Pattern Management Gone Crazy

- Incorporating national guidelines into practice
- Explore the importance of patient assessment in determining a realistic dosing strategy.
- Discuss strategies to initiate and modify insulin therapy with a focus on safety.
- List strategies on adjusting bolus and basal insulin to achieve glucose control.
- Glucose patterns and adjustment strategies

Pattern Management – AKA

How to think like a pancreas
Poll question 1

- Which of the following are bolus insulins?
  a. Lantus, Levemir
  b. Novolog, Humalog, NPH
  c. Reg, Novolog, Afrezza
  d. Insulin pens
  e. not sure

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)
Insulin Efficacy

- How is the effectiveness of bolus insulin determined?
  - 2 hour post meal (if you can get it)
  - Target < 180
  - Before next meal blood glucose
  - Target 80-130

- How is the effectiveness of basal insulin determined?
  - Fasting blood glucose
  - Target 80-130

Glycemic Targets

- Adult non pregnant A1c goals
  - A1c < 7% - a reasonable goal for adults.
  - A1c < 6.5% - may be appropriate for those without significant risk of hypoglycemia or other adverse effects of treatment.
  - A1c < 8% - may be appropriate for patients with history of hypoglycemia, limited life expectancy, or those with longstanding diabetes and vascular complications.

Approach Depends on Patient

- Insulin dosing is relative to body weight
  - Kidney function
  - Other meds
  - Activity level
  - Social support
  - Goals of care
  - Patients ability
Poll question 2

What best describes inhaled insulin?

- a. Liquid insulin that is aerosolized.
- b. Powdered long acting insulin.
- c. Insulin that is inhaled via a pipe.
- d. Regular insulin in powdered form.
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

Afrezza Inhaler

Know your AFREZZA® inhaler:

Replace inhaler every 15 days – Do not wash
Afrezza – Combos to get right dose

Sample situations - Pt on....
- 7 units Humalog at meals, 20 u Lantus at hs
- 5 units regular break, dinner, 10 units detemir
- 10 units aspart at meals, 30 Lantus
- Carb counts – 1:15 .. Had 75 gms
  - Type 1
  - Type 2
  - BG before meal 67
  - BG before meal 170

Sample situations - Pt on....
- 7 units Humalog at meals, 20 u Lantus at hs
  - Type 1 or 2 - 8 units Afrezza.
    - BG 67 – reduce to 4 units? BG 170 – 8 units ok
  - 5 units regular break, dinner, 10 units detemir
    - Type 1 – 4 units, Type 2 - 8 units?
    - BG 67 – 4 units. BG 170 – Type 1, 4 units. Type 2, 8 units?
  - 10 units aspart at meals, 30 Lantus
    - Type 1, 8 or 12 units? Type 2, 12 units.
    - BG 170 – 12 units both. BG 67, 8 units both
  - BG 140 - Carb counts – 1:15 .. Had 75 gms carb
    - Type 1, 4 units (ck in 2 hrs, give more?). Type 2, 8 units?
Pattern Management

Poll Question - 3

- 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)
Case Study

- 68 yr old, avid walker
- BMI 24, Weighs 90kg
- A1c – 9.6%, BG 270s during day for past mos
- Insulin – 40 units Lantus
- Oral Meds: glyburide, metformin
  - What medication changes?
  - What insulin changes?
  - Big insurance copay

Type 2, 90kg – A1c 9.6% Pt on Metformin, Glyburide- Max dose- Lantus started

<table>
<thead>
<tr>
<th></th>
<th>Break</th>
<th>Lunch</th>
<th>Dinner</th>
<th>HS</th>
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<td>190s</td>
<td></td>
<td></td>
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<tr>
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<td></td>
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<td>10uLan</td>
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<tr>
<td>Mo 2</td>
<td>180s</td>
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<td></td>
<td>233</td>
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<td>20uLan</td>
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<tr>
<td>Mo 3</td>
<td>160s</td>
<td></td>
<td></td>
<td>216</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30uLan</td>
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<tr>
<td>Mo 4</td>
<td>130s</td>
<td>278</td>
<td>184</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>40uLan</td>
</tr>
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</table>

Next Step - Insulin

- Add GLP1 Agonist? No
- Add a SGLT-2 Inhibitor? no
- DPP-IV? No due to $$$
- Stop Glyburide (not indicated if on insulin. Increase risk for hypo and mortality)
- Need to improve insulin therapy
  - Look at eating patterns
  - Refer to RD, Education
  - Great support system
When is it Too much basal insulin?

**Basal Insulin**

- **Max basal dose is 45 units** (90kg x 0.5). At 40 units now.
- Next step – Add bolus insulin or switch to 70/30.
- After discussing with patient, decide to add regular* insulin to largest meal.
- Dose – 4 units or 10% of basal (40 x 10% = 4 units).
- When is largest meal (most carbs)?

*Cheapest
### Cost Per Vial in Northern CA

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<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>$23*</td>
<td>$92</td>
<td>$99</td>
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<tr>
<td>NPH</td>
<td>$25*</td>
<td>$92</td>
<td>$99</td>
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<tr>
<td>70/30</td>
<td>$25*</td>
<td>$92</td>
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<td>$180</td>
<td>$246</td>
<td>$178</td>
</tr>
<tr>
<td>Levemir</td>
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<td>$100</td>
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<tr>
<td>Lantus</td>
<td>$226</td>
<td>$221</td>
<td>$206</td>
</tr>
</tbody>
</table>

### Food diary – Finding Largest Meal

- **Breakfast**
  - Big bowl of oatmeal with walnuts, banana, coffee
- **Lunch**
  - Sandwich and piece of fruit
  - A few cookies around 3pm
- **Dinner**
  - Big salad, BBQ meat, dinner roll, glass of wine
- **Late night snacking**
  - Peanut butter on celery, nuts, cheese

### Poll Question 4

- Which is his largest meal from a carb perspective?
  - A. Breakfast
  - B. Lunch
  - C. Dinner
  - D. Breakfast or Lunch
### Pt on Metformin, Lantus 40
**Type 2, 90kg – A1c 9.6%**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Wk 1</td>
<td>130s 4uR</td>
<td>190</td>
<td>160</td>
<td>180 40uLan</td>
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<tr>
<td>Wk 2</td>
<td>120s 5uR</td>
<td>170</td>
<td>160</td>
<td>170 40uLan</td>
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<td>160</td>
<td>170s 40uLan</td>
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<tr>
<td>Wk 4</td>
<td>80s 7uR</td>
<td>130s</td>
<td>160s</td>
<td>160s 35uLan</td>
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### Intensive Diabetes Therapy
**Insulin Dosing Strategy**

**50/50 Rule**
- 0.5-1.0 units/kg day
  (5 units/kg most common)
- Basal = 50% of total
  - Glargine Q day
  - NPH or Detemir BID
- Bolus = 50% of total
  - usually divided into 3 meals

**Example**
- Wt 90kg x 0.5 = 45 units of insulin/day
- Basal dose: 23 units
  - Glargine 23 units Q day
  - NPH/Detemir 12u BID
- Bolus dose: 22 units
  - 7 units NovoLog, Apidra, Reg, Humalog each meal

---

### Pt on Metformin, Lantus 40
**Type 2, 90kg – A1c 7.6%**

<table>
<thead>
<tr>
<th></th>
<th>Break</th>
<th>Lunch</th>
<th>Dinner</th>
<th>HS</th>
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<tr>
<td>Wk 1</td>
<td>130s 7uR</td>
<td>130</td>
<td>130</td>
<td>160 25uLan</td>
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<tr>
<td>Wk 2</td>
<td>120s 7uR</td>
<td>120</td>
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<tr>
<td>Wk 3</td>
<td>100s 7uR</td>
<td>110</td>
<td>120s</td>
<td>140s 25uLan</td>
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<tr>
<td>Wk 4</td>
<td>100s 7uR</td>
<td>110</td>
<td>120s</td>
<td>140s 25uLan</td>
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</tbody>
</table>
Intensive Diabetes Therapy
Insulin Dosing Strategy

50/50 Rule
- 0.3-1.0 units/kg day
  (5 units/kg most common)
- Basal = 50% of total
  - Glargine Q day
  - NPH or Detemir BID
- Bolus = 50% of total
  - usually divided into 3 meals

Example – You Try
- Wt 80 kg x 0.5 = ___ units of insulin/day
- Basal dose: _____ units
  - Glargine _____ units QD
  - NPH/Detemir _____ BID
- Bolus dose: _____ units
  - _____ units NovoLog, Apidra
  - Humalog each meal

Poll Question - 5
- What is the bolus dose each meal?
  a. 5 units
  b. 8 units
  c. 6-7 units
  d. Not sure
Nancy - 78 yr old on 4 injections a day
- A1c 9.3%, BMI 27 – Wt 70kg
- BG levels consistently above 200
- Checks BG 3-4 xs a day, keeps log.
- Pt starting to have dementia, husband primary care giver
- Insulin dose:
  - 5 units Apidra at each meal
  - 6 units Lantus at bedtime

Based on Body Wt of 70 kg
- Calculate insulin needs
  - 70 x 0.5 = 35 units a day
  - ½ Basal = 18 units
  - ¼ bolus = 17 / 3 meals – 6 break 6 lunch 5 dinner
- Other issues
  - In am, pt injects insulin at 6am and eats at 8am
  - Rest of day, pt takes insulin after meals
  - Husband needs to assist with all BG checks, logs and insulin administration
  - Husband tells you, BG is often above 200 and I don’t know how to adjust insulin. MD just says to increase.

Assessment
- Given situation, is this a realistic plan or is it too intensive?
- Keep things safe and don’t make too many changes at once.
- Pt’s husband needs framework to adjust insulin based on BG levels.
- When leaving, husband mentions that the Apidra and Lantus are very expensive. They are having difficulty affording it.
- Husband is getting tired.
Plan

- What A1c and BG targets are realistic?
  - A1c < 8% (now 9.3%): Want to drop BG by 40 points
  - BG premeal 100-140, post meal <180
  - Keep checking BG 3-4 times a day
  - Give Apidra 5 units plus supplemental scale BEFORE each meal
  - TIE – Test, Inject and Eat within 5 mins of injecting insulin
  - Continue 6 units Lantus at night
  - Call with glucose results in one week

Apidra Scale

- Apidra Scale

After One Week

Blood Sugar Log

<table>
<thead>
<tr>
<th>Date</th>
<th>Goal</th>
<th>Goal</th>
<th>Goal</th>
<th>Goal</th>
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<tbody>
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<td>2/17</td>
<td>200</td>
<td>5%</td>
<td>200</td>
<td>5%</td>
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<td>2/18</td>
<td>229</td>
<td>7%</td>
<td>257</td>
<td>9%</td>
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<tr>
<td>2/19</td>
<td>164</td>
<td>6%</td>
<td>355</td>
<td>10%</td>
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<td>2/20</td>
<td>155</td>
<td>10%</td>
<td>220</td>
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<td>2/21</td>
<td>120</td>
<td>7%</td>
<td>115</td>
<td>9%</td>
</tr>
<tr>
<td>2/22</td>
<td>205</td>
<td>5%</td>
<td>120</td>
<td>7%</td>
</tr>
<tr>
<td>2/23</td>
<td>205</td>
<td>5%</td>
<td>120</td>
<td>7%</td>
</tr>
<tr>
<td>2/24</td>
<td>163</td>
<td>6%</td>
<td>141</td>
<td>7%</td>
</tr>
<tr>
<td>2/25</td>
<td>126</td>
<td>7%</td>
<td>120</td>
<td>7%</td>
</tr>
<tr>
<td>2/26</td>
<td>83</td>
<td>6%</td>
<td>120</td>
<td>7%</td>
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<tr>
<td>2/27</td>
<td>120</td>
<td>7%</td>
<td>120</td>
<td>7%</td>
</tr>
</tbody>
</table>
**Recommendations**

- Increase Apidra to 6 units at breakfast and lunch.
- Increase Lantus to 8 units at hs
- Check back in one week
- Consider changing to 70/30 insulin
- Calculating 70/30
  - Add up TOTAL insulin she takes a day ~ 30 units
  - Compare to weight calculation $70 \times 0.5 = 35$ units/day
  - Start conservative – 30 units
    - 2/3 am 20 units (14 basal + 6 bolus)
    - 1/3 before dinner 10 units (7 basal +3 bolus)
    - Gradually increase to get to target

**Poll question 6**

What best describes 70/30 insulin?

A. 70 percent bolus, 30 percent basal
- B. 70 percent analog, 30 percent bolus
- C. 70 percent basal, 30 percent aerosolized
- D. 70 percent basal, 30 percent bolus
- E. Not sure

**Combo Sub-Q Insulin**

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

**Considerations:**
- Pre-mixed, difficult to fine tune therapy
Type 1 for 30 Years – On injections
Lantus and Humalog

- Rob weighs 80kg, BMI 23
- Insulin dosing
- Lantus 22 units AM
- Humalog
  - Before breakfast 9-14 units
  - Lunch 2-4 units
  - Dinner 2-6 units
  - Bedtime 1-2 units if > 200

2. Not keeping any type of log
3. Not counting carbs – just ballparking
4. A1c 6.7 – no Endo

Type 1 for 30 Years – 80kg

- Based on wt, dose of insulin?
- Total daily dose -80 x 0.5 = 40 units/day
  - Basal dose 50% = 20 units a day
  - Bolus dose 50% = 20 units/3 meals = 7 + 6 + 6
- Current dose (total = 26) “Adjusted”
  - 14 breakfast 10 units
  - 4 lunch 4 units
  - 4 -6 dinner 4 units

1. Adjusts insulin down if active at work
2. Starts to feel hypo around 60-70
3. Doesn’t always have snacks

Plan – Keep BG log for 1 week
Prevent Hypos as much as possible

Day before app, wife got results off of meter and wrote them down. Wife also circled numbers she was concerned about.
Type 1 for 30 Years – On injections
Lantus and Humalog (6 x’s a day)

- Rob weighs 80kg, BMI 23
- Insulin dosing
  - Lantus 22 units AM
  - Humalog
    - Before breakfast 9-14 units
      - 2 hrs post breakfast 2 more units (based on BG)
    - Lunch 2-4 units
    - Dinner 2-6 units
      - 2 hours after lunch, 2-4 more units (based on BG)
    - Bedtime 1-2 units if > 200

Worried about getting complications

Plan

- Keep detailed log for one wk, include insulin dose and carbs eaten
- Decrease Lantus to 18 units in am
- Try not to stack humalog (take extra after meal)
- Try to carb count
  - Breakfast - 1 unit for every 10gm
  - Lunch/dinner – 1 unit for every 15 gms
- When BG < 70, don’t wait – treat

Bolus Basics

- Carbohydrate/Prandial Coverage
  - Match the insulin to the carbohydrates
  - 1 unit for 10 - 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
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?

Carbohydrate Ratio How does that work?
Rapid/Fast Acting Insulin

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<tr>
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<td>6</td>
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<tr>
<td>7</td>
<td>70 gms cho</td>
<td>7 units</td>
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</table>

Blood Glucose 165mg/dl

- Breakfast (70 gms cho)
- Rice Chex (60 gms)
- Milk (12 gms)
- Black coffee

Carb coverage
1 unit for every 10 gms
Outcomes

- Keep detailed log for one wk, include insulin dose and carbs eaten - success
- Decrease Lantus to 18 units in am - success
- Try not to stack humalog, just take before meals and try to carb count – success
- Count carbs – some success – Refer to RD
- When BG < 70, don’t wait, treat. Needs work

Next Steps

- Put alarm on phone to eat snack at 9am.
- If drinking, 15gms carb for every drink. May need to decrease insulin coverage (be conservative)
- Consider insulin pump, CGM and downloading glucose results
- When BG above 130 premeal, add correction bolus (1700 rule) – 1 unit for every 45 above target
- Return visit in 3-6 months

More detailed Insulin Plan – Clarify correction scale

Carb ratio:
- 1 unit for every 10 gms at breakfast
- 1 unit for every 15gm at lunch and dinner

Insulin Sensitivity Calculation:
- 1700 Rule
  - 1700 / Total Daily Dose = insulin sensitivity
  - 1700 / 40 = 43 (42.5)
  - 1 unit drops BG 45 points – “Correction”
- Carb coverage plus correction = total mealtime bolus dose
Poll question 7

- If Robs BG is 68 before eating, what is the best insulin adjustment strategy?
- A. Take bolus insulin ½ hour after eating
- B. Reduce usual bolus insulin dose by 1 unit
- C. Eat 30 gms of carb, then eat meal
- D. Decrease pm basal

Correction Bolus for Rob

<table>
<thead>
<tr>
<th>Analog Insulin (1 unit:45 mg/dl-130)</th>
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<td>Less than 70 mg/dl</td>
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<td>221-265 mg/dl</td>
</tr>
<tr>
<td>266-310 mg/dl</td>
</tr>
<tr>
<td>311-356 mg/dl</td>
</tr>
</tbody>
</table>

Adjusting Robs Bolus Insulin With Ratios

Rob plans to eat 70 gms of carbohydrate, BG before breakfast 165.

Carb coverage: 70gms / 10 = 7 units insulin
Correction Scale - 165-130 = 35 over target – 1 unit
- 7 units bolus insulin to cover carbs in meal
- 1 units bolus insulin to correct to target

Total adjusted dose: 8 units humalog insulin
Adjusting Robs Bolus Insulin With Ratios - You Try

BG before breakfast 175, plans to eat 80 gms of carbohydrate.
____ - 130 = ____ over target, ____/45 = ____ units
____ gms / ____ = ____ units insulin for carbs
• ____ units insulin to correct for hyperglycemia
• ____ units insulin to cover carbs in meal
Total adjusted dose: ____ units novolog insulin

Based on Mr R’s clinical picture – In hospital

How Much Insulin Needed?
• Creatinine 1.6
• 76 years old
• Not very hungry
• BMI 21
• Weighs 80 kg
• Glucotrol 5 mg at home
• A1c 7.2%

Calculate Daily Insulin Needs
• Based on unique characteristics of pt, where would you start?
  • Body wt in Kg x ________ = total daily dose
  • May need more or less based on clinical presentation

Less 0.3 u/kg 0.5 u/kg More 1.0 u/kg

Thin, elderly, creat Heavy, infection, steroids
Calculate Insulin Needs
Basal/insulin carb/correct

- Body wt in Kg x 0.3
- 80 kg x 0.3 = 24 units daily

- Basal = 12 units
- Bolus = 12 units / 3 meals = 4 units each meal
- What if he is nauseated?

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

<table>
<thead>
<tr>
<th>U-100 syringe</th>
<th>Fill a U-100 syringe up to this marking</th>
<th>Fill a U-500 syringe up to this marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>5</td>
<td>0.05</td>
</tr>
<tr>
<td>75</td>
<td>15</td>
<td>0.15</td>
</tr>
<tr>
<td>125</td>
<td>25</td>
<td>0.2</td>
</tr>
<tr>
<td>175</td>
<td>35</td>
<td>0.3</td>
</tr>
<tr>
<td>225</td>
<td>45</td>
<td>0.4</td>
</tr>
<tr>
<td>275</td>
<td>50</td>
<td>0.5</td>
</tr>
<tr>
<td>325</td>
<td>60</td>
<td>0.6</td>
</tr>
<tr>
<td>375</td>
<td>70</td>
<td>0.7</td>
</tr>
<tr>
<td>425</td>
<td>80</td>
<td>0.8</td>
</tr>
<tr>
<td>475</td>
<td>90</td>
<td>0.9</td>
</tr>
<tr>
<td>500</td>
<td>100</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Convert Pt from u-100 to u-500

- Pt currently on a total dose of 250 units a day
  - 250/5 = 50 units a day
  - 2/3 in am = 30 units u500
  - 1/3 in pm = 20 units u500
- Pt currently on a total dose of 300 units a day
  - 300/5 =
  - 2/3 in am =
  - 1/3 in pm =

Poll question 8

- Pt on 300 units of u-100 insulin a day. Which is an accurate conversion to u-500.
  - A. Take 60 units once daily
  - B. Take 30 units daily
  - C. Take 24 units am and 36 pm
  - D. Take 36 units am and 24 units pm
Thank You

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