Starting and Titrating Insulin in Type 2 Diabetes

Objectives

- Describe types of insulin
- Describe common insulin regimens
- Describe methods to start and titrate insulin
History of Insulin

1921: Frederick Banting and Charles Best discover insulin Toronto, Canada.

http://www.joslin.org/info/History of Insulin.html
http://www.accessdata.fda.gov/Scripts/cder/DrugsatFDA

Clinical Indicators for Insulin in Type 2 Diabetes

Initiate if one or more of the following:

- A1C ≥ 12% and/or fasting or postmeal BG ≥ 350
- Clinically unstable because of hyperglycemia or metabolic decompensation (eg. Moderate to large ketones or dehydration)

Background + all meals preferred
Premixed acceptable

Guide to Starting and Adjusting Insulin for Type 2 Diabetes, IDC © 2015
IDC Practice Guidelines 2015

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Clinical Indicators for Insulin in Type 2 Diabetes

Consider initiating if one or more of the following*

- Clinically stable but BG above target and medical need for rapid glucose control (Pre- or post-surgery, infection or steroid induced hyperglycemia)
- A1C and/or BG above target for more than 3 months and on max effective dose of at least one noninsulin therapy

* If clinically stable and high intake of sweetened beverages (>36 oz or 3 cans/day), eliminate sweetened beverages and re-evaluate need for insulin in 1-2 weeks

Patient-Friendly Natural History

1. No diabetes
   Your pancreas works well and makes enough insulin.

2. Prediabetes
   Your pancreas works harder to make more insulin. This typically occurs 10 to 20 years before diabetes starts.

3. Diabetes
   Your pancreas can’t make enough insulin.

4. Diabetes progressing
   Your pancreas keeps trying to make insulin, but wears out. This occurs 5 to 15 years after diabetes starts.
Video: Meet Gordon

Patient Concerns

- Injections (shots)
- Diabetes more serious
- Complicated
- Weight Gain
- Hypoglycemia
- Cost

What about provider concerns?


IDC Patient Discussion Guide

- Takes positive approach
- Helps patient identify if insulin is needed
- Reviews risk for complications and natural history of diabetes
- Includes list of common concerns
- Helps plan for next steps

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IDC Health Professional Guide

- Insulin regimen options
- Starting dose calculations
- Insulin types and action times
- Nutrition strategies
- Monitoring BG
- Titration

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Primary Care Approach to Insulin

Guide to Starting and Adjusting Insulin for Type 2 Diabetes

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PRACTICAL INSULIN

© 2011 American Diabetes Association

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Normal Insulin Secretion

Mealtime (bolus) insulin needs ~ 50%

Background (Basal) Insulin Needs ~ 50%

Kruszynska et al. Diabetologia 30: 16-21, 1987

Background Insulin

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>2-4 hrs</td>
<td>4-8 hrs</td>
<td>10-16 hrs</td>
</tr>
<tr>
<td>Long-acting</td>
<td>2 hrs</td>
<td>No significant peak</td>
<td>Up to 24 hrs</td>
</tr>
<tr>
<td>Long-acting</td>
<td>Develops over 6 hrs</td>
<td>No peak</td>
<td>24 hrs or longer</td>
</tr>
<tr>
<td>Concentrated</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Intermediate: Humulin® N NPH
Novolin® N
ReliOn® N

Long Acting (LA): Detemir® (Levemir)
Glargine® U-100 (Lantus)

Long-acting Concentrated: Glargine U300 (Toujeo)

Bergenstal International Textbook of Diabetes Mellitus
Vol 1. 3rd Ed 2004:995-1015

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**Mealtime Insulin**

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid</td>
<td>15 min</td>
<td>1-2 hrs</td>
<td>3-4 hrs</td>
</tr>
<tr>
<td>Rapid Inhaled</td>
<td>5-15 min</td>
<td>45-75 min</td>
<td>2-3 hrs</td>
</tr>
<tr>
<td>Short</td>
<td>30-45 min</td>
<td>2-3 hrs</td>
<td>4-8 hrs</td>
</tr>
</tbody>
</table>

Rapid-acting (RA): Aspart (Novolog), Glulisine (Apidra), Lispro (Humalog), Inhaled insulin (Afrezza)

**Premixed Insulin**

- **Humalog Mix 75/25**
- **Humalog Mix 50/50**
- **NovoLog Mix 70/30**
- **Premixed with Rapid-acting**
- **Premixed with Regular**

<table>
<thead>
<tr>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Rapid-Acting</td>
<td>15 min.</td>
<td>1-2 hrs / Some increase at 4-8 hrs</td>
</tr>
<tr>
<td>With Regular</td>
<td>30-45 min.</td>
<td>2-3 / 4-8 hrs</td>
</tr>
</tbody>
</table>

Hirsch, NEJM, 352:2, 2005

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6 Steps to Starting and Adjusting Insulin

1. Select initial regimen
2. Calculate starting insulin dose
3. Address non-insulin therapy when starting insulin
4. Explain hypoglycemia risk and treatment
5. Provide nutrition guidelines
6. Adjust insulin based on BG monitoring data

Insulin Regimens

1 injection per day
- Background

2-3 injections per day
- Background plus 1 or 2 meals
- Premixed
- Background plus GLP-1 agonist

3-4+ injections per day
- Background plus all meals
- U500
### Selecting an Initial Insulin Regimen (Step 1)

<table>
<thead>
<tr>
<th>Insulin Regimens</th>
<th>Clinical Considerations</th>
<th>Patient Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background (basal)</td>
<td>• BG: Fasting elevated</td>
<td>• Simple regimen desired</td>
</tr>
<tr>
<td></td>
<td>• Postmeal reasonably controlled</td>
<td>• Patient overwhelmed</td>
</tr>
<tr>
<td></td>
<td>• A1C within 2% points of target</td>
<td></td>
</tr>
<tr>
<td>Background + Mealtime (bolus)</td>
<td>• BG: Fasting elevated</td>
<td>• Gradual approach to all meal regimen if needed</td>
</tr>
<tr>
<td>1 or 2 meals</td>
<td>• Postmeal - at least 1 elevated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use as initial start or transition from background only</td>
<td></td>
</tr>
<tr>
<td>Background + Mealtime (bolus) All</td>
<td>• BG: Fasting elevated</td>
<td>• Desires tight control</td>
</tr>
<tr>
<td>meals</td>
<td>• Postmeal- most elevated</td>
<td>• Desires flexibility</td>
</tr>
<tr>
<td></td>
<td>• Opposed to more than 2 injections per day</td>
<td>• Snacks may require injection</td>
</tr>
<tr>
<td>Premixed</td>
<td>• BG: Fasting elevated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Postmeal- most elevated</td>
<td>• Consistent mealtimes and carb intake</td>
</tr>
</tbody>
</table>

Guide to Starting and Adjusting Insulin for Type 2 Diabetes © 2015

### Starting Background Insulin in Type 2 Diabetes

- **Metformin / Sensitizers**
- **Incretin therapies**

![Graph showing insulin levels and BG testing](image)

- **Titrating dose based on fasting**
- **BG Testing:** fasting each morning (minimum)

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Starting Background Insulin  (Step 2)

<table>
<thead>
<tr>
<th>Background Insulin</th>
<th>A1C &lt;9%</th>
<th>A1C ≥9%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 units/kg/day (or 10 units)</td>
<td>0.2 units/kg/day (or 20 units)</td>
</tr>
</tbody>
</table>

- Evening dose preferred
- Start with single dose of background
  - Detemir (Levemir)
  - Glargine (Lantus)
  - Glargine U-300 (Toujeo)

If cost concerns: Intermediate-acting insulin NPH at bedtime

Address Noninsulin Therapy: Starting Insulin  (Step 3)

- Start or maintain metformin unless contraindicated
- If taking sulfonylurea (SU), discontinue when starting any insulin regimen
  
  Add another 0.1 units/kg/day to starting background dose
  
  May titrate insulin more rapidly
- Discontinue or decrease dose of TZD
- If patient experiencing positive response, consider maintaining
  - GLP-1 agonist
  - DPP-4 inhibitor
  - SGLT2 inhibitor

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Practice Calculating Background Dose

Patient: John 200 lbs, A1C 8.7% On metformin

- Weight in pounds ÷ 2.2 = Weight in kg
  - 200 lbs. ÷ 2.2 = 91 kg

- Calculate dose using current A1C
  - A1C is < 9%, so multiply 91kg x 0.1 = 9 units

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Brkfst</th>
<th>Lunch</th>
<th>Evening</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glargine</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Continue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Provide Nutrition Guidelines: (Step 5)
Background Insulin Only

<table>
<thead>
<tr>
<th>Meals</th>
<th>Snacks</th>
</tr>
</thead>
</table>
| Background Insulin | Aim for 3 meals per day:  
  - Women 2-4 carb choices per meal  
  - Men 3-5 carb choices per meal*  
| *Not needed  
  - If desired, should be small; 1-2 carb choices per snack |

*One carb choice = 15 grams of carbohydrate
Titrating Background Insulin: (Step 6)
Look at Fasting BG

If more than half fasting BG:

≥ 200 mg/dL
• increase total daily dose 0.1 units/kg per day until more than half fasting BG < 200 mg/dL

< 200 mg/dL
• Use titration table (table 2 on adjustment guide)
• Consider dosing at a different (consistent) time based on BG patterns or if patient missing injections
• Avoid splitting dose; commits patient to additional injection

Adjust 1-2 times per week

Which Glucose Levels are Out of Target?

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Evening Meal</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Med</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Mon</td>
<td>265</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tue</td>
<td>244</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wed</td>
<td>254</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thur</td>
<td>229</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weight: 91 kg
Background Insulin Titration

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Evening Meal</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Med</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>Mon</td>
<td>265</td>
<td></td>
<td></td>
<td>9 LA</td>
</tr>
<tr>
<td>Tue</td>
<td>244</td>
<td></td>
<td>200</td>
<td>220</td>
</tr>
<tr>
<td>Wed</td>
<td>254</td>
<td></td>
<td></td>
<td>9 LA</td>
</tr>
<tr>
<td>Thur</td>
<td>229</td>
<td></td>
<td>198</td>
<td>210</td>
</tr>
</tbody>
</table>

Additional Insulin needed: weight: 91 kg x 0.1 = 9 units

Split the Background Insulin Dose?

What is the evidence?

Type 1

- 15% had plasma glargine levels waning at the end of 24 hours; no difference in hypoglycemia in daily vs BID dosing
- Once daily Detemir found to be non-inferior to BID detemir (no significant difference in A1C)

Type 2

- No evidence, only anecdotal reports

Ashwell et al Diabet Med 23(8) 2006
Lefloch et al Diabetes Care 32(1), 2009

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**When to Consider Mealtime Insulin or GLP-1 Agonist  (Step 6)**

- If total daily dose (TDD) reaches 0.6 units/kg and glycemic targets not met
- Pattern of bedtime to breakfast drop of more than 50 mg/dL as a result of too high background insulin dose

**Background Insulin + GLP-1  (Table 3)**

If adding GLP-1 instead of starting mealtime insulin

- If A1C:
  - \( \leq 8\% \) ➔ reduce background dose by 20%
  - \( > 8\% \) ➔ maintain current background dose
Background + 1 Mealtime vs Premixed

Benefits of Background + 1 Mealtime
- Still 2 injections
- Less risk of hypoglycemia
- Can titrate both insulins separately
- More meal time flexibility

But 2 Copays (vs 1 with premixed)

How to Add 1 or 2 Mealtime Doses (Table 3)

Calculating initial mealtime dose
- 10% of background dose
- Give at 1 or 2 meals
- Subtract from background dose
- Add mealtime insulin at largest meal or highest post-meal BG

Example:
Background dose: 50 unit
Meal dose calculation:
\[ 50 \times 0.1 = 5 \text{ units} \]
New background dose: 45 units
Largest Meal vs. Highest Post Meal BG

ExtraSTEP = highest post meal BG
SimpleSTEP = largest meal

Both groups:
- Started with 4 units per meal
- Equal A1C reduction at 48 wks

Which Glucose Levels are Out of Target?

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Evening Meal</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Med</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Mon</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tue</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wed</td>
<td>109</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thur</td>
<td>128</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Adding One Mealtime Dose

<table>
<thead>
<tr>
<th></th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Evening Meal</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Med</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Mon</td>
<td>121</td>
<td>131</td>
<td>114</td>
<td>227</td>
</tr>
<tr>
<td>Tue</td>
<td>113</td>
<td>120</td>
<td>216</td>
<td>50 LA</td>
</tr>
<tr>
<td>Wed</td>
<td>109</td>
<td>111</td>
<td>106</td>
<td>234</td>
</tr>
<tr>
<td>Thur</td>
<td>128</td>
<td>5 RA</td>
<td>117</td>
<td>189</td>
</tr>
<tr>
<td>Fri</td>
<td>132</td>
<td>112</td>
<td>120</td>
<td>5 RA</td>
</tr>
</tbody>
</table>

Stepwise Addition of Bolus Insulin

- Basal
- Stepped Prandial
  - Add prandial insulin at main meal
- Further intensification
- Intensification
- Insulin initiation

Lifestyle changes and Metformin

Leahy, Endocrinol Met Clinics N Am, 2012
Starting Background and Mealtime All Meals

**Metformin / Sensitizers**

**Incretin therapies**

**BG Testing:**
- Fasting: Before all meals
- 1-2 hrs after at least one meal

Starting Background + Mealtime: All meals (Step 2)

<table>
<thead>
<tr>
<th>A1C &lt;9%</th>
<th>A1C ≥9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background &amp; Mealtime Insulin</td>
<td>0.1 units/kg background (or 10 units)</td>
</tr>
<tr>
<td>AND</td>
<td>AND</td>
</tr>
<tr>
<td>0.1 units/kg mealtime, distributed ⅓ per meal (or 3-4 units per meal)</td>
<td>0.2 units/kg mealtime, distributed ⅓ per meal (or 6-7 units per meal)</td>
</tr>
<tr>
<td>Total 0.2 units/kg/day</td>
<td>Total 0.4 units/kg/day</td>
</tr>
</tbody>
</table>

- Divide 50% background, 50% mealtime
- Divide mealtime dose between 3 meals
Calculating Background/Mealtime Dose

Patient: Weight 230 lbs (105 kg)  A1C 9.5%

- Calculate Background dose  \((A1C \geq 9\%, \text{ kg } \times 0.2)\)
  \[105 \times 0.2 = 21 \text{ units}\]

- Calculate Mealtime dose  \((A1C \geq 9\%, \text{ kg } \times 0.2)\)
  \[105 \times 0.2 = 21 \text{ units} \text{ divided between 3 meals}\]

Distributing Mealtime Dose: Fixed Dose

Total mealtime dose = 21 units

1/3 per meal: no known information on meal size or carbs

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Brkfst</th>
<th>Lunch</th>
<th>Evening</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mealtime</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

Meal size or carbs known, small breakfast, large evening meal

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Brkfst</th>
<th>Lunch</th>
<th>Evening</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mealtime</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Background</td>
<td></td>
<td></td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>
Provide Nutrition Guidelines: (Step 5) Background and Mealtime

<table>
<thead>
<tr>
<th></th>
<th>Meals</th>
<th>Snacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background &amp; Mealtime</td>
<td>Initially consistent carb If appropriate, advance to insulin-to-carb ratio</td>
<td>Not needed If greater than 1 carb choice, may need additional injection</td>
</tr>
</tbody>
</table>

*One carb choice = 15 grams of carbohydrate

Adding All Meal Coverage (Table 3) (From background, background + 1 or background + 2)

- Calculate current total daily dose:
  (include all background and any mealtime insulin)
- Redistribute
  50% background
  50% mealtime (divided between meals)
- Next future dose increase: If more than 50% BG ≥ 200,
  Increase Total Daily Dose by 0.1 units/kg
  Divide between background and mealtime doses

IDC Clinical Guidelines 2015
Example: Adding All Meal Coverage to Background Weight 220# = 100 kg

- Determine current units/kg/day (TDD)
  Background insulin: 60 units or 0.6 u/kg/day

- Distribute 50% background/50% mealtime
  30 units background insulin
  30 units mealtime insulin distributed across 3 meals

Titrating Background & Mealtime: (Step 6)

If more than half of BG

\[ \geq 200 \text{ mg/dL} \]
- increase total daily dose 0.1 units/kg per day
- Add half to background, distribute remaining half equally among meals

\[ < 200 \text{ mg/dL} \]
- Use titration table (table 2 on adjustment guide)

Adjust 1-2 times per week
ADA Approach to Starting and Adjusting Insulin in Type 2 Diabetes

Starting Premixed with Rapid-Acting Insulin Regimen

Humalog Mix 75/25 or NovoLog Mix 70/30

Metformin / Sensitizers

Incretin therapies

BG Fasting and pre-dinner BG every day
Testing: Consider before midday meal and bedtime occasionally

When to use Premixed with Regular?
Starting Premixed Insulin (Step 2)

<table>
<thead>
<tr>
<th>Premixed Insulin Dose</th>
<th>A1C &lt;9%</th>
<th>A1C ≥ 9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 units/kg before breakfast (or 10 units)</td>
<td>0.2 units/kg before breakfast (or 20 units)</td>
<td></td>
</tr>
<tr>
<td>0.1 units/kg before evening meal (or 10 units)</td>
<td>0.2 units/kg before evening meal (or 20 units)</td>
<td></td>
</tr>
<tr>
<td>Total 0.2 units/kg/ day</td>
<td>Total 0.4 units/kg/ day</td>
<td></td>
</tr>
</tbody>
</table>

- Start with two doses; before breakfast and dinner
- Stop sulfonylurea, assess other noninsulin therapies

Practice Calculating Premixed Dose

Patient: Weight 200 lbs (91kg) A1C 8.2%

- Calculate dose  (A1C < 9%; kg x 0.1)
  
  \[ 91 \text{ kg} \times 0.1 = 9 \text{ units} \]

- Give this dose twice per day

<table>
<thead>
<tr>
<th>Insulin</th>
<th>Brkfst</th>
<th>Lunch</th>
<th>Evening</th>
<th>HS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premixed</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Provide Nutrition Guidelines: (Step 5) Premixed Insulin

<table>
<thead>
<tr>
<th>Meals</th>
<th>Snacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premixed</td>
<td>• Eat 3 meals at consistent times with consistent carb</td>
</tr>
<tr>
<td></td>
<td>• Do not skip meals</td>
</tr>
<tr>
<td></td>
<td>• No more than 10-12 hours between breakfast and evening meal</td>
</tr>
<tr>
<td></td>
<td>• Rapid-Acting: Usually not needed. If desired, should be small; 1-2 carb choices</td>
</tr>
<tr>
<td></td>
<td>• Regular: May need small snacks</td>
</tr>
</tbody>
</table>

*One carb choice = 15 grams of carbohydrate

Titrating Premixed Insulin (Step 6)

If more than half BG:

≥ 200, increase total daily dose by 0.1 units/kg
   Distribute equally between doses

< 200, but not in target, use titration table (table 2) to adjust out of target values

Adjust 1-2 times per week
Severe Insulin Resistance

- Requiring > 2 units/kg/day of U100
  Or
- Requiring > 200 units per day (U100)

Contains 500 units of insulin/ml
5x more concentrated than Humulin R U-100

At Park Nicollet: Patients seen by Endocrinologist
Segal et al. Am J Health-System Pharm, 2010

U-500 Concentrated Insulin

<table>
<thead>
<tr>
<th>Type of insulin</th>
<th>Regular (Eli Lilly Co)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin action profile</td>
<td>Acts like Regular and NPH</td>
</tr>
<tr>
<td></td>
<td>Onset within 30 min</td>
</tr>
<tr>
<td></td>
<td>Lasts up to 24 hours from one dose</td>
</tr>
<tr>
<td>Vial only (no pen)</td>
<td>20 ml/vial (Stable 40 days after opening)</td>
</tr>
<tr>
<td>Number of shots/day</td>
<td>2-4 shots/day</td>
</tr>
</tbody>
</table>

Differentiators
- Gray cap
- Larger bottle
- Red warning label
- Striped box

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Benefits and Barriers to Using U500

**Benefits**
- Fewer injections
- Smaller volume
- Less hypoglycemia after titration
- Improved glycemic control
- Improved quality of life

**Barriers**
- Confusion with dosing
- Confusion with syringe
- Inexperience of providers/educators
- Weight gain
- More hypoglycemia before dose titration

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**Insulin Pumps**

- **Accuchek Combo**
- **Animas One Touch Ping**
- **Animas Vibe**
- **Medtronic 530G**
- **TSlim**
- **Insulet Omnipod**

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Insulin Pumps, aka continuous subcutaneous insulin infusion (CSII)

- Rapid-acting insulin for both bolus (meal-time) and basal (background)
- Battery operated
- Disposable reservoir or pod (2-3 days insulin)
- Disposable infusion set, includes a cannula for subcutaneous infusion with or without tubing

Five Ways to Assess if the Pump is Functioning:

1. The pump is turned on.
2. It contains insulin (open door to see cartridge).
3. The needle is in the skin and the site is not leaking.
4. The tubing is not leaking.
5. The infusion site looks clean with no blood backed up in the line.

Resource: Call the 1-800 number located on the back of pump for customer service 24 hours/day.
Continuous Glucose Monitoring (CGM)

- Highlights patterns and BG trends
- Need to verify BG with at least 2 fingerstick BG daily
- Currently not covered by Medicare

Titrating Insulin: Getting Better Glucose Data

- Look at the record book each time to emphasize importance of data
- Reinforce that 3-4 days of complete data is better than many days of sporadic readings
- Options for obtaining records
  - Fax glucose records or upload to the cloud
  - Call health support nurse/CDE with glucose readings

**Record Book Data**

<table>
<thead>
<tr>
<th>Date</th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Dinner</th>
<th>Bedtime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BG</td>
<td>Med</td>
<td>BG</td>
<td>Med</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Electronic Record Book: Verified Data**

<table>
<thead>
<tr>
<th>Date</th>
<th>No. of Readings</th>
<th>No. of Low BG</th>
<th>No. of High BG</th>
<th>No. of Med BG</th>
<th>No. of BG</th>
<th>No. of Med BG</th>
<th>No. of High BG</th>
<th>No. of Low BG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 1, 2005</td>
<td>948</td>
<td>218</td>
<td>294</td>
<td>285</td>
<td>966</td>
<td>224</td>
<td>303</td>
<td>282</td>
</tr>
<tr>
<td>Nov 2, 2005</td>
<td>948</td>
<td>218</td>
<td>294</td>
<td>285</td>
<td>966</td>
<td>224</td>
<td>303</td>
<td>282</td>
</tr>
<tr>
<td>Nov 3, 2005</td>
<td>948</td>
<td>218</td>
<td>294</td>
<td>285</td>
<td>966</td>
<td>224</td>
<td>303</td>
<td>282</td>
</tr>
<tr>
<td>Nov 4, 2005</td>
<td>948</td>
<td>218</td>
<td>294</td>
<td>285</td>
<td>966</td>
<td>224</td>
<td>303</td>
<td>282</td>
</tr>
</tbody>
</table>
### Starting vs. Final Insulin Dose

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Starting Dose (units)</th>
<th>Final Dose (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>220 lb (100 kg) A1C 9%</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Background Insulin</td>
<td>0.2 units/kg (20 units)</td>
<td>~0.5 units/kg (50 units)</td>
</tr>
<tr>
<td>Premixed Insulin</td>
<td>0.2 units/kg BID (40 units total)</td>
<td>1.0-1.2 units/kg (100-120 units)</td>
</tr>
<tr>
<td>Background &amp; Mealtime Insulin</td>
<td>0.2 units/kg background 0.2 units/kg mealtime</td>
<td>1.0-1.2 units/kg (100-120 units)</td>
</tr>
</tbody>
</table>
Ultimate / Typical Insulin Needs

Type 1:
- Adult with normal insulin sensitivity
  requires 0.7 units/kg/day
  Waldhausl, Diabetologia, 1986

Type 2:
- High dose insulin required often
- Average 1.2 units/kg/day - insulin only
- Average 1.0 units/kg/day - with Metformin
  Bergenstal, Diabetes Vol. 47, 1998

Questions?