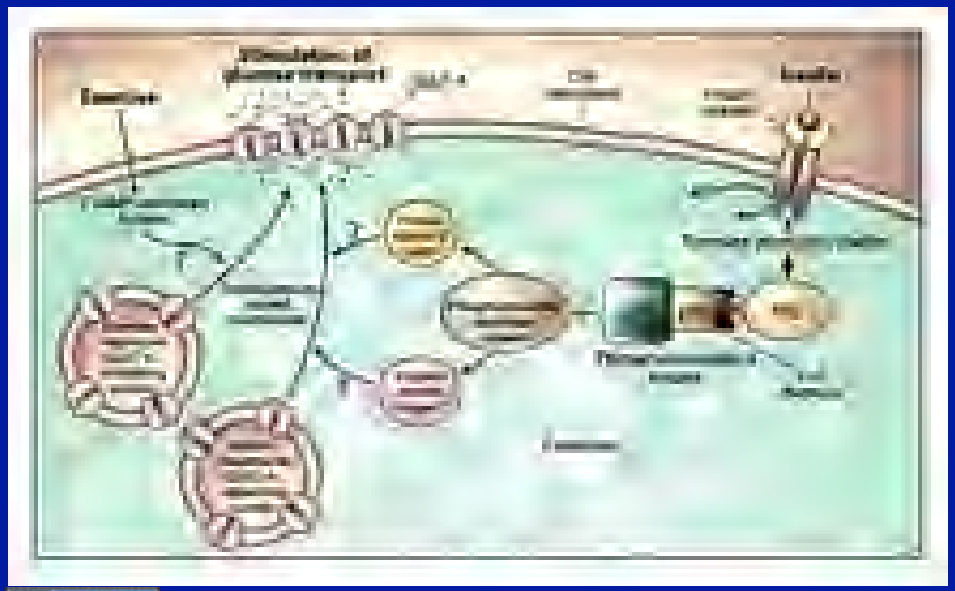


PD-INEL Bode and Hirsch *Diab Tech Therapeutics* 2 (Suppl 1), 2000

Representative CGMS profile in 35 y/o woman with type 1 diabetes and HbA1c of 7.1%.

Insulin Therapy and Exercise

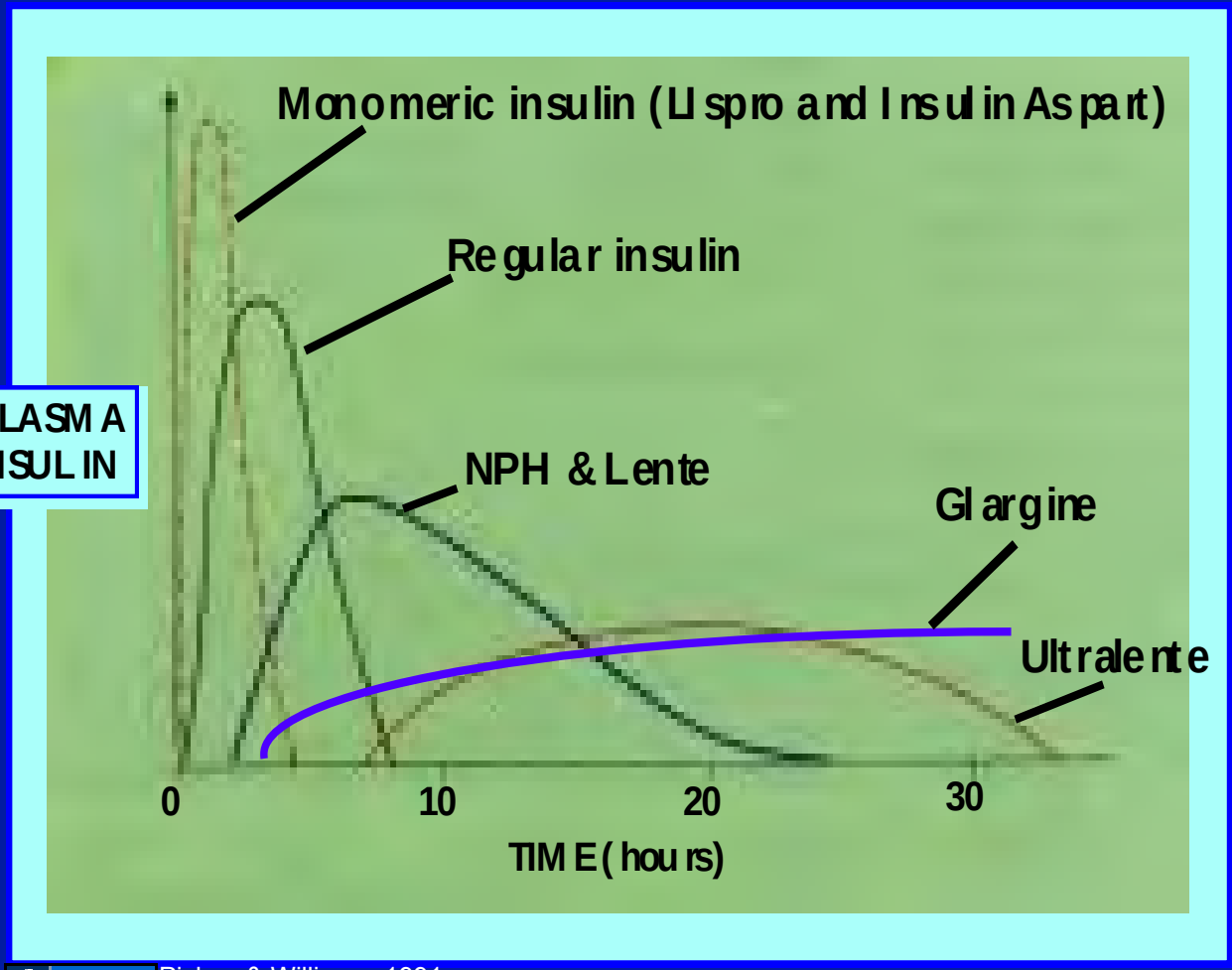
BY-NC-SA Urban Jogger by Leonard John Matthews (Flickr)



PD-INEL Source Undetermined

Physical activity increases glucose transport independent of insulin and decreases insulin requirements. Adjustments of insulin dosages must be made when anticipating periods of increased physical activity.

Insulin Preparations



Pickup & Williams, 1991

Insulin Preparations

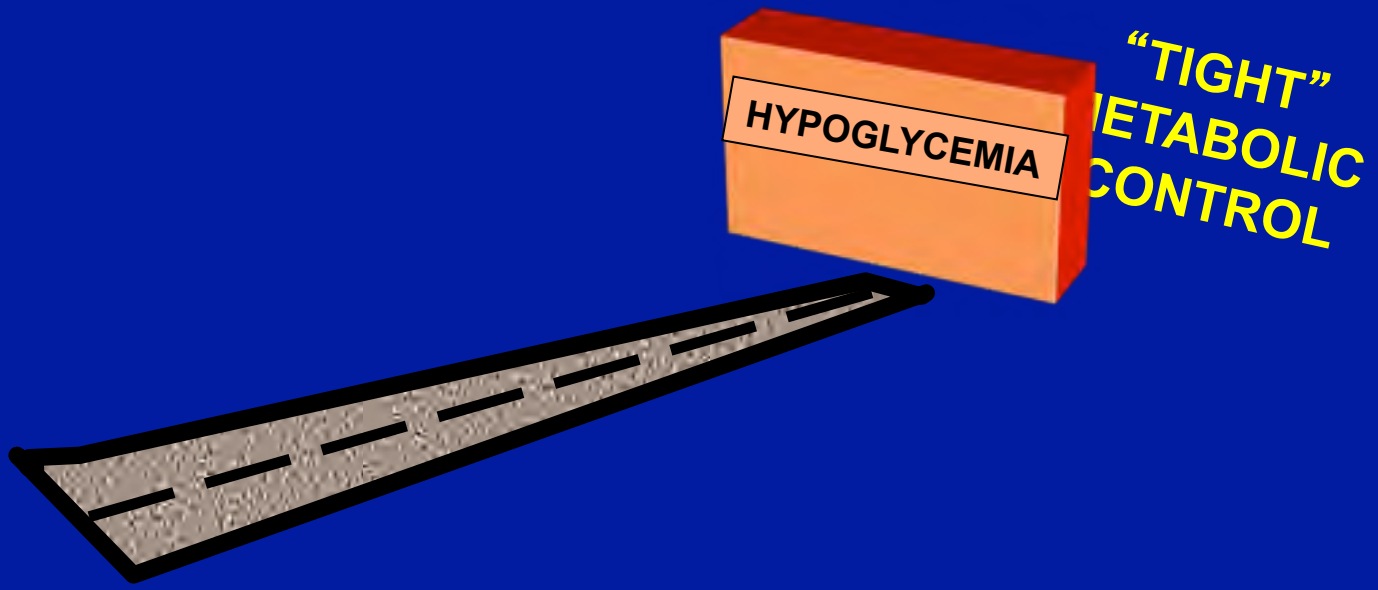
Type	Onset	Duration
RAPID		
√ Lispro (Humalog)	5-10 min.	~3 hrs
√ Aspart (Novalog)		
Gluisine (Apidra)		
√ Regular	20-30 min.	4-6 hrs
INTERMEDIATE		
√ NPH	1-2 hrs.	12-18 hrs
LONG-ACTING		
√ Glargine (Lantus)	4-6 hrs.	>24 hr
Detemir (Levemir)		

√ = be familiar with these

Insulin Therapy

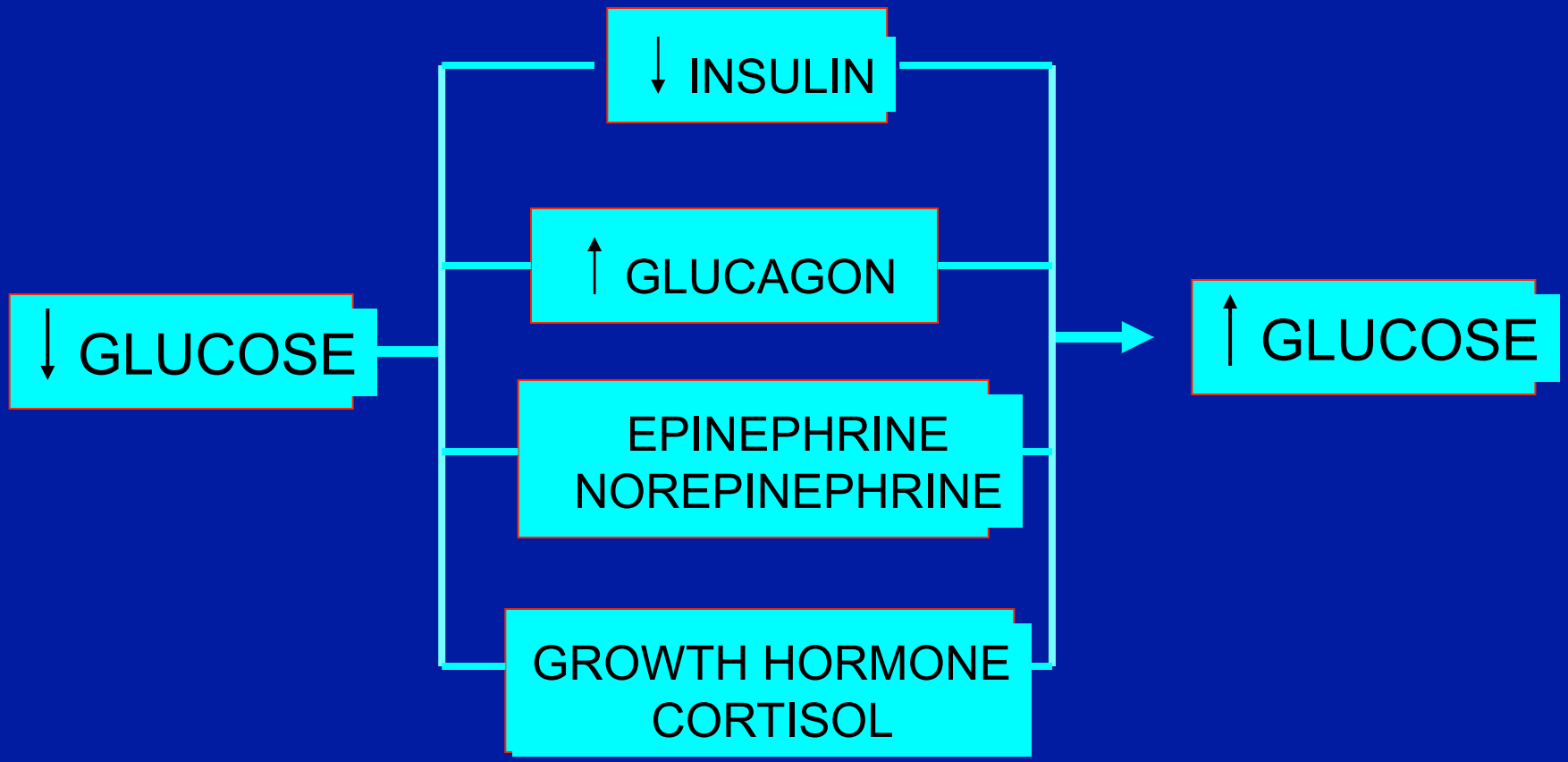
Side Effects

Insulin Therapy



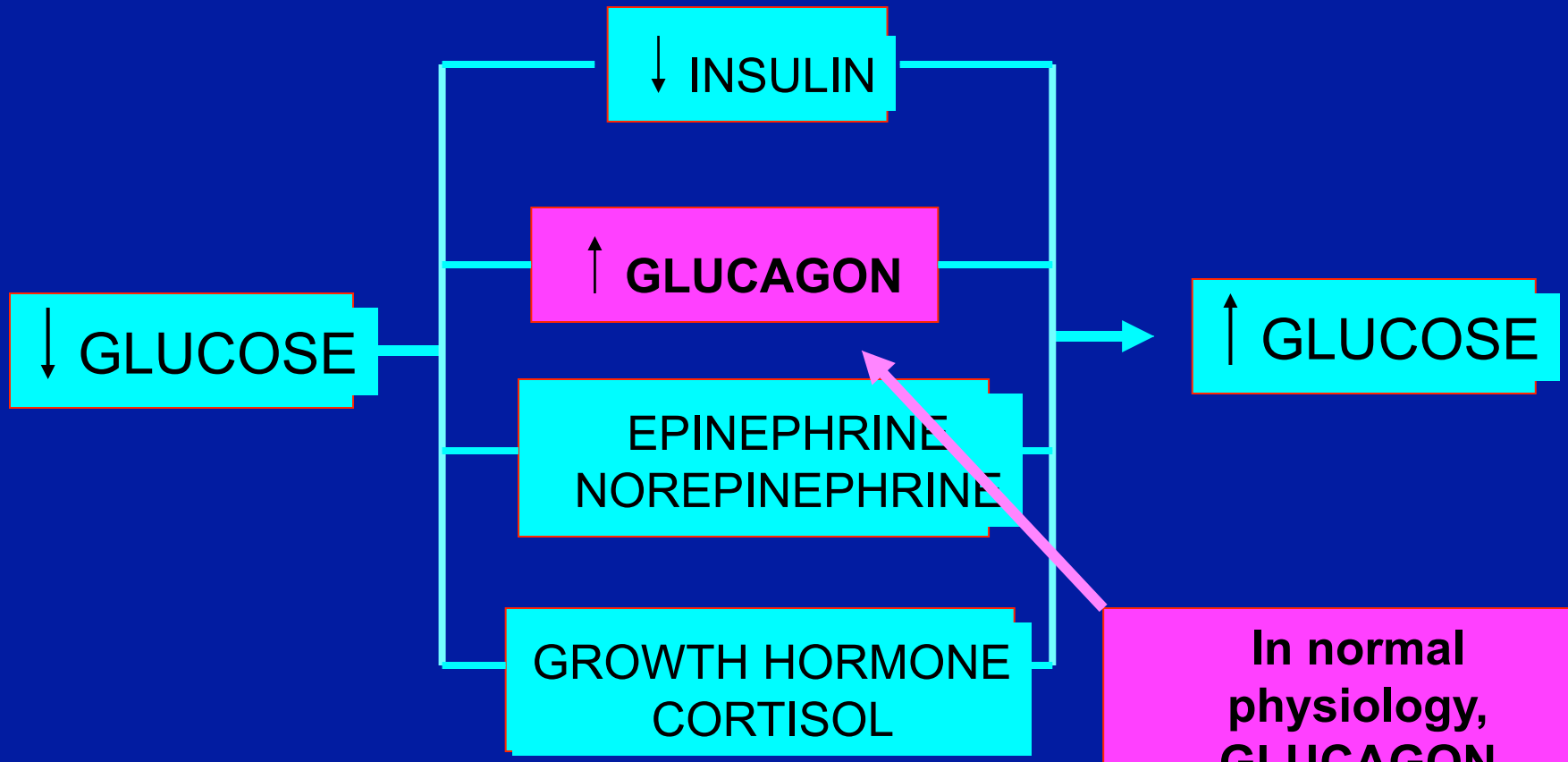
Iatrogenic hypoglycemia is the limiting factor in the treatment of insulin-dependent diabetes mellitus.

DEFENSE AGAINST HYPOGLYCEMIA: The Counterregulatory Response



Adapted from Cryer PE. Banting lecture. Hypoglycemia: The limiting factor in the management of iddm. Diabetes 1994; 43(11): 1378-89

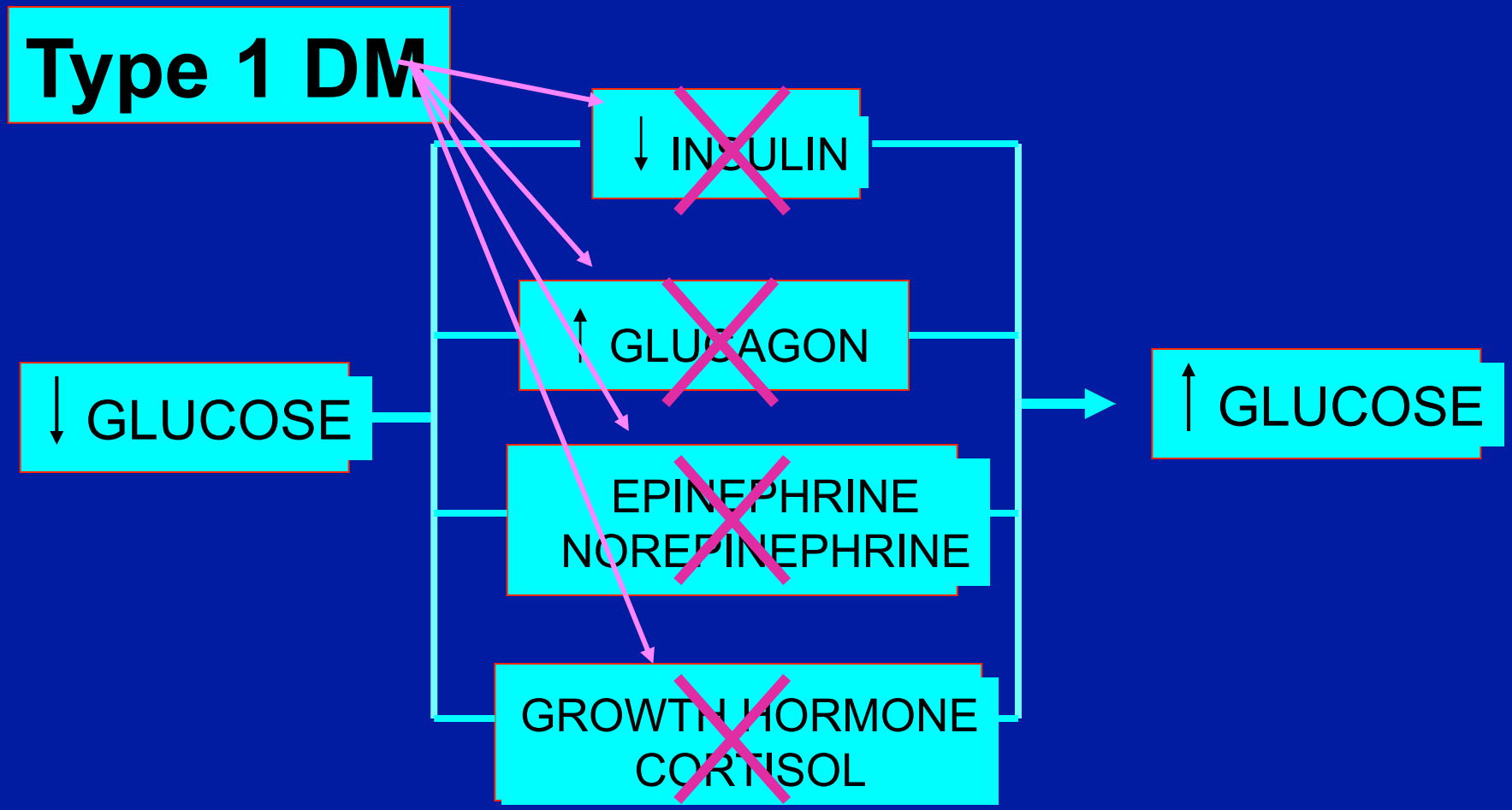
DEFENSE AGAINST HYPOGLYCEMIA: The Counterregulatory Response



In normal physiology, GLUCAGON secretion is the main defense against hypoglycemia.

Adapted from Cryer PE. Banting lecture. Hypoglycemia: The limiting factor in the management of iddm. Diabetes 1994; 43(11): 1378-89

DEFENSE AGAINST HYPOGLYCEMIA: The Counterregulatory Response



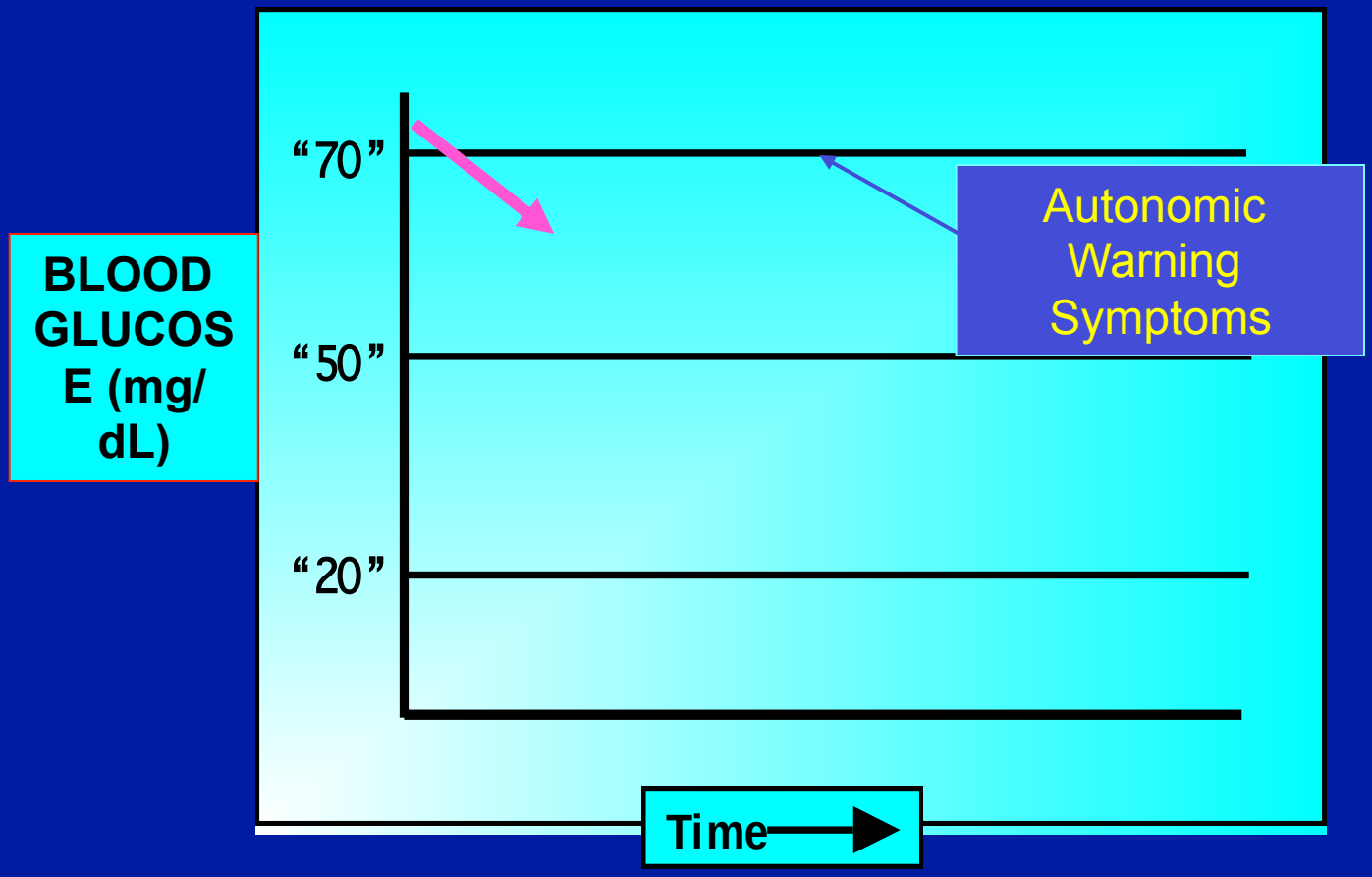
Adapted from Cryer PE. Banting lecture. Hypoglycemia: The limiting factor in the management of iddm. Diabetes 1994; 43(11): 1378-89

Symptoms of Hypoglycemia

"AUTONOMIC"	NEUROGLYCOPENIC
• Tremulousness • Palpitations • Sweating • Anxiety • Warmth • Feelings of "Impending Doom"	• Impaired concentration • Fatigue • Headache, dizziness • Slurred speech • Confusion • Disorientation • Coma • Seizures

"Warning symptoms of hypoglycemia"

The Slippery Slope of Hypoglycemia



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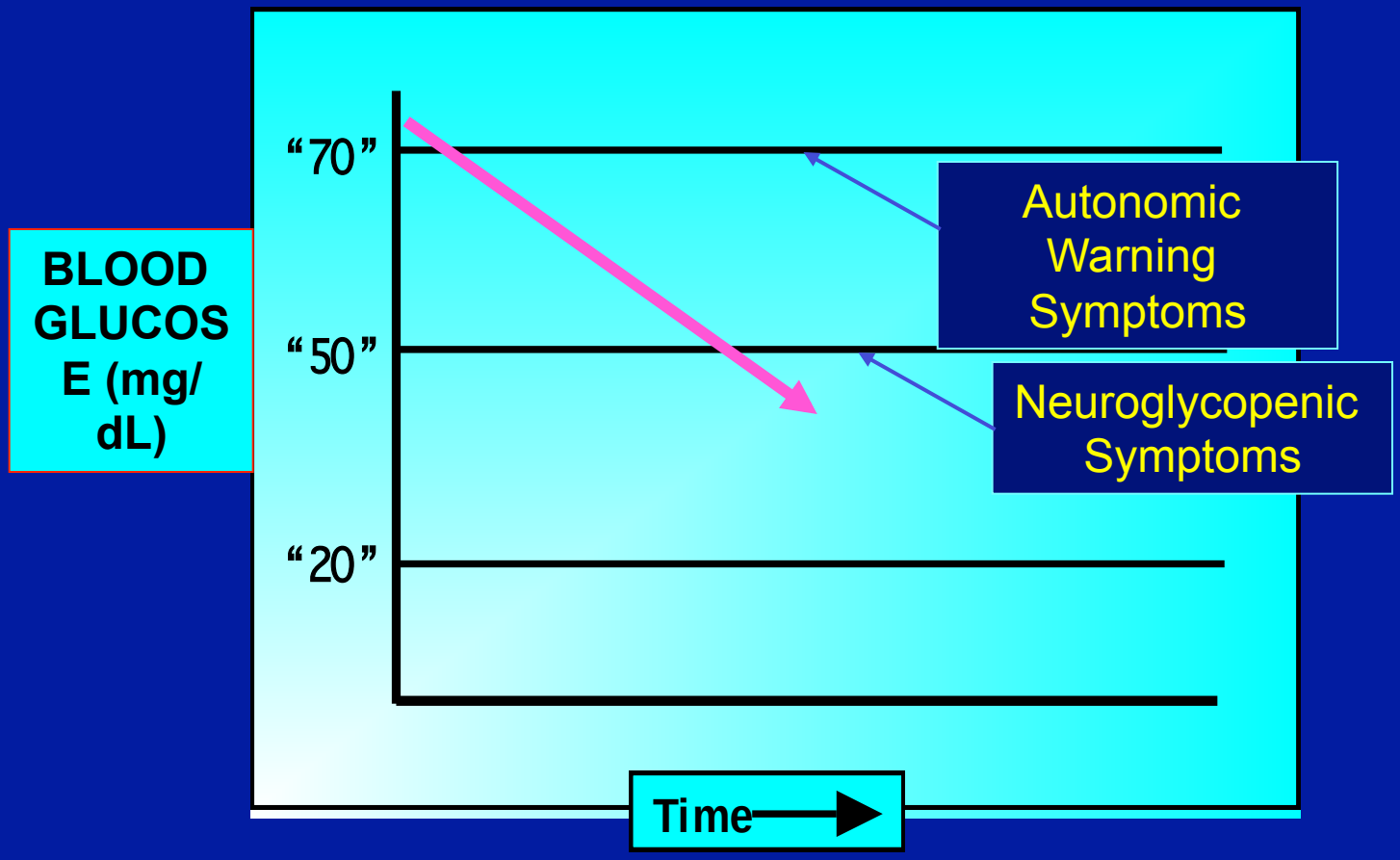

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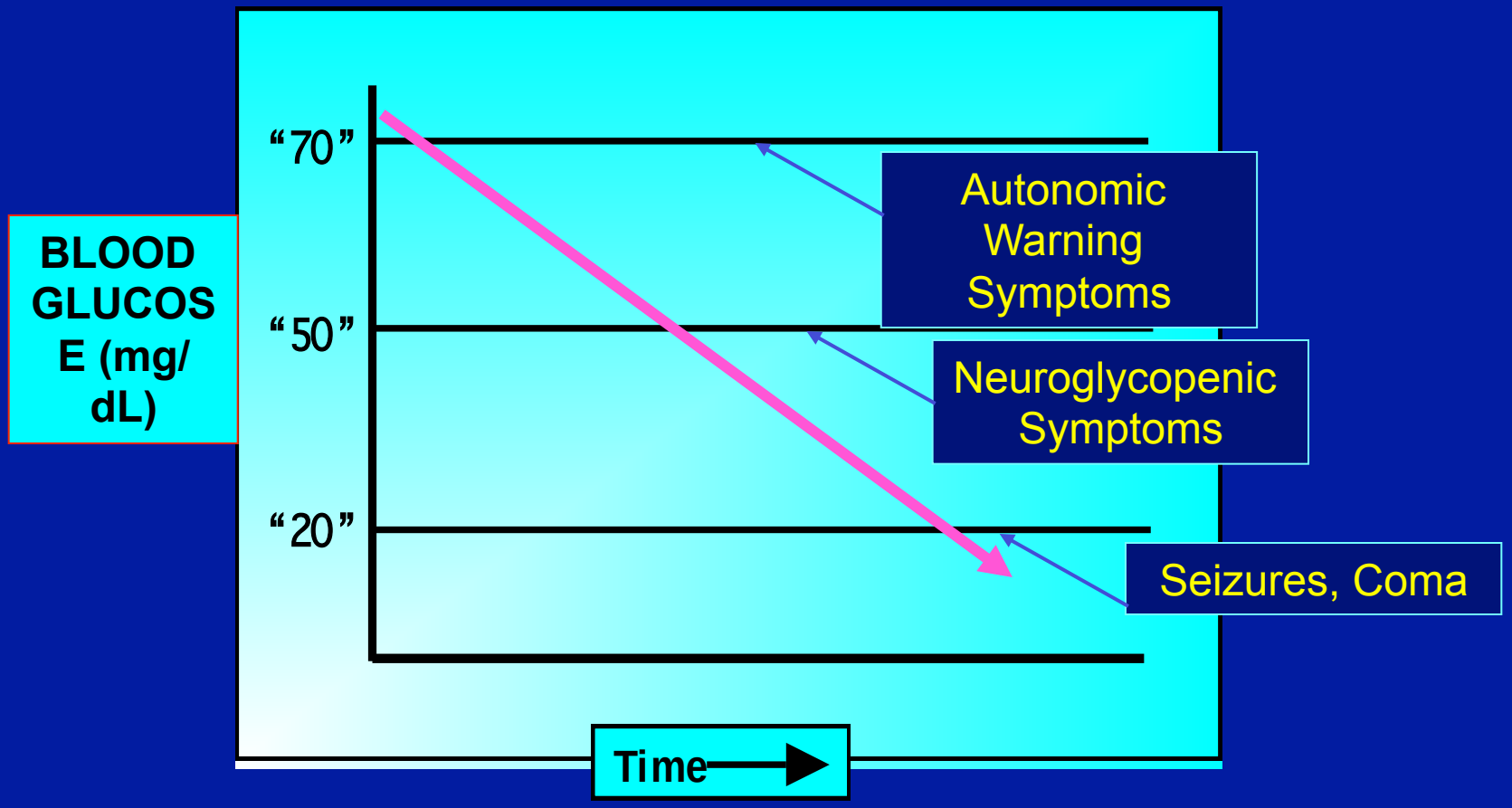
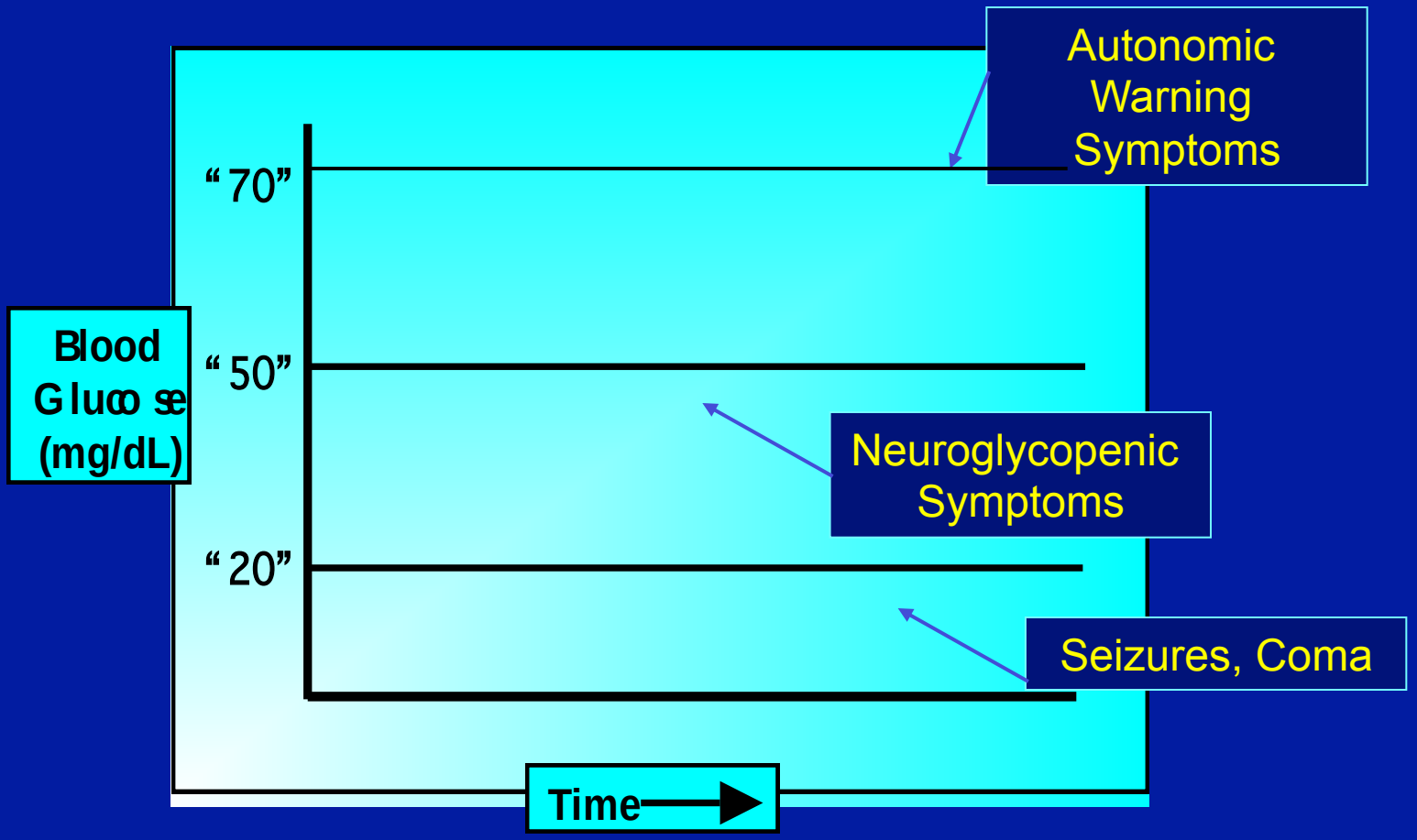
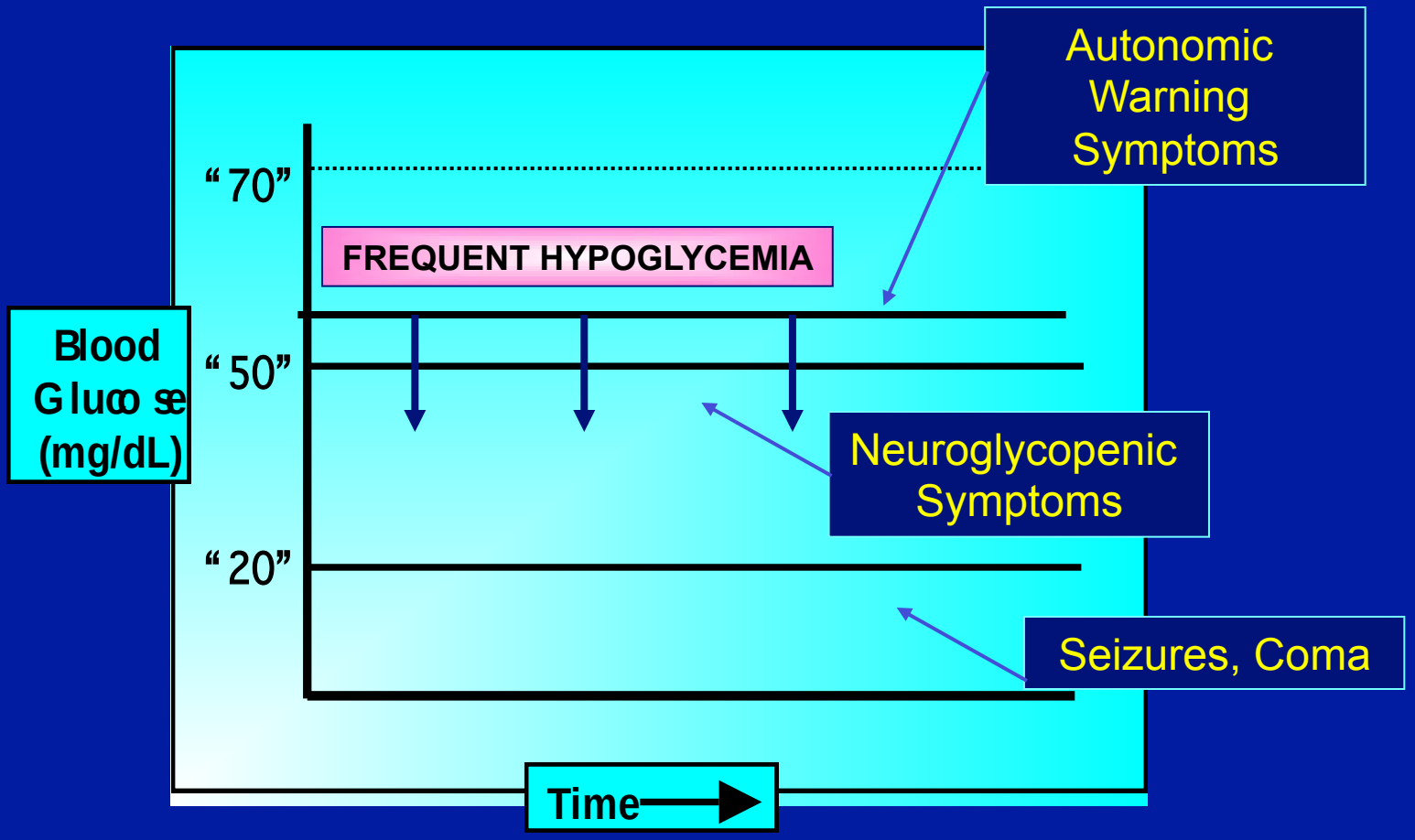


The Slippery Slope of Hypoglycemia



The Slippery Slope of Hypoglycemia



HYPOGLYCEMIA

HYPOGLYCEMIA UNAWARENESS

The onset of neuroglycopenia in the absence of prior autonomic warning symptoms

HYPOGLYCEMIA

Hypoglycemic episodes may be terrifying for the individual with diabetes and for his/her family and friends and may contribute to a sense of total loss of control over one's health and one's life

Hypoglycemia Treatment

If conscious and can swallow safely,

Oral carbohydrate replacement: glucose tablets

If unconscious or delerious:

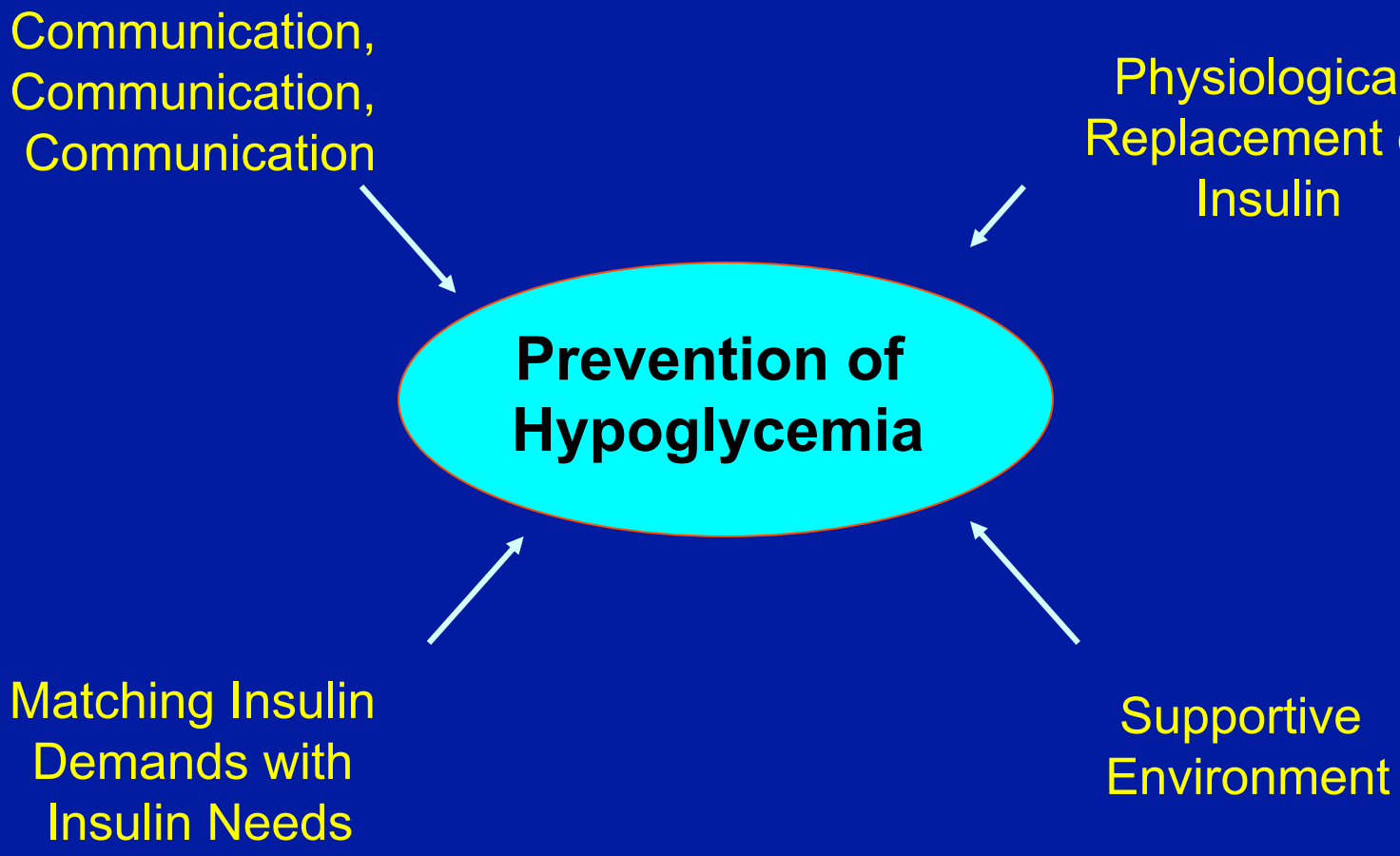
- **In the hospital:**
  50% dextrose IV push
- **At home:**

PD-SELF Mbbradford, (wikipedia)

HYPOGLYCEMIA: Treatment

Medical Alert Bracelet

HYPOGLYCEMIA: Prevention



Living with Diabetes

The Role of the Diabetes Care Provider

You gotta help 'em keep their "mojo workin' …."

-- Muddy Waters

Insulin Therapy: Complications

WEIGHT GAIN: Causes

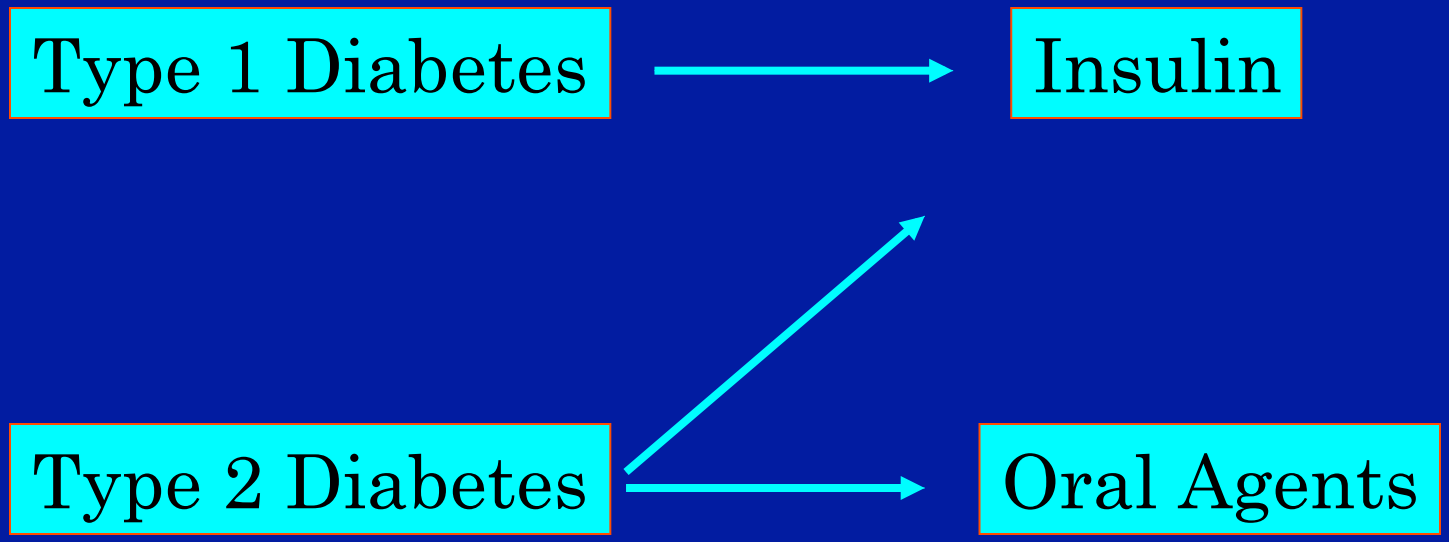
- Overeating in anticipation of possible hypoglycemia.
- Overeating in response to hypoglycemia.
- Minor effect: decreased caloric loss from resolution of glucosuria.

–Vicious cycle" of insulin leading to increased appetite, weight gain, increased insulin resistance, increased insulin, increased appetite, further weight gain, etc.

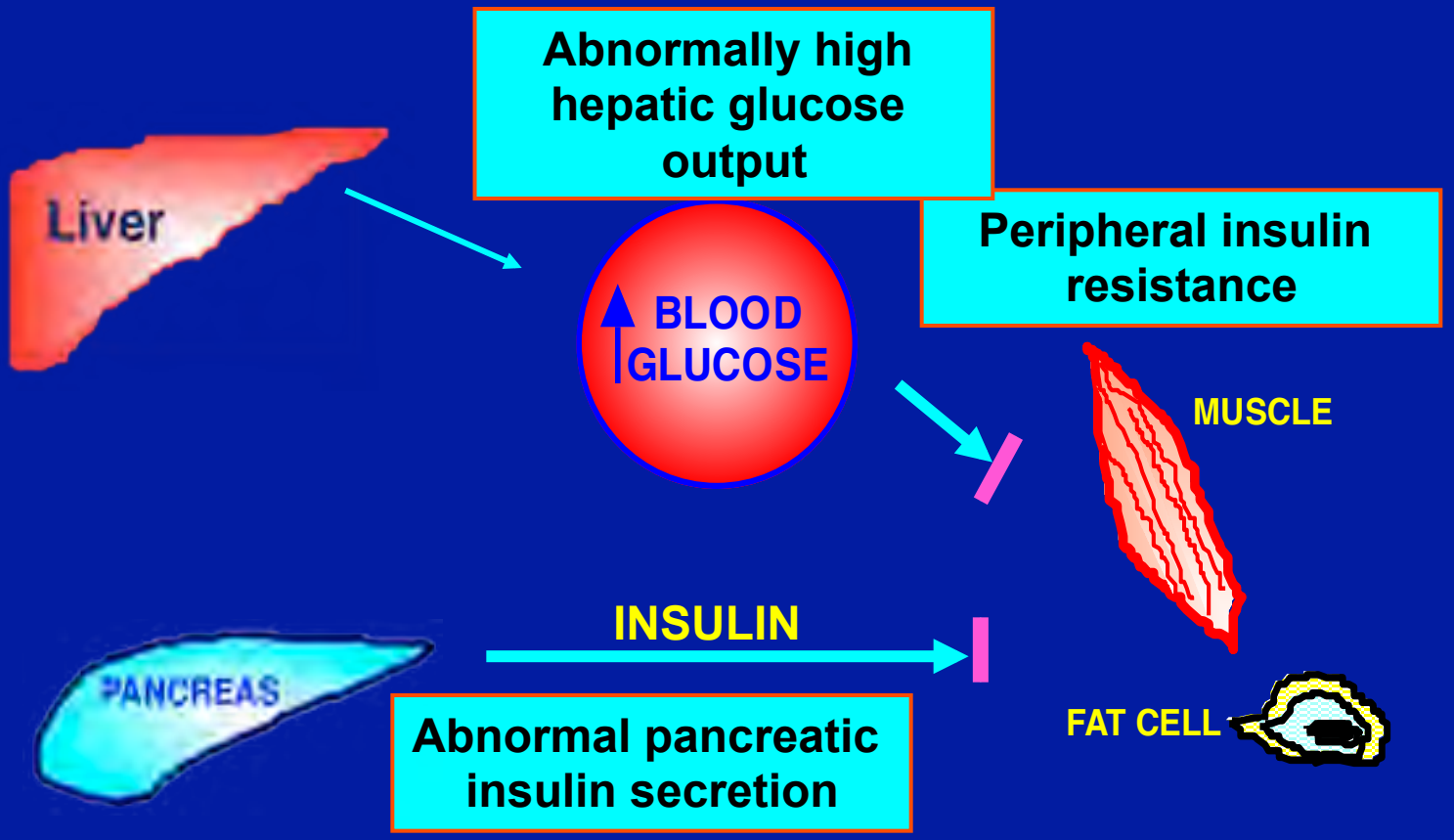
Management of Diabetes Mellitus

Oral Agents

Management of Diabetes Mellitus



Management of Type 2 Diabetes Mellitus



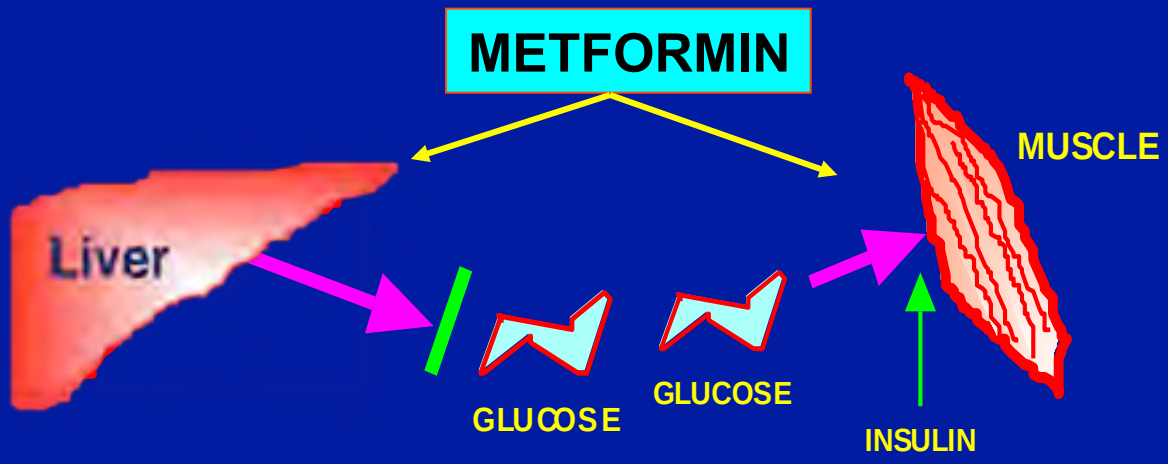
Oral Agents: The Sulfonylureas or "A Long History of Flogging the Pancreas"

Glyburide
Glipizide
Meglitinides

↑ INSULIN

- **ACTION: Stimulates insulin secretion by inhibiting b cell potassium channels.**
- **EFFECTIVENESS: Decreases blood glucose by average of ~60 mg/dL.**
- **SIDE EFFECTS: Hypoglycemia, particularly in patients with impaired renal function (e.g., diabetic nephropathy).**

Oral Agents: Metformin (Glucophage)



- ACTION: Inhibits excessive hepatic glucose output (MAJOR) and increases tissue sensitivity to insulin (minor).
- SIDE EFFECTS:

  -- GI Distress: Slowly increasing dose helps.

  -- Lactic acidosis: esp. in renal impairment or volume depletion. High mortality.

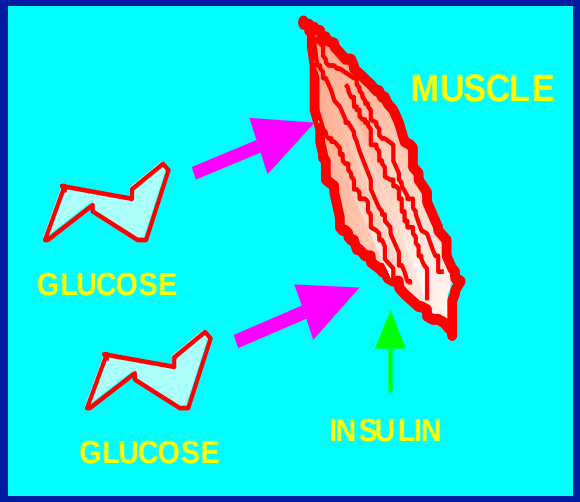
  -- Appetite suppression

Oral Agents: Thiozolidindiones "The Glitazones"

"GLITAZONES"

Rosiglitazone

Pioglitazone



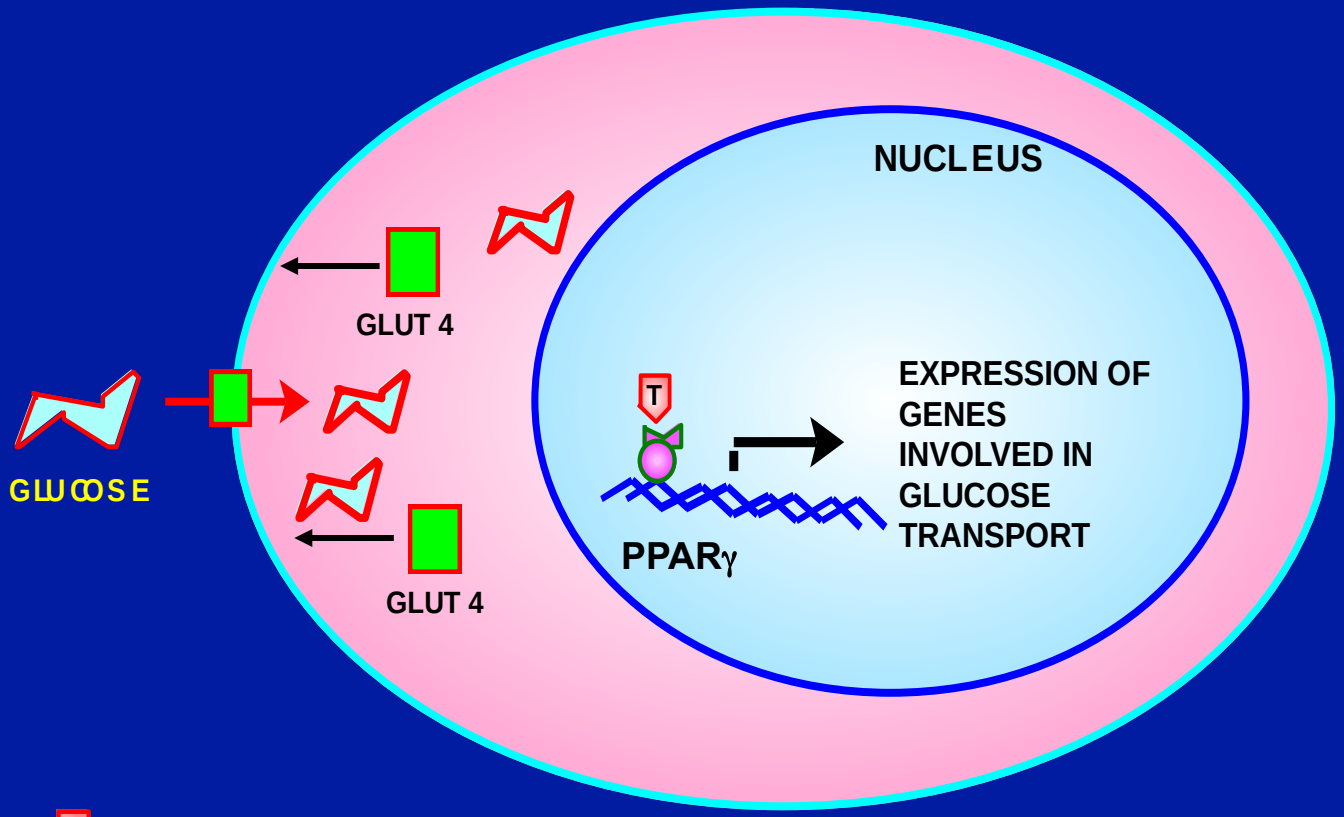
- ACTION: "Insulin sensitizers:" increase tissue sensitivity to insulin.
- EFFECTIVENESS: Slightly more potent than metformin. May be used in combination with other oral agents (and maybe insulin).
- SIDE EFFECTS:

  -- Edema: worse with insulin. May worsen heart failure.

  -- Hepatic dysfunction: liver function tests must be monitored regularly.

  -- Possible increased cardiac events with rosiglitazone (ugh…)

Thiozolidendiones: Molecular Mechanisms

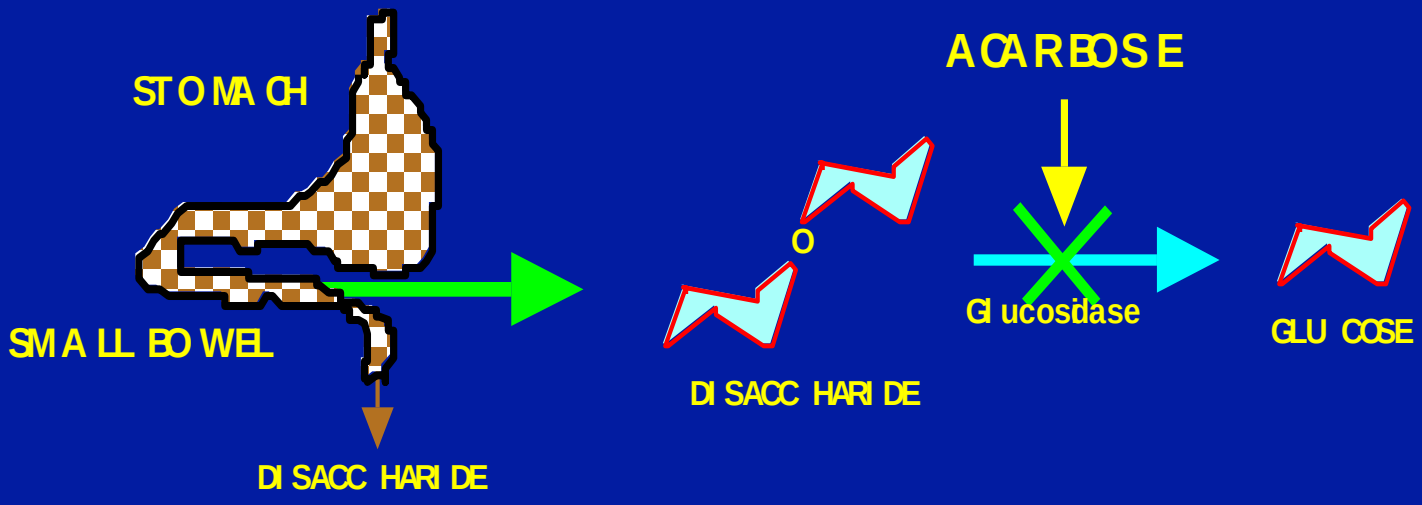


T = THIOZOLIDINEDIONE

PPAR-γ = Nuclear Peroxisome Proliferator-Activated Receptor, gamma isoform

The "Glitazones" = PPARγ Activators

Oral Agents: Acarbose (Precose)



- Blocks α-glucosidase blocks carbohydrate absorption in the small bowel.
- Lowers postprandial glucose by up to 55 mg/dL.
- Side effects: Significant GI distress, bloating, flatulence and occasional diarrhea.

ORAL AGENTS SUMMARY

Oral Agent	Major Action	Side Effects
Sulfonylureas	Stimulate insulin secretion	Hypoglycemia
→ Metformin	Suppresses hepatic glucose output	GI Distress, Lactic acidosis, Appetite Suppression
→ "Glitazones"	Sensitize peripheral tissues to insulin	Edema LFT abnormalities
→ Acarbose	Blocks carbohydrate absorption	GI Distress!

IMPORTANT!

→ = Does not cause hypoglycemia when used alone

New Agents

Exenatide (Byetta)
and
Inhaled Insulin

Diabetes Drugs, continued

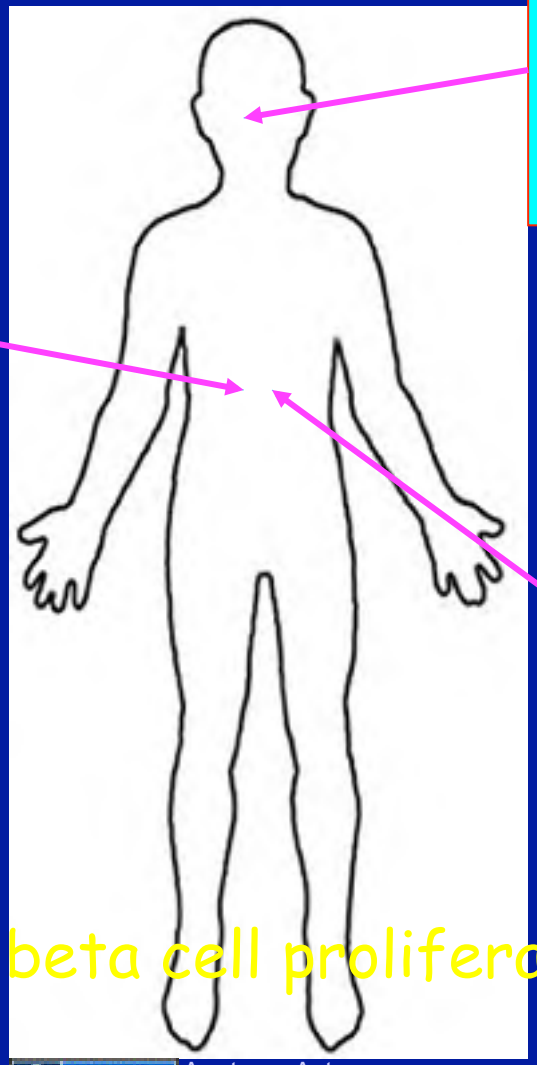
Exenatide (Byetta)= Incretin mimetic, which has potent glucagon-like peptide-1 (GLP-1) properties.

Gila Monster by Blueag9 (wikimedia commons)

- Originally isolated from gila monster venom
- Part of the INCRETIN family of gut hormones
- GLP-1 is rapidly secreted from the distal ileum and colon following food ingestion and act on the pancreas, stomach, muscle, fat, and brain.

Exenatide (Byetta): modes of action

Stimulates insulin secretion from beta cells & inhibits postprandial glucagon secretion from alpha cells



Works directly on hypothalamus to decrease appetite

Delays gastric emptying (decreases absorption)

Evidence of beta cell proliferation in animal models

Exenatide (Byetta): Clinical Effects

PD-SELF MPDY, (wikimedia commons)

Exenatide pens for injection

CLINICAL EFFECTS: For use in type 2 DM ONLY

- Decreases postprandial rise in blood sugar
- Decreases HbA1c by up to 1.5%
- Induces weight loss of up to 10-20 lbs with long-term use.

Management of Diabetes Mellitus

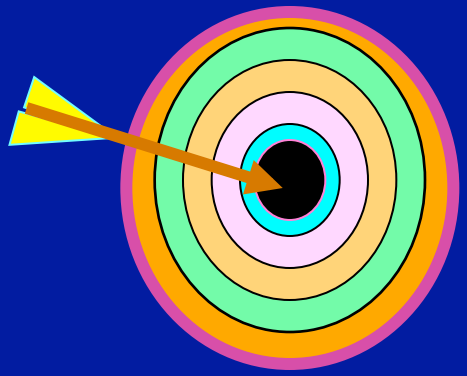
The Diet

- Current move away from a special "Diabetic Diet" and towards an emphasis on personal and cultural preferences and considerations: The "Diabetic Diet" is being replaced by the concept of healthy eating.
- Especially for type 2 DM: emphasis on weight reduction.
- Renal failure: low protein, low potassium.
- For those on insulin and sulfonylureas: balance carbohydrates with medication to avoid postprandial or exercise-associated hypoglycemia.

Management of Diabetes

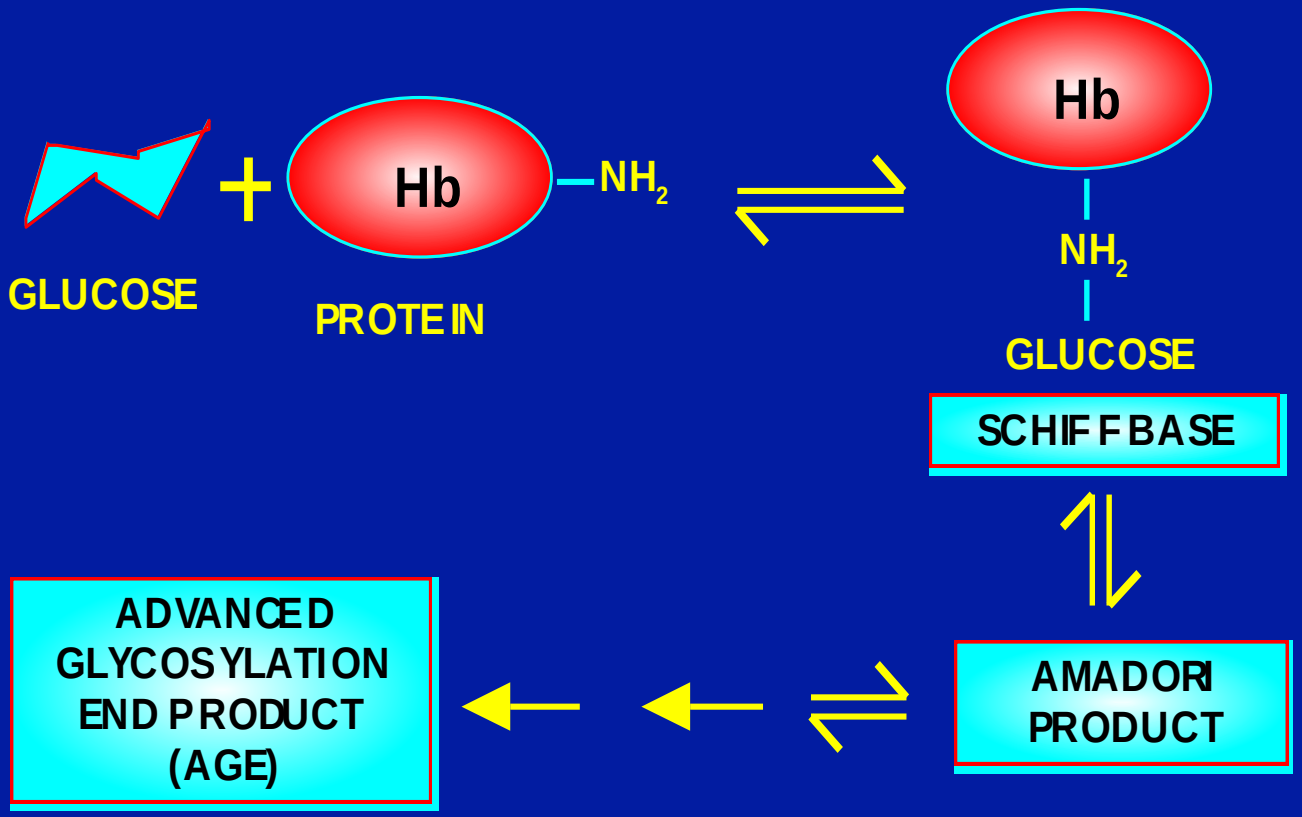
Remember: EXERCISE works to help control both type 1 and type 2 diabetes independent of weight loss!

Diabetes Care
Treatment Goals



- Premeal blood glucose values: 80-120 mg/dL
- HbA1c values: less than 7%
- Minimal hypoglycemia
- Incorporation of diabetes care successfully into one's life.

Measures of Glycemic Control: Nonenzymatic Glycation



Nonenzymatic Glycation

Important!

Hemoglobin A_{1c} (HbA1c) or Glycosylated hemoglobin a long-term measurement of overall metabolic control.

- **gives good picture of glycemic control over *3 months***
- **(Normal ranges HbA1c < 6.5% and Glyc. Hb < 8%)**

Recent News…

The New York Times, Feb 7, 2008

Study Undercuts Diabetes Theory

- National Institutes of Health announced the results of the ACCORD Study suggested that individuals with type 2 diabetes who were under rigorous metabolic control (HbA1c ≤ 6.0%) had a higher risk of death than those under less rigorous control…
- Patients at risk were older with previous history of MI.
- Interim results from the ADVANCE Trial, involving ~13,000 high risk pts did not show an increased risk of death…
- So the jury is still out…

Diabetes Care
How Often Should One Check?

- Blood glucose monitoring

  Type 1 DM: as often as possible each day (3-4x).

  Type 2 DM: "as often as necessary" to achieve metabolic control."

- HbA1c

  Type 1 DM: every 3 months.

  Type 2 DM: every 6-9 months.

DIABETIC COMPLICATIONS: Screening Exams

- Retinopathy: Retina exam
- Nephropathy: Urine microalbumin-to-creatinine ratio on random urine specimen.
- Neuropathy:
  -- Foot exam (for cracks, fissures, foreign bodies, etc.)
  -- Test vibratory sensation with 128 Hz tuning fork
  -- 10-gram monofilament test

Diabetes Care
Screening Tests for Complications

ANNUAL EXAMS:

- Ophthalmologic exam
- Urinary microalbumin/creatinine ratio (random urine)
- Cholesterol profile
- TSH (type 1 diabetes)
- Vibration testing (at least annually).

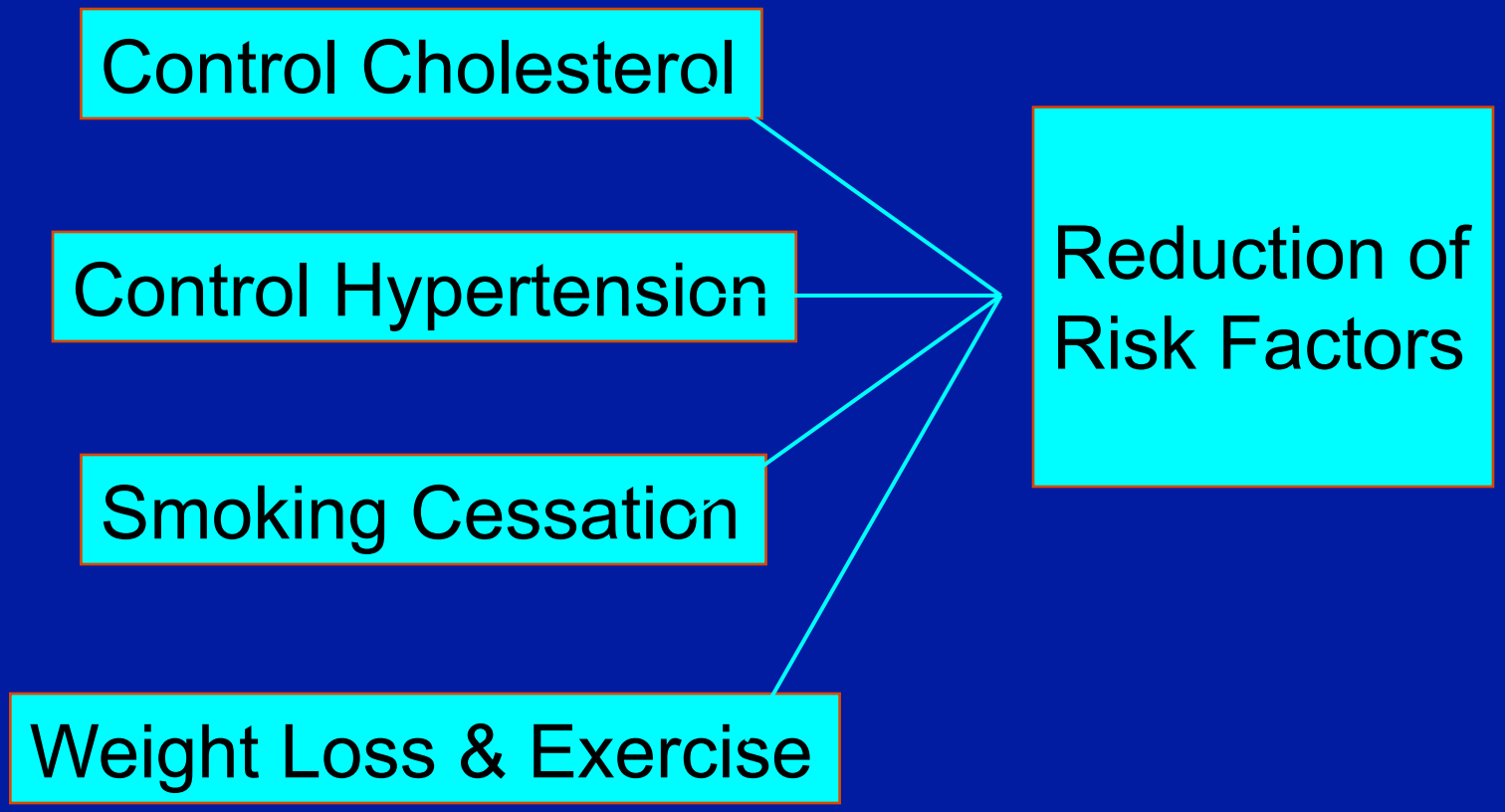
QUARTERLY (or Every Visit):

- Careful foot exam

IMMUNIZATIONS:

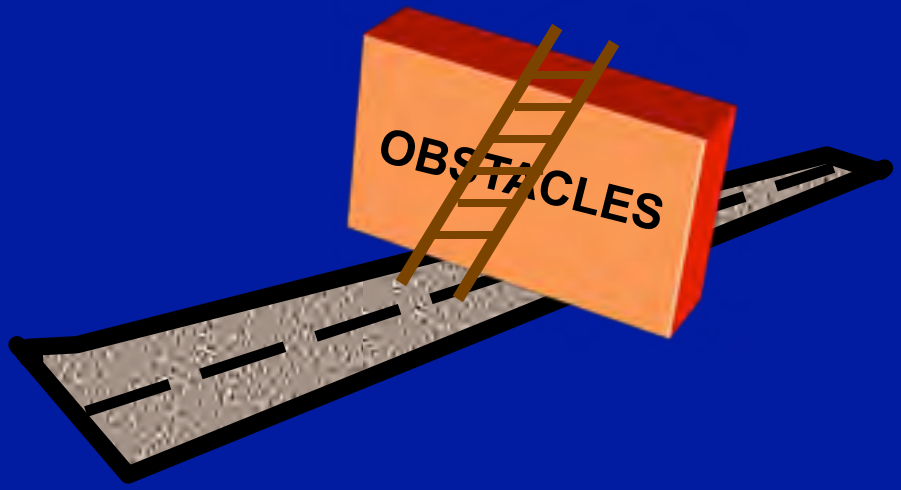
- Flu vaccine - every season
- Pneumonia vaccine (Pneumovax) - every 5 years.

Reduction of Risk Factors



DIABETES MELLITUS:
Societal Issues

The Physician as Patient Advocate



"Non-compliant" or "Uncomfortable"?
"Uninterested" or "Unable"?

It is the physician's responsibility as much as the patient's to find ways to overcome obstacles in diabetes care.

Diabetes Mellitus

PREVENTION

Diabetes Mellitus: Prevention of Type 1 DM

Animal studies and small clinical trials: low-dose insulin in individuals at high risk for type 1 DM can prevent or delay onset, either through "islet cell rest" or through undefined immunologic mechanisms.

The Diabetes Prevention Trial-Type 1 (DPT-1) *NEJM* 326:1685, 2002

- Very low-dose insulin or nothing given to relatives of individuals with type 1 DM who are at high risk for disease.
- Followed for median of 3.7 years.
- Incidence and prevalence of type 1 DM not different between treatment and control groups.

Diabetes Mellitus: Prevention of Type 2 DM

Hereditary influences very well-known to increase risk of type 2 DM. What lifestyle factors can be modified to prevent its onset?

The Finnish Diabetes Prevention Study *NEJM* 344:1343, 2001

Diabetes Prevention Program *NEJM 346:393, 2002*

-- Individuals with impaired glucose tolerance

-- Weight loss of at least 5%

-- Moderate exercise: walking, jogging, skiing, etc.

Lifestyle modification lowered the risk of type 2 DM by UP TO 58%, and the closer one met the intervention goals, the lower the risk.

Management of Diabetes Mellitus

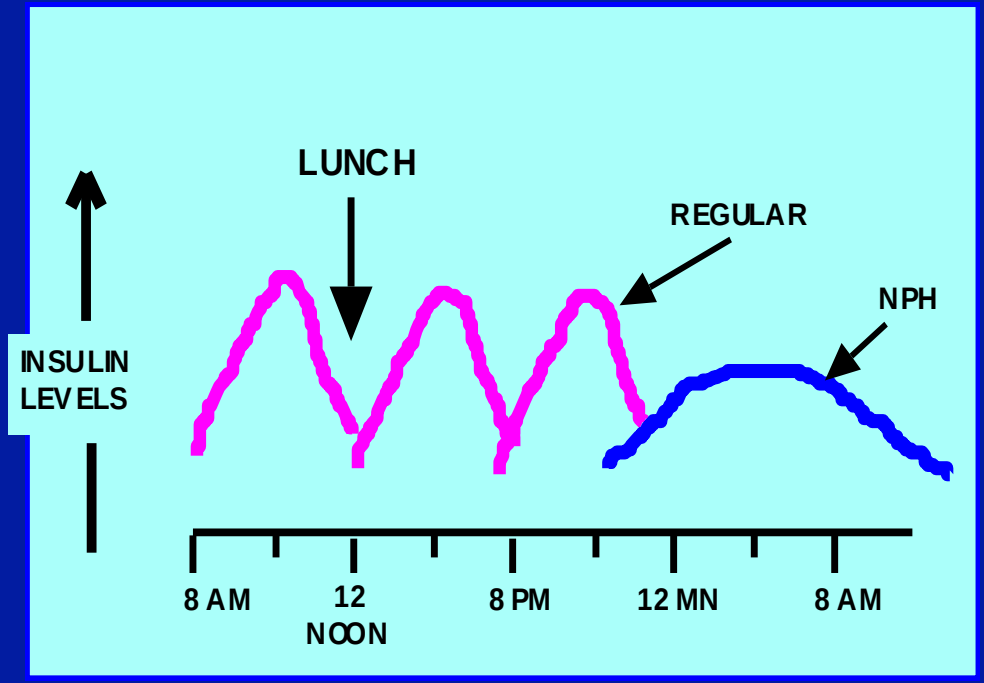
Cases

Case #1

Mark N., a 40-year old engineer with type 1 diabetes, experiences persistent elevations in his prelunch BG's. He is on a multiple-dose insulin regimen consisting of NPH 5 units at breakfast and 15 units at bedtime, along with a sliding scale of Regular insulin, 8-10 units with each meal. How may we best treat his high blood sugars at lunch?

A. Increase his breakfast NPH.
B. Increase his breakfast Regular.
C. Increase his bedtime NPH.
D. Add bedtime Regular.
E. Increase his lunchtime Regular.

Case #1

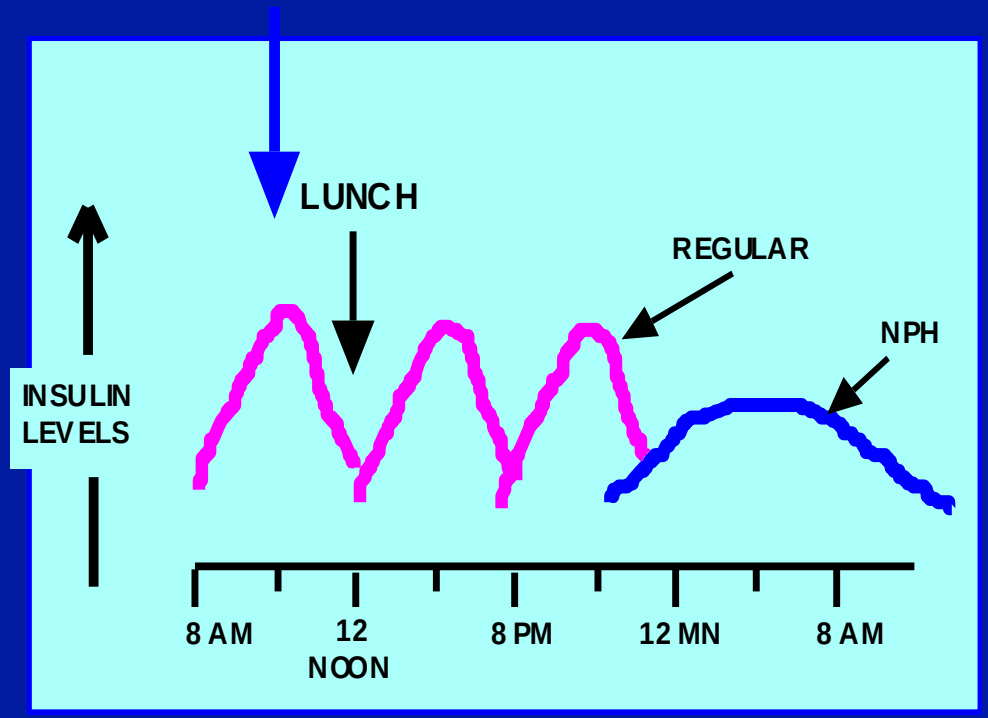


A. Increase his bedtime NPH
B. **Increase his breakfast Regular**
C. Add bedtime Regular
D. Add breakfast NPH
E. Increase his lunchtime Regular

A. Kumagai

Case #1

BREAKFAST REGULAR WILL AFFECT THE LUNCHTIME BG.



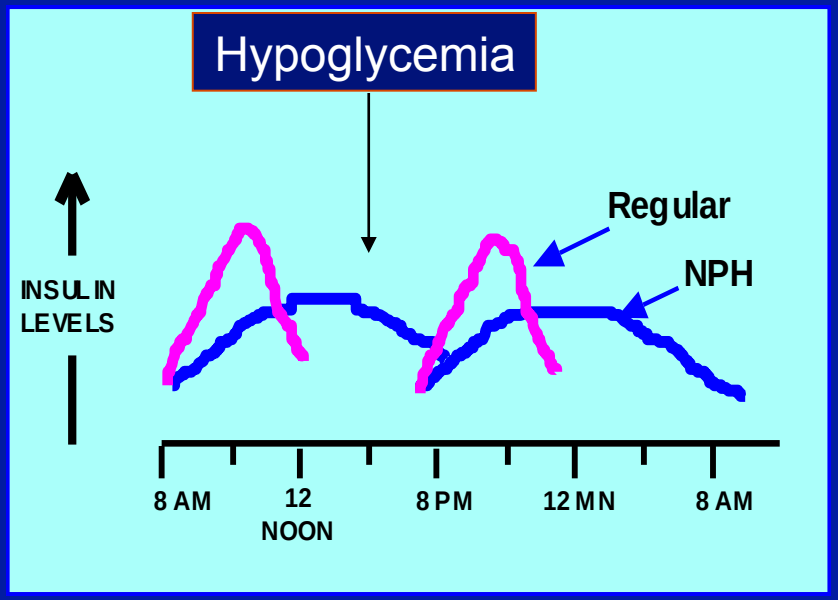
A. Increase his bedtime NPH
B. Increase his breakfast Regular
C. Add bedtime Regular
D. Add breakfast NPH
E. Increase his lunchtime Regular

Case #2

Diana W., a 52-year-old woman with type 2 diabetes, is managing her diabetes with a regimen of NPH 25 units and Regular 7 units at breakfast and NPH 24 and Regular 10 units at dinner. Ms. W. notes frequent episodes of hypoglycemia in the late afternoon while at work. You would suggest:

A. That she decrease her morning Regular.
B. That she decrease her morning NPH.
C. That she eat a much larger lunch.
D. That she leave work early and eat at 5:00 pm every day.

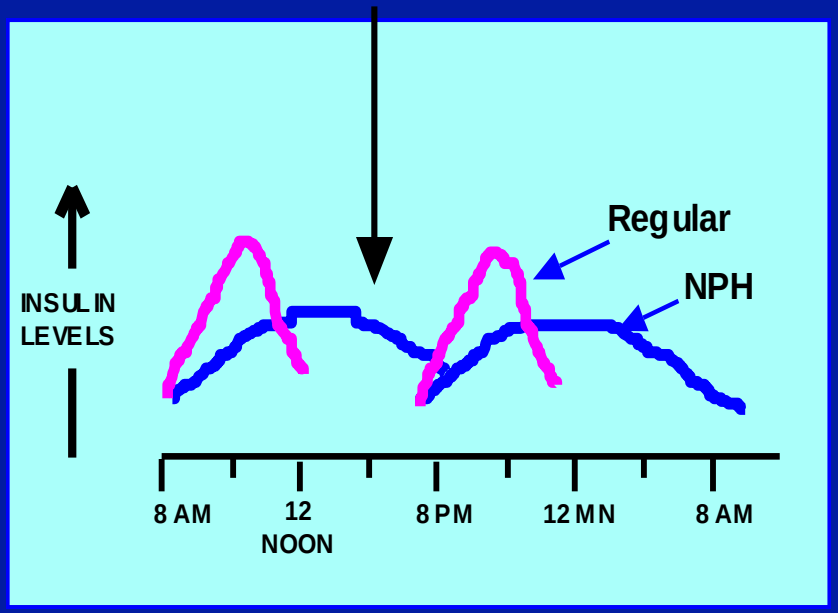
Case #2



A. That she decrease her morning Regular.
B. That she decrease her morning NPH.
C. That she eat a much larger lunch.
D. That she leave work early and eat at 5:00 pm every day.

Case #2

ON A 2-INJECTION REGIMEN, LATE AFTERNOON HYPOGLYCEMIA IS TREATED BY A DECREASE IN THE MORNING NPH.



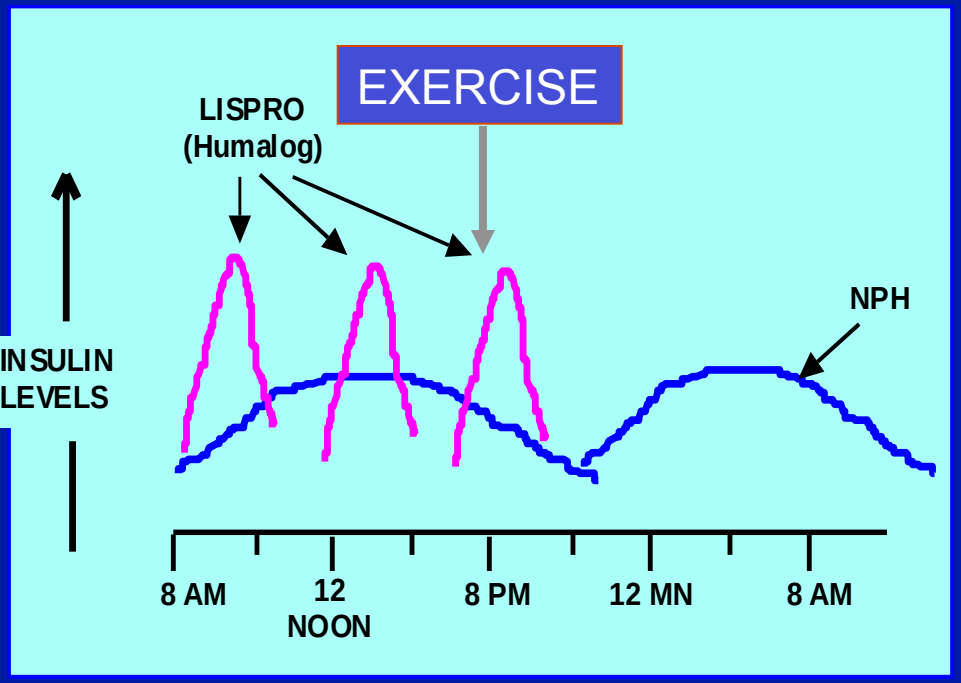
A. That she decrease her morning Regular.
B. That she decrease her morning NPH.
C. That she eat a much larger lunch.
D. That she leave work early and eat at 5:00 pm every day.

Case #3

Anita R. is a 21-year-old physical fitness buff with type 1 diabetes on a multiple daily injection regimen consisting of NPH at breakfast and bedtime and Lispro (Humalog) by sliding scales with meals. She experiences hypoglycemia approximately 30 minutes after her 8 p.m. (i.e., after dinner) workouts. Two days ago, Anita became disoriented and confused during one of these episodes and had to be treated by paramedics. In order to avoid further episodes of hypoglycemia while maintaining "tight" metabolic control, you would advise Anita to:

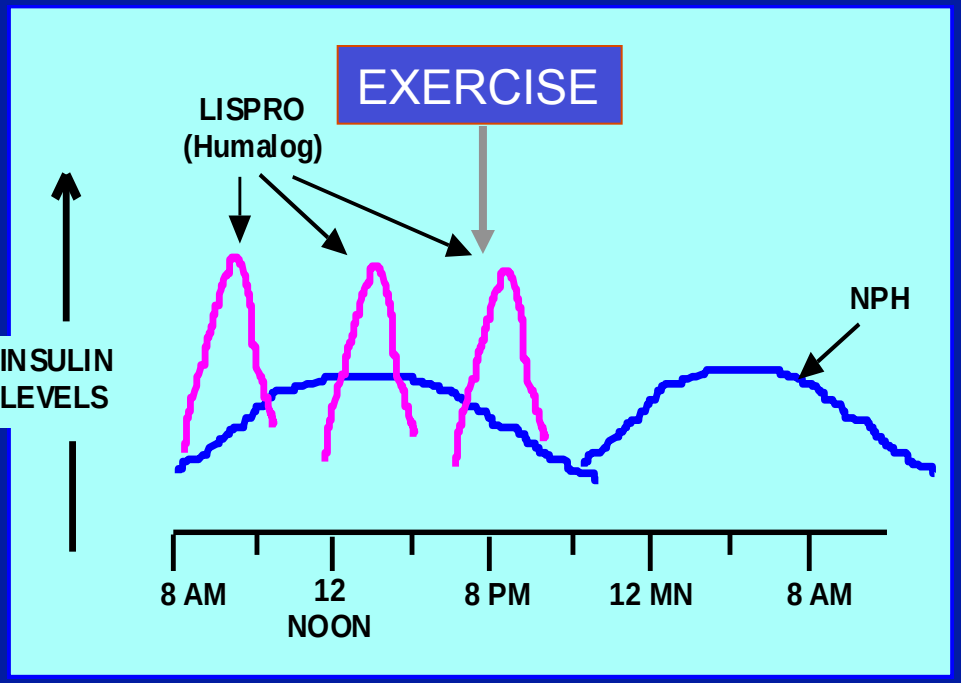
A. Decrease her morning NPH.
B. Decrease her dinnertime Humalog.
C. Decrease her bedtime NPH.
D. Eat a huge dinner.
E. Don't work out, stay at home and watch TV.

Case #3



A. Decrease her morning NPH.
B. Decrease her dinnertime Humalog.
C. Decrease her bedtime NPH.
D. Eat a huge dinner.
E. Don't work out, stay at home and watch TV.

Case #3



A. Decrease her morning NPH.

B. Decrease her dinnertime Humalog.

C. Decrease her bedtime NPH.

D. Eat a huge dinner.

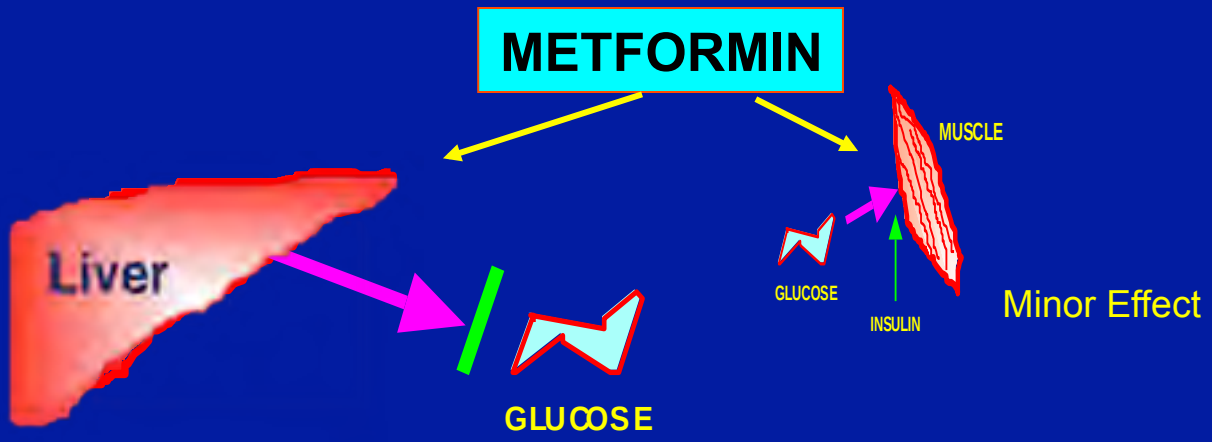
E. Don't work out, stay at home and watch TV.

Case #4

Jerry G., a 48-year-old rock ‘n roll guitarist, has type 2 diabetes. His diabetes is complicated by obesity (5’8”, 285 lbs), mild retinopathy, and peripheral neuropathy. He has no kidney, heart or liver disease. Mr. G. been unable to control his diabetes with the maximal dose of a sulfonylurea, glipizide, and insulin, which he abhors (hates to give himself injections). In order to avoid further (or progressive) diabetic complicatons, you would give him:

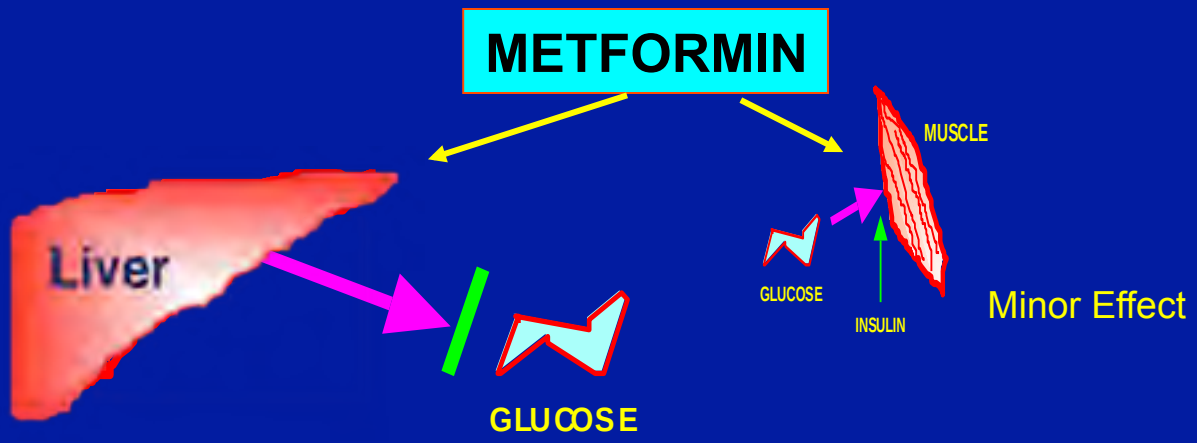
A. A trial of another sulfonylurea.
B. Metformin (Glucophage).
C. A “glitazone,” such as rosiglitazone.
D. Your strongest recommendation that he “just keep truckin’, be a man and take the insulin.

Case #4



A. A trial of another sulfonylurea.
B. Metformin (Glucophage).
C. A “glitazone,” such as rosiglitazone.
D. Your strongest recommendation that he “just keep truckin’, be a man and take the insulin.

Case #4



One significant "side effect" of metformin is
APPETITE SUPPRESSION

A. A trial of another sulfonylurea.
B. Metformin (Glucophage).
C. A "glitazone," such as rosiglitazone.
D. Your strongest recommendation that he "just keep truckin' be a man and take the insulin.

Case #5

Salvador D., a 72-year-old painter, has type 2 diabetes, complicated by proliferative retinopathy, peripheral neuropathy and coronary artery disease with congestive heart failure. Mr. D. is on multiple medications for his heart, and takes insulin, NPH at bedtime, and metformin at maximal dose (1000 mg BID). His most recent HbA1c is 9.0% (target ≤ 7.0%). In order to improve his overall glycemic control, you would recommend:

A. A sulfonylurea.

B. A "glitazone," such as rosiglitazone.

C. More insulin.

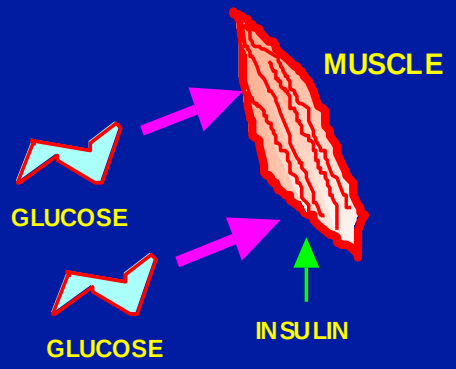
D. Zinc or chromium supplements.

Case #5

"GLITAZONES"

Rosiglitazone

Pioglitazone



A side effect of the thiozolidendiones ("glitazones") is fluid retention and edema. This effect is apparently exacerbated by insulin, and may worsen CHF.

A. A sulfonylurea.
B. A "glitazone," such as rosiglitazone.
C. More insulin.
D. Zinc or chromium supplements

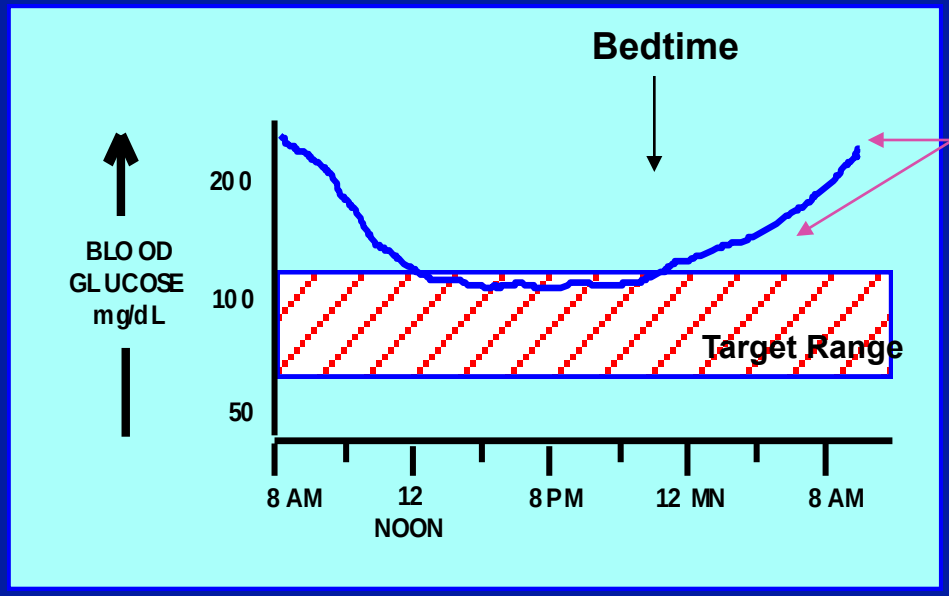
Case #6

Peggy S., a 37-year-old woman with type 1 diabetes on a multiple-daily injection regimen of Glargine (Lantus) insulin, 18 units at bedtime, along with a sliding scale of Lispro (Humalog) insulin. She is experiencing frequent episodes of fasting hyperglycemia, with blood sugars in the 210-230 mg/dL range. To remedy this situation, you would suggest:

A. That she increase her bedtime Glargine.
B. That she decrease her bedtime Glargine.
C. That she less dinner.
D. That she check several 3:00 am blood sugars.

Case #6: two different scenerios

The "Dawn Phenomenon"



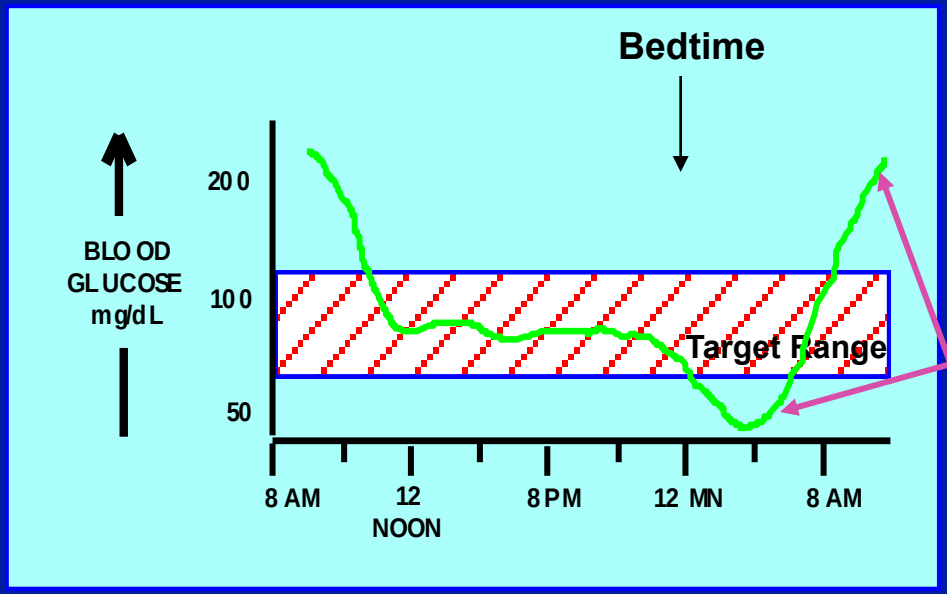
Rise in cortisol secretion between 4-6 am causes elevated fasting blood sugars.

You suggest:

A. That she increase her bedtime Glargine.
B. That she decrease her bedtime Glargine.
C. That she less dinner.
D. That she check several 3:00 am blood sugars.

Case #6 : two different scenerios

The "Simogi Effect"



Nocturnal hypoglycemia from *too much* insulin causes rebound hyperglycemia in the morning.

You suggest:

A. That she increase her bedtime Glargine.

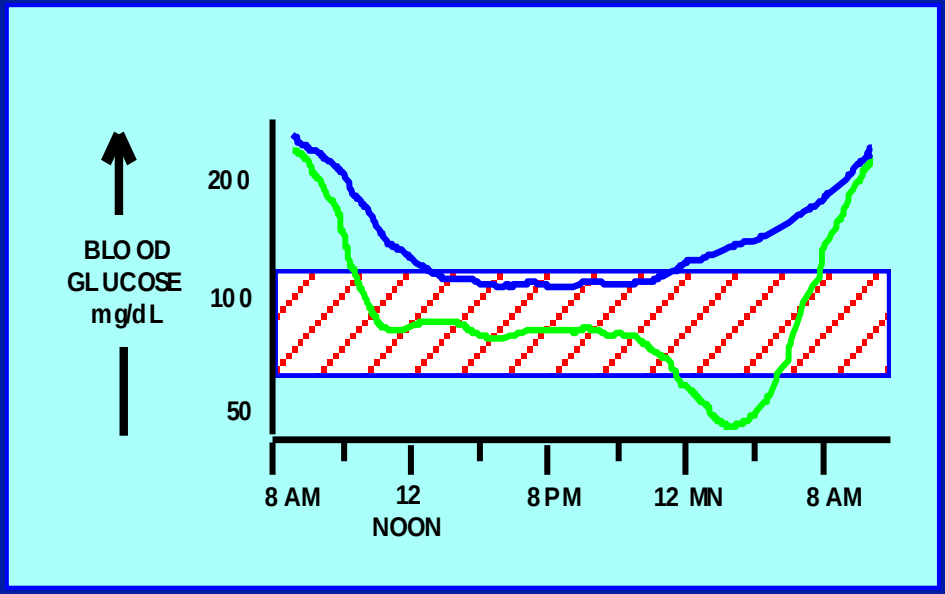
B. That she decrease her bedtime Glargine.

C. That she less dinner.

D. That she check several 3:00 am blood sugars.

Case #3

Bottom Line: Fasting hyperglycemia may be caused by EITHER insufficient or excessive insulin.



You suggest:

A. That she increase her bedtime Glargine.
B. That she add bedtime Lispro.
C. That she less dinner.
D. That she check several 3:00 am blood sugars.

Additional Source Information

for more information see: http://open.umich.edu/wiki/CitationPolicy

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