

1. [What is Basal Bolus Insulin Therapy \(BBIT\)?](#)
2. [What evidence supports the use of subcutaneous Basal Bolus Insulin Therapy?](#)
3. [Does Basal Bolus Insulin Therapy apply to all patients?](#)
4. [What's wrong with Sliding Scale Insulin \(SSI\)?](#)
5. [When should subcutaneous Sliding Scale Insulin \(SSI\) order sets be retired from clinical use?](#)
6. [What insulins are used in Basal Bolus Insulin Therapy?](#)
7. [Will the change to BBIT increase pager calls to medical staff when patients are hyperglycemic?](#)
8. [Why are the patient's BG readings on BBIT above target initially?](#)
9. [How would you suggest we manage patients on call to the OR for a surgical procedure or in the immediate post-operative period?](#)
10. [The calculated weight based suggested BBIT dose seems large for my patient and likely to cause hypoglycemia. I would prefer to use SSI, which gives smaller doses of insulin and minimize the risk for hypoglycemia.](#)
11. [My patient population has many elderly patients with variable intake, the BBIT insulin dose calculations seem large for my patient.](#)
12. [Where do I find more educational resources for clinicians prescribing BBIT?](#)

[References](#)

1. What is Basal Bolus Insulin Therapy (BBIT)?

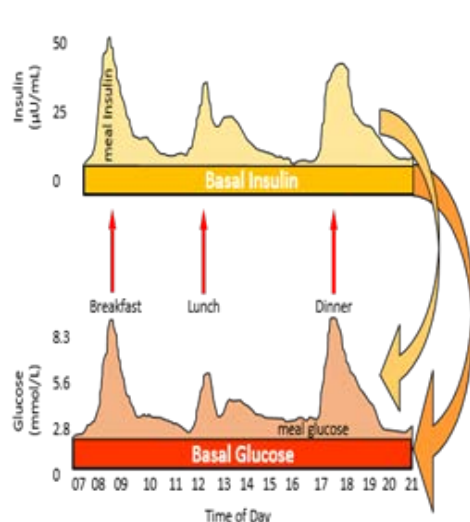
BBIT is a physiologic way to replace insulin, mimicking normal insulin release:

Basal- long or intermediate acting insulin administered once or twice daily to cover the glucose released continuously from the liver and to a lesser extent the kidneys.

Bolus- short or rapid acting insulin administered with meals to cover the glucose rise from the anticipated meal eaten.

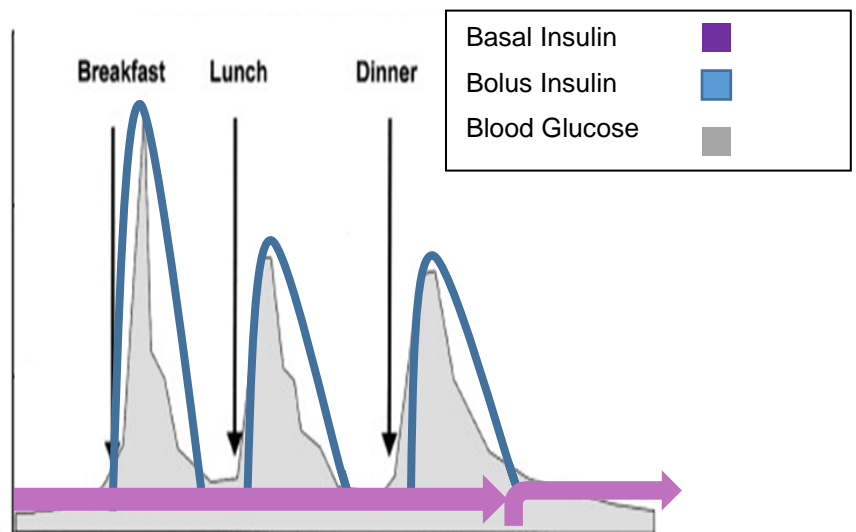
Insulin Correction- short or rapid acting given with bolus insulin to correct unanticipated hyperglycemia

Titration- Insulin doses are to be titrated every 24-72 hours to maintain recommended in-target Blood Glucose (BG) values, as the initial conservative calculated insulin dose may not be therapeutic.



Normal Physiological Insulin Secretion

Adapted with permission Galloway, 1991



Mimicking physiological insulin secretion

Adapted with permission Edelman, 2005

2. What evidence supports the use of subcutaneous Basal Bolus Insulin Therapy?

Basal Bolus Insulin Therapy has been shown in prospective, multi-site randomized control trials to improve glycemic control and patient outcomes in individuals who require insulin in hospital. See [RABBIT 2](#) (medical) and [RABBIT 2\(Surgery\)](#) studies as well as a Canadian Agency for Drugs and Technologies in Health (CADTH) review on the www.bbit.ca (references tab).

Diabetes Canada (formerly Canadian Diabetes Association) since at least 2003 has always recommended using a basal bolus insulin regimen for the administration of subcutaneous insulin therapy in hospital.

3. Does Basal Bolus Insulin Therapy apply to all patients?

Yes, if subcutaneous insulin is required, Basal Bolus Insulin Therapy is recommended best practice.

If patients require IV insulin (e.g. in critical care), IV insulin is recommended best practice. When transitioned from IV insulin to subcutaneous insulin, Basal Bolus Insulin Therapy is recommended over sliding scale insulin alone.

If patient is safely meeting their recommended in-hospital BG targets on home medication regimen, the patient should remain on the same.

4. What's wrong with Sliding Scale Insulin (SSI)?

*Subcutaneous sliding scale insulin has **NEVER** been shown in the published literature to improve glycemic control or clinical outcome. This is reflected in the Diabetes Canada Clinical Practice Guidelines for inpatient diabetes management, which strongly suggests avoidance of SSI in hospital:*

<http://guidelines.diabetes.ca/browse/chapter16>

Subcutaneous sliding scale insulin use is associated with increased hyperglycemia and hypoglycemia. Hyperglycemia and hypoglycemia are associated with increased morbidity, mortality, length of stay and cost. This has been demonstrated in both critically ill and non-critically ill patients, as well as medical and surgical inpatients. Improving glycemic control improves patient outcomes and reduces length of stay and cost.

5. When should subcutaneous Sliding Scale Insulin (SSI) order sets be retired from clinical use?

A discussion at each site, among champions, is encouraged to determine when all subcutaneous (sc) sliding scale insulin (SSI) order sets are to be retired from clinical use. It is known that the availability of pre-populated sc SSI order sets is a barrier to the implementation and uptake of Basal Bolus Insulin Therapy.

6. What insulins are used in Basal Bolus Insulin Therapy?

AHS & Covenant Formulary Insulin:

Insulin Type (trade name)	Onset	Peak	Duration
Insulin aspart (NovoRapid®)	10-15 min	1-1.5 h	3-5 h
Insulin lispro (HumaLOG®)	10-15 min	1 - 2 h	3.5-4.75 h
Insulin regular (HumuLIN®-R)	30 min	2 - 3 h	6.5 h
Insulin NPH (HumuLIN®-N)	1 - 3 h	5 - 8 h	12-14 h
Insulin detemir (Levemir®)	90 min	Not applicable	16-24 h
Insulin glargine (Lantus®)	90 min	Not applicable	24 h

7. Will the change to BBIT increase pager calls to medical staff when patients are hyperglycemic?

In the literature, BBIT has been shown to reduce hyperglycemia when compared to SSI. The Calgary Hospitalist group (who are responsible for over 800 acute care patient beds across 4 sites) has been using the BBIT order set since April 2016 and the data supports a reduction in severe hyperglycemia (blood glucose above 18.0mmol/L) of 1%. This translated into 1000 fewer pager calls per year for BG levels above 18.0mmol/L.

8. Why are the patient's BG readings on BBIT above target initially?

The initial weight based calculations for BBIT are purposefully very conservative to avoid hypoglycemia. Therefore, if blood glucose values are above recommended in-hospital targets, insulin doses will need to be increased to reach therapeutic doses. Titration is recommended every 24-72 hours, and daily review of BG results is necessary to ensure the patients' diabetes needs are being met. See "How to BBIT: Prescribers guide for Basal Bolus Insulin Therapy" on www.bbit.ca

9. How would you suggest we manage patients on call to the OR for a surgical procedure or in the immediate post-operative period?

Patients with Type 2 Diabetes Mellitus who are on anti-hyperglycemic agents that are to be held should have BG levels monitored 4 times daily (before each meal/feed or at usual unit meal/feed times if patient is NPO, and at bedtime). IF BG levels are above recommended in-hospital targets (5-10 mmol/L), subcutaneous insulin should be used, even if it is expected that it will be temporary. Diabetes Canada Clinical Practice Guidelines recommends using basal bolus insulin therapy (BBIT) if IV insulin is not indicated. BBIT best replicates the body's normal physiological insulin secretion. Basal insulin (intermediate or long acting insulin) is administered once or twice daily to stabilize BG values and if dosed appropriately is less likely to cause hypoglycemia. Bolus insulin (short or rapid acting insulin) is held in times of fasting and given if the patient is having caloric intake. Correction insulin (same brand as bolus insulin) is ordered, regardless of whether the patient is eating or NPO, to correct unanticipated hyperglycemia.

For patients with Type 1 Diabetes Mellitus basal insulin (subcutaneous or intravenous) is always administered as the patient is at risk of developing DKA without insulin.

10. The calculated weight based suggested BBIT dose seems large for my patient and likely to cause hypoglycemia. I would prefer to use SSI, which I feel gives smaller doses of insulin and minimizes the risk for hypoglycemia.

Basal Bolus Insulin Therapy is a customized (weight based) insulin therapy that if dosed appropriately should be associated with a lower risk of hypoglycemia. A calculated total daily amount of insulin is administered over the 24 hour period, where and when it is required physiologically.

Basal insulin is administered once or twice daily and released slowly over the 12-24 hour period, covering glucose being continuously released from the liver and to a lesser extent the kidneys.

Bolus insulin is administered with a meal to match the nutritional rise in glucose from the meal. Bolus insulin is to be held when the patient is NPO.

Correction insulin is administered to correct unanticipated hyperglycemia, typically not administered at bedtime.

A typical SSI regimen does not take into account individual patient characteristics (weight, meal intake, or physiologic insulin needs in the overnight period), often leading to over or under dosing of insulin.

Let's compare:

E.g. 70 kg, poor appetite, current BG 14.4mmol/L

BBIT

- 0.3 units/kg/day = 21 units
- Basal: 10 (over 24 hours – covers liver’s production of glucose)
- Bolus: 11 bolus = 3-4 units tid with meals – may reduce 25- 50% for poor appetite = 1-2 units tid with meals. HOLD IF NOT EATING
- Correction:

Condition	From	To	Dose/Instructions	UOM
Blood Glucose (mmol/L)	0	4	Use Hypoglycemia Protoc	
Blood Glucose (mmol/L)	4.1	10	0	unit(s)
Blood Glucose (mmol/L)	10.1	14	1	unit(s)
Blood Glucose (mmol/L)	14.1	18	2	unit(s)
Blood Glucose (mmol/L)	>18		Call MD	

- Total meal dose:
 - 3-4 units (if dose reduced)
 - 2 units if NPO
 - 6 units maximum (assuming full diet)

SSI

Trade: regular (HUMULIN R)

Sliding Scale Dose: Use CHR Hypoglycemia Protocol if Blood Glucose (mmol/L) 0 - 4.1
 Give 0 Unit(s) if Blood Glucose (mmol/L) 4.2 - 9
 Give 4 Unit(s) if Blood Glucose (mmol/L) 9.1 - 12
 Give 6 Unit(s) if Blood Glucose (mmol/L) 12.1 - 15
 Give 8 Unit(s) if Blood Glucose (mmol/L) 15.1 - 18
 Give 10 Unit(s) if Blood Glucose (mmol/L) 18.1 - 22
 Give 12 Unit(s) if Blood Glucose (mmol/L) >22

Total meal dose – 6 (even if NPO)

Route: SUBCUTANEOUSLY

Trade: regular (HUMULIN R)

Sliding Scale Dose: Use CHR Hypoglycemia Protocol if Blood Glucose (mmol/L) 0 - 4.1
 Give 4 Unit(s) if Blood Glucose (mmol/L) 4.2 - 7
 Give 6 Unit(s) if Blood Glucose (mmol/L) 7.1 - 9
 Give 8 Unit(s) if Blood Glucose (mmol/L) 9.1 - 12
 Give 10 Unit(s) if Blood Glucose (mmol/L) 12.1 - 15
 Give 12 Unit(s) if Blood Glucose (mmol/L) 15.1 - 18
 Give 14 Unit(s) if Blood Glucose (mmol/L) 18.1 - 22
 Give 16 Unit(s) if Blood Glucose (mmol/L) >22

Total meal dose – 10 (even if NPO)

Route: SUBCUTANEOUSLY

11. My patient population has many elderly patients with variable intake, the BBIT insulin dose calculations seem large for my patient.

Basal Bolus Insulin Therapy is a customized insulin therapy that if dosed appropriately is less likely to cause hypoglycemia. The BBIT calculations suggest patients who are more sensitive to insulin (Type 1 Diabetes Mellitus, those with a BMI of <25, those who have undergone a pancreatectomy, reduced renal function, decreased oral intake, liver failure, history of hypoglycemia and the frail elderly) use a conservative weight based calculation of 0.3-0.5 units/kg/day to calculate the TDD. For patients with variable meal intake, consider lowering the bolus (may reduce by 25-50%) if concerns of nausea or vomiting. Bolus insulin is to be held when NPO.

Let's compare:

E.g. 45kg, poor appetite, current BG 10.8mmol/L

BBIT

- 0.3 units/kg/day = 13.5 units
- Basal: 7 (over 24 hours – covers liver's production of glucose)
- Bolus: 6 bolus = 2 units tid with meals – may reduce 25- 50% for poor appetite = 1 unit tid with meals. HOLD IF NOT EATING
- Correction

Condition	From	To	Dose/Instructions	UOM
Blood Glucose (mmol/L)	0	4	Use Hypoglycemia Protoc	
Blood Glucose (mmol/L)	4.1	10	0	unit(s)
Blood Glucose (mmol/L)	10.1	14	1	unit(s)
Blood Glucose (mmol/L)	14.1	18	2	unit(s)
Blood Glucose (mmol/L)	>18		Call MD	

- Total meal dose:
 - 2 units (if dose reduced)
 - 1 unit if NPO
 - 3 units maximum (assuming full diet)

SSI

Trade: regular (HUMULIN R)

Sliding Scale Dose: Use CHR Hypoglycemia Protocol if Blood Glucose (mmol/L) 0 - 4.1
 Give 0 Unit(s) if Blood Glucose (mmol/L) 4.2 - 9
 Give 4 Unit(s) if Blood Glucose (mmol/L) 9.1 - 12
 Give 6 Unit(s) if Blood Glucose (mmol/L) 12.1 - 15
 Give 8 Unit(s) if Blood Glucose (mmol/L) 15.1 - 18
 Give 10 Unit(s) if Blood Glucose (mmol/L) 18.1 - 22
 Give 12 Unit(s) if Blood Glucose (mmol/L) >22

Total meal dose – 6 (even if NPO)

Route: SUBCUTANEOUSLY

Trade: regular (HUMULIN R)

Sliding Scale Dose: Use CHR Hypoglycemia Protocol if Blood Glucose (mmol/L) 0 - 4.1
 Give 4 Unit(s) if Blood Glucose (mmol/L) 4.2 - 7
 Give 6 Unit(s) if Blood Glucose (mmol/L) 7.1 - 9
 Give 8 Unit(s) if Blood Glucose (mmol/L) 9.1 - 12
 Give 10 Unit(s) if Blood Glucose (mmol/L) 12.1 - 15
 Give 12 Unit(s) if Blood Glucose (mmol/L) 15.1 - 18
 Give 14 Unit(s) if Blood Glucose (mmol/L) 18.1 - 22
 Give 16 Unit(s) if Blood Glucose (mmol/L) >22

Total meal dose – 10 (even if NPO)

Route: SUBCUTANEOUSLY

12. Where do I find more educational resources for clinicians prescribing BBIT?

A detailed website with multidisciplinary education is found at www.bbit.ca.

References

1. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. *Can J Diabetes* 2013;37(suppl 1):S1-S212
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