This program is presented by The Whittier Institute for Diabetes, a subsidiary of Scripps Health. Since founded in 1982 the Whittier has played a significant leadership role in the scientific and medical battles against diabetes.

As one of the largest American Diabetes Association’s recognized patient education programs in the nation and winner of the 2005 NOVA Award by the American Hospital Association for Project Dulce, a community health program, The Whittier is on the front lines of treating patients with diabetes. As with all of The Whittier’s professional education programs this conference carries forth our mission to improve the quality of life for people with diabetes by developing programs that increase the level of diabetes knowledge among health care professionals.
Today’s presentation will be presented by Dr. Athena Philis-Tsimikas.

Dr. Athena Philis-Tsimikas is board certified in the subspecialty of Diabetes and Endocrinology is the Executive Director and Chief Medical Officer of The Whittier Institute for Diabetes located in La Jolla, CA, and an Associate Clinical Professor at the University of California, San Diego in the Division of Endocrinology/Diabetes and Metabolism.
Today’s presentation will also be presented by Susan LaRue.

Susan LaRue is an experienced diabetes educator with 25 years of direct patient contact, manager of the comprehensive insulin management program for patients and a certified insulin pump trainer for all the major pump companies and is the co-creator and Manager of the Professional Education Programs for The Whittier Institute for Diabetes.
Objectives

Using a case based approach participants at the completion of this program should be able to:

• Describe common concerns for both patient and health care professional about insulin therapy and how to overcome these barriers

• Determine when and how to initiate and titrate insulin for patients with type 2 diabetes

• Identify common “user errors” in insulin therapy.

• Explain how to calculate insulin boluses for meals and hyperglycemia

Using a case based approach from actual patients the objectives of this program are to:

Describe the common concerns both patient and health care professional experience when initiating insulin therapy some techniques to help overcome these barriers.

Determine when to initiate insulin therapy in type 2 diabetes and how to titrate insulin to help get and keep patients at target.

Common “user errors” in insulin therapy will be identified.

Formulas for calculating insulin boluses for meals and hyperglycemia will be explained.

1990

1999

2001

No data                      <4%                     4-6%                  6-8%                     8-10%                     > 10%

If we take the incidence of complications associated with diabetes this is what it looks like on a daily basis.

Every 24 Hours

- 4,100 new cases of diabetes
- 230 amputations in people with diabetes
- 120 people enter end stage kidney disease programs
- 55 people with diabetes go blind
The direct costs of diabetes are estimated at $92 billion in 2002, compared to $44 billion in 1997.

$40.3 billion was spent for inpatient hospital care and $13.8 billion for nursing home care for people with diabetes. Represents 19% of total personal health care expenditures in the U.S. However, diagnosed diabetes patients account for only 4.2% of the total U.S. population. Cardiovascular disease accounts for appx. 20% of the direct medical costs.

Cardiovascular disease is the most costly complication of diabetes, accounting for more than $17 billion of the $92 billion annual direct medical costs for diabetes in 2002.

Indirect costs include disability, work loss and premature mortality. In 2002, diabetes accounted for a loss of nearly 88 million disability days.
Where Are We?

-~30% of type 2 on insulin have A1C < 8%
-Harmel et al.

~20 to >40% have A1C > 9.5%
-NHANES/BRFSS; Harmel et al.; NCQA 2000

~40 to >50% have A1C > 8%
-NHANES/BRFSS; Harmel et al.

ADA: recommended target
<7

AACE/ACE: recommended target
<6.5

Upper limit of normal range
6

ADA. Diabetes Care 2003; 26(S1):S33-S50
ACE Consensus Conference on Guidelines for Glycemic Control. Endocrine Practice, 2002
State of Managed Care Quality. National Committee for Quality Assurance, 2000
Where Are We Going?

• Lifetime risks for developing diabetes
• Of individuals born in 2000
  – 32.8% of all males
  – 38.5% of all females
• Of Hispanic and African American individuals born in 2000
  – 45.4% of all males
  – 52.5% of all females
• Diagnosed at age 40
  – Men lose 11.6 life years
  – Women lose 14.3 life years

Venkat Narayan et al. JAMA, October 8, 2003-Vol.290, No.14
Maxine

- 52 year old Hispanic female
- Type 2 x 15 years
- 5’2” 200 lbs. (91 kg)  BMI 37 kg/m²
- A1C 9.7%
- Max orals (glipizide, metformin, TZD)
- HTN and dyslipidemia treated with meds

Recent data from the Centers for Disease Control and Prevention (CDC) show that Latinos develop diabetes at twice the rate of the general population. (www.diabetes.org Diabetes in the Latino Population.)
Question

• What is the next logical step in Maxine’s diabetes management plan?
  A. Counsel on need to improve glycemic control and give her 3 months to improve or you will start her on insulin.
  B. Refer for diabetes education
  C. Start insulin now
Answer

• What is the next logical step in Maxine’s diabetes management plan?
  A. Counsel on need to improve glycemic control and give her 3 months to improve or you will start her on insulin.
  B. Refer for diabetes education
  C. Start insulin now
## ADA: Glycemic Control, BP, and Lipid Targets in Type 2 Diabetes

<table>
<thead>
<tr>
<th>Glycemic control</th>
<th>Goal</th>
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<tbody>
<tr>
<td>Hemoglobin A₁c</td>
<td>&lt;7.0%*</td>
</tr>
<tr>
<td>Pre-prandial plasma glucose</td>
<td>90-130 mg/dL</td>
</tr>
<tr>
<td>Peak postprandial plasma glucose</td>
<td>&lt;180 mg/dL</td>
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</tbody>
</table>

| Blood pressure                                        | <130/80 mm Hg         |

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<th>Lipids</th>
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<tr>
<td>LDL-C</td>
<td>&lt;100 mg/dL</td>
</tr>
<tr>
<td>TG</td>
<td>&lt;150 mg/dL</td>
</tr>
<tr>
<td>HDL-C</td>
<td>&gt;40 mg/dL‡</td>
</tr>
</tbody>
</table>

*For individual patient A₁C as close to normal (<6%) as possible without significant hypo.
‡For women, an HDL-C goal 10 mg/dL higher may be appropriate.

We know that you know the essentials but let’s just take a moment to review these.
## Correlation Between A1C and Mean Plasma Glucose

<table>
<thead>
<tr>
<th>A1C(%)</th>
<th>Mean Plasma Glucose (mg/dL)</th>
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<tbody>
<tr>
<td>6</td>
<td>135</td>
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<td>7</td>
<td>170</td>
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*Diabetes Care 2006(suppl1): S11*
Many of your are very familiar with this slide which can be used to explain that many patients not at target did not achieve their goal because of “noncompliance” but rather this slide indicates that progressive beta cell failure is a natural course of this disease and many people will need insulin to compensate for this.

With this in mind Insulin should not be considered as a “last resort” therapy in type 2 diabetes when their control is not optimal and they are on maximum oral diabetes medications. This slide indicates that progressive beta cell failure is a natural course of this disease and many people will need insulin to compensate for this.
I’m sure we have all seen the resistance, reluctance and fear that most of our patients have expressed when we introduce the need to initiate insulin. This study supports those feelings our patients experience. They deny the need, “please just give me another 3 months and I will follow my diet, lost weight or whatever they feel they need to do to get their bg under control.” They are concerned about their relationship with you as the health care provider and do not want to alienate you or make you angry with them. They recognize that insulin is time consuming. They have all these feelings in addition to the fear of “the needle.”
Interesting enough this study also confirms that the health care professional seems to be experiencing those same feelings along with their patient. We keep hoping they will follow their diet, lose their weight, start exercising so we give them 3 more months. We certainly recognize that insulin management is time consuming and the rear of hypoglycemia is real. Many people express a fear of the needle but that does not seem to be a major obstacle for those getting Botox injections. I once heard that insulin resistance begins in the physician's office. Using insulin as a treatment option when oral agents or the patient have failed will make the transition to insulin more difficult for the patient. Recognizing that type 2 diabetes is a progressive disease may help alleviate this resistance on both our parts and that of the patient.
Question

• Which insulin choices might best meet Maxine’s basal requirements?
  A. NPH, Glargine (Lantus), Detemir (Le vemir), Premixed insulin
  B. Lente, Glargine, Detemir,
  C. Ultralente, Glargine, Detemir, Premixed
  D. Glargine, Regular, NPH, Aspart

From what you know about Maxine, which insulin choices would you choose to meet her basal requirements?
• Which insulin choices might best meet Maxine’s basal requirements?

A. NPH, Glargine (Lantus), Detemir (Levemir), Premixed insulin
B. Lente, Glargine, Detemir,
C. Ultralente, Glargine, Detemir, Premixed
D. Glargine, Regular, NPH, Aspart

A. Would be the best choices. Lente and Ultralents are no longer available and regular, NPH and Aspart are bolus insulins which are used to cover meals and correct a high blood glucose.
When on Max Oral Agents and Not at Target

- Start with a basal (background) insulin
  - Targets fasting glucose
  - Suppresses glucose production between meals and overnight
  - Provides 50% of daily needs
  - Nearly constant/background source of insulin

When your patient is on maximum orals and not at target introducing a basal insulin will target their fasting glucose, suppress the conversion of glycogen to glucose between meals and overnight when additional glucose is not needed. When on full insulin therapy a basal insulin provides about 50% of our daily insulin requirements. Choosing a basal insulin that provides nearly constant insulin will help to reduce some of the peaks and valleys of bg we often see.
This slide compares the profiles of the different human insulins and analogues. The rapid-acting analogues, Aspart, Glulisine and Lispro, have a more rapid onset of action and a shorter duration of action than regular human insulin. Thus, these analogues are more appropriate for countering a postprandial glycemic load than regular human insulin. All of the rapid-acting analogs have a rapid onset of action, produce peak effects within one hour, and have an effective duration of approximately 3-4 hours.

Compared with the rapid-acting analogs, regular insulin has a slower onset of action, a later peak effect, and a duration of approximately 8 hours although its effective duration is 3-6 hours.

NPH, an intermediate-acting insulin, has peak effects within 4-10 hours with a duration of approximately 12-20 hours.

Detemir and glargine, both basal insulin analogues, have an onset within 1-4 hours with a relatively flat profile and a duration of action up to 24 hours.

The action of any insulin may vary considerably in different individuals and at different times in the same individual. The insulin analogs have less variability.
People who take 2 injections of split-mixed or pre-mixed insulin will typically take approximately 2/3 of the total daily dose as the morning injection and 1/3 of the total daily dose with the evening meal.

One major advantage of taking split mixed insulin regimen is that they can provide basal and bolus insulin in 2 injections daily. This simpler approach of starting the patient on a split mixed at dinner and then adding a morning dose as needed can work well when initiating insulin therapy in type 2. Because it does not match the normal endogenous secretory pattern, shown in the shaded background, these type 2 diabetes patients may experience late morning or nocturnal hypoglycemia. As these problems arise you may need to switch the NPH to bedtime leaving the bolus insulin at dinner or move the patient on to a 24 hour basal and bolus doses at meals.
Question

• How much basal insulin to start?
  A.  5 to 10 units twice daily
  B.   0.1 units per kg daily
  C.  0.2 units per kg daily
  D. 0.5 units per kg daily
  E. 10 units daily
  F.  B or E
  G.  C or E

Looking at Maxine who is on maximum oral hyperglycemic agents, obese with a BMI of 37 and her A1C is 9.7% which approach or approaches would you chose to calculate her starting insulin dose?
Answer

• How much basal insulin to start?
  A. 5 to 10 units twice daily
  B. 0.1 units per kg daily
  C. 0.2 units per kg daily
  D. 0.5 units per kg daily
  E. 10 units daily
  F. B or E
  G. C or E

G. Is the correct choice. You have the option of either starting her on 0.2 units per kg or 10 units daily.
Question

- How will you adjust the basal?
  A. Ask Maxine to check her blood sugars daily and return in 3 months
  B. Check her A1C in one month and use this to adjust insulin
  C. Teach Maxine how to adjust her own insulin
  D. Call you daily for instruction

What approach would you choose to titrate Maxine’s insulin?
Answer

- How will you adjust the basal?
  A. Ask Maxine to check her blood sugars daily and return in 3 months
  B. Check her A1C in one month and use this to adjust insulin
  C. Teach Maxine how to adjust her own insulin
  D. Call you daily for instruction

C. Is the best choice. Titration of insulin is extremely important. Most patients will require a higher insulin dose than their starting dose. Learning how to titrate their own insulin and giving them the tools to do this can help to put them in charge of their own diabetes. It will also be important to schedule follow up by phone (usually in about 3 days) and then an appointment in about 2 weeks to help guide them in this process.
When initiating a basal insulin for Maxine you will want to continue her on her oral glycemic agents as she will need the additional support they provide.

Starting a basal insulin at 10 units daily can be one choice that is often used. With an A1C of 9.7% and 91 kg, you could start Maxine out with 0.2 units/kg which would be 18 units of detemir, glargine or NPH. NPH because it is an intermediate acting insulin is usually started at bedtime rather than dinner to reduce the risk of hypoglycemia occurring overnight.

Detemir is recommended at evening meal or bedtime but considering the person’s lifestyle you can consider giving it a different time. The importance of glargine dosing is that it be given every 24 hours.

By having Maxine check her fasting blood glucose daily she can use these guidelines to titrate her own insulin weekly based on her average fasting glucose level with a target usually around 100 mg/dL. As an alternate approach might be to start Maxine on a premixed insulin formulation at dinner.
A third option would be to start at either of the previous basal starting doses and teach Maxine to titrate one unit daily until her set target is reached. This helps the patient to feel like they are actively treating their “own” diabetes… taking ownership. Whichever approach you choose remember that when the person with diabetes is taking an injection every day they will expect to see improvement in their diabetes. By teaching them how to titrate their own insulin allows this to happen rather than waiting for a follow up visit with you in the not so near future. Whichever approach you use always remember that adjusting for hypoglycemia takes precedence over any other adjustment.
If only initiating insulin therapy was as easy as calculating the dose. Once everyone is ready, we’ve calculated the dose, considered the patients lifestyle in choosing the insulin and the most appropriate time to administer the insulin, we need to then give the patient clear and concise instructions on how to titrate their own insulin. They need to be very clear about the causes, symptoms and treatment for hypoglycemia because once they start experiencing hypoglycemia they may become quite reluctant to tightly control their bg levels. And if this isn’t enough let’s see what else we need to consider when initiating insulin if we want our patients to be successful.
Be sure your instructions are clear and in writing. Math is a challenge for many people. It always helps to give them some scenarios to be sure they understand how to actually titrate their insulin. Does the patient actually know that a bg of 190 is between 140 and 250? Vision can affect accurate dosing. This is of great concern when patients have elevated blood glucose levels and their vision is blurred. If you want to see how this plays out look at a syringe with your glasses off or you eyes squinted and see how accurate you dose. Have you ever seen how little 1 unit of insulin actually is? Considering the scenario where one unit of insulin might lower your blood glucose 50 points a slight inaccuracy in dosing could result in a major problem in your blood glucose.

Self monitoring of blood glucose… Do they have a meter, know how to use it, when to check and what to do if values above target? What is their understanding of their diet? Are the guidelines realistic? Is the insulin matched to their eating style? There are enough insulin options that it is easier to match the insulin to their eating style than trying to change their eating style.

What about their activity level? Do they have one? For someone who is trying to lose weight and is exercising you don’t want them to have to eat before they exercise to avoid a low blood glucose so you need to consider the type, time and amount of insulin they take. For someone who is walking in the afternoon NPH in the morning would not be a good choice as it would be peaking when they are exercising. When one person has diabetes it will have some affect on everyone in the family. Explore the family dynamics with them and perhaps including a family member in the next visit you have with them might be helpful.

As with any medication insurance and cost are always a consideration. Going the extra step to get authorization for the best insulin for that patient may take a little time in the beginning but if that insulin provides better coverage for the patient it will save you time in the long run.
Maxine and Insulin

• Type 2 DM is progressive
• Consider ways to get Maxine and yourself ready to start insulin in a timely manner.
• Match the insulin choice to Maxine
• Teach Maxine how to adjust her basal
Diabetes Moves On
As would be expected with the addition of insulin and improved glycemic control Maxine has gained 15 lbs. With an A1C of 8.3% her mean 2 hr pp is well into the 300’s. She continues maximum orals and not only has her basal been increased but a rapid acting bolus has been added for meal coverage. In an effort to help her manage her weight she has been given an 1800 calorie ADA diet to follow.
Question

• Why is Maxine not at target?
  A. Basal dose is inadequate
  B. Basal dose should be given bid
  C. Bolus dose is inadequate
  D. She has stopped checking her blood glucose
Answer

• Why is Maxine not at target?
  A. Basal dose is inadequate
  B. Basal dose should be given bid
  C. Bolus dose is inadequate
  D. She has stopped checking her blood glucose
Question

- What would you change with Maxine’s insulin regime?
  A. Increase bolus insulin
  B. Increase basal insulin
  C. Ask her to restart checking her blood glucose and see you in 1 month.
  D. Split basal dose
Answer

• What would you change with Maxine’s insulin regime?
  A. Increase bolus insulin
  B. Increase basal insulin
  C. Ask her to restart checking her blood glucose and see you in 1 month.
  D. Split basal dose
Question

• What would you do with Maxine’s oral diabetes medications?
  A. D/C all oral diabetes meds
  B. Continue all oral diabetes meds
  C. D/C glipizide
  D. D/C metformin
  E. D/C Thiazolidinedione (TZD)
Answer

- What would you do with Maxine’s oral diabetes medications?
  A. D/C all oral diabetes meds
  B. Continue all oral diabetes meds
  C. D/C glipizide
  D. D/C metformin
  E. D/C Thiazolidinedione (TZD)
As beta cell exhaustion occurs basal bolus therapy is required. When your patient is on maximum oral hyperglycemic agents, their basal is 0.5-0.7 units per kg, their A1c is not at target and or their bg before dinner is > 180 mg/dl it is time to add a bolus insulin. Maxine’s basal is close to 0.8 units/kg so the focus should now be on her bolus insulin. She has stopped checking her blood glucose perhaps because she is not seeing any progress in her glycemic control despite taking 4 insulin injections per day. A bolus of 5 units tid was a start but a more appropriate start for Maxine would have been 10 units at dinner and adding on at the other meals based on her food plan. Be careful not to stop titrating the insulin too soon. People with type 2 diabetes and obesity are quite insulin resistance and can easily require up to 1.5 units/kg.
Advancing Basal/Bolus Insulin

- **Insulin options**
  - If taking bedtime NPH, add morning NPH and progress to mealtime bolus insulin
  - If taking suppertime premixed insulin, add morning premixed insulin
  - If taking Detemir or Glargine, add mealtime bolus insulin

- **Oral agent adjustments**
  - Stop insulin secretagogue
  - Continue metformin and glitazone for glycemic stability

The basal insulin is primarily targeting the FPG. If you had started Maxine on NPH at bedtime you would need to progress her to a morning dose of NPH to cover her basal requirements during the day. If she was on a premixed insulin at dinner and her bg before dinner is > 180mg/dl she will need a morning premixed insulin dose using the guideline of 2/3 of the total insulin dose in the morning and 1/3 before the evening meal. If on detemir or glargine and the patient’s insulin dose has reached the 0.5-0.7 units per kg it is time to add a bolus insulin. Once a bolus insulin is added you will probably want to stop the insulin secretagogue but continuing the metformin and glitazone will help with glycemic stability.
Here are the results from a study from NHANES where adults with type 2 diabetes not on insulin were given a 75 gram OGTT. Postprandial hyperglycemia is known to have a negative effect on glycemic control and here we see the reality of postprandial glucose levels associated with their A1C. 63% of those under good control had a 2 hour glucose level ≥ 200 mg/dl following the 75 g OGTT. As a side note 1 cup of cooked rice and 2 corn tortillas or 1 cup of cooked pasta with 2 small slices of bread would provide 75 grams of carbohydrate.
Monnier and colleagues found that the impact of postprandial glucose levels on overall glycemia is most prominent at lower A1C levels. At an A1C of 7.3%, postprandial glucose makes up about 70% of the equation whereas when the A1C reached 10.2% it was the FPG that made up ~70% of the equation. The impact of FPG decreases as the gradually decreases as the A1C decreases.

The majority of patients fall into the 2nd and 3rd quintiles where postprandial glucose contributes to greater than 40% of the overall A1C level.

When we are looking at the FPG.

Remember it is a determinant of PPG. If you start your day off high you usually will just go higher unless you actively correct your bg.

It has a greater overall impact on the A1C when the A1C is above 8.4%. Poor glucose control.

Contributes ~ 70% when A1C > 10.2%.

The PPG becomes more important when:
Pre-prandial glucose, but not A1C, at goal
Better glucose control (A1C < 8.4%)
Contributes ~ 70% when A1C < 7.3%
Is frequently the earliest abnormality of type 2 diabetes
Checking PPG
For patients using medications targeting PPG
If PP hypoglycemia is suspected
Regular insulin which is a short acting insulin should be given about 30 minutes before meals while the rapid acting insulin should be given immediately before eating (usually 5-15 minutes). We call these dose and dine or shoot up and eat. Consider the challenge of giving your insulin 30 minutes before you think you are going to eat and knowing what and how much you will eat 30 minutes before the meal is in front of you. There are many circumstances that can make this a disaster waiting to happen such as eating out, family/personal disruptions or maybe you are not as hungry as you thought or even hungrier than you had anticipated.

Detemir and glargine are both long acting clear basal insulins with a relatively flat action profile and up to 24 hour duration of action. Neither of these 2 insulins can be mixed with other insulin preparations. Patients should be counseled about the importance of giving these insulins at the same time every day. When given at bedtime the insulin is adjusted based on the fasting glucose level. Detemir is associated with less weight gain and its action profile is dose dependent (the more you take the longer it lasts). All these insulins with the exception of detemir should be used within 28 days after opening. Detemir is good for 6 weeks.

For once daily dosing the dose should be administered with the evening meal or at bedtime. For those who require twice daily dosing for effective blood glucose control, the evening dose can be administered either with the evening meal at bedtime or 12 hours after the morning dose.

NPH is an Intermediate acting with variable absorptions. For full basal coverage it will need to be given twice daily. Although it may be mixed with regular insulin and rapid acting analogs because of its action profile it is best to give the evening dose at bedtime rather than with dinner to avoid overnight hypoglycemia. NPH is the only insulin that is cloudy and will need to be mixed before injecting. Be sure to caution patients on dual clear insulin preparations to keep their basal and bolus preparations separate or even put a rubber band around their basals so they do not get the two mixed up.
Serum free insulin concentration mU/L. Mean dose of 15.4 units.
The major metabolic defects that are present in type 2 diabetes mellitus which lead to glucose elevation are: decreased glucose transport and utilization at the level of muscle and adipose tissue, increased glucose production by the liver and relatively decreased insulin secretion by the pancreas. Added to this abnormal flux is any dietary carbohydrate which is absorbed as glucose or converted to glucose during the absorption or postabsorptive process.

The oldest agents used to treat what we now recognize as type 2 diabetes and which stimulate increased pancreatic insulin secretion include the sulfonylureas. More recently, repaglinide, a meglitinide, has been added to the available agents that stimulate increased pancreatic insulin secretion. Insulin administration, the oldest pharmacologic therapy for diabetes is also a choice to increase circulating insulin levels in response to a failing beta-cell function. Biguanides increase the sensitivity of the liver to circulating insulin, thereby participating in a reduction in the level of excess glucose produced by that organ in type 2 diabetes.

PPAR-g activators act at a number of sites to lower blood glucose levels. They also improve insulin sensitivity at the level of the liver, thereby decreasing the excess glucose production by that organ. But they are more commonly recognized for their action in increasing insulin sensitivity in muscle and adipose tissue peripherally. By improving this sensitivity, they allow for improvement in the utilization of glucose by these organs. It should be noted that biguanides, in high doses, also have some mild effect on increasing peripheral glucose utilization. To decrease the rapid influx of carbohydrate from ingested food, alpha-glucosidase inhibitors are used to slow the digestion of starches and the absorption of glucose and several other sugars.
Goals of Insulin Management

- Target A1C <7.0% (ideally closer to 6%)
- Pre-meal plasma blood glucose
  - 90-130 mg/dL
- Peak post prandial plasma glucose
  <180 mg/dL
- No severe or nocturnal hypoglycemia
- Less intensive glycemic control may be needed for some individuals

The A1C goal is as close to normal as possible without severe hypoglycemic episodes.
Post prandial glucose measurements should be made 1-2 hours after the beginning of the meal. AACE guidelines for glycemic control are pre-prandial < 110 mg/dL and post prandial < 140 mg/dL.
Adjust pre-meal and bedtime target upwards if decreased life expectancy; frail elderly; cognitive disorders; or other medical concerns.
What are your thoughts on Maxine's 1800 calorie diet?

A. Calories are excessive for a 5'2" 215lb female
B. Reduce calories to 1200 calorie diet
C. Teach her how to reduce her fat intake
D. Teach her about carbohydrates
Answer

• What are your thoughts on Maxine's 1800 calorie diet?
  A. Calories are excessive for a 5'2" 215lb female
  B. Reduce calories to 1200 calorie diet
  C. Teach her how to reduce her fat intake
  D. Teach her about carbohydrates

Although weight loss would help to improve her glycemic control by improving her insulin resistance when initiating insulin teaching the patient about carbohydrates can greatly improve their glycemic control.
Adjusting Meal Bolus

- Carbohydrates are the key
  - Use carb counting or
  - Fixed/consistent carb meal plan

- SMBG before and 1.5-2 hours PP
  - Goal: 30-50mg/dL rise in blood glucose

The rapid acting insulins, aspart and lispro, provide the best match for carbs. Carbs are converted into glucose and reach the bloodstream within about 10 minutes and bg levels will reach their peak within 1 hour after ingestion (high fat intakes will delay the digestion). Regular insulin needs to be given 30 to 45 minutes before eating to better match the conversion of carbs to glucose in the blood. To check to see if your meal bolus is accurate check your blood glucose before eating and 1 ½ to 2 hours after eating to see how much the bg increased. A reasonable goal is a 30 to 50 mg/dL meal rise. To check this out do the pre and post meal check when you do not need a bg correction.
There are many ways to teach “carbohydrate counting.” A simple way to start is using a sample plate which defines what a carb is and what it is not and then keep the portion of carbs consistent can be an easier way to introduce someone to carb counting without having to weigh and measure food or read complicated food labels.
Insulin Storage

• Keep unopened insulin in refrigerator until expired
• After opening:
  – Most vials good for 28-30 days
  – Detemir good for up to 42 days
  – Store at room temp (59-86°F) or refrigerator
• Do not expose to direct heat or sunlight
• Discard if frozen, clumping, frosty or if clear insulin is cloudy
• All insulins are clear except for premixed formulations and NPH

Once insulin is opened the expiration date varies significantly from product to product. Most vials are good for 28-30 days after opened but detemir is good for 42 days. This is an important consideration for patients on low dose insulin. Anyone using less than 35 units of any one kind of insulin daily will not use their opened vial up within a month. Maxine was only on 15 units of rapid bolus daily so her vial would have lasted for over 2 months. Pens and vials are good from anywhere from 10-28 days. For low dose insulin regimes a pen might work better.
Maxine Moves On Along With Her Diabetes

- Don’t stop with the basal
- Add bolus when basal approaches 0.5-0.7 units per kg.
- When A1C approaches 8.5% or less postprandial blood glucose is a major factor
- Choose your bolus wisely
- When adding bolus D/C insulin secretagogue
- Provide practical information on carbohydrates
  - Sources first
  - Amount next
- Give the patient a reason to SMBG

Frank

- 52 year old African American
- Type 2 x 12+ years
- A1C 8.7%
- 5’7” 180 lbs. (82 kg)    BMI 28 kg/m²
- Maximum metformin and TZD
- Current dose (TDD 65 units):
  - Regular  14 --- 0 --- 11 --- 0
  - NPH      30 --- 0 --- 0 --- 10 (often forgets hs NPH)
- SMBG usually only fasting
- NPH switched to 40 units long acting q am
- 3 month follow up: A1C 8.6%
Question

• Was the conversion of NPH to a long acting basal correct?
  A. True
  B. False

When the NPH was converted to a long acting basal were the correct guidelines used?
Keeping the dose to 40 units of basal provides Frank with 0.5 units basal per kg which is reasonable as a bolus insulin is in place.
Replacing NPH with Detemir or Glargine

- **Bedtime dose**
  - Convert unit for unit (1:1)

- **BID NPH**
  - For detemir convert unit to unit
  - For glargine take total NPH dose and decrease by 20% for starting dose

- *Titrate with dosage increase until fasting glucose target reached (for basal taken at bedtime)*
Question

- Why did Frank’s A1C not improve with switch to once daily basal in the morning?
  A. Frank is only checking his fasting glucose
  B. Bolus should have been increased as well
  C. Frank was using the wrong technique

Despite switching Frank to a more appropriate insulin regimen why did his A1C not improve?
Answer

• Why did Frank’s A1C not improve with switch to once daily basal in the morning?
  A. Frank is only checking his fasting glucose
  B. Bolus should have been increased as well
  C. Frank was using the wrong technique

Unfortunately we overlooked checking out how Frank was injecting his insulin.
What’s Right?

**New Insulin Therapy:**
- Simplified the insulin therapy by switching to long acting once daily dose
- Basal not decreased as A1C elevated.
- TDD 1.0 unit per kg

**Oral Diabetes Meds:**
- Remains on metformin and TZD

**Patient Self Management:**
- Basal moved to the morning when he is more likely to remember

Many of our current strategies for Frank were correct. Let’s look at what we did right. For his New Insulin Therapy we selected a more appropriate insulin regimen for by moving to a once daily dosing of a long acting basal insulin and switching the basal to morning where he was more consistent with taking this insulin, we did all the correct calculations and his TDD is not up to 1.0 units per kg, he continues on his metformin and TZD.
What’s Wrong?

• **New Insulin Therapy:**
  – May need to switch from Regular insulin to rapid acting for lunch coverage

• **Oral Diabetes Meds:** OK

• **Patient Self Management:**
  – When basal increased to 40 units he did not take because he only had a 30 unit syringe
  – SMBG:
    • Checks irregularly
    • May get discouraged with continued high numbers

What might we have done differently?
When we switched from morning NPH to long acting basal he will most likely need to switch to a rapid acting at meals as he has no lunch coverage. No change is needed in his oral medications. The main problem was that Frank was taking his morning NPH before he left for work and then took his breakfast regular when he got to work as that is where he had his breakfast. Because he was previously not taking more than 30 units of insulin at any one time he used only a 30cc syringe. So when we switched his morning basal from 30-40 units he only took 30 units as that was all his syringe held. He also was checking his bg irregularly as it always seemed to be high.
Insulin Syringes

• Use right syringe to accurately measure
  – 1/3 cc delivers up to 30 units insulin
  – 1/2 cc delivers up to 50 units insulin
  – 1 cc delivers up to 100 units insulin

• Needle size:
  – Short length for children and thin adults
  – Regular length for others

• Insulin pens
  – Allow for more accurate dosing
  – More convenient

Check with our patients to be sure they have the right size syringe for their insulin dose. Using a 1cc syringe for 14 units of insulin will most likely create the opportunity for inaccurate dosing.

Although the short length needles look less intimidating they are not the most appropriate size for our the overweight patient.

Insulin pens offer more accurate dosing as well as convenience. The needle gage is also the smallest on the pen needles so comfort is an added bonus.
Insulin Management
Insulin Management
May Be Simpler
Than You Think
Pete

- 35 year old Caucasian male
- A1C 6.4%  6’0” 165 lbs. (75 kg)  
  BMI 22.4 kg/m²
- Type 1 x 21 years (no DM complications)
- Insulin pump. Rapid acting insulin
- TDD 40-46 units/day (average 43 units/day)  
  – Basal 0.8-1.0 units per hour. Total 22.3 units  
  – **Correction** 1:50  **Meal** 1:16 (18-24 units/day)
- SMBG 6-9 times/day  
  – Wide variances 54-284 mg/dl
Calculating Insulin Type 1

- Normal daily insulin excretion in healthy, non-pregnant, non-obese adult is
  - ~ 0.3 – 0.5 units per kg day
- Type 1 within 20% IBW: 0.5-1.0u/kg/day
- Honeymoon phase: significant reduction
- Type 1 during pregnancy:
  - 2nd trimester 0.8 units/kg
  - 3rd trimester 0.9 units/kg
- BASAL: 1/2 of Total Daily Dose (TDD)
- BOLUS: 1/2 of TDD to cover meals
- Custom Fit Insulin Therapy


When calculating insulin in type 1 diabetes consider normal daily insulin excretion in healthy, non pregnant, non obese adults is 0.3-0.5 units per day. The guidelines recommended for type 2 diabetes within 20% of their IBW is 0.5-1.0 units per day. Weight, activity and carbohydrate intake need to be considered when establishing their dose. The honey moon phase will require significantly less insulin and may be as low as 0.2-0.25 units/kg per day. During pregnancy insulin requirements may nearly double with the pregnant woman with type 1 requiring up to 1.0 units per kg at term. Typically their basal and bolus will each provide about 50% of their total daily requirements.
Meal Bolus

- **500 Rule for Rapid Acting Insulin**
  - \( 500 \div \text{TDD} = \text{Amount of CHO covered by 1 unit of rapid acting insulin} \)
  - Example: \( 500 \div 43 = 12 \)
  - 1 unit of rapid acting insulin covers \(~12\text{ g CHO}\)

- **450 Rule for Regular**
  - \( 450 \div 43 = 10 \)
  - 1 unit of regular insulin covers \(~10\text{ g CHO}\)

Using insulin to carbohydrate ratios are considered the gold standard and can provide patients with the flexibility they need. To determine the appx grams of carbohydrate covered by unit of rapid acting insulin you divide the total daily insulin dose of both their basal and bolus insulin by 500. This is referred to as the 500 Rule. Using Pete’s TDD of 43 units per day we find that 1 unit of RA insulin should cover \(~12\text{ grams of carbohydrate}\). The difference between a ratio of 1:16 which is what Perfect Pete is taking and 1:12 which is what this new calculation says may not sound like a significant difference. However, this means that when he eats 60 grams of carb he would take 3.75 units of rapid as compared to 5 units which he would take with this calculation.

If the person is on regular insulin you divide the TDD by 450 to get the amount of carbohydrate covered by 1 unit of regular insulin. These types of calculations can only be used for people on full basal bolus insulin therapy.
The next step in flexible insulin management is to calculate how much one unit of bolus insulin will lower their bg. To do this we use the 1800 rule for RA insulin and the 1500 rule for regular insulin. By dividing Pete’s TDD of 43 units into 1800 we see that 1 unit of RA insulin would lower his bg ~ 42 mg/dL. Perfect Pete’s current correction is 1 unit to reduce his bg 50 points. If he is trying to correct his bg by 100 points he currently takes 2 units whereas his new calculation he would need 2.5 units. Although these differences may seem slight on paper they can be significant by the end of the day when several boluses are administered using the wrong calculation.
Injecting Insulin

• Accurate dose

• Consistent technique

• Site rotation

There is an art to correctly injecting insulin on a regular basis and we need to be sure to explore with our patients their knowledge, ability and consistency in injecting an accurate dose with a consistent and acceptable technique while rotating their injection site.
This is the results of data from a 3 day CGMS where each color represents a different day’s bg readings. We see wide variances in bg readings which is quite typical in many of our patients. Because we were perplexed with Pete’s wide bg variations we decided to use the CGMS to obtain more definitive data. When we went to insert the sensor we noticed that Pete was inserting his insulin pump infusion set in the same place every day thus affecting the variability of his insulin absorption. All we asked Pete to do was move his pump infusion set to a different area and the results from his 3 day CGMS were astonishing.
With no other changes in Pete’s insulin program other than rotating his site, his bg levels were almost perfect. This same principle of site rotation can make the same difference in glycemic control on our patients using syringes. Many people get comfortable with injecting in the same place. Be sure to check out your patients injection sites to see if this might be one of the problems.
The Bottom Line

• Use the RIGHT insulin
• At the RIGHT time
• In the RIGHT amount
• With the RIGHT device(s)
• For the RIGHT to live well with diabetes

• P.S.
  – Small doses Small problems
  – Large doses Large problems

The bottom line with insulin management is to…

Another valuable philosophy to have is to remember that small doses create small problems and large doses can create large problems. Be cautious when adjusting insulin but don’t stop too early and remember diabetes management changes over time.
Don’t make the mistake the Trojans did. Getting off to a good start and actively managing diabetes can help our patients avoid the devastating complications of poorly controlled diabetes.
Thank You