

# In-hospital management of diabetes

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General Management principles:

1. target FBS 5-10 in all acutely ill patients.
2. avoid oral agents unless clinically stable > 72 hrs or awaiting transfer/discharge
3. avoid hypoglycemia  
FBS <5 is too low in hospital & requires mandatory insulin or sulfonylurea down-titration
4. avoid hyperglycemia  
glucose >10 fasting requires basal insulin start (or increase) and > 10 before meals  
requires with rapid insulin correction
5. avoid ketogenesis  
ensure basal insulin is maintained in Type 1 or in sick insulin-requiring Type 2 diabetics
6. use insulin infusions in sick diabetic patients with sugars consistently > 15

## **Capillary blood glucose monitoring (CBGM)**

QID to start (Q6H if on tube feeds or TPN); reduce testing based on clinical judgement.

## **Hypoglycemia management**

If FBS < 5.0 & patient asymptomatic give scheduled meal within 10 minutes (if at HS give snack). If FBS < 5.0 & patient symptomatic but coherent give 10 g starch (125 ml of ½ cup juice) stat. If NPO or incoherent give IV D50W 25 ml stat. Repeat glucometer at 5 minute intervals with same intervention until glucose >4.9.

## **Using Basal insulins**

### choices of insulin

insulin glargine given as single dose acd or bedtime (1800hrs if not eating)  
or  
twice daily NPH given at 0800 & 2200

### dose of basal insulin

if on basal insulin prior to hospitalization reduce dose by 20%

to start basal insulin with insulin glargine use 0.1 U/kg/day. If starting with NPH give as two equal doses of 0.05 U/kg.

If already on basal insulin and FBS 5-10 give same dose as yesterday

If already on basal insulin and FBS >10.0 see up-titration of basal insulin below.

If already on basal insulin and FBS <5.0 give 20% less than yesterday (see down-titration of basal insulin below).

### up-titration of basal insulin

By default basal insulin is only increased if FBS is >10. Determine total dose of correction insulin given in previous 24 hours. Add ½ this number to previous day's basal insulin dose.

This becomes the new basal insulin dose. If in doubt add less than less than  $\frac{1}{2}$ .

Example 1 – patient received 20 U insulin glargine previous day – in the subsequent 24 hours he/she required 12 U of correction insulin. New dose of basal insulin is  $20 + 12/2 = 26\text{U}$ .

Example 2 – patient received NPH 8 U at breakfast & 8 U at bed previous day - in the subsequent 24 hours required 8 U of correction insulin. New dose of basal insulin is  $8+8/4 = 10\text{ U}$  at breakfast & bed.

### Down-titration of basal insulin

If FBS < 5 or nocturnal hypoglycemia reduce dose of basal insulin by 20%. If new dose is a fraction of a unit round the dose down.

Example 1 - FBS 3.6; previous day dose of insulin glargine was 40 U. New dose basal insulin =  $40 \times 0.8 = 32\text{ U}$ .

Example 2 – FBS 4.8; in the previous 24 hours patient received two dose- of NPH 12 U at bed & 12 U at breakfast. New dose of NPH =  $12 \times 0.8 = 9.6\text{ U}$  – this is rounded down to 9 U twice daily.

### Using insulin corrections

Correction insulin is typically given at mealtimes when glucose > 10. It should not be given if patient is not eating (exception is if no basal insulin was prescribed). Correction insulin is given Q6H in tube-fed or TPN patients.

### choice of correction insulin

rapid insulin is preferred (glulisine, lispro or aspart). If rapid insulin not available use human regular insulin (Novolin R or Humulin R)

### timing of corrections

By default give corrections before meals (ac) only. If using HS correction give  $\frac{1}{2}$  the doses outlined below.

### Levels of correction dosing algorithm

The default (standard = low-dose) algorithm is used when basal insulin dose <20 U per day. Medium dose algorithm is given when basal insulin dose 20-40 U per day. High dose algorithm is used when basal insulin dose > 60 U per day.

mealtime glucose	<u>Insulin Correction</u>		
	default	basal 20-40U	basal >40U
<10.1	0	0	0
10.1-12.0	1	2	4
12.1-14.0	2	4	8
14.1-16.0	3	6	12
>16.0	4	8	16

### Insulin infusions

If sugar > 15 for previous 12-24 hours & patient considered to be “sick” by hospital standards or if patient showing ketones in urine or ketones in blood start insulin infusion protocol (approved by VGH Pharmacy 2008):

<http://drtomelliott.com/handouts/Diabetes/Insulin%20Infusion%20Protocol.pdf>.

Caveat with insulin infusion protocol: regardless of ambient glucose value, the insulin infusion rate should be reduced if the level of glucose has fallen by >4.0 in the previous hour. Failure to observe this caveat may result in unexpected hypoglycemia.

### **Type 1 diabetes**

Type 1 diabetic patients require special consideration. If the patient is in DKA the insulin infusion protocol described above should be instituted in conjunction with measures to correct volume depletion and to replace potassium (recommended acutely if  $K^+ < 5.0$ ). If a Type 1 diabetic patient is “sick” but not in DKA the infusion protocol above should be instituted.

Continue insulin infusion for a minimum of 24 hours after patient's condition has stabilised.

To convert to sub-cutaneous insulin calculate total dose of IV insulin given in previous 24 hours & give 1/2 this as first day's sub-cutaneous basal insulin.

### **Nutritional insulin**

Nutritional insulin is rapid insulin given with meals in addition to correction insulin. Nutritional insulin is not recommended as a standard treatment in acutely ill patients, either Type 1 or Type 2 diabetic. Nutritional insulin should only be used where a good understanding of the principles of carbohydrate counting exists, either with an autonomous patient or where specially trained staff (physician/diabetes nurse/dietitian) are supervising therapy.

For an introduction to carbohydrate counting the reader is referred to:

<http://drtomelliott.com/handouts/Diabetes/Carbohydrate%20Counting.pdf>

Rational nutritional insulin therapy demands the measurement of CBGM 2 hours after meals.

### **Recommended resources**

Various national diabetes agencies have useful websites. I maintain a repository of clinically useful handouts for endocrinology in general, and diabetes specifically:

<http://drtomelliott.com/handouts/index.php>

this site includes handouts on basal & prandial (meal-time) insulin adjustment, carbohydrate counting and insulin infusions.

This handout is available online at <http://drtomelliott.com/handouts/Diabetes/In%20hospital%20management%20of%20diabetes%20mellitus.pdf>.

### Admitting orders for Diabetes Mellitus

1. stop oral blood glucose lowering agents
2. QID capillary blood glucose monitoring (CBGM)
3. if glucose < 5.0 activate hypoglycemia protocol
4. give correction insulin s/c before meals if patient eating. Use one of the following insulins (circle choice): preferred choice: rapid insulin (glulisine, lispro or aspart) or regular insulin

glucose	insulin dose
< 10.1	0 units
10.1-12.0	1 unit
12.1-14.0	2 units
14.1-16.0	3 units
>16.0	4 units

(Suggest double above correction doses if total daily basal insulin 20-60 units per day.  
Suggest quadruple above correction doses if total daily basal insulin > 60 units per day)

5. if patient on insulin at home start basal insulin with either

insulin glargine \_\_\_\_\_ units at 1800 hrs (or HS)

(suggested dose = 80% of previous total daily dose of glargine or NPH, do not count rapid or regular insulin dose)

or

NPH \_\_\_\_\_ units at 0800 and \_\_\_\_\_ units at HS

(suggested dose for each time = 40% of previous total daily dose of NPH)

6. if fasting glucose > 10.0 & patient not on basal insulin (either glargine or NPH)

start basal insulin with either

insulin glargine \_\_\_\_\_ units at 1800 hrs (or HS)

(suggested dose = 0.1 U/kg)

or

NPH \_\_\_\_\_ units at 0800 and \_\_\_\_\_ units at HS

(suggested dose for each time = 0.05 U/kg)

7. if fasting glucose > 10.0 & patient on basal insulin (either glargine or NPH)  
increase the dose of basal insulin by adding half the total previous 24 hours of correction insulin (if previous dose of basal insulin = X units & a total of Y units of correction insulin were given in the previous 24 hours the new dose of basal insulin = X + Y/2).
8. If fasting glucose < 5.0 reduce the dose of basal insulin by 20%
9. If previous 3 glucose values > 15.0 activate Insulin Infusion Protocol.
10. Discharge planning - if 72 hours prior to intended discharge total daily dose insulin > 20 units ask Diabetes Educator to see with a view to insulin teaching. Suggest discharge on basal insulin at 80% of last in-hospital dose.

