

# Therapeutics Bulletin

FEBRUARY 2015



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## Suggestions or comments?

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## Insulin therapy: basal bolus in, sliding scale out

### Hyperglycaemia during hospitalisation increases morbidity and mortality

Hyperglycaemia during acute medical or surgical illness is a marker of poor clinical outcome and mortality. Morbidity and mortality increases in hospitalised community acquired pneumonia patients with elevated blood glucose levels. The relative risk for infections increases by nearly 6-fold in postoperative patients with one or more blood glucose level(s) exceeding 12.2 mmol/l, on any postoperative day.

### Prescribing subcutaneous insulin in hospitalised patients

Subcutaneous (SC) insulin is frequently used in the management of known and newly diagnosed diabetics admitted with acute medical or surgical problems as well as non-diabetic patients experiencing transient stress-induced hyperglycaemia. With this edition of the Therapeutic Bulletin we aim to provide general principles for prescribing SC insulin therapy in hospitalised, non-pregnant, adult diabetic and non-diabetic patients.

### A diabetic patient's home regimen may be inappropriate during hospitalisation

Insulin requirements typically increase (but may also decrease) due to stress, hypotension, acute renal failure, oedema, surgical procedures and altered carbohydrate intake (nil per mouth (NPO) and hospital diets). The continued use of oral anti-diabetic medicines (biguanides and sulphonylureas) must be balanced against the risk of hypoglycaemia (risk factors include renal impairment and anticipation of NPO status) and lactic acidosis (combination of multiple risk factors including iodinated contrast-induced renal dysfunction, renal, liver or cardiac disease, metabolic acidosis, severe infection and hypoxemia).

### Do not use short-acting insulin "sliding scales" as the only form of insulin – they may cause harm

In non-critical medical and surgical type 2 diabetic patients, basal-bolus SC insulin regimens improve glucose control with no increased risk of hypoglycaemia compared to

sliding scales alone. Hospitalised diabetics' insulin regimens should include long-acting (**basal insulin**) to cover hepatic glucose production and short-acting (**bolus insulin**) to cover caloric intake (meals, enteral feeds or total parenteral nutrition (TPN)). In addition to the basal-bolus regimen, an **optional** short-acting insulin "sliding scale" (**correctional insulin**) may be given together with the bolus insulin before meals to correct pre-meal hyperglycemia.

### How to manage hospitalised diabetics with SC insulin

There is no "one size fits all" insulin regimen for hospitalised diabetics or patients with transient hyperglycaemia. Optimise glucose control during the period of stress in diabetics on oral medication or bi-daily insulin regimens by switching to a basal-bolus SC insulin regimen and initiate SC insulin in newly diagnosed diabetics and non-diabetics with transient stress-induced hyperglycemia. Adapt initial insulin dosing according to patient response and characteristics (age, diabetes type, renal function, concomitant glucocorticosteroids, etc.).

## Key points

### Basal-bolus insulin regimens

- ▶ Basal + bolus + correctional insulin regimen is preferred to sliding scale (correctional) insulin alone.
- ▶ Correctional insulin alone is a reactive strategy to glucose control and if used, should only be used in conjunction with a basal-bolus regimen.
- ▶ Type 1 diabetics always require

basal insulin, even if they are not eating.

- ▶ IV soluble insulin infusion may be preferred above SC insulin regimen in the critically ill.

### Correctional insulin (also called short-acting insulin sliding scale)

- ▶ Avoid routine correctional insulin as the only insulin regimen

in diabetics.

- ▶ The only place for correctional insulin is in conjunction with a basal-bolus insulin
- ▶ If patients are eating, inject bolus (prandial) insulin before meals as per plasma glucose level and predicted food intake and NOT every 4 (or 6) hours.
- ▶ Do not give correctional insulin at bedtime.

## Step 1

Calculate the total daily dose (TDD) insulin required.

**Type 1 diabetics** may be sensitive to insulin, therefore start with a low dose of **0.3-0.5 units/kg/day**.

**Type 2 diabetics** have varying degrees of insulin resistance, therefore start with **0.3-0.7 units/kg/day**.

De novo insulin users should be started on lower end of the given dosage range and titrated up as required.

Experienced insulin users with suboptimal glucose control should start on the higher end. If uncertain, start with 0.5 units/kg/day.

## Step 2

Divide the TDD insulin requirement into a basal and bolus component:

Prescribe 30-40% of the TDD as longer acting basal insulin (Protophane® HM or Humulin® N) to be given not later than 22h00.

60-70% of the TDD divided into 3 equal doses should be given as short-acting bolus insulin (Actrapid® HM or Humulin® R) 30 min before breakfast, lunch and supper.

## Step 3

Estimate the correctional insulin dose for the **optional** short-acting insulin "sliding scale" to be given in conjunction with short-acting bolus insulin 30 min before meals.

A quick and easy estimation for the scale increment is to use 5% of the total daily dose of insulin (TDD insulin).

For example, for TDD of 80 units insulin the scale should increase with 4 unit increments (5% of 80 = 4). No additional insulin should be given for blood glucose levels below 8.1 mmol/L (if hypoglycaemia is a concern use a higher blood glucose cut-off value). Thus, for a blood glucose of

8.1-11 mmol/L give 4 extra units of short-acting insulin, for

11.1-14 mmol/L give 8 extra units of short-acting insulin, for

14.1-17 mmol/L give 12 extra units of short-acting insulin, for

> 17.1 mmol/L give 12 extra units of short acting insulin plus evaluate patient (measure serum ketones in DM1).

Review clinical status and steps 1 and 2 when correctional insulin is required.

## Step 4

Monitor the patient's response to insulin

Blood glucose monitoring

Finger prick blood glucose monitoring requirements depend on patients' nutrition pattern (and insulin regimen) and time points may include:

- When eating: 30min before meals, at bedtime and at 03h00
- When receiving enteral feeding boluses: 30min before each feeding or 6 hourly
- When NPO: 6 hourly

Immediate blood glucose measurement is required if patients develop any symptoms suggestive of hypo- or hyperglycaemia.

Blood glucose targets

Targets below are appropriate for the majority of hospitalised patients, but individualised targets may be needed for special treatment groups. For example terminally ill patients require less stringent blood glucose control.

- Pre-meal glucose < 7.8 mmol/L
- Random glucose < 10 mmol/L

## Step 5

Review and modify the insulin regimen

Review the individual's blood glucose response daily and adapt the insulin regimen when required by revisiting steps 1 & 2. Patients with deteriorating renal function may require insulin dosage reduction and those on concomitant glucocorticosteroids higher bolus (prandial) doses.

## Step 6

Consult an endocrinologist when:

- Hyperglycaemia persists despite following this therapeutic bulletin's guidance
- Patients are hyperglycaemic and receiving more than 1mg/kg glucocorticosteroids (eg. prednisone)
- Type 1 diabetics present with unexplained hypoglycaemia or hypoglycaemia unawareness
- A secondary cause of diabetes is suspected (Cushing's disease, acromegaly, etc.)
- Patient develop ketosis in hospital

### REFERENCES AND BIBLIOGRAPHY:

1. Umpierez, Guillermo E., Dawn Smiley, Ariel Zisman, Luz M. Prieto, Andres Palacio, Miguel Ceron, Alvaro Puig, and Roberto Mejia. "Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes (RABBIT 2 trial)." *Diabetes Care* 30, no. 9 (2007): 2181-2186.
2. Pomposelli JJ, Baxter JK, 3rd, Babineau TJ, Pomfret EA, Driscoll DF, Forse RA, Bistrian BR: Early postoperative glucose control predicts nosocomial infection rate in diabetic patients. *JPEN J Parenter Enteral Nutr* 22:77-81, 1998
3. Falguera M, Pifarre R, Martin A, Sheikh A, Moreno A: Etiology and outcome of community-acquired pneumonia in patients with diabetes mellitus. *Chest* 128:3233-3239, 2005
4. Umpierez, Guillermo E., Dawn Smiley, Sol Jacobs, Limin Peng, Angel Temponi, Patrick Mulligan, Denise Umpierez, Christopher Newton, Darin Olson, and Monica Rizzo. "Randomized study of basal-bolus insulin therapy in the inpatient management of patients with type 2 diabetes undergoing general surgery (RABBIT 2 surgery)." *Diabetes Care* 34, no. 2 (2011): 256-261.
5. Draznin, Boris, Yunjiao Wang, Stacey Seggelke, R. Matthew Hawkins, Joanna Gibbs, Mark Bridenstine, Neda Rasouli, and Cecilia Low Wang. "Glycemic control and outcomes of hospitalization in non-critically ill patients with Type 2 diabetes admitted with cardiac problems or infections." *Endocrine Practice* (2014): 1-14.
6. Cox, Mary E., Mark N. Feinglos, Leonor Corsino, and Guillermo Umpierez. *Glycemic control in the hospitalized patient*. Edited by Lillian F. Lien. Springer Science+ Business Media, LLC, 2011.
7. American Diabetes Association. "Standards of medical care in diabetes—2014." *Diabetes Care* 37, no. Supplement 1 (2014): S14-S80.