

BASAL - BOLUS SUBCUTANEOUS (SUBQ) INSULIN THERAPY: A HOSPITAL PRACTICE

Margaret Cuevas Baggett, MSH, BSN, RN, CDE

INTRODUCTION

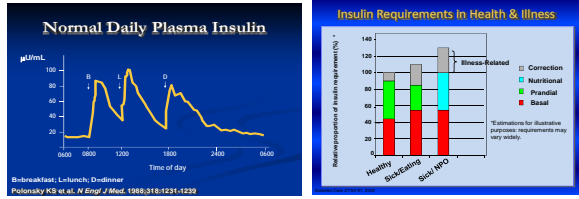
Hyperglycemia is evident as beta cell secretion declines and as illness, injury, trauma or use of certain medications such as steroids affects an individual's admission. With health and illness, insulin requirements increase. Insulin is a most effective agent when given in appropriate doses for reaching desired glycemic control on medical / surgical type hospitalized patients. In other words, insulin therapy is the preferred method for achieving glycemic control in most clinical inpatient situations where glucose levels tend to get out of control as a result of injury, illness or trauma.

There is no clear evidence or specific studies to date that establish specific guidelines for treating hyperglycemia in the non-critically ill or medical / post surgical type patient. However, premeal glucose targets of < 140 mg/dl and random glucose targets of < 180 mg/dl have been established as long as these targets are "safely achieved."

In an effort to promote subcutaneous insulin management and improve glycemic control of the hospitalized patient, according to current recommendations and evidenced based research and practice, a different strategy of subcutaneous insulin therapy management emerged. Basal-Bolus subcutaneous (SubQ) insulin therapy is a practice adopted to treat non-critical ill patients with hyperglycemia or diabetes.

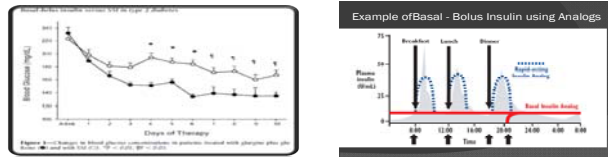
Basal - Bolus SubQ insulin therapy supports the ADA Standards of Medical Care in Diabetes and the American Association of Clinical Endocrinologists (AAACE) standards of care for hospitalized patients. The ADA Standards of Medical Care in Diabetes and the AAACE recommend using Basal-Bolus insulin therapy in treating adult hospitalized patients with diabetes or hyperglycemia because it works most closely to the body's own natural release of insulin.

Basal-Bolus attempts to mimic physiologic insulin secretion imitating what a "normal" pancreas does at producing insulin: A little insulin all day and all night; A little insulin with meals. Its three components include Basal, Bolus Prandial or Premeal (Nutritional) and Bolus Correctional. Basal targets fasting blood glucose with basal insulin adjustment. Bolus targets post-meal or post-prandial glucose with bolus insulin adjustments. And, the correction dose insulin is used as a supplement to optimize blood glucose control associated with illness, injury or trauma of the hospitalized patient.



EVIDENCE BASED RESULTS

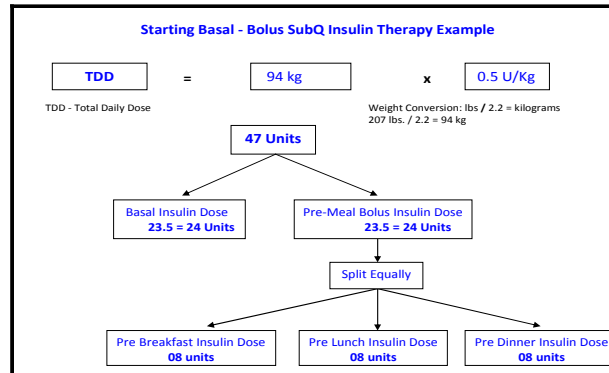
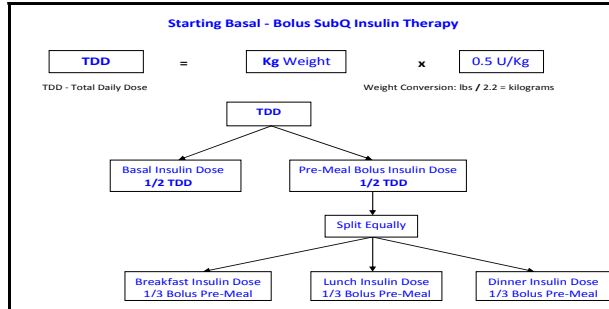
- Insulin therapy has been shown to decrease the prevalence of hyperglycemia, decrease the complications associated with hyperglycemia, achieve and maintain steady-state glucose control within target glucose ranges, and prevent hypoglycemic episodes.
- Basal-Bolus SubQ insulin therapy or management has been studied in several trials, the largest being the RABBIT 2 trial conducted in 2007 by Umperiez et al. On the results of this trial, it was shown that Basal-Bolus significantly improved glycemic control without an increased risk of hypoglycemia in an adult internal medicine population.
- A prospective, multicenter, randomized trial study conducted by Umperiez, et al on the optimal management of hyperglycemia in non-intensive care unit patients with type 2 diabetes using Basal-bolus dosing vs. sliding scale insulin (SSI). Basal glargine was used daily and Bolus glulisine before meals and at bedtime, starting at 0.4 units/kg/day (BG 140-200 mg/dl) or 0.5 units/kg/day (BG >200 mg/dl) versus the standard sliding scale four times a day (qid). Glycemic control was defined as BG <140 mg/dl. Results indicated the following:
 - Achieved the goal 68% in basal-bolus vs. 38% in SSI group
 - Insulin requirement was larger in SSI group
 - Significant difference in basal-bolus dosing vs. SSI in achieving goal
 - No differences in hypoglycemia or hospital stay
- Sliding Scale Insulin (SSI) has been found to be ineffective in treating hyperglycemia. SSI is NOT recommended by the experts, mainly ADA and the AAACE. Joint Commission clearly states SSI is NOT effective. Therefore, Basal - bolus is the preferred SubQ insulin therapy. A standard of practice for a hospitalized patient with diabetes is to be on a basal, meal or prandial, and correction dose SubQ insulin therapy, more commonly referred to as Basal-Bolus.



METHODS: A DIFFERENT STRATEGY

- How much insulin is ordered or prescribed for basal, prandial and correctional doses is based on the total daily dose. It is necessary to have a correct weight on each patient on admission to help calculate the correct insulin dose and in effort to prevent under-dosing or over-dosing.
- Using the current kilogram (kg) weight of the patient, the total daily dose (TDD) is determined by taking the kg weight of the patient and multiplying by a coefficient of 0.5 Units of insulin per kg (0.5 U/kg). In patients more sensitive to insulin such as in malnourished, renal, cardiac or the elderly, the coefficient is reduced to a more conservative 0.3 U/kg.
- TDD is then distributed as approximately 50% basal and 50% bolus insulin. The Basal insulin dose becomes one half of the TDD. The Bolus Prandial insulin is one half of the TDD split equally before breakfast, before lunch and before dinner meals. Correctional bolus insulin is added to the premeal scheduled doses from specific glucose level regimens. The correction dose regimens are Low, Medium, High or Other Dose. These are not to be confused with "sliding scale insulin." Based on the TDD of insulin of the patient, each regimen contains a glucose range with a specified amount of insulin in units to administer. Low and Medium normally start with one unit. High dose starts with two units. And, other dose is written in by physician or endocrinologist.
- The following is an example of Bolus Correction dose regimens as they may appear:

(TDD ≤40 units of insulin)	(TDD= 40-80 units of insulin)	(TDD>80 units of insulin)	(Write in desired unit amount)
150-170 1	150-160 1	150-160 2	
171-220 2	161-180 2	161-180 4	



DISCUSSION

Evidenced based research and practice has shown that more closely mimicking endogenous insulin secretion provides for better glucose control with minimal or no hypoglycemia.

The Basal-Bolus SubQ insulin therapy is a multi-injection program that involves the administration of a long acting (Lantus or Levemir) or intermediate acting (NPH) insulin as a basal or foundation insulin and rapid insulin (Novolog, Humalog, Apidra) or short acting (Regular) insulin for prandial (meal) and correction bolus dosing.

Basal insulin: Long-acting Insulin Analogs Glargine (Lantus), Detemir (Levemir) or Intermediate- acting Insulin NPH (Humulin N and Novolin N)

- Pre-determined amount of insulin necessary to maintain euglycemia in the fasting state
- Provides for a stable, all day and all night insulin coverage of endogenous production of glucose preventing hyperglycemia between meals and at night, even when not eating
- Controls glucose production by the liver preventing gluconeogenesis and ketoneogenesis
- Suppresses hepatic glucose production between meals and overnight preventing ketone formation
- It is not held, even if the patient is NPO
- It is not held, especially in Type 1 diabetes

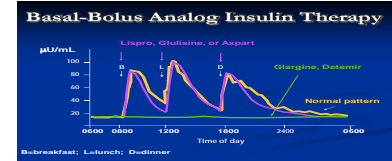
Bolus Prandial or Premeal insulin: Rapid-acting Insulin Analogs: Lispro (Humalog), Aspart (Novolog), Glulisine (Apidra) or, Short Acting insulin Regular (Humulin R and Novolin R)

Acting insulin Regular (Humulin R and Novolin R)

- Scheduled specific amount of insulin based on what the patient will be eating
- Corrects glycemia that occurs with feedings or meals eaten
- Is food or meal related
- Helps use and store carbohydrates consumed

Bolus Correction (supplemental) insulin: Rapid-acting Insulin Analogs: Lispro (Humalog), Aspart (Novolog), Glulisine (Apidra) or, Short Acting insulin Regular (Humulin R and Novolin R)

- Supplemental insulin for treatment of unexpected hyperglycemia
- Treats an acute elevation in blood glucose associated with acute status
- Covers hyperglycemia that forms outside of the meal
- Timed around meals, given in addition to scheduled premeal insulin for patients receiving meals
- May be given to patients on continuous feeds, enteral or parenteral feeds
- Should always match the type of Pre-meal insulin ordered due to action times
- Regimens are Low, Medium, High or Other Dose as prescribed by provider (for example, starting at one unit insulin coverage at glucose levels of 150 mg/dl on the low dose)
- It is not sliding scale and should not be implemented or used as such



CONCLUSION

Evidence and clinical research practice suggest that utilizing Basal-Bolus SubQ insulin therapy in the adult non-critical inpatient population can lead to better glucose control. Prolonged insulin therapy with SSI as the sole regimen is discouraged. Basal - Bolus SubQ Insulin therapy is preferred.

Current practice provokes the physician or practitioner to focus on implementing all three components of Basal-Bolus SubQ insulin therapy in a non-critical hospitalized patient with diabetes not requiring intensive intravenous insulin therapy.

Major support in implementing Basal-Bolus SubQ insulin therapy is needed by endocrinologists, physicians, pharmacists, nurse leaders, staff nurses, nurse educators for diabetes and certified diabetes educators in the inpatient setting. Endocrinologists, Physicians, Medical and Clinical practitioners, Certified Diabetes Educators plus Nursing professionals with a greater understanding and appreciation of Basal-Bolus SubQ insulin therapy have a greater opportunity to promote and improve glycemic control and the quality of medical and nursing care of the hospitalized patient with diabetes.

Hospitals such as Shands Jacksonville Medical Center in Jacksonville, Florida have placed themselves on the cutting edge by implementing evidence based Basal-Bolus SubQ insulin therapy into their clinical practice management of the non-critical hospitalized patient with diabetes.

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