

Intensive insulin therapy in children with type 1 DM

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Overview

- Goals and Purpose of Insulin Therapy
- Barriers to the use of Insulin
- Basal/Bolus Insulin
- Sliding Scales !
- Insulin Pump Therapy
- Conclusion

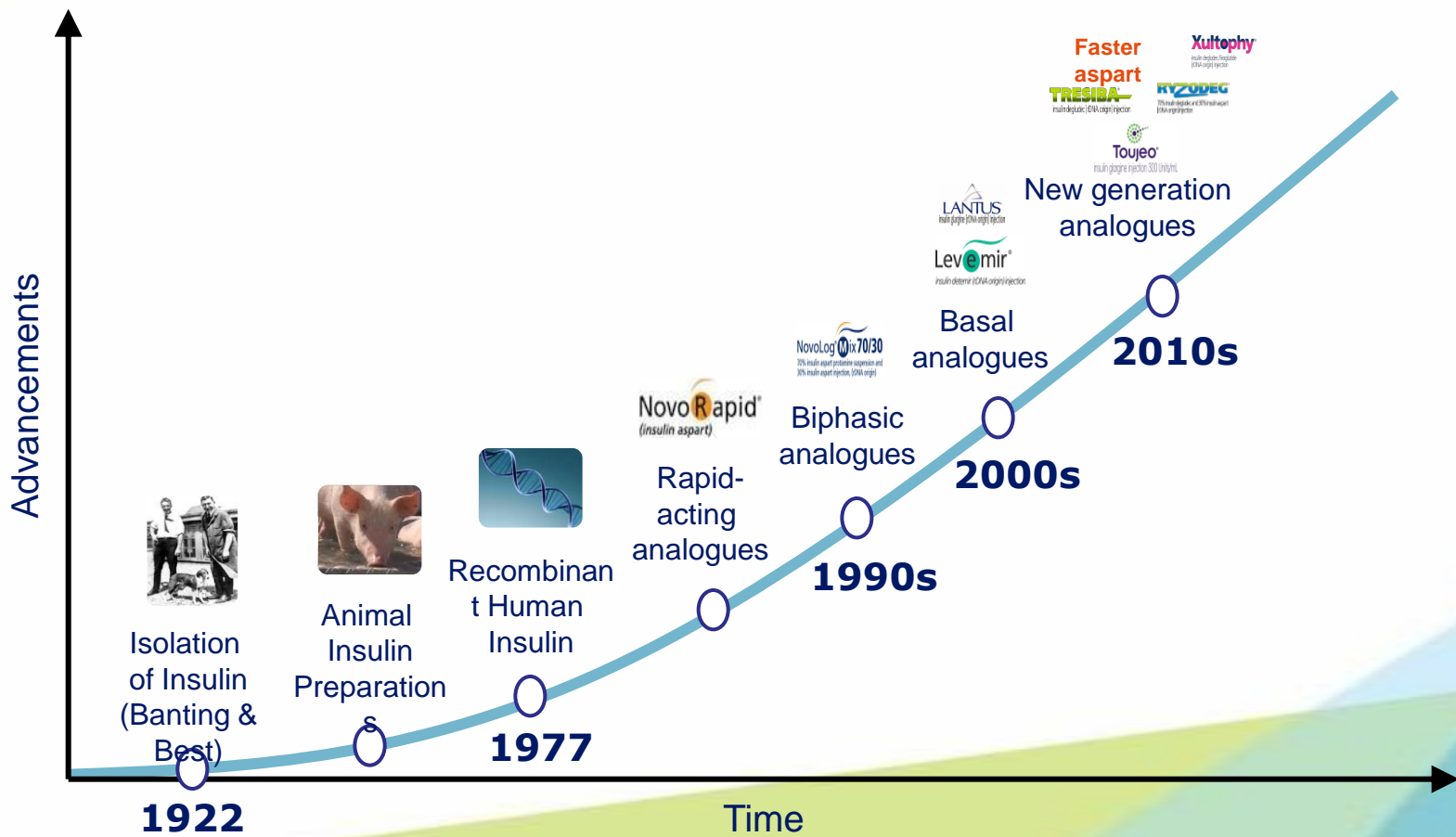
Prevalence of Type 1 Diabetes

Table 3.16 Top 10 countries/territories for the incidence rates (per 100,000 population per year) with Type 1 diabetes (<20 years),2017

Rank	Country	Incidence rates with type 1 diabetes
1	Finland	57.2
2	Kuwait	44.5
3	Sweden	39.5
4	Saudi Arabia	33.5
5	Norway	29.8
6	Algeria	26.0
6	Morocco*	26.0
8	United Kingdom	25.9
9	Ireland	24.3
10	Denmark	23.0

Challenges while managing pediatric patients with type 1 DM





Discovery of Insulin

1921



Banting



Best

Insulin was the first discovered (late 1920's) which won the doctor and medical student who discovered it the Nobel Prize (Banting and Best)



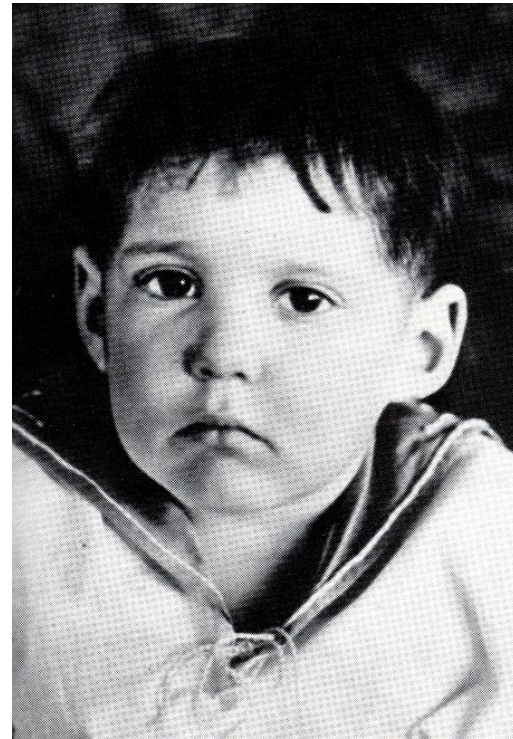


Banting & Best

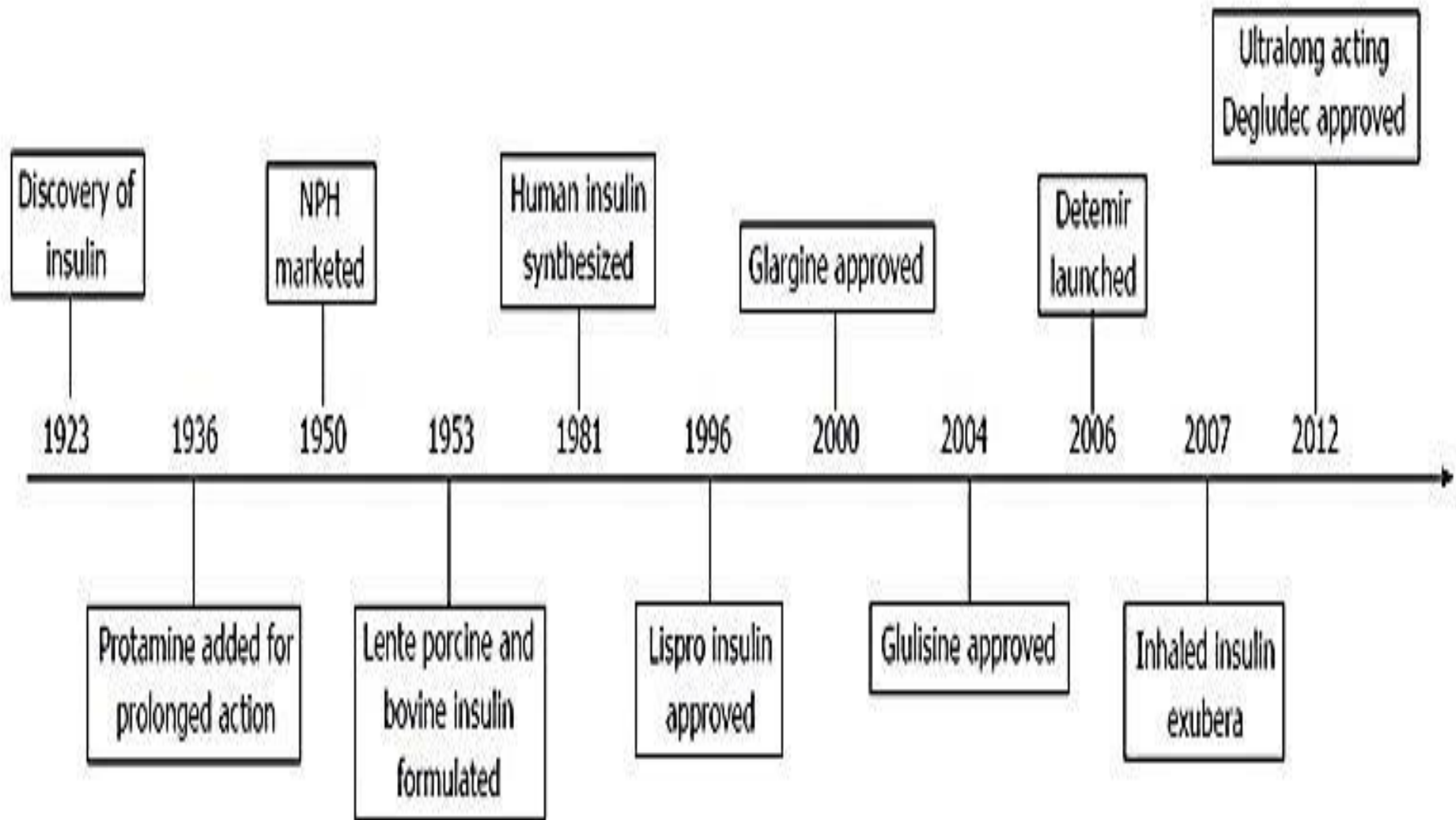
The Miracle of Insulin



Patient J.L., December 15, 1922



February 15, 1923



Patient-Centered Approach

- *“...providing care that is respectful of and responsive to individual patient preferences, needs, and values - ensuring that patient values guide all clinical decisions”*
- **Shared Decision Making** – a collaborative process between patient and clinician, using best available evidence and taking into account the patient’s preferences and values
- Final decisions regarding **lifestyle choices** ultimately lie with the patient

WHAT!?
Did you say
INSULIN?!



Barriers to the Use of Insulin

Everyone has different needs



Insulin Therapy

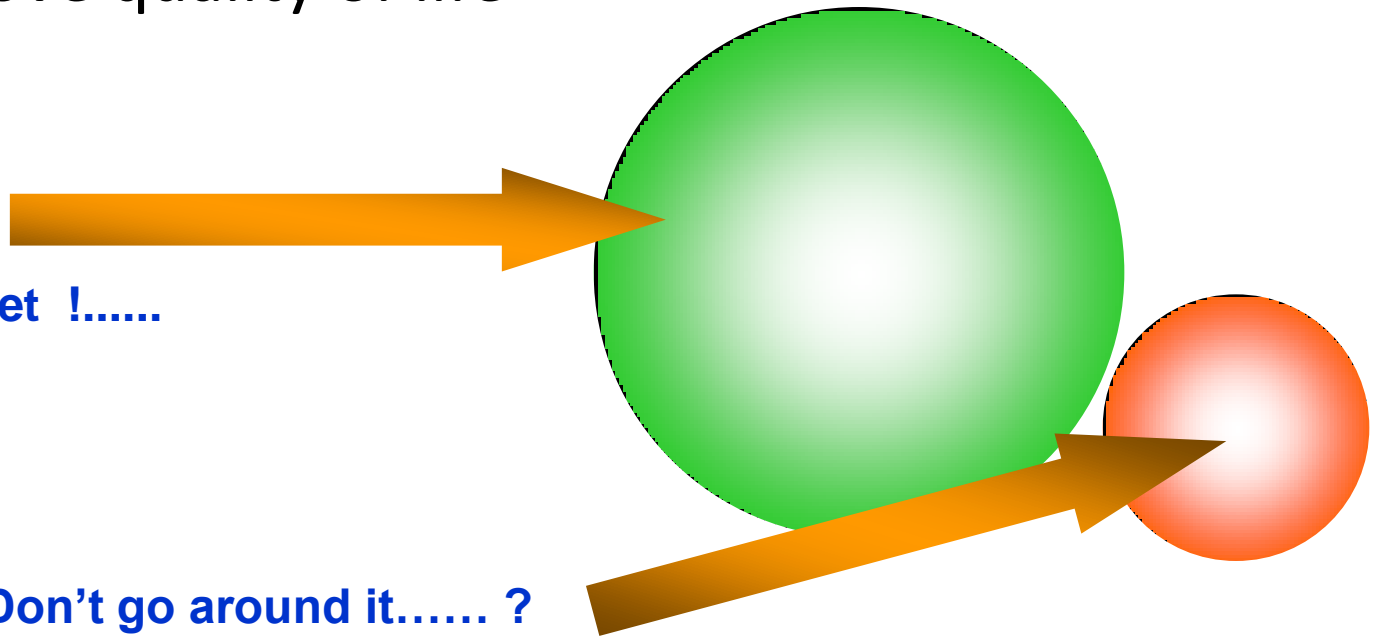
- Two main Methods
 - Conventional therapy
 - BD insulin injections
 - Intensive therapy
 - Multiple daily injections (basal – bolus regimen)
 - Insulin Pump Therapy

Goals of insulin therapy

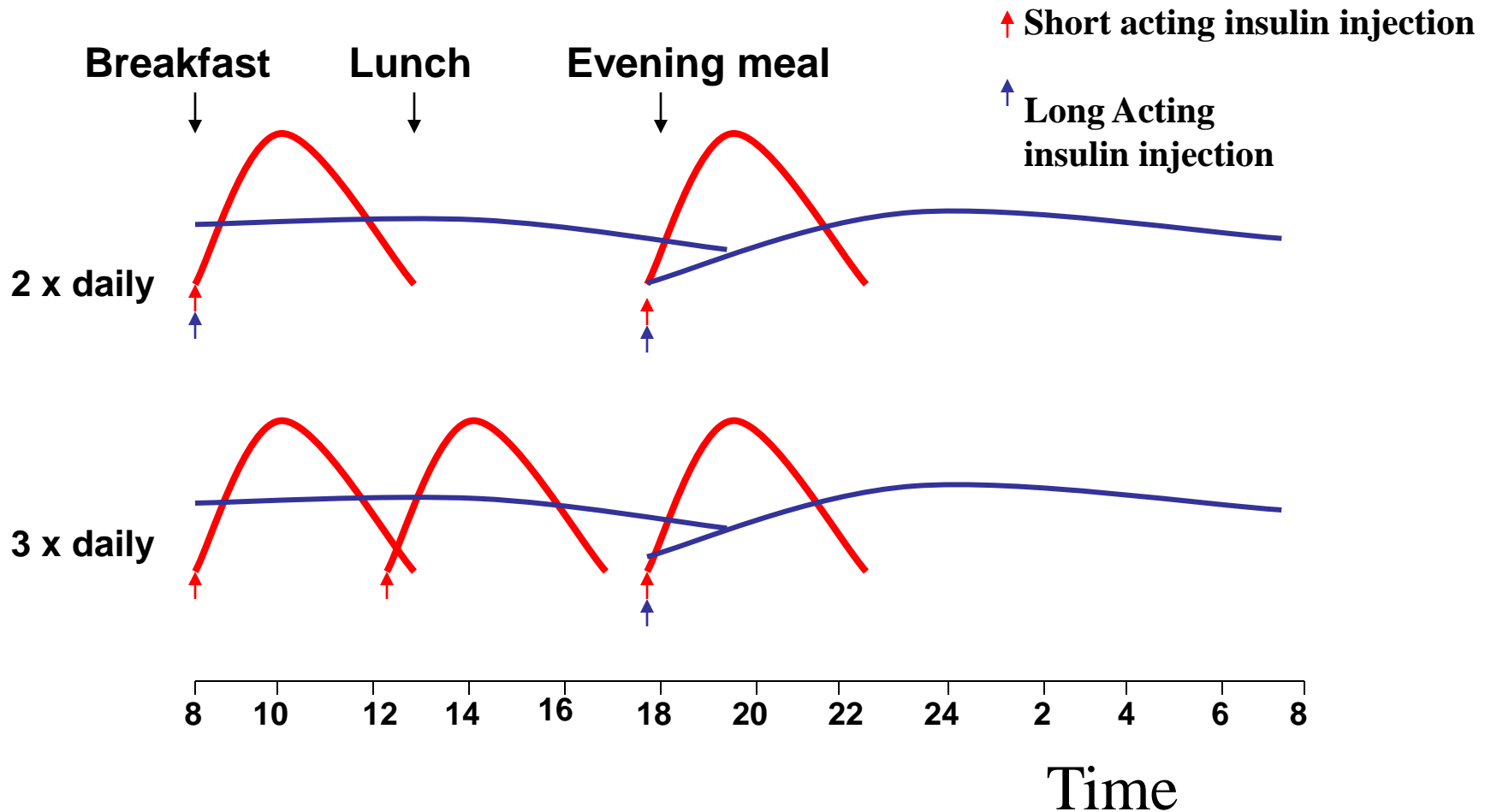
- 1) Maintain near-normal glycaemia
- 2) Avoid short-term crisis
- 3) Minimize long-term complications
- 4) Improve quality of life

Treat The Target !.....

Don't go around it..... ?

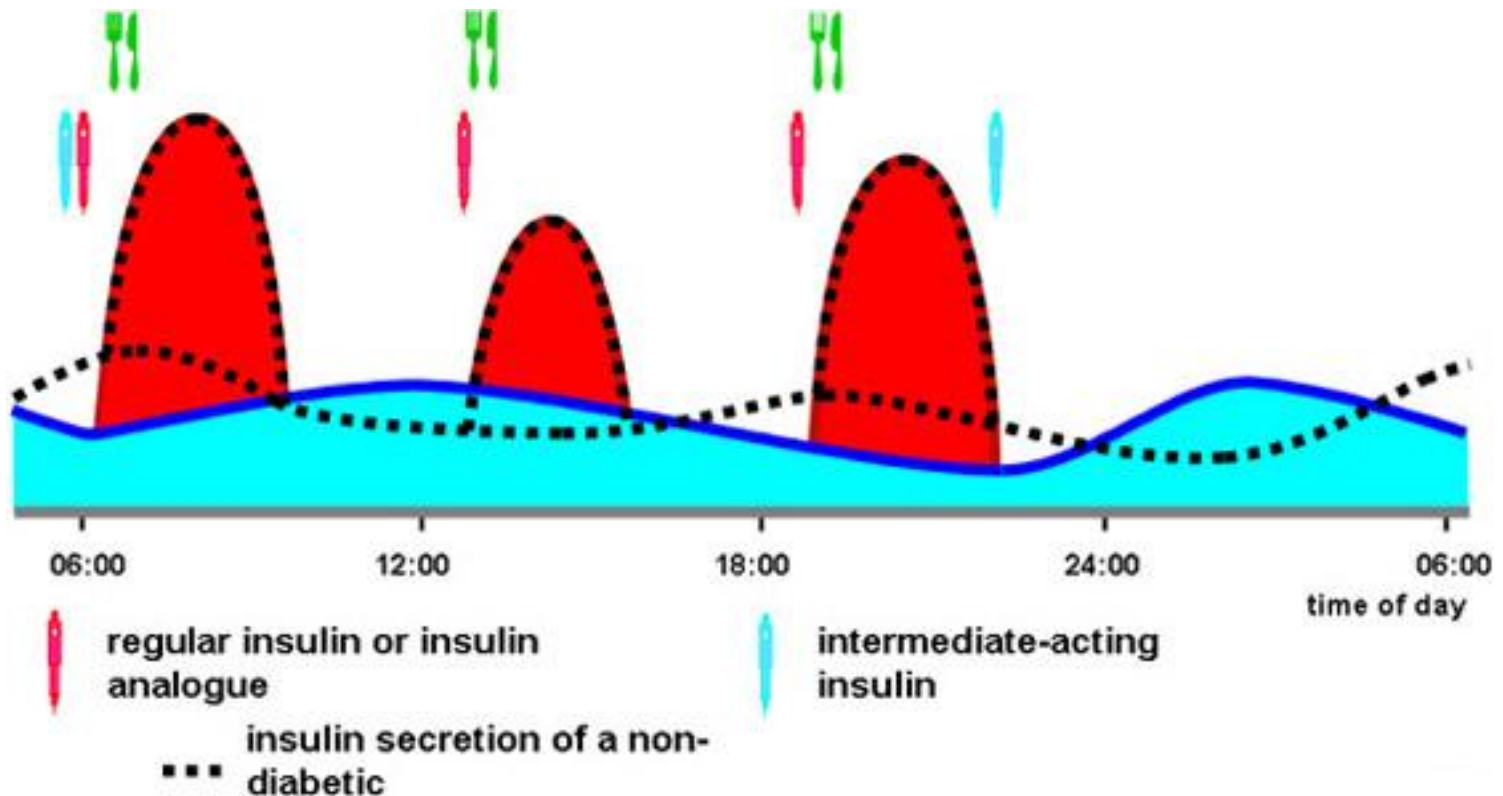


Typical insulin injection profiles



Basal bolus Therapy

Administration of insulin is arranged to mimic the normal basal, prandial & post-prandial secretion of insulin. Short acting forms are usually combined with longer acting preparations to achieve this effect.



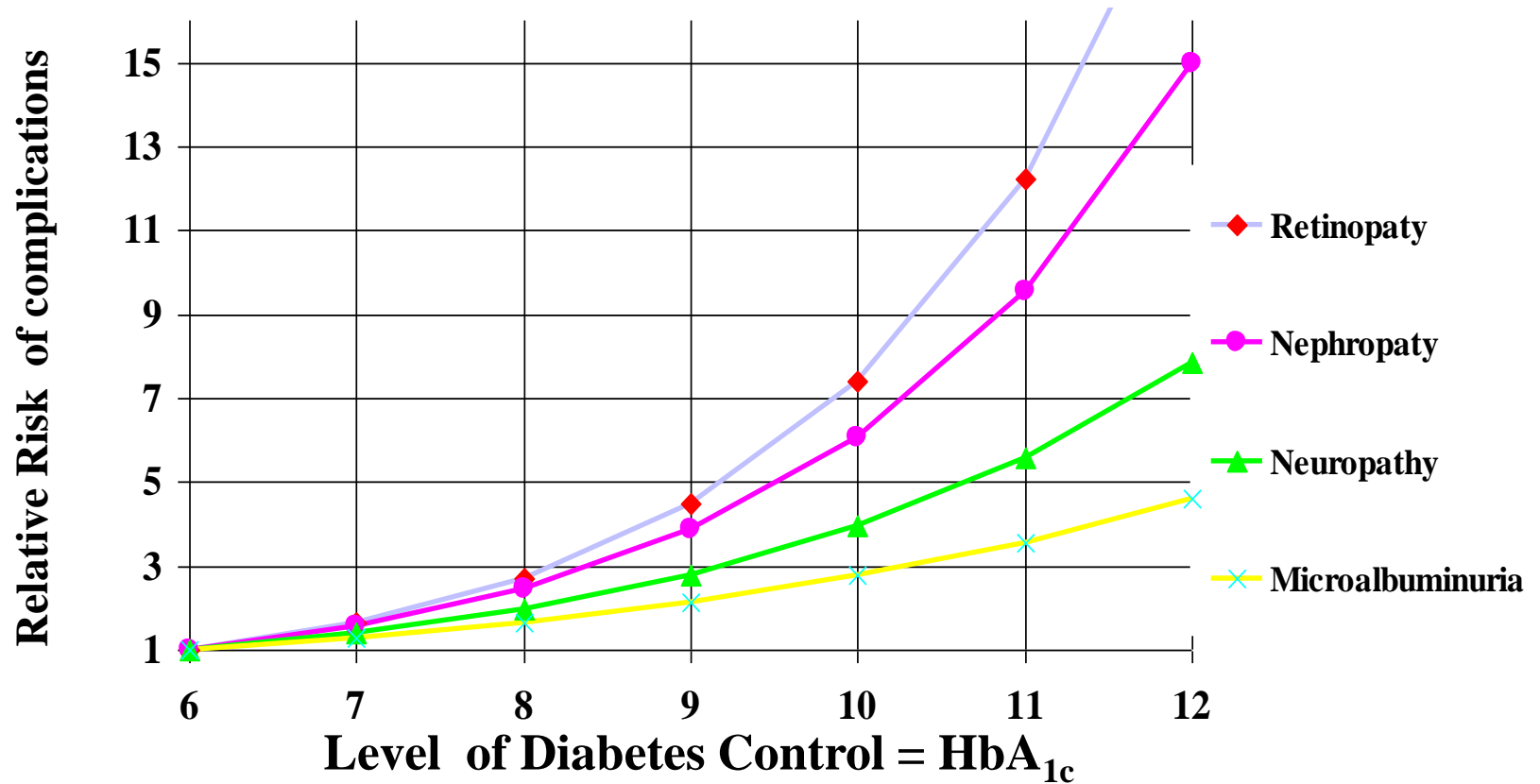
All

Type 1 diabetics should be on a
basal / bolus insulin regimen
to control glucose while minimizing
hypoglycemia

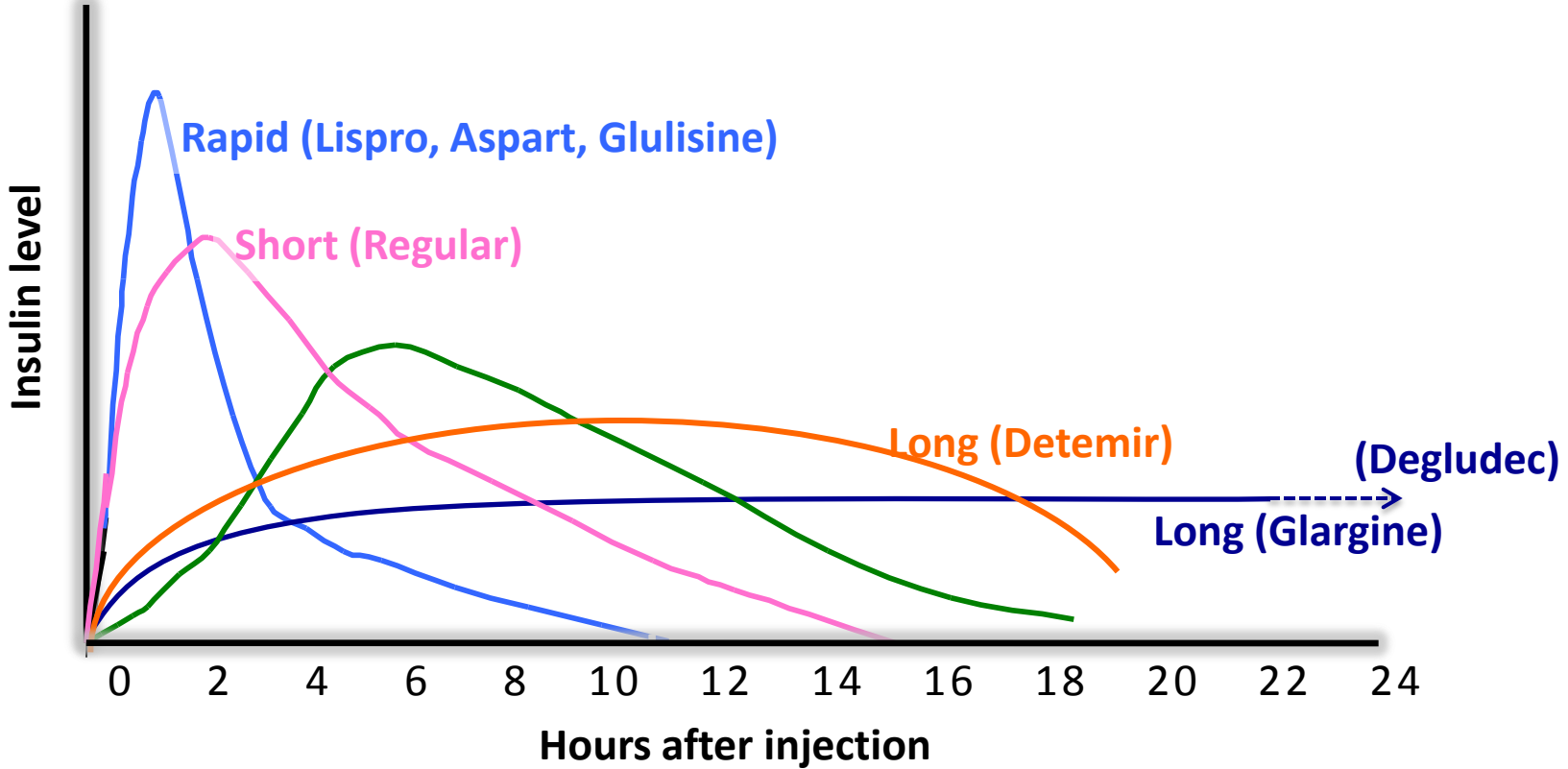
Basal bolus insulin therapy

- Patients for multiple injection therapy should:
 - be selected carefully
 - understand the relationship between insulin, food and physical exercise
 - be motivated and have family support
 - be willing to measure blood glucose several times each day
 - be willing to inject insulin at school

Relative Risk of Progression of Diabetes Complications by Mean HbA1c: based on DCCT Data



Various Insulin Preparations



Ideal basal insulin

- should be slowly & evenly absorbed with no peak
- have consistent bioavailability
- have a long half-life that permits once-daily administration
- have a reproducible response to allow consistent dosing

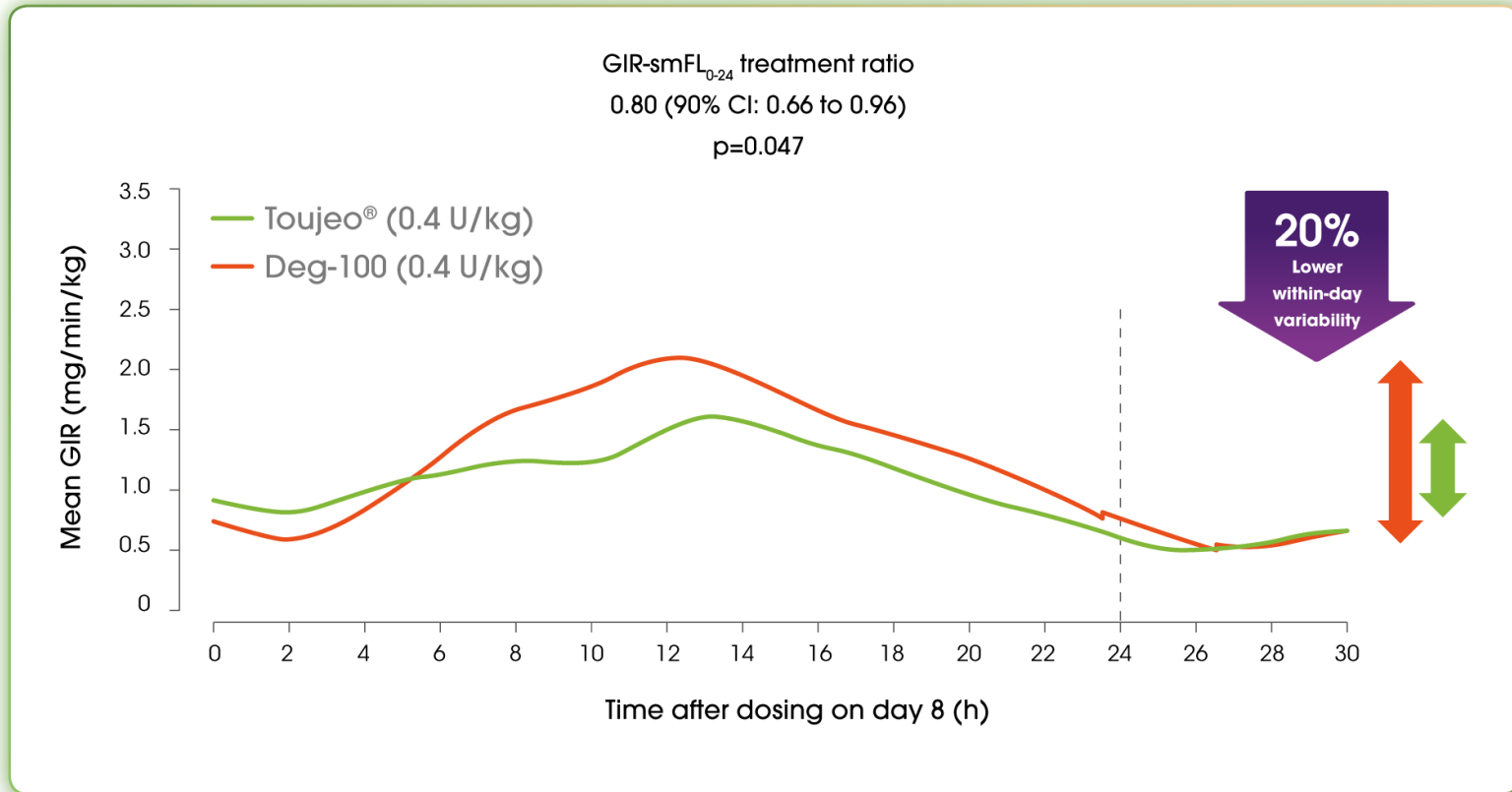
50% of insulin secretion is basal, 50% is postprandial

Toujeo (GI-300)
Novel Next Generation Insulin Glargine for
the Treatment of Patients with Diabetes

**A NEXT GENERATION
INSULIN GLARGINE**

**FROM THE MAKERS
OF LANTUS®**

Lower within-day variability with Toujeo® vs Deg-100



Within-day variability of the smoothed GIR (GIR-smFL0-24) was significantly lower (20%) with Toujeo® versus Deg-100

Toujeo (GI-300)

Novel Next Generation Insulin Glargine for the Treatment of Patients with Diabetes



A NEXT GENERATION
INSULIN GLARGINE

FROM THE MAKERS
OF LANTUS®



More stable and prolonged activity profile beyond 24 hours²



Lower risk of both nocturnal and anytime hypoglycaemia* than Gla-100³



Significantly less weight gain than Gla-100⁴



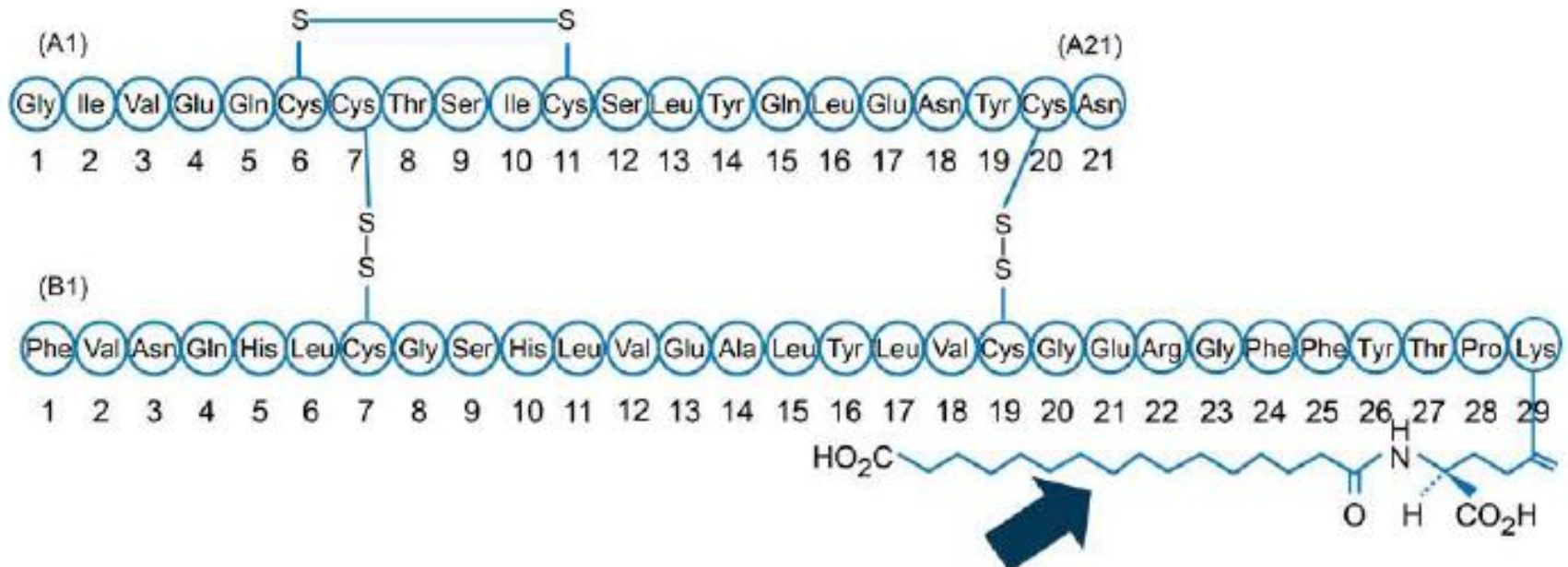
The advantage of dosing flexibility when needed⁵

1. Zhang et al. Diabetology & Metabolic Syndrome 2014, 6:37.
2. Becker RH, et al. Diabetes Care. 2015;38:637-643.
3. Bolli GB, et al. Diabetes Obes and Metab.2015;17(4):386-394.
4. Ritzel R. et al, Diabetes Care Metab 17:859,2015.
5. Toujeo® European Summary of Product Characteristics. December 2015.
6. Gerstein HC, et al. New Eng J Med. 2012;367:319-328.

Insulin Degludec

- Novel ultra long-acting insulin analogues are being developed
- Insulin Degludec provides basal insulin coverage for more than 42 hours, and achieves similar glycaemic control with less overnight hypoglycemia than glargine
- Degludec is approved for use in Europe, Saudi Arabia & Gulf countries

Insulin Degludec*



Formation of multiple hexamers contributes to a half-life of 24.5 hours

*The FDA has not approved this medication for use.

From Owens DR. Insulin Preparations with prolonged effect. *Diabetes Technol Ther.* 2011;13:S5-S14. Republished with permission.

Flexible Bolus calculation Food bolus & correction Bolus

Carbohydrate Counting

- Insulin dosing (bolus) is based on CHO intake
- Permits more exact dosing of insulin
- Carbohydrate content can be easily determined
- Requires familiarity with portion sizes
- Requires ability to do simple calculations
- Direct patient to materials on CHO counting

Examples of some calculation

- All of the below contain approximately 15 grams of carbohydrate:
 - $\frac{1}{2}$ cup of fruit juice
 - $\frac{1}{2}$ cup canned fruit
 - 1 cup of whole fresh fruit
 - 1 slice of bread
 - 1 cup of milk
 - $\frac{1}{2}$ cup of potatoes, rice, pasta, beans, peas

Reading Food Labels

Nutrition Facts			
Serving Size 1 oz. (28g/About 21 pieces)			
Servings Per Container About 2			
Amount Per Serving			
Calories 170	Calories from Fat 110		
% Daily Value*			
Total Fat 11g			17%
Saturated Fat 1.5g			8%
Trans Fat 0g			
Cholesterol 0mg			0%
Sodium 250mg			10%
Total Carbohydrate 14g			5%
Dietary Fiber less than 1g			2%
Sugars 0g			
Protein 2g			
Vitamin A 2%	•	Vitamin C 0%	
Calcium 0%	•	Iron 4%	
Vitamin E 6%	•	Thiamin 4%	
Riboflavin 2%	•	Niacin 4%	
Vitamin B ₆ 2%	•	Phosphorus 2%	
* 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

Calculation of Premeal Bolus Doses

Methods

1. Estimate patient's individual insulin-to carb ratio
2. Formula: 500 Rule
3. Weight based Method

Determination of Insulin to Carb Ratio: Method 1

EXAMPLE: Estimate 1 unit of insulin: 15 gm carb

Note: 1 unit: 15 gm is often a “safe” starting point

for most patients . . .

Determination of Insulin to Carb Ratio: Method 2

Use the 500 Rule:

Divide 500 by TDD= 1 unit insulin to ____ gm CHO as bolus

EXAMPLE: $500 \div 34 \text{ u} = 15$

Bolus ratio is 1 u insulin : 15 gm CHO

Correction Bolus Insulin

- To be taken to correct for hyperglycemia
- Based on insulin sensitivity factor
- Goal is for correction bolus to lower blood glucose to within 30 to 50 mg/dl of target value

Insulin Sensitivity Factor

Use to ↓ high blood glucose

1 unit of insulin will ↓ blood glucose by: _____ mg/dl

Regular: 1500 Rule

Humalog: 1800 Rule

1500 or 1800 divided by TDD= amount of blood glucose lowered by 1 unit insulin

Insulin Sensitivity Factor

EXAMPLE

TDD is 34 units

1500 Rule: $1500 \div 34 = 44$

1 unit of Regular \downarrow bg 44 mg/dl

1800 Rule: $1800 \div 34 = 53$

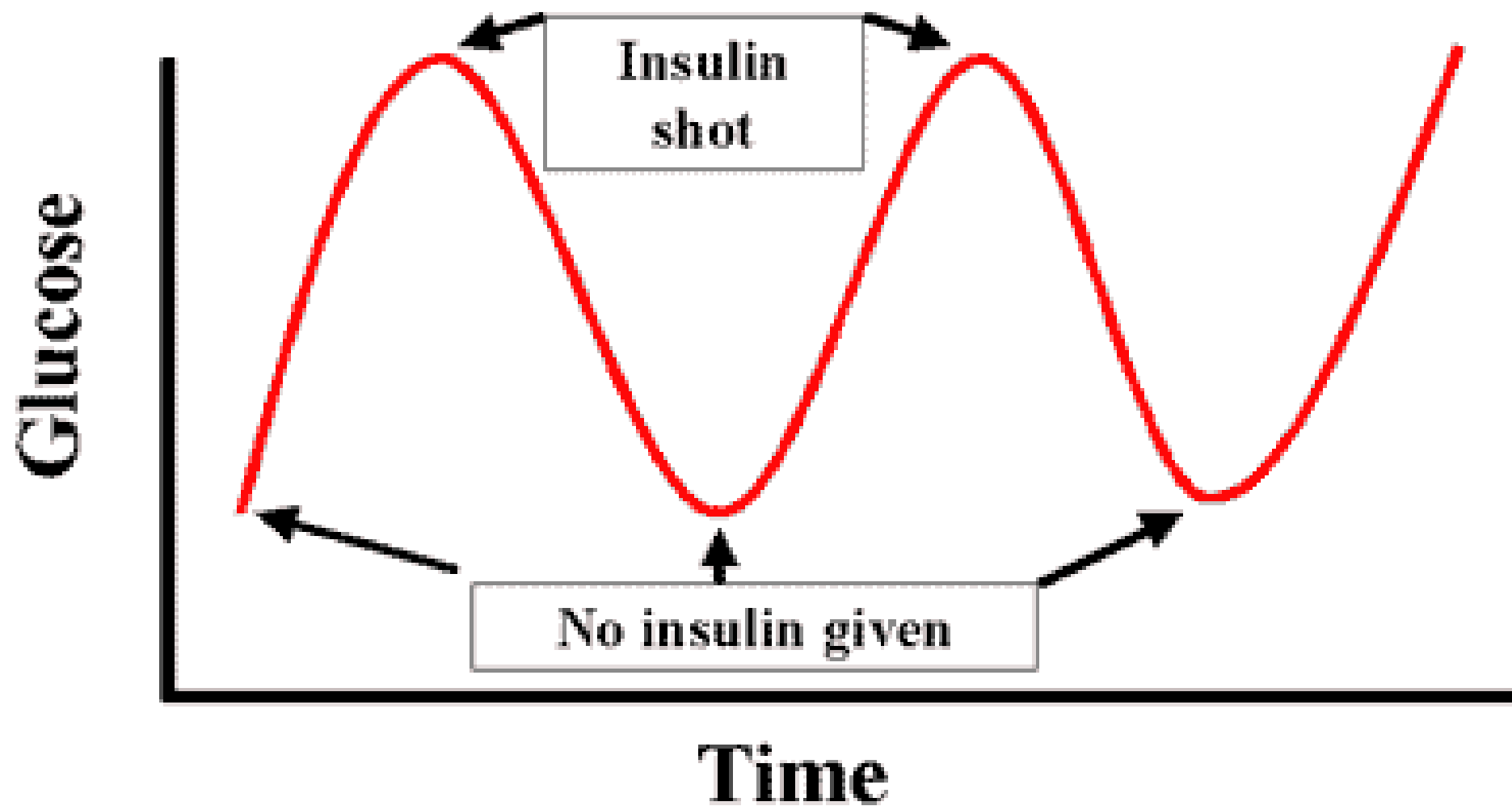
1 unit of Humalog \downarrow bg 53 mg/dl

A Quick Word on using Sliding
Scale Insulin....

Don't!

Roller Coaster Effect of Insulin

Sliding Scale

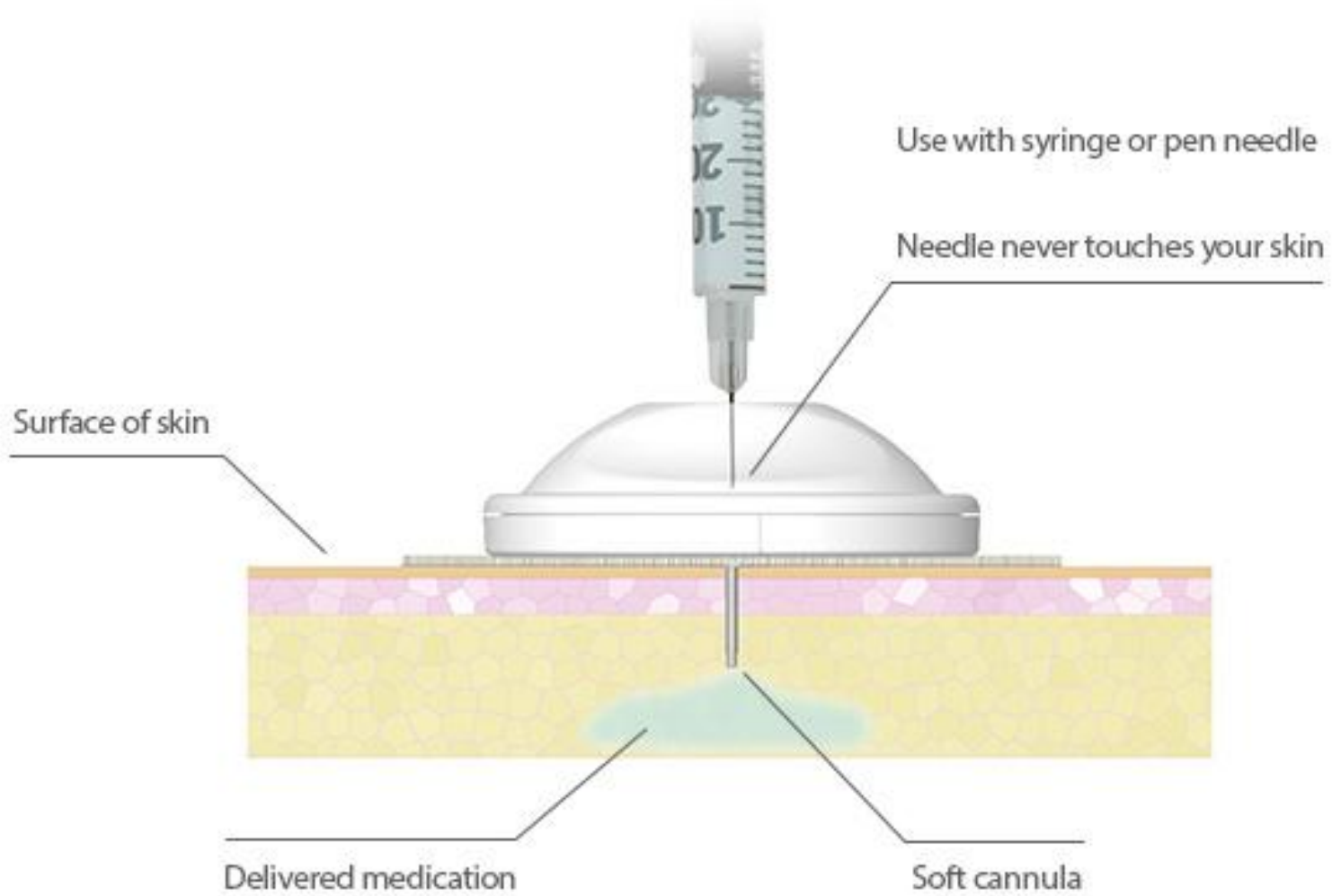


Technological Advancements with i-Port Advance

Value summary

The value of
i-Port Advance[®]
in patients requiring
daily subcutaneous
injections



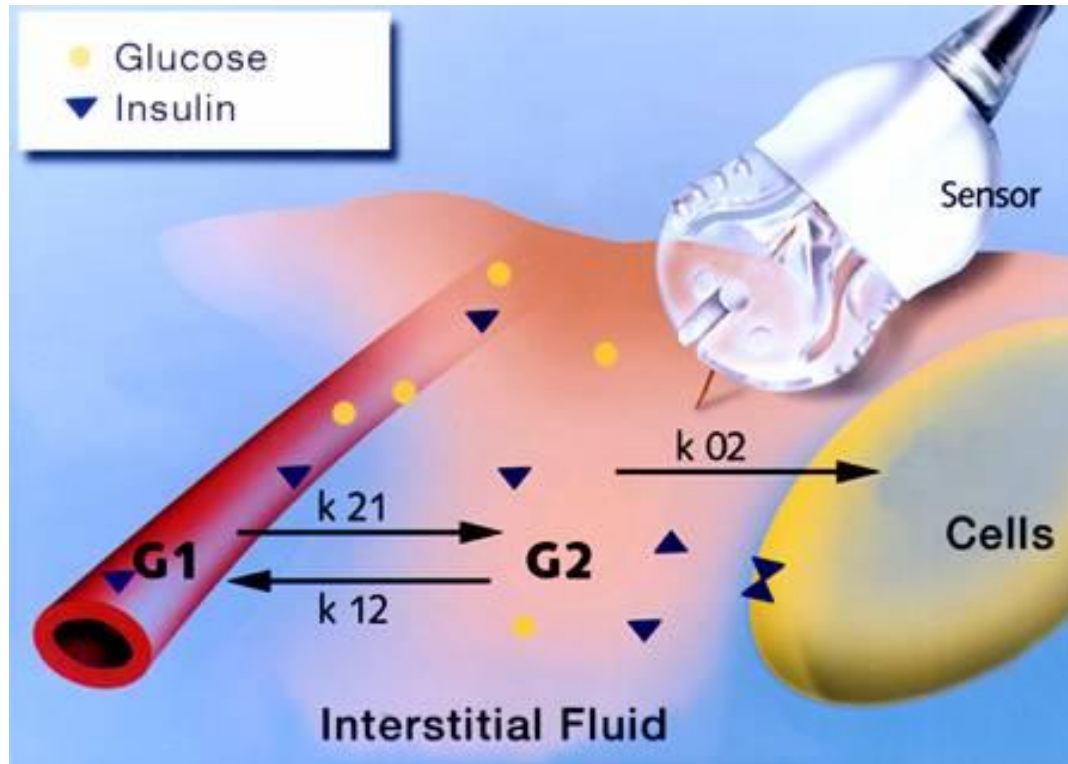


No needle remains under the skin

Non invasive Glucose Monitoring

- Non invasive sensors ,use a plastic needle containing a sensor inserted into the subcutaneous
- Enzymatic sensors using Glucose Oxidase are the currently used sensing systems
- Various types/ various companies
- They are replaced every 7 days and require calibration 2-3 times daily with SMBG
- FGMS (free style – Libre) by Abbott , not continuous but has advantages of 14 days sensor and no calibration, with cheapest price among all other non invasive sensors

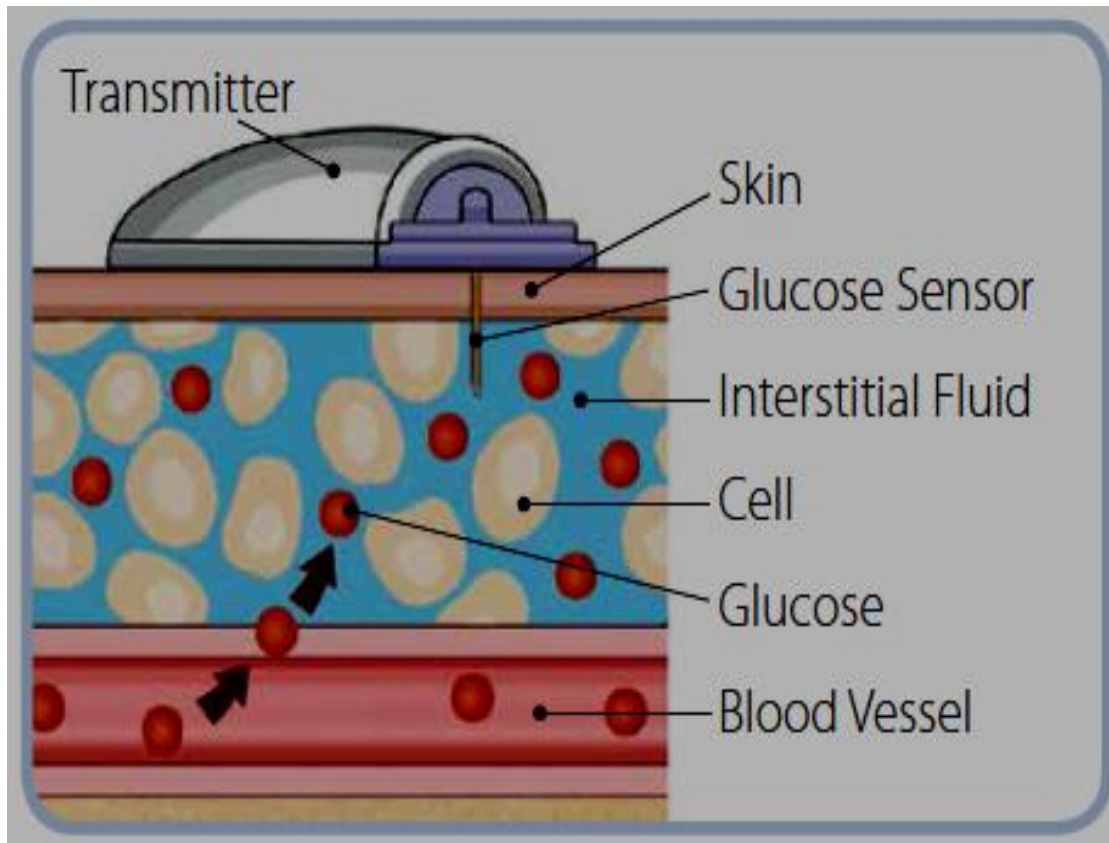
Interstitial Fluid Glucose Measurement



Interstitial fluid glucose (G2) is almost always comparable with blood glucose (G1)

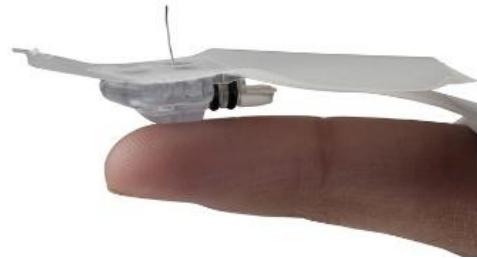
How Does CGM Work?

- Glucose in the **interstitial fluid** hits the sensor causing an glucose-oxidation reaction to occur



CGMS Parts

- Sensors



- Transmitters



- Receivers



- Inserters



The first Glucose Sensors

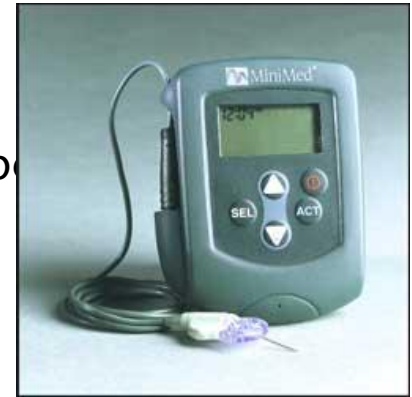
Glucowatch Biographer
FDA approval 2001 -2007
Reverse iontophoresis
Cynngus/Animas



Freestyle navigator
2008 -2011



Enzyme tipped



Medtronic Guardian
Real time



Dexcom STS 2



Dexcom STS 7 Continuous Glucose Monitor Sensor and Receiver.
Courtesy of Dexcom.

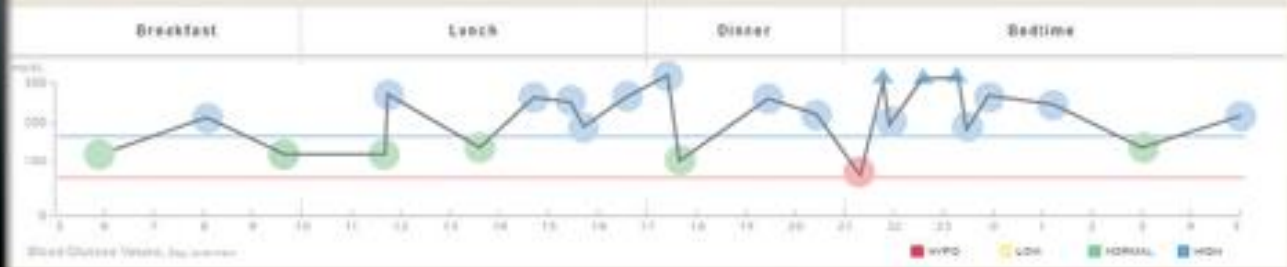
Availability of various CGMS



Welcome, Bill Davis.

There is new data and reports for you.
[Add] Add a new logbook entry
07/25/2013 - 07/31/2013

Care, Bill
Your last visit was on 07/01/2013
21:00
Last uploaded data on 07/31/2013 20:33



Hypo

2 14% of your blood glucose values are below hypo limit. Target bar for all BG values.

Before meal BG

2 above target. 22% of your before meal blood glucose values are above target.

After meal BG

3 above target. 50% of your after meal blood glucose values are above target.

Glucose Sensors & Blue-tooth communications



Glucose Sensors & Blue-tooth communications

- Receiver s could share blue-tooth capability built-in so no
- need to have a cable and phone attached to receiver
- Must have iPhone, iPod touch, or iPad with internet
- connection close to receiver



Insulin Pump Therapy: Present



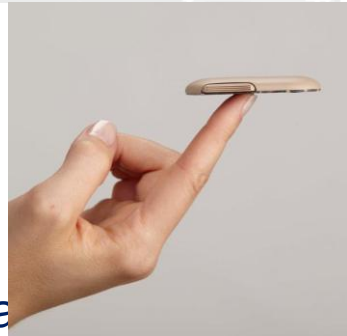
Benefits of Insulin Pump Therapy

- Improved glycemic control
- Less frequent / severe hypoglycemia
- Enhanced quality of life
- Improved patient satisfaction
- Ease of management
- Reduced glucose toxicity, which may also result in improved β -cell function



Patch Pumps

Cellnovo
France & UK

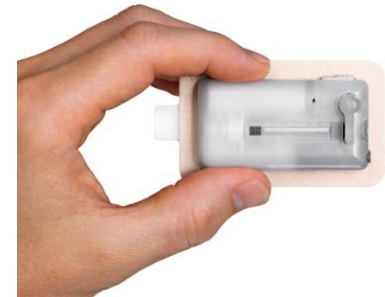


Ca
(FDA approved in Jan. 2010)
Launch in 2016
200 units of insulin

us only pump 1-2 units of Insulin / 0.5-5 unit boluses



Medingo Solo Roche
(FDA approved in July 2009)



Valeritas V-Go
(FDA approved in Dec. 2010)
Preset basal rate to deliver 20, 30, or 40
Bolus dosing in 2 Unit increments up to
36 Units

Wearable Pumps

Relatively large



OmniPod[™]

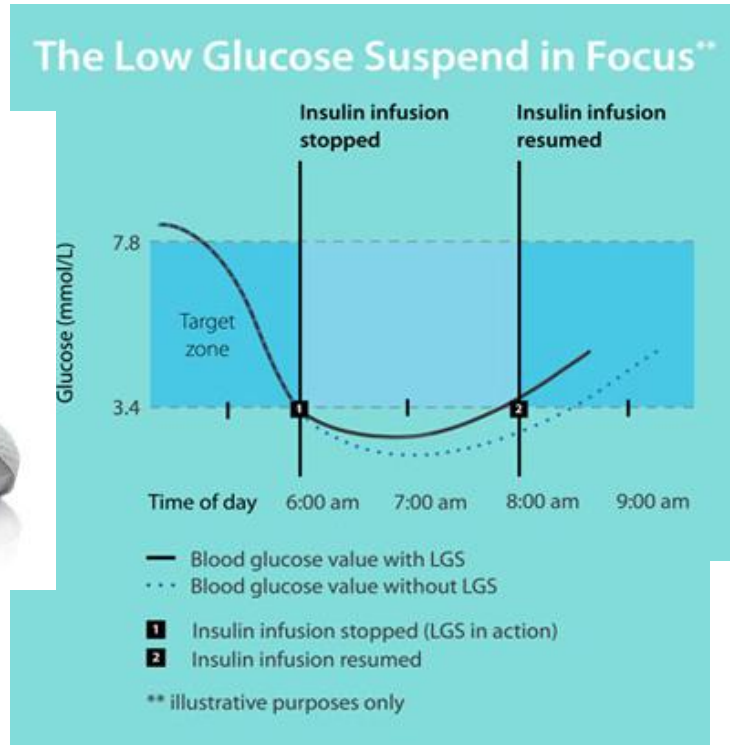
Insulin Management System

Designed to make diabetes a smaller part of life and CSII therapy easy to prescribe.

Sensor Augmented Insulin Pumps (SAP)



Medtronic MiniMed 530G system



Animas Vibe system



'SMARTGUARD™ TECHNOLOGY PROVIDES ADVANCED PROTECTION AGAINST HYPOGLYCEMIA (AUTO SUSPENSION & AUTO-RESUME OF INSULIN)

AUTO SUSPEND

S 1- Suspend Before Low*

Low Limit

R

AUTO RESUME

- ✓ Auto based on SG value
- ✓ Auto based on 2 hour max



Bionic Pancreas – the iLet Dual Chamber pump (Glucagon and Insulin Reservoir)



<http://sites.bu.edu/bionicpancreas/about-us/the-bionic-pancreas-ilet/>

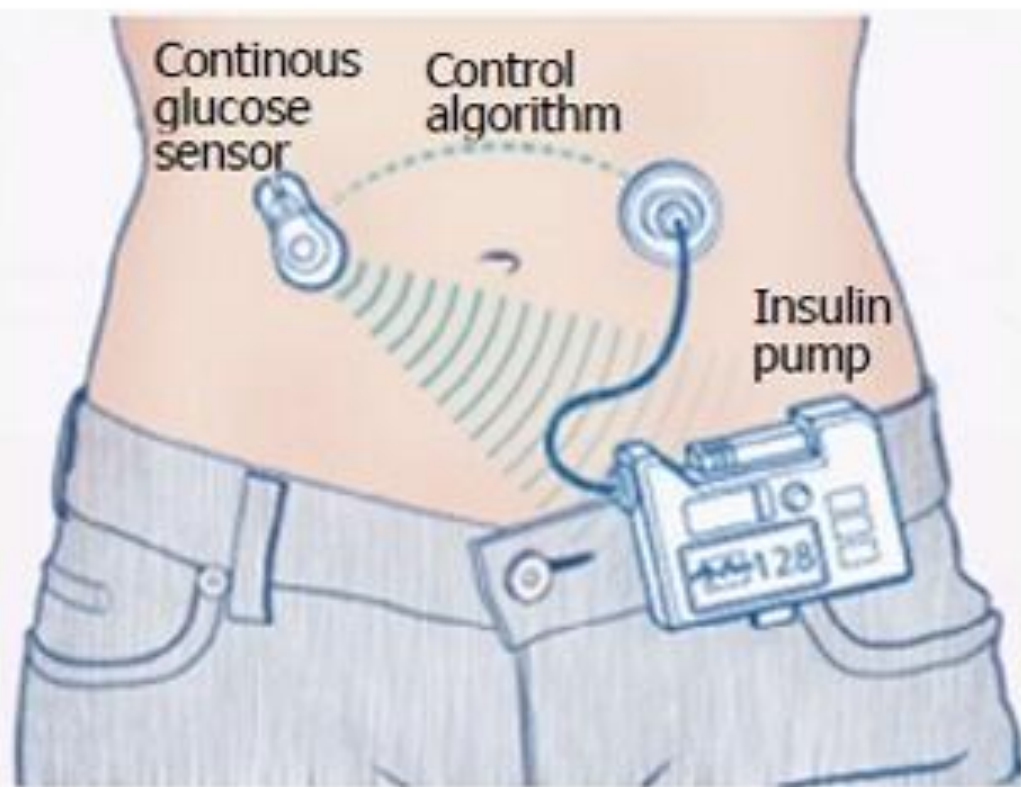
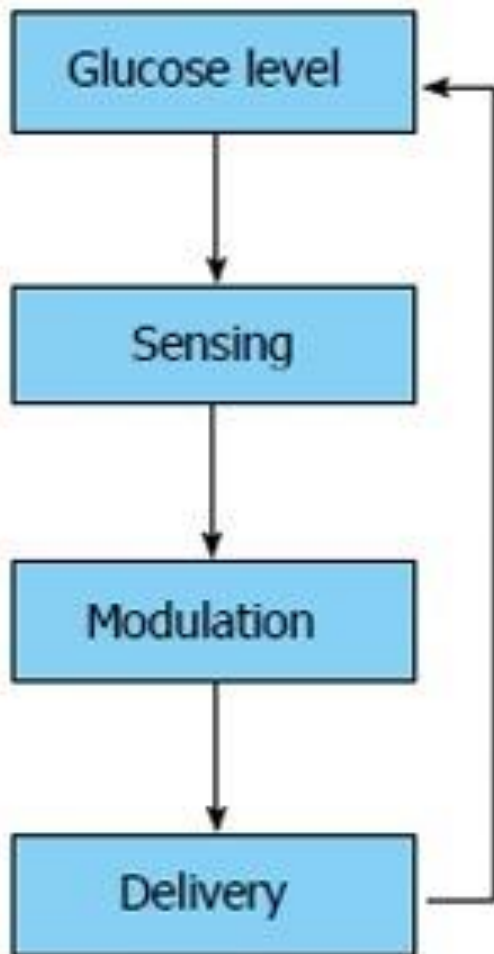
Insulin

Glucagon



The artificial pancreas (AP)

- known as closed-loop control of blood glucose in diabetes, is a system combining of:
 - glucose sensor
 - smart” control algorithms
 - insulin infusion device



Breaking News: FDA Approves the MiniMed 670G System, World's First Hybrid Closed Loop System
September 28, 2016



Conclusion

- Timely initiation of insulin is critical
- Insulin analogs most closely match normal physiology, but some children still need short acting insulin
- There is a wide variety of insulin regimens and insulin delivery methods
- It is important to match the insulin regimen to patient lifestyle and characteristics
- When blood glucose goals are not met, titrate insulin in a timely manner

Conclusion

- Basal-bolus therapy should be the treatment of choice:
 - Enabling FBG & PPBG to be controlled separately
 - Allowing for flexible dosing and timing of injections
 - Basal Insulin analogues offer peakless 24-hour coverage & new ones extends further more to improve glycaemic control and improve day-day variability with less risk of hypoglycaemia
- Rapid – Acting analogue Insulin offer a fast onset of action & effective post-meal glycaemic control

