THE PRACTICAL ISSUES RELATED TO INSULIN ADMINISTRATION

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MIXING

Lente/Regular (L/R) are not stable mixtures in any ratio. They remain in a flux for up to 24 hours.
Lente Insulin has an acetate base and was never designed to be mixed with Regular.
NPH/Regular stable at five minutes after drawing into the syringe (2:1 & 3:1 ratio's).
L/R and NPH/R about 50 percent of the R is converted to NPH or Lente.
Lispro (Humalog) can be **acutely** mixed (i.e., just before injection) with either NPH or Ultralente without affecting its rapid absorption.
LANTUS Insulin **can not** be mixed in the same syringe with any insulin.

INJECTION TECHNIQUE:

Teach straight in or perpendicular. People do not understand the concept of 90 degrees. Unless the person is underweight, debilitated as often is the case in the elderly or a small child, no angle should be used. Nursing books and most sources still cite to use a 45 degree angle. Needles today are only ½" vs. 5/8 ". Thus, the length is shorter and the insulin does not get injected subcutaneously where it is intended to be injected.
Insulin should be injected at room temperature and not cold from refrigerator or absorption may be delayed by 15 to 20 minutes and may result in higher post prandial (after a meal) blood glucose levels.
Timing is important! Regular Insulin should be given 15 – 30 minutes prior to a meal to match the onset more closely with blood glucose rise following the meal. The Insulin Analogs (Lispro and Aspart) should be given **with the meal** or in some cases after the meal (i.e., gastroparesis, poor oral intake, nausea, vomiting or sudden change in patient status).

ASPIRATION: Not necessary today even though all sources still recommend teaching it to patients. Insulin pump patients do not aspirate!

SYRINGE REUSE: Research data supports disposable syringe reuse up to five times. Four methods exist:

1. Recap, store in a cool, dry location at room temperature.
2. Recap, store in refrigerator.
3. Wipe needle with alcohol & store in a cool, dry location at room temp.
4. Wipe needle with alcohol and store in refrigerator.

ROOM TEMPERATURE vs. REFRIGERATOR :
Do not use insulin if it has been frozen or exposed to high temperatures. If kept out of refrigerator, the temperature should not exceed 86 degrees. Insulin is stable at room temperature for 30 days. Refrigerated insulin is usable until the expiration date on the vial is out of date. Refrigerated insulin should be at room temperature about 15 minutes to allow it to warm up before drawing up and injecting. Clinical experience has demonstrated that injecting insulin at room temperature vs. ice cold decreases most local allergic type reactions that have been thought to be related to insulin.

SITES: Abdomen is the best, followed by the arm and then the leg. Buttocks has not been studied. Abdomen has 86 percent better absorption than leg; arm has 45 percent better absorption than leg and the insulin absorption from the leg may increase up to 100 times normal rate with moderate to intense exercise up to 2 hours after injection.

PENS AND INJECTORS: Injectors are expensive @ $ 750 and most insurances do not want to pay for them. Most popular in children.
PENS: 2 TYPES:

1. Durable (Cartridge): Novo Nordisk, BD, Owen Mumford
2. Disposable: Novo Nordisk, and Eli Lilly

SYRINGES: 1/3 cc; 1/2cc; 1cc; and 2cc (special order)

SYRINGE DISPOSAL: Safe storage and disposal practices should always be followed to prevent accidental needle stick injuries. **Do not break off** or cut needles. Place used needles, syringes and lancets in a large coffee can or other similar puncture resistant container. When the container is full, replace the lid and tape securely with duct tape. You may want to label the container "contaminated materials". Dispose of the container as you would your normal household trash. **Recent articles have reported** that **one of the most common foreign bodies** found in a non-healing wound or diabetic ulcer is an insulin needle. Current practice is to teach patients **NOT** to break the needles off their insulin syringes.

BARRIERS TO INSULIN ADMINISTRATION: People have developed a **Fear** of needles over the years. Others believe that taking insulin means your diabetes is bad. Many people with diabetes never accept their diabetes until they have to take insulin.

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Check all patients ability to draw up correct doses and look at injection sites! The patients concept of correct sites on the arm or leg may be totally different than the recommended areas!

MANAGEMENT TIPS:
Normal Functioning pancreas: 35-60 units per day
If patient is on insulin, is it a proper dose based on weight for Type 1 patients?

Basal requirement vs. meal requirements (Prandial)

Type 1: How to determine total daily insulin dose: weight divided by 2.2 = kgs. then multiply kgs. starting with .5 up to 1.0. This is the total daily insulin dose to begin with when ordering insulin.

Basal insulin requirements: Begin with 50 percent of the total daily insulin dose as Lantus preferably at hs - 9pm - 10pm or NPH divided into 2 injections (preferably 2/3 @ breakfast and 1/3 @ hs - 9pm - 10pm).

Prandial (meal) requirements: Take the remaining 50 percent of the total daily insulin dose and give as Lispro, Aspart, or regular divided into coverage for 3 meals breakfast, lunch and dinner on a prandial and/ or correction scale. Human preparations have a shorter duration and giving NPH at suppertime may not be therapeutic for many patients as they will not have basal coverage towards morning and the fasting blood glucose will be elevated. Also, they may have nocturnal hypoglycemia or low blood glucose during the early AM.

General guideline on how to determine PRANDIAL and/or CORRECTION Scale for Type 1:

Breakfast	Lunch	Supper
0- 50	**No insulin**. Take 15 -20 grams of CHO and check blood glucose in 10-15 minutes. Then take prandial insulin according to the **rechecked** blood glucose and eat meal.	
51-100	If blood glucose is in the 50's eat first and then take insulin. Generally, decrease regular insulin proportionately, usually 2-3 units on scale for every 50 points of blood glucose readings.	
101-150	**Divide remaining 50 percent of insulin requirements determined by patients weight into 3 doses prior to meals. This can be adjusted to meal size for each patient.**	
151-200	Increase regular insulin proportionately, usually 1-2 units on scale for every 50 points of blood glucose readings.	
201-250		
251-300		
> 300		

Prandial Insulin Scales are more reliable when they are based on CHO Counting which requires a registered dietician to instruct patient and analyze food records.

70/30 and 75/25 bid **will not** adequately control most patients with type 1 diabetes.

GOLDEN RULE: In the management of Type 1 and Type 2's - go after the fasting blood glucose first.

Simplistically, therapeutic approaches that work best for type 2's:

FPG 110-125mg/dl: Diet and exercise
FPG 126-200mg/dl: Oral agents (monotherapy)
FPG over 200mg/dl: Combined oral agents
FPG over 250mg/dl: Insulin ± oral agents

Starting Lantus:

Insulin naive patients: 10 units at Bedtime and titrate up every 3-4 days based on FPG.
Patients on once a day NPH or Ultralente - convert unit for unit.
Patients on NPH BID - reduce by 20% total dose and give at HS.
Converting patients from Regular Insulin to an Analog (Aspart of Lispro): 1:1 ratio (i.e., 5 units Regular order 5 units of Analog).

Determining starting Bedtime NPH Dose for Type 2's:

Weight in kgs. divided by 4.
Start with 0.2units/kg and titrate up.
Realize there exists variability with reconstituting cloudy basal insulins prior to each dose.
Patients who are over 100 units per day - consider a referral or consult with an endocrinologist. Most of these patients are Type 2's who are overweight and are not on basal insulin therapy at bedtime.
A more therapeutic regimen may be to try Lantus at bedtime and combination of oral drug therapy during the day.

*****Most types 2's will end up on insulin.** This is part of the natural history and progression of the disease. It is not because they are noncompliant.

*****Exercise caution** in ordering doses of Regular, Novolog or Humalog over 10 units on sliding scales until a determination has been established as to whether the patient is insulin sensitive or insulin resistant.

***Patients should be **instructed to keep blood glucose records** even if the meter they use has memory so they can see their blood glucose ranges daily to identify patterns early and call for medical advice.

***Current Standards of Care **recommend making adjustments in insulin** regimens more frequently than has been practiced in the past.

Recent studies and reports have cited that:
SLIDING SCALE INSULIN REGIMENS can be DANGEROUS!

This is especially true when basal insulin (Lantus, NPH, Ultra Lente, Lente,) are discontinued due to hospitalization or NPO for surgery or tests and replaced solely with prandial insulin (Regular, Lispro (Humalog), Aspart (Novolog) which have been traditionally used for sliding scale and supplemental insulin because they are faster acting and have a shorter duration.

Regular insulin is the only insulin product “routinely” used for intravenous administration at MUHA.

Regardless of the dose of insulin analog (Lispro or Aspart) injected subcutaneously, its duration is no more than 3-4 hours, whereas regular human insulin in moderate doses (15 plus units) lasts much longer and the **intensity of the peak increases with the size of the dose.**

Remember the 50/50 rule for the physiologic delivery of insulin by the normal functioning beta cell:

50% Basal insulin which has no relationship to food and simplistically is an hourly amount of insulin needed to maintain euglycemia
50% Prandial or meal insulin ideally calculated on (CHO’s) carbohydrates consumed.

Formulas:

1. CALCULATING IV INSULIN INFUSIONS:

$$\frac{\text{ordered units to be added}}{\text{ordered amount (cc) IV solution}} \times \frac{X}{1cc} = \text{\# units per cc}$$

Then take # units per cc times ordered hourly cc's = the # units of insulin pt. receiving hourly to be infused

2. HOW TO FIGURE GLUCOSE CONTENT and CALORIES IN IV SOLUTION:

cc's times % of dextrose = grams of glucose times 3.4 (calories/gram) = calories/cc's
(i.e., 1000cc x .05 = 50 x 3.4 = 170 calories/liter. If infusion rate is 100cc's per hour this is only 17 calories hourly or 5 grams of glucose).

3. CARBOHYDRATE COUNTING (CHO) is usually 1:10 or 1:15 (One unit of insulin for every 10 or 15 grams of CHO).

4. CALCULATING PLASMA or SERUM OSMOLALITY (mOsm/L):

$$2(Na + K) + \frac{\text{Blood Glucose}}{18} + \frac{BUN}{2.8}$$

FAST ESTIMATION OF SOSM (SERUM OSMOLALITY) - 2(Na)

NORMAL VALUE IS APPROXIMATELY 285-305

5. ANION GAP:

Na – (CL + HCO3) = 12 $\pm$ 2 mEq

or

Na + K - (Cl + HCO3) = 16 $\pm$ 2 mEq

6. Transition IV to SC therapy:

*** SQ administration of insulin (rapid, short-acting or long-acting) should begin at least 2 hours before discontinuing insulin drip**

Example:

Patient has received an average of 3 U/hr IV during previous 6 hours.

Recommended doses as follows:

SC TDD (total daily dose) is 80% of 24 hr insulin required:

80% of (3 U/hr x 24) = 58 U

Basal dose is 50% of SC TDD:

50% of 72 U = 29 U of long-acting analogue

Bolus dose is 50% SC TDD:

50% of 72 U = 29 U of total prandial rapid-acting analogue or 12 U with each meal

Correction dose is actual BG minus target BG divided by the CF (correction factor), and CF is equal to 1700 ÷ TDD:

CF = 1700 divided by 58 = ~ 29 mg/dL

Correction dose: (BG – 100) ÷ 29

Hypoglycemia Protocol for Hospital.

Driving Guidelines for all patients on insulin.