

DM Fundamentals – Class 3
Insulin Pattern Management

Beverly Thomassian, RN, MPH, BC-ADM, CDE
 President, Diabetes Education Services

© Copyright 1999-2014, Diabetes Education Services, All Rights Reserved.

Insulin Hormone Replacement Therapy – Class 3

- ▶ Incorporating national guidelines into practice
- ▶ Using basal/bolus insulin therapy to improve glucose control from hospital to home
- ▶ Glucose patterns and adjustment strategies

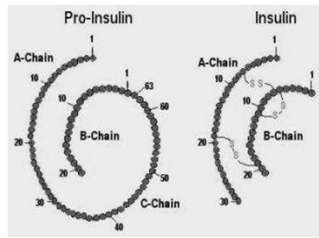
Insulin Therapy
From Ants to Analogs:



Insulin – the Ultimate Hormone Replacement Therapy

Objectives:

- Discuss the actions of different insulins
- Describe using pattern management as an insulin adjustment tool.



Diabetes Education SERVICES

The Miracle of Insulin



Patient J.L., December 15, 1922



February 15, 1923



Diabetes Education SERVICES

The Nobel Prize in Physiology or Medicine 1923



Frederick G. Banting

Born: 14 November 1891, Alliston, Canada
Died: 21 February 1941, Newfoundland, Canada
Affiliation at the time of the award: University of Toronto, Toronto, Canada
Prize motivation: "for the discovery of insulin"
Field: endocrinology, metabolism



Diabetes Education SERVICES

Psychological Insulin Resistance (PIR)



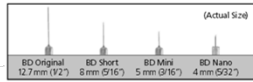
- ▶ 50% of providers in study threatened pts “with the needle”.
- ▶ Less than 50% of providers realized insulins’ positive effect on type 2 dm
- ▶ Most pts don’t believe that insulin would “better help them manage their diabetes”.
- ▶ Solutions: Find the root of PIR and address it, use more insulin pens

Diabetes Attitudes, Wishes, Needs Study - Rubin



Diabetes Education SERVICES

Needle Size often a Barrier Size Does Matter

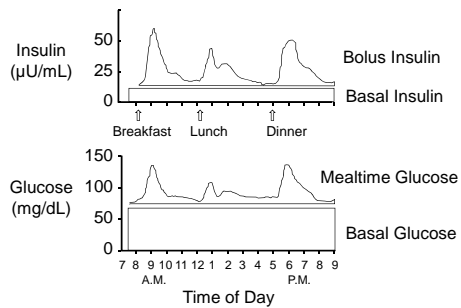


- ▶ Use more short needles – 4 mm
- ▶ Effective for pts with BMI of 24- 49
- ▶ Keeps it subq
- ▶ If pt thin, inject at angle
- ▶ To avoid leakage, count to 10 before withdrawing needle
- ▶ ½ the patients who could benefit from insulin are not using it due to needle phobias



Diabetes Education SERVICES

Physiologic Insulin Secretion: 24-Hour Profile



Diabetes Education SERVICES

Insulin Action Teams

- ▶ Bolus: lowers after meal glucose levels
 - ▶ Rapid Acting
 - ▶ Aspart, Lispro, Glulisine
 - ▶ Short Acting
 - ▶ Regular
- ▶ Basal: controls glucose between meals, hs
 - ▶ Intermediate
 - ▶ NPH
 - ▶ Long Acting
 - ▶ Detemir (Levemir)
 - ▶ Glargine (Lantus)



Diabetes Education SERVICES

Cost Per Insulin Vial in Northern CA

Per vial cost	Walmart	Walgreens	Costco
Regular Insulin	\$25*	\$92	\$99
NPH	\$25*	\$92	\$99
70/30	\$25*	\$92	\$101
Humalog	\$200	\$220	\$178
Novolog	\$197	\$217	\$178
Apidra	\$180	\$246	\$178
Levemir	\$300	\$300	\$300
Lantus	\$226	\$221	\$206



Diabetes Education SERVICES

Bolus Insulins

($\frac{1}{2}$ of total daily dose \div meals)

Name	Onset	Peak Action
▶ Lispro (Humalog)	15-30 min	1-1.5 hrs
▶ Aspart (NovoLog)		
▶ Glulisine (Apidra)		
▶ Afrezza (Inhaled)		
▶ Regular	30 mins	2-4 hrs



Diabetes Education SERVICES

Afrezza – Inhaled Insulin – Approved 2014 – Type 1 or 2

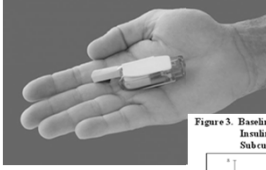
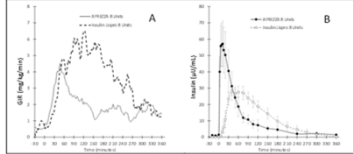


Figure 3. Baseline-Corrected Glucose Infusion Rate (A) and Baseline-Corrected Serum Insulin Concentrations (B) after Administration of AFREZZA or Subcutaneous Insulin Lispro in Type 1 Diabetes Patients*



* Despite the faster absorption of insulin (FI) from Afrezza, the onset of activity (OT) was comparable to insulin Lispro.

Only studied in adults over 18
Not indicated for pregnancy, while breastfeeding

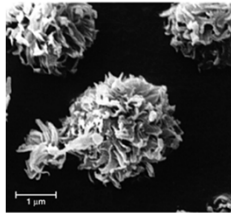


© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

Diabetes Education SERVICES

Steps, Cost, Terms

- ▶ 1st step – FDA approved. Will take time to produce, market and distribute
- ▶ Pricing – similar pricing as pens ~ \$300 a month
- ▶ Afrezza is regular human insulin in powder form using Technosphere technology.
- ▶ Referred to as TI in papers – “Technosphere Insulin”



© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

Diabetes Education SERVICES

Afrezza Dosing and Considerations

- ▶ Bolus regular insulin – inhaled before meals
- ▶ Dosing: 4 and 8 unit cartridges
 - ▶ Convert with 1:1 ratio to existing insulin dose
- ▶ Lung function test before start (FEV1)
 - ▶ Not for pts w/ chronic lung issues
 - ▶ Asthma, COPD, history of lung cancer, smokers
 - ▶ Can cause acute bronchospasm – Black box warning
- ▶ Side effects:
 - ▶ Hypoglycemia, sore throat, cough
 - ▶ Less hypoglycemia than injected insulin



© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

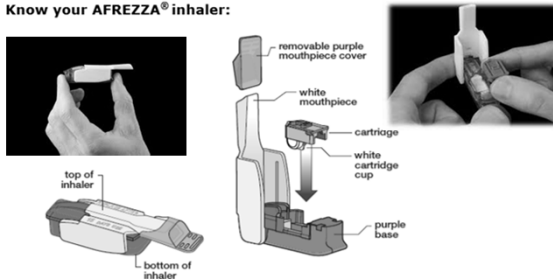
Diabetes Education SERVICES

Lung function

- ▶ Lung function diminishes over first 3 months and then stabilizes (in 2 yr study)
- ▶ Measured by Forced Expiratory Volume (FEV1)
- ▶ Measure lung function with Incentive Spirometry at baseline, 6 months and yearly
- ▶ If FEV1 declines by more than 20%, consider stopping Afrezza
- ▶ Not tested on smokers
- ▶ Enhanced absorption for those on albuterol

Afrezza Inhaler

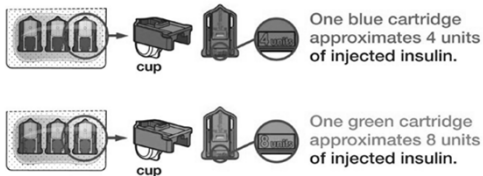
Know your AFREZZA® inhaler:



Replace inhaler every 15 days –
Do not wash

Afrezza – Strengths

There are two strengths of AFREZZA® cartridges:



Let insulin cartridges and inhaler sit at room temp for 10 minutes before using

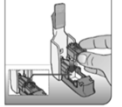
Afrezza – Loading Cartridge into device



▶ Hold inhaler level



▶ Open inhaler by lifting white mouthpiece



▶ Hold insulin cartridge with cup facing down.



▶ Place cartridge inside and close lid. Keep level.

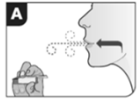
▶ Make sure cartridge has been at room temp for 10 minutes



© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

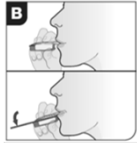
Diabetes Education SERVICES

Afrezza – Proper Inhale Technique



▶ Exhale

▶ Position inhaler in mouth (take off cover)



▶ Tilt inhaler down toward chin, keep head level

▶ Inhale deeply and hold breath for as long as comfortable



▶ Remove cartridge

▶ Replace cover



© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

Diabetes Education SERVICES

Case Study

- ▶ 70 yr old, weighs 100kg
- ▶ History of CABG, tobacco
- ▶ A1c – 11.3%, BG 400-500 for past weeks
- ▶ Insulin – 100+ units Lantus at hs (solostar)
- ▶ Oral Meds: Metformin, Invokana
- ▶ What is a better insulin dosing strategy?
- ▶ Pt can't afford insulin pen – what other option
- ▶ Diabetes Meds on a Budget - 2014 - provides practical and affordable strategies to manage hyperglycemia



© Copyright 1999-2014, Diabetes Educational Services, All Rights Reserved.

Diabetes Education SERVICES

Cost Per Vial in Northern CA

Per vial cost	Walmart	Walgreens	Costco
Regular Insulin	\$25*	\$92	\$99
NPH	\$25*	\$92	\$99
70/30	\$25*	\$92	\$101
Humalog	\$200	\$220	\$178
Novolog	\$197	\$217	\$178
Apidra	\$180	\$246	\$178
Levemir	\$300	\$300	\$300
Lantus	\$226	\$221	\$206



Diabetes Education SERVICES

Bolus Insulin Summary

- ▶ Regular, Novolog, Humalog, Apidra, Afrezza
- ▶ Starts working fast (15-30 mins)
- ▶ Gets out fast (3-6 hours)
- ▶ Post meal BG reflects effectiveness
- ▶ Should comprise about ½ total daily dose
- ▶ Covers food or hyperglycemia.
- ▶ 1 unit
 - ▶ Covers ≈ 10 -15 gms of carb
 - ▶ Lowers BG ≈ 30 – 50 points



Diabetes Education SERVICES

Bolus Insulin Timing

- ▶ How is the effectiveness of bolus insulin determined?
 - ▶ 2 hour post meal (if you can get it)
 - ▶ Before next meal blood glucose
- ▶ Glucose goals (ADA) – may be modified by provider/pt
 - ▶ 1-2 hours post meal <180
 - ▶ Before next meal – 70 - 130



Diabetes Education SERVICES

Bolus – Insulin Sliding Scale

Starts at 150, 2 units for every 50 mg/dl >150

	Break	Lunch	Dinner	HS
Day 1	94 no insulin	212 4 uR	148 no insulin	254 6 uR
Day 2	243 4uR	254 6 uR	201 4uR	199 no insulin
Day 3	189 2uR	243 4uR	162 2uR	244 4uR
Day 4	66 No insulin	287 6uR	144 none	272 6uR



Diabetes Education SERVICES

Basal Insulins

(½ of total daily dose)

Intermediate Acting Peak Action Duration

▶ NPH 4-12 hrs 12-24

Long Acting Peak Action Duration

▶ Detemir (Levemir) peakless 20 hrs

▶ Glargine (Lantus) No peak 24 hrs

Fasting BG reflects efficacy of basal



Diabetes Education SERVICES

Basal Insulin Summary

- ▶ NPH, Levemir, Lantus
- ▶ Covers in between meals, through night
- ▶ Starts working slow (4 hours)
- ▶ Stays in long (12-24 hours)
 - ▶ NPH/ Lente 12 hrs
 - ▶ Levemir, Lantus 20-24 hrs
- ▶ Fasting blood glucose reflects effectiveness



Diabetes Education SERVICES

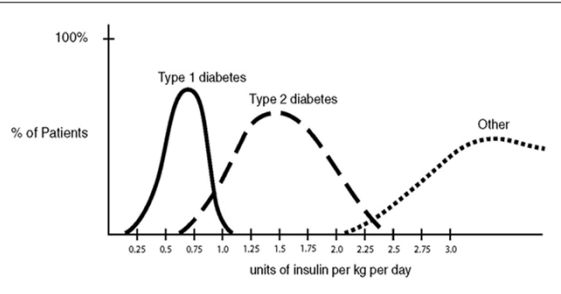
Basal Only
Type 2, 60kg – A1c 8.7%

	Break	Lunch	Dinner	HS
Mo 1	170s			298 10uLan
Mo 2	160s			233 20uLan
Mo 3	140s	283	265	206 30uLan



Diabetes Education SERVICES

Insulin Dosing Type 1 & 2



U-500 Insulin: When More With Less Yields Success: Diabetes Spectrum March 20, 2009 vol. 22 no. 2 116-122



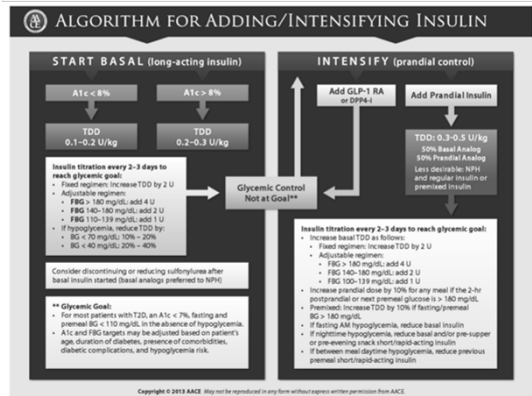
Diabetes Education SERVICES

More than 200 units a day?



Source: Am J Health-Syst Pharm © 2010 American Society of Health-System Pharmacists

AACE Algorithm



Combo Sub-Q Insulin

Insulin Type	Onset	Peak
Humalog Mix 75/25: 75% NPL, 25% lispro 50/50: 50% NPL, 50% lispro	0.25 - 0.5 hr	0.5-6.5 hrs
NovoLog Mix 70/30: 70% NPA, 30% aspart	0.25 - 0.5 hr	1 - 4 hrs
NPH + Reg Combo 70/30: 70%N /30%R 50/50: 50%N /50%R	0.5 - 1.0 hr	2 - 16 hrs

- Considerations:**
- Pre-mixed, difficult to fine tune therapy



10u 70/30 BID Patterns? Changes needed?

	Break	Lunch	Dinner	HS
Day 1	102	63	92	181
Day 2	112	67	106	195
Day 3	98	56	112	201
Day 4	99	71	132	211



Pattern Management



Diabetes Education SERVICES

Pattern Management

- ▶ Safety 1st!! - Evaluate 3 day patterns
- ▶ **Hypo:** eval 1st and fix:
 - ▶ If possible, decrease medication dose
 - ▶ Timing of meals, exercise, medications
- ▶ **Hyperglycemia:** evaluate 2nd
 - ▶ Identify patterns
 - ▶ Before increase insulin, make sure not missing something (carbs, exercise, omission)



Diabetes Education SERVICES

Type 2 – Amaryl 4mg AM, 10u Lantus pm

	Break	Lunch	Dinner	HS
Day 1	164	94	66	162
Day 2	169		59	195
Day 3		84	81	242
Day 4	159		43	211



Diabetes Education SERVICES

Basal Bolus – What Adjustments?

Pt weighs 80kg

	Break	Lunch	Dinner	HS
Day 1	69 7H	79 5H	245 8H	190 22u Det
Day 2	81 7H	87 5H	170 8H	133 22u Det
Day 3	73 7H	94 5H	194 8H	110 22u Det
Day 4	62 7H	83 5H	211 8H	127 22u Det



Diabetes Education SERVICES

Intensive Diabetes Therapy

Insulin Dosing Strategy

50/50 Rule

▶ 0.5-1.0 units/kg day

▶ Basal = 50% of total

- Glargine QD
- NPH or Detemir BID

● Bolus = 50% of total

- usually divided into 3 meals

Example

▶ Wt 50kg x 0.5 = 25 units of insulin/day

▶ Basal dose: 13 units

- Glargine 13 units QD
- NPH/Detemir 6u BID

▶ Bolus dose: 12 units

- ▶ 4 units NovoLog, Apidra Humalog, Regular each meal



Diabetes Education SERVICES

Intensive Diabetes Therapy

Insulin Dosing Strategy

50/50 Rule

▶ 0.5-1.0 units/kg day

▶ Basal = 50% of total

- Glargine QD
- NPH or Detemir BID

● Bolus = 50% of total

- usually divided into 3 meals

Example – You Try

▶ Wt 60 kg x 0.5 = ____ units of insulin/day

▶ Basal dose: ____ units

- Glargine ____ QD
- NPH/Detemir ____ BID

▶ Bolus dose: ____ units

____ units NovoLog, Apidra Humalog, Reg each meal



Diabetes Education SERVICES

Intensive Diabetes Therapy Insulin Dosing Strategy

50/50 Rule

▶ 0.5-1.0 units/kg day

▶ Basal = 50% of total

- Glargine QD
- NPH or Detemir BID

● Bolus = 50% of total

- usually divided into 3 meals

Example – You Try

▶ Wt 60kg x 0.5 = 30 units of insulin/day

▶ Basal dose: 15 units

- Glargine 15 QD or
- NPH/Detemir 7u BID

▶ Bolus dose: 15 units

- ▶ 5 NovoLog, Apidra, Humalog, Reg each meal



Diabetes Education SERVICES

Basal Bolus – Using 50/50 Rule - Pt weighs 80kg

	Break	Lunch	Dinner	HS
Day 1	84 6H	89 7H	145 7H	190 20 u Det
Day 2	81 6H	97 7H	107 7H	133 20u Det
Day 3	79 6H	104 7H	124 7H	110 20u Det
Day 4	69 6H	103 7H	208 7H	193 20u Det



Diabetes Education SERVICES

Bolus Basics



▶ Carbohydrate/ Prandial Coverage

- ▶ Match the insulin to the carbohydrates
- ▶ 1 unit for 15 gms - Common starting point

▶ Correction Bolus - targets hyperglycemia

- ▶ 1 unit for every 30-50 points over target

▶ Adjust ratios depending on sensitivity and response



Diabetes Education SERVICES

Carbohydrate Ratio How does that work?

Rapid/Fast Acting Insulin

► Dinner (60 gms cho)

- Lemon Chicken
- 1 cup rice pilaf
(45 gms cho)
- Asparagus
- Dinner Roll
(15 gms cho)

Blood Glucose 165mg/dl

Serving Size	Gms CHO	Insulin
1	15 gms cho	1 unit
2	30 gms cho	2 units
3	45 gms cho	3 units
4	60 gms cho	4 units

Adjusting Bolus and Correction Doses Carbohydrate-to-Insulin Ratio

Based on three questions before meals:



1. How much carbohydrate am I going to eat?
2. What is my insulin dose for this amount of carbohydrate?
3. Should I lower the dose because I plan to be very active or have recently been active?



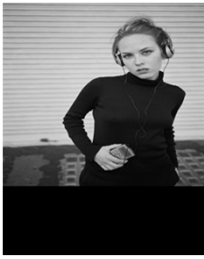
Diabetes Education Services

Correction Bolus

Rapid/Fast Acting Insulin (1 unit:50 mg/dl>150)

Less than 70	Subtract 1 unit
70-150 mg/dl	0 units
151-200 mg/dl	1 unit
201-250 mg/dl	2 units
251-300 mg/dl	3 units
301-350 mg/dl	4 units
351-400 mg/dl	5 units

Type 1 and a Teen



- ▶ Cindy is trying to carb count and adjust her insulin, but is still having trouble. She weighs 60kg.
 - ▶ What is her daily dose of insulin?
 - ▶ What is her basal dose?
1. Pre meal target BG is 120
 2. Post meal goal < 180.
 3. Carb ratio: 1 unit for every 15 gms
 4. Hyperglycemic correction factor is one unit for every 55 above goal (she uses Humalog and 1700 rule)

1700 Rule
 $1700 / TDD = \text{insulin sensitivity}$
 $1700 / 30 = 56$
 1 unit drops BG 56 points



Diabetes Education SERVICES

Correction Bolus for Cindy

Analog Insulin (1 unit:55 mg/dl>120)

Less than 70 mg/dl	Subtract 1 unit
70-119 mg/dl	0 units
120-175 mg/dl	1 unit
176-230 mg/dl	2 units
231-285 mg/dl	3 units
286-340 mg/dl	4 units
341-395 mg/dl	5 units



Diabetes Education SERVICES

Adjusting Cindy's Bolus Insulin With Ratios

BG before lunch 285, she plans to eat 45 gms of carbohydrate.

$285 - 120 = 165$ over target, $165 / 55 = 3$

$45\text{gms} / 15 = 3$

- 3 units bolus insulin to correct to target
- 3 units bolus insulin to cover carbs in meal

Total adjusted dose: 6 units humalog insulin



Diabetes Education SERVICES

Adjusting Cindy's Bolus Insulin With Ratios - You Try

BG before lunch 230, plans to eat 60 gms of carbohydrate.

____ - 120 = ____ over target, ____ / 55 = ____ units

____ gms / ____ = ____ units ins for carbs

- ____ units insulin to correct for hyperglycemia
- ____ units insulin to cover carbs in meal

Total adjusted dose: ____ units humalog insulin



Diabetes Education SERVICES

Adjusting Cindy's Bolus Insulin With Ratios - Answers

Fingerstick before lunch 220, plans to eat 60 gms of carbohydrate.

$220 - 120 = 110$ over target, $110 / 55 = 2$

$60 \text{ gms} / 15 = 4$ units for carbs

- 2 units insulin to correct hyperglycemia
- 4 units insulin to cover carbs in meal

Total adjusted dose: 6 units humalog insulin



Diabetes Education SERVICES

Insulin Teaching Keys

- ▶ Bolus insulin with meals
- ▶ Basal 1-2xs daily
- ▶ Abdomen preferred injection site
- ▶ Stay 1" away from previous site
- ▶ Don't re-use ultra fine syringes
- ▶ Keep unopened insulin in refrigerator
- ▶ Toss opened insulin vial after 28 days
- ▶ Proper disposal
- ▶ Review patients ability to withdraw and inject.
- ▶ Side effects include hypoglycemia/wt gain
- ▶ Insulin pens –
 - ▶ Prime needle to assure accurate insulin dose given
 - ▶ Hold needle in for 5 seconds after injection
 - ▶ Roll 70/30 pens



Diabetes Education SERVICES

Sharps Disposal: Product and Info

- ▶ Look in the Government section white pages for a household hazardous waste listing for your city or county.
- ▶ Call 1-800-CLEANUP (1-800-253-2687)
- ▶ Search for collection centers on the California Integrated Waste Management Board (CIWMB) Web site:
<http://www.ciwmb.ca.gov/HHW/HealthCare/Collection/>



Diabetes Education SERVICES

Thank You



- ▶ Questions?
- ▶ Email
bev@diabetesed.net
- ▶ Web
www.diabetesed.net



Diabetes Education SERVICES
