DM Fundamentals – Class 3
Insulin Pattern Management

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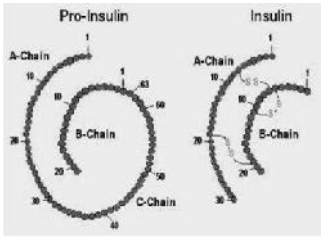
Insulin Hormone Replacement Therapy – Class 3

- 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.



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

Poll question

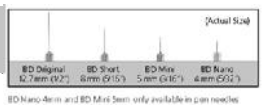
- A patient tells you she doesn't want to start on insulin. What is your best response?
  a. The needles are so small, you won't feel a thing.
  b. You might die if you don't take insulin.
  c. Tell me why.
  d. There is a doctors' order to start insulin.
  e. Not sure

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

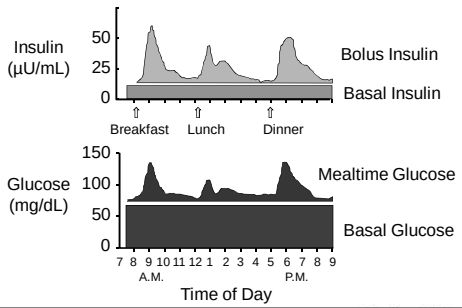
Needle Size often a Barrier Size *Does* Matter



- 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

- 3. What best describes the role of bolus insulins?
  a. cover carbs at meals and hyperglycemia
  b. helps to lower fasting blood glucose
  c. keeps overnight blood sugars under control
  d. should be used during hypoglyemic episodes
  e. not sure

Physiologic Insulin Secretion: 24-Hour Profile



Insulin Action Teams

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

Poll question

- Which insulins are cheapest?
  - a. Lantus, Levemir
  - b. Novolog, Humalog
  - c. Reg, NPH
  - d. Insulin pens
  - e. not sure

Bolus Insulins
(½ of total daily dose ÷ 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

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

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

afrezza

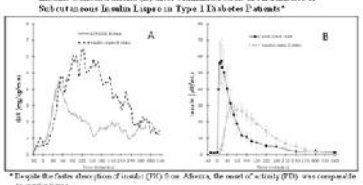
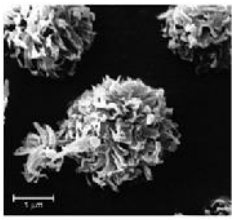


Figure 3. Baseline-Corrected Glucose Infusion Rate (A) and Baseline-Corrected Serum Insulin Concentrations (B) after Administration of AFREZZA or Subcutaneous Insulin Lispro in Type 1 Diabetes Patients*

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

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"



Afrezza Dosing and Considerations

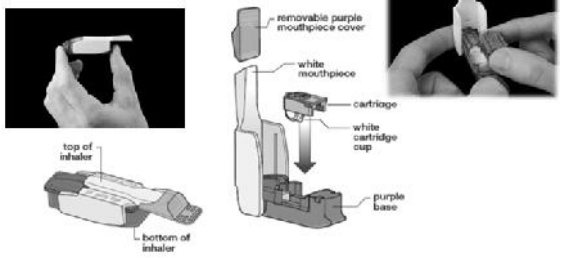
- Bolus regular insulin – inhaled before meals
- Dosing: 4 and 8 unit cartridges
  - Convert with 1:1 ratio to existing insulin dose
- Lung function test before start (FEV1)
  - Not for pts w/ chronic lung issues
    - Asthma, COPD, history of lung cancer, smokers
    - Can cause acute bronchospasm –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

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

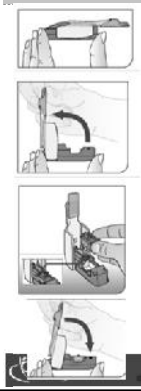
Afrezza Inhaler

Know your AFREZZA® inhaler:



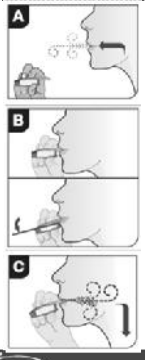
Replace inhaler every 15 days – Do not wash

Afrezza – 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

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

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

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 – 80 - 130

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

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

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

Pattern Management

Poll Question

- When looking at glucose patterns, which problem do you fix first?
  - a. Hyperglycemia
  - b. Hypoglycemia
  - c. non-compliance
  - d. legible writing
  - e. not sure

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)

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

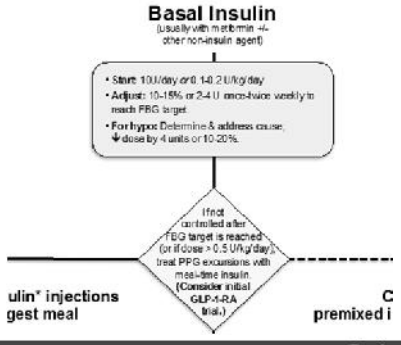
Case Study

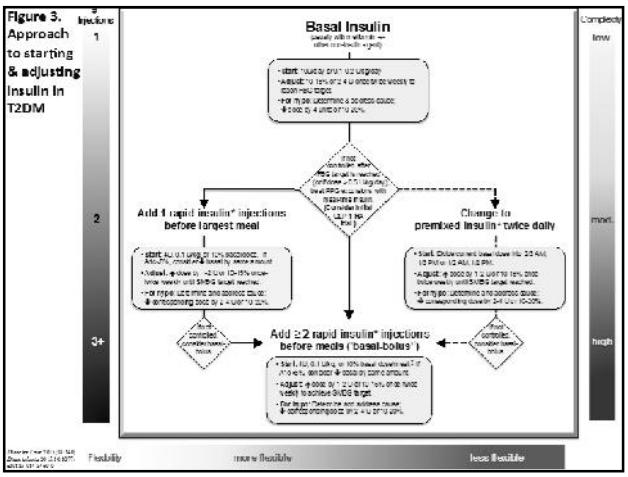
- 70 yr old, avid walker
- BMI 24, Weighs 60kg
- A1c – 9.8%, BG 250s during day for past weeks
- Insulin – 30 units Lantus (solostar pen)
- Oral Meds: glipizide 20mg
  - What medication changes?
  - What insulin changes?
  - Pt can't afford insulin pen – what other option

Basal Only
Type 2, 60kg – A1c 9.8%

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

When is it Too much basal insulin?





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

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Case Study

- 70 yr old, avid walker
- BMI 24, Weighs 60kg
- A1c – 9.8%, BG 300s for past weeks
- Insulin – 30 units Lantus (solostar pen)
- Oral Meds: glipizide 20mg
  - What medication changes? Stop glipizide
  - What insulin changes? Try adding 1 bolus injection at largest meal, or switch to 70/30. 2/3s am, 1/3 pre dinner = 20units 70/30 am, 10 units 70/30 pre dinner
  - Pt can't afford insulin pen – use vial and syringes

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20u 70/30 am, 10u 70/30 pm
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

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

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

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

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

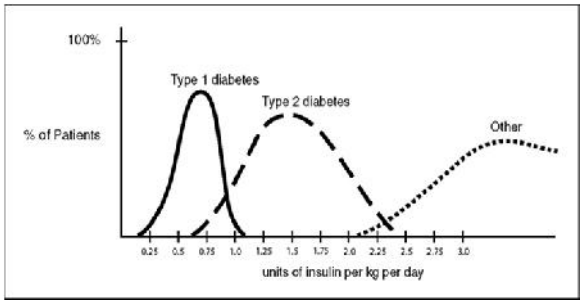
Example – You Try

- 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

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

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*

More than 200 units a day?

Consider u-500

- Consider U-500 (5 x's more potent)
  - 1 unit on U-100 syringe = 5 units insulin
  - Dosing – take total daily needs and split into two doses
    - 60% am / 40% pm
  - 500 units per mL – 20 units a vial = 10,000 units per vial
  - Costs ~ $400 per vial
  - No basal insulin needed, because U-500 has bolus and basal action
  - Needs careful monitoring/ education

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

U-500 Dose

U-100 syringe and TB Syringe

If this is **your dose** of Humulin R U-500	Fill a U-100 **insulin syringe** up to this marking	Fill a **tuberculin syringe** up to this marking
25	5	0.05
50	10	0.1
75	15	0.15
100	20	0.2
125	25	0.25
150	30	0.3
175	35	0.35
200	40	0.4
225	45	0.45
250	50	0.5
275	55	0.55
300	60	0.6
325	65	0.65
350	70	0.7
375	75	0.75
400	80	0.8
425	85	0.85
450	90	0.9
475	95	0.95
500	100	1.0

Basal Bolus

- Carb counting
- Prandial coverage
- Correcting for hyper and hypoglycemia

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

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?

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 = insulin sensitivity
1700 / 30 = 56
1 unit drops BG 56 points

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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

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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

45gms / 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

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 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

Poll question

- Which of the following are suggested insulin teaching keys?
  - a. Test, inject, eat – TIE
  - b. abdomen is preferred injection site
  1. c. use a sharps container to dispose of needles/lancets
  - d. always have treatment for hypo available
  - e. all of the above

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

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/
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Thank You

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

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