

**DIABETES  
CANADA**

# Insulin Order Sets & In-Hospital Management of Diabetes



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# Key elements from Diabetes Canada 2018 Clinical Practice Guidelines

## Introduction:

Hyperglycemia is common in hospitalized patients, even in those not previously known to have diabetes. Common interventions in hospital such as intravenous and oral glucocorticoids, total parenteral nutrition and, enteral feeds can predispose patients to hyperglycemia and subsequent increased risk of adverse outcomes when they lead to hyperglycemia.

The primary goal of hospital management of diabetes is the prevention of short-term complications of diabetes: symptoms of hyper- and hypoglycemia, prevention of infections, and prevention of surgical complications. This is best achieved with intravenous insulin for critically ill patients and scheduled basal, bolus, and a correction (supplemental) subcutaneous insulin program for non-critically ill patients.

A systems approach to the hospital care of patients with diabetes can be associated with improved outcomes. System components demonstrated to improve outcomes include: policies to recognize and treat hypoglycemia, targeted glycemic levels for acutely ill and critically ill patients, diabetes care teams, and clinic order sets or computer pharmacy order entry to facilitate optimal insulin ordering.

## Hyperglycemia in hospital – How common is it?

In a review of the medical records of over 2,000 adult patients admitted to a community teaching hospital in the United States, hyperglycemia was present in 38% of patients. Of these patients, 26% had a known history of diabetes and 12% had no history of diabetes prior to admission (Umpierrez, 2002).

In a large clinical trial, 39% of patients in an intensive care unit required insulin treatment because they had one or more blood glucose levels over 11.9 mmol/L. Of the 783 insulin requiring subjects, 13% had a pre-existing diagnosis of diabetes and only 4% had been

previously treated with insulin (van den Berghe, 2001).

In a recent paper examining hyperglycemia in steroid treated patients, Fong et al ( 2013) evaluated 80 patients treated with high-dose steroids (prednisone 25 mg / day, dexamethasone 4mg / day, hydrocortisone 100 mg / day, or more) and found 86% with one or more BG > 8 mmol/L and 70% with one or more BG > 10 mmol/L. Among those who developed hyperglycemia, it occurred within the first 48 hours in 94% of subjects. Multiple studies (Oliveira, 2013; Pasquel, 2010) have shown that hyperglycemia occurring while on TPN is associated with an increase in multiple adverse outcomes, including death. In the Pasquel study, 10% of subjects had a mean daily blood glucose over 10.0 mmol/L and 30% had a mean daily blood glucose over 7.8 mmol/L. Ninety-five per cent of those subjects were treated with insulin.

## Preventing diabetes-related complications in hospital

### 1) Critical Care

One study in critical care patients demonstrated improved outcomes, including decreased mortality, with an intravenous insulin strategy aiming for blood glucose levels of 4.4 – 6.1 mmol/L, compared to a strategy aiming for blood glucose levels of 10.0 – 11.1 mmol/L. The mean morning blood glucose values in the two groups were 5.7 and 8.5 mmol/L, respectively (van den Berghe, 2001). However, a subsequent study in critical care patients demonstrated worse outcomes, including increased mortality, with an intravenous insulin strategy aiming for blood glucose levels of 4.5 – 6.0 mmol/L, compared to a strategy aiming for blood glucose levels of 8.0 – 10.0 mmol/L. The mean morning blood glucose values in the two groups were 6.5 and 8.1 mmol/L, respectively (Finfer, 2009).



Therefore, *Diabetes Canada's 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada* (CPGs) recommendation is:

For most medical/surgical critically ill hospitalized people with diabetes with hyperglycemia, a continuous intravenous insulin infusion should be used to maintain blood glucose < 10.0 mmol/L and > 6.0 mmol/L.

## 2) Post-operative – CABG

A systematic review of randomized controlled trials supports the use of intravenous insulin infusion targeting a blood glucose of 5.5 to 11.1 mmol/L over correction only subcutaneous insulin for perioperative glycemic control in cardiovascular surgery patients. This was demonstrated by a marked reduction in surgical site infections with an odds ratio of 0.13 (Boreland, 2015).

Therefore, the 2018 CPGs recommendation is:

For people with diabetes undergoing CABG, a continuous intravenous insulin infusion protocol targeting intraoperative glycemic levels between 5.5 and 11.1 mmol/L should be used to prevent postoperative infections.

## 3) Post-operative - Non-cardiac surgery

One clinical trial in a general surgery population compared a basal-bolus-supplemental insulin program with an aggressive short-acting / correction only (sliding scale) insulin program. The patients treated with the basal-bolus-correction (supplemental) program had lower blood glucose at all times of day and had 1/3 of the major post-operative complications, compared to patients treated with correction insulin alone (Umpierrez, 2011).

Therefore, the 2018 CPGs recommendation is:

Perioperative glycemic levels should be maintained between 5.0 and 10.0 mmol/L for most other surgical situations; with an appropriate protocol and trained staff to ensure the safe and effective implementation of this therapy and to minimize the likelihood of hypoglycemia.

## 4) General Medicine

One clinical trial in a general medical population compared a basal-bolus-supplement insulin program with an aggressive short-acting / correction only (sliding scale) insulin program. The basal-bolus-correction program lowered blood glucose at all times of day without an increase in hypoglycemia. No difference in outcomes was seen (Umpierrez, 2007).

Therefore, the 2018 CPGs recommendations are:

For the majority of noncritically ill hospitalized people with diabetes, pre-prandial blood glucose targets should be 5.0 to 8.0 mmol/L in conjunction with random blood glucose values < 10.0 mmol/L as long as these values can be safely achieved and; For hospitalized people with diabetes treated with insulin, a proactive approach that includes basal, bolus and correction (supplemental) insulin, along with pattern management, should be used to reduce adverse events and improve glycemic control, instead of only correcting high blood glucose with short- or rapid-acting insulin.

## What systems improve in-hospital care of patients with diabetes?

- An interprofessional team-based approach (Koproski 1997; Mackey, 2014)
- Health-care professional development regarding in-hospital diabetes management (Moghissi, 2015)
- Algorithms, order sets and decision support (Nirantharakumar, 2012; Lin, 2015)
- Comprehensive quality assurance initiatives, including institution-wide BG monitoring systems, inpatient education, and transition/continuity of care and discharge planning

# A practical guide to order set implementation in your hospital

## How to implement basal-bolus-supplemental insulin clinical order set (COS) in your hospital – A stepwise approach

1. Gather a multi-disciplinary team with an interest in in-hospital diabetes management and improving clinical outcomes. Suggested team members include: diabetes educators, ward nurses, pharmacists, dietitians, family doctors, hospitalists, internists, endocrinologists, nursing educators, managers, and quality improvement associates.
2. Identify “diabetes champions” within each of these groups who will help you get out your message.
3. Consider a baseline review or chart audit to determine how you are doing currently. This may help build your case for change.
4. Build a hypoglycemia recognition and treatment protocol if you don’t already have one. This should be in place first.
5. Set initial achievable goals. For example, a target of less than 10% of all subcutaneous insulin orders that are correction scale only may be a reasonable initial goal; or a 50% reduction from your baseline audit.
6. Develop a COS (or adapt your computer pharmacy order entry) to facilitate the ordering of basal-bolus-supplement insulin and discourage the ordering of correction only insulin. You may also want to develop a series of IV insulin COSs for specific units (surgery, ICU, CCU) or situations (DKA, HHS).
7. Educate all team members on why you are doing this. Attention should be paid to physician groups who are high-volume insulin users in your hospital (hospitalists, internists) and nurses on high-volume insulin-using units (medicine, cardiology, oncology, etc.). Use your champions to support and encourage team members.
8. Determine your metrics and review your progress after 6 months to a year. Are you making progress? What implementation strategies have worked or not worked? What groups have done better than others and why?
9. Investigate reasons for why implementations did not work as well as others. Provide support targeted to barriers identified. For example, adapt your COS(s) to facilitate ease of use. Celebrate those individuals or groups or units who are doing well.
10. Progress to next goal once one program is implemented and working well.

## Developing an basal-bolus-supplemental insulin COS in hospital

Outside of hospital, basal-bolus-correction insulin is commonly used for patients with type 1 diabetes and is occasionally used in patients with type 2 diabetes; it has also been called multiple daily insulin (MDI) or basal-bolus insulin therapy (BBIT). The suggestions and calculations below are based on Umpierrez, 2007 and Umpierrez, 2011. Low Wang, 2013 provides similar calculations.

### Step 1:

- Estimate the patient’s total daily dose (TDD) of insulin
- If previously on insulin, use patient’s current TDD
- If not previously on insulin, use patient’s weight (in kg) times 0.4 – 0.5

### Step 2:

- Order the basal insulin (insulin type, time of day, dose)
- Basal insulin type options are NPH, glargine, glargine 300, detemir or degludec
- Basal insulin is typically given at bedtime (although not always with glargine, detemir, degludec)
- Basal insulin dose will be TDD times 0.4 – 0.5

### Step 3:

- Order the bolus, sometimes called prandial or meal time insulin (insulin type, time of day, dose)
- Rapid acting insulin analogues (aspart, glulisine, lispro, fast-acting aspart) are the preferred type of bolus insulin in hospital, but regular insulin can also be used
- Bolus insulin is typically given before each meal
- Bolus insulin dose will be TDD minus the basal insulin dose, evenly divided between the 3 meals or TDD times 0.2 at each meal
- Bolus insulin should be held in patients who are temporarily not eating

### Step 4:

- Order the supplemental or correction insulin (insulin type, time of day, dose)
- Correction or supplemental insulin should be the same type as the bolus insulin; so usually a rapid acting insulin analogue.
- Correction insulin, if necessary, is typically given before each meal. Correction insulin may be used cautiously at bedtime if markedly hyperglycemic
- The dose of correction insulin is added to the dose of bolus insulin and the two doses are given together. The correction insulin will typically only be given when the blood glucose is greater than 8 or 10 mmol/L

### Step 5:

- Review the patient's diabetes and insulin record daily and make changes according to the blood glucose pattern(s)

## Developing intravenous (IV) insulin COSs

Intravenous insulin is appropriate for hospitalized patients who are not eating but who require insulin to control hyperglycemia.

Those patients could include:

1. Patients with a hyperglycemic emergency – diabetic ketoacidosis (DKA) or hyperosmolar hyperglycemic state (HHS) (2018 CPGs, chapter 15).
2. Patients with hyperglycemia in an intensive care unit (ICU) (2018 CPGs, chapter 16).

3. Patients with hyperglycemia newly admitted with a myocardial infarction (MI) or acute coronary syndrome (ACS) (2018 CPGs, chapter 27).
4. Patients having surgery (2018 CPGs, chapter 16).
5. Patients receiving continuous enteral (EN) or total parenteral (TPN) nutrition (2018 CPGs, chapter 16).

Note that these patients may or may not have a pre-existing diagnosis of diabetes. Patients with type 1 diabetes should not have IV insulin interrupted unless and until they are started on subcutaneous insulin which includes a basal insulin.

## How to write an IV insulin COS

1. Add a set amount of regular human insulin (Humulin R®, Novolin Toronto®) to a set amount of normal saline. For purposes of continuity and patient safety, this concentration should be consistent within a hospital or within a unit. Examples are 50 units in 250 mL saline (0.2 units / mL) or 100 units in 100 mL saline (1 units / mL). The first concentration is appropriate for most non-critically ill patients; the second concentration is often used in critically ill patients where minimization of infused IV fluid volume may be important.
2. Set a target blood glucose. The attached COS have a target blood glucose of 5.0 – 10.0 mmol/L for non-critically ill (surgical) patients; 6.0 – 10.0 for critically ill patients in ICU; and 7.0 – 10.0 for patients with an ACS.
3. Set a starting insulin infusion rate. This can be set based on current blood glucose, patient's weight, or patient's previous subcutaneous (SC) insulin requirements. The sample Acute Coronary Syndrome COS recommends starting the IV insulin at 5 units / hour. This was the starting dose used and proven to be effective in the DIGAMI trial (Malmberg, 1997).
4. Insulin rate adjustments are then managed within the COS algorithm. The insulin rate will "auto correct". If the blood glucose is above target, the insulin infusion rate will increase. If the blood glucose is below target or dropping rapidly, the insulin infusion rate will decrease. The algorithm will also determine when the

next bedside blood glucose monitoring (BBGM) check should occur. If the blood glucose is stable and at target, the interval between tests is extended, but never beyond 4 hours. If the blood glucose is unstable and / or not at target, the interval between tests is shortened, often to 30 or 60 minutes.

5. Safety measures must be in place for any patient receiving IV insulin. With the exception of patients being treated for a hyperglycemic emergency, all patients receiving IV insulin should be receiving at least some IV glucose (or continuous EN or TPN). A plan should be in place for nursing staff to recognize and treat symptomatic or asymptomatic hypoglycemia. This could involve IV glucose or oral glucose tablets, depending on the clinical situation.

## Frequently asked questions

### What are the goals for in-hospital glycemic control?

The 2018 CPGs suggest trying to obtain fasting and pre-meal BG between 5.0 and 8.0 mmol/L for most non-critically ill hospitalized patients with diabetes, whether treated with oral anti-diabetic therapy or SC insulin.

### When is subcutaneous insulin not used for a hospitalized patient?

Patients with good pre-existing glycemic control with noninsulin medications and in whom those medications are not contra-indicated (metformin with acute renal failure, metformin after contrast dye administration) could be continued on their current, outpatient therapy, while in hospital, while keeping a close eye on their bedside blood glucose monitoring (BBGM). Insulin could be started if these medications failed to continue to provide adequate glycemic control.

The 2018 CPGs recommendation is:

Provided that their medical conditions, dietary intake and glycemic control are stable, people with diabetes should be maintained on their prehospitalization noninsulin antihyperglycemic agents or insulin regimens.

Patients who are critically ill (DKA, intensive care, immediately post-myocardial infarction) are usually better treated with a continuous IV insulin infusion. Patients who are NPO for a brief period, like for surgery, are often treated with a continuous IV insulin infusion. Patients receiving TPN or continuous (enteral) tube feeds could be treated with either a continuous IV insulin infusion or scheduled SC insulin.

### What's wrong with correction insulin only?

Correction or supplemental insulin only (previously called sliding scale insulin therapy) is rapid- or fast-acting insulin alone, without basal insulin, and given only if the BBGM is above a certain level. It has been shown to be associated with worse glycemic outcomes and worse clinical outcomes than a scheduled basal-bolus-supplement insulin program (Miller, 2011; Umpierrez, 2007; Umpierrez, 2011). It treats hyperglycemia only after it has

occurred and is therefore not recommended as the sole insulin therapy. By contrast, a "supplemental" or "correction" insulin dose, in addition to scheduled basal +/- bolus or prandial insulin is recommended. An insulin COS should discourage / prevent the use of correction insulin only while making it easier to order basal-bolus-supplement insulin.

### What doses of insulin should be chosen?

Patients previously treated with insulin, at home, will usually continue their same dose in hospital. The BBGM can be followed closely and insulin dose adjustments can be made daily. Most hospital patients require QID insulin for optimal flexibility, minimization of hypoglycemia, and best outcomes. For insulin naive patients, clinical trials of basal-bolus-supplement insulin have generally started patients on a TDD of insulin of 0.3 – 0.6 units / kg / day. The lower doses are appropriate for older patients (over 70 years), patients with only modestly elevated BBGM on admission, insulin sensitive patients, or patients with impaired renal function. The higher doses are appropriate for insulin resistant patients, obese patients, patients with significantly elevated BBGM on admission, patients receiving glucocorticoids, or patients receiving TPN or enteral tube feeds.

Once the TDD is established, the individual doses can be set in one of three ways. Some authors recommend 50% of the TDD of insulin be administered as basal and then the rest divided evenly between the three meals – this is the 50:50 approach. Some authors recommend administering the insulin in a 1:1:1:2 ratio with the 1's representing the meal insulin doses (20% each) and the 2 representing the basal insulin at bedtime (40% of the TDD) – this is the 1:1:1:2 approach. In all cases, these are simply the starting insulin doses that then need to be adjusted daily based on the BBGM pattern and the patient's clinical condition.

The correction or supplemental insulin dose is calculated in this way: the insulin sensitivity factor (ISF) is the degree of blood glucose lowering expected from one unit of insulin. The ISF is calculated by dividing 100 by the TDD; so a patient receiving 50 units of insulin per day would have an ISF of 2.0 – 1 unit of insulin would be expected to lower the blood glucose by 2.0 mmol/L. A patient receiving 100 units of insulin per day would have an ISF of 1.0 – 1 unit of insulin to lower the BG by 1.0 mmol/L. When there are choices given for



supplemental / correction insulin doses those choices are usually based on the TDD calculations of this sort.

### **What types of insulin should be used in hospital?**

Generally, rapid-acting insulin analogues are recommended for the bolus / mealtime / prandial insulin and the correction (supplemental) insulin, in preference to regular human insulin. In all cases, the bolus and correction (supplemental) insulin should be the same. Any of the insulin analogues (aspart, glulisine, lispro, faster-acting aspart) can be used and they are roughly equivalent to one another. The basal / long-acting insulin can be NPH, insulin detemir, insulin glargine (or glargine 300), or degludec and is generally given once a day at hs.

Intravenous insulin should be regular human insulin diluted in normal saline (0.9% NaCl).

### **What about the patient who isn't eating?**

Generally, patients who are NPO should still receive their basal long-acting and their supplemental rapid-acting insulins, but not receive a scheduled bolus / mealtime / prandial insulin. Some facilities have a separate COS for the fasting / NPO patient; other facilities simply have an order box stating something like "hold prandial, give basal and supplemental insulin if patient is not eating or is NPO for test / procedure".

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# SAMPLE SUBCUTANEOUS INSULIN CLINICAL ORDER SET

Addressograph

## Adult Inpatient Acute

This subcutaneous (SC) insulin order set is for use on all adult inpatients unless there is an order set that is more appropriate (eg. critical care, obstetrics).

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### INVESTIGATIONS

#### Bedside Blood Glucose Monitoring

(BBGM) (mmol/L)

QID – AC meals, 2200h & prn

add 0200h x 3 days

other

### NON-INSULIN ANTIHYPERGLYCEMIC MEDICATIONS

#### Other non-insulin antihyperglycemic medications

discontinue (list all):

order (list all):

no change



### INSULIN CONSIDERATIONS

- Most patients should receive scheduled and supplemental/correction insulin
- If patient is on insulin pre-hospitalization, initial dose should be based on usual home insulin requirements
- If new to insulin:
  - 0.3 units / kg / day if age > 70 years or eGFR < 60 mg / mmol
  - 0.4 units / kg / day if random BG < 11.0 mmol/L
  - 0.5 units / kg / day if random BG > 11.0 mmol/L or BMI > 27 kg/m<sup>2</sup> or patient on glucocorticoid
  - 40-50% of total insulin dose is given as basal; balance as prandial / pre-meal bolus


### INSULIN

Discontinue all previous insulin orders

### SCHEDULED INSULIN

	Breakfast	Lunch	Supper	Bedtime / hs
<b>Basal</b> - Long-acting:	_____ units SC		_____ units SC	_____ units SC
<b>Prandial / bolus</b> - Short-acting:	_____ units SC	_____ units SC	_____ units SC	

**SCHEDULED INSULIN** continued

	<b>Breakfast</b>	<b>Lunch</b>	<b>Supper</b>	<b>Bedtime / hs</b>
<b>Premixed</b>	_____ units SC	_____ units SC	_____ units SC	

**SUPPLEMENTAL / CORRECTION INSULIN** (Should be the same type/brand as prandial insulin)

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> No correction                 | <input type="checkbox"/> Humalog® (lispro)          | <input type="checkbox"/> Novolin® ge Toronto (human regular) |
| <input type="checkbox"/> Apidra® (glulisine)           | <input type="checkbox"/> Humalog® 200 (lispro)      | <input type="checkbox"/> NovoRapid® (aspart)                 |
| <input type="checkbox"/> FiAsp® (faster-acting aspart) | <input type="checkbox"/> Humulin® R (human regular) |  |

	<input type="checkbox"/> Insulin sensitive < 40 units / day of scheduled insulin	<input type="checkbox"/> Standard 40 – 80 units / day of scheduled insulin	<input type="checkbox"/> Insulin resistant > 80 units / day of scheduled insulin	<input type="checkbox"/> Customized
<b>BBGM (mmol/L)</b>	<b>AC meal</b>	<b>meal</b>	<b>meal</b>	<b>meal</b>
< 4.0	Follow hypoglycemia protocol			
4.1-8.0	Give scheduled insulin			
8.1 – 10.0	0 units	1 units	2 units	
10.1 – 12.0	1 units	2 units	4 units	
12.1 – 14.0	2 units	3 units	6 units	
14.1 – 16.0	2 units	4 units	8 units	
16.1 – 18	3 units	6 units	12 units	
18.1 – 20	4 units	7 units	14 units	
> 20	Contact prescriber for orders if BG > 20 mmol/L.			

Signature, Designation:	College License#:	Date:	Time:
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# SAMPLE IV INSULIN CLINICAL ORDER SET

Addressograph

## Adult Inpatient Acute

This IV insulin order set is for use on all acute adult inpatients unless there is an order set that is more appropriate (eg. critical care, obstetrics).

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- Discontinue all previous insulin, non-insulin antihyperglycemic agents and Bedside Blood Glucose Monitoring (BBGM) orders
- Hold insulin if IV dextrose/glucose, TPN or tube feed stopped for greater than 1 hour. Notify MD ordering insulin for further orders

### PATIENT POPULATION

- Patients who are NPO or unpredictable PO intake and receiving IV dextrose/glucose, TPN or continuous tube feeds
- NOT for peripartum use, Diabetic Ketoacidosis (DKA) or hyperosmolar hyperglycemic state (HHS)

### INVESTIGATIONS

#### Ongoing Capillary Blood Glucose Monitoring

##### Blood Glucose (mmol/L)

Less than 4

4.1 to 5

5.1 to 10

10.1 to 14

Greater than 14.1

##### Monitoring frequency

q 15 minutes

q 30 minutes

q 60 minutes,

THEN reduce to q 2 hours if no infusion rate change for 3 consecutive q 60 minute checks,

THEN reduce to q 4 hours if no infusion rate change for 3 consecutive q 2 hour checks

q 60 minutes

q 30 minutes

### INSULIN

#### Starting insulin dose:

- Mix 50 units regular human insulin in 100 mL 0.9% sodium chloride for 0.5 unit/mL OR
- Mix 100 units of regular human insulin in 100 mL 0.9% sodium chloride for 1 unit/mL

**(Please select one of the above insulin mixtures to preprint for your institution to avoid prescriber need to complete)**

- If previously on insulin: total daily insulin dose x 0.5 = \_\_\_\_\_ units/24 hours = \_\_\_\_\_ unit/h
- If insulin-naive: weight \_\_\_\_\_ kg x 0.02 = \_\_\_\_\_ unit/h
- Other: \_\_\_\_\_ unit/h

- Prime the IV line with insulin solution and let it stand for 15 minutes (if time permits). Then flush 20 mL of solution through the line prior to connecting to the patient

## MAINTENANCE INSULIN IV INFUSION

Adjustment based on current and previous glucose values as follows:

<b>Current value</b> Bedside Blood Glucose (mmol/L)	<b>INCREASE in glucose</b> Current value higher than previous	<b>SMALL DECREASE in glucose</b> Current value lower than previous by less than 3 mmol/L	<b>MODERATE to LARGE DECREASE in glucose</b> Current value lower than previous by 3 mmol/L or greater
< 4	Stop infusion, treat per hospital hypoglycemia protocol. Repeat blood glucose monitoring in 15 minutes. Resume infusion at x 0.5 of previous rate when blood glucose greater than or equal to 5 mmol/L.		
4 – 5.9	Reduce rate by 1 unit/h	Reduce rate by 1 unit/h	Reduce rate by x 0.5
6 – 10 (target)	No change in rate	No change in rate	Reduce rate by x 0.5
10.0 – 12	Increase rate by 0.5 unit/h	Increase rate by 0.5 unit/h	Reduce rate by 1 unit/h
12.1 – 15	Increate rate by 1 unit/h	Increate rate by 1 unit/h	No change in rate
15.1 – 18	Increase rate by 2 unit/h	Increase rate by 2 unit/h	No change in rate
>18	Increase rate by 3 unit/h	Increase rate by 3 unit/h	No change in rate
	Notify physician ordering insulin.		

Signature, Designation:

College License#:

Date:

Time:

# SAMPLE INSULIN INFUSION CLINICAL ORDER SET

## Critical Care Adult

Addressograph

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### PATIENT POPULATION

- Appropriate for use in patients with pre-existing diabetes
- Appropriate for use in patients without pre-existing diabetes who have stress hyperglycemia (blood glucose greater than 10 mmol/L)
- Do not use in patients with diabetic ketoacidosis (DKA) or hyperglycemic hyperosmolar non-ketotic state

### INITIAL INSULIN INFUSION RATE

- Discontinue all previous insulin orders and anti-hyperglycemic medication orders
- Mix 100 units Regular (Human) insulin in 100 mL 0.9% sodium chloride (0.9% NaCl)
- Prime the IV line with insulin solution and let it stand for 15 minutes (if time permits). Then flush 20 mL of solution through the line prior to connecting to the patient
- Check capillary blood glucose (CBG) and initiate IV insulin infusion **NOW** using table below

Blood glucose (mmol/L)	Regular Insulin Infusion Rate (units/h)
Less than 5	Hold, start infusion when CBG is 5 mmol/L or more
5.1 to 8	0.5
8.1 to 10	1
10.1 to 13	2
13.1 to 16	3
16.1 to 20	4
Greater than 20	5

### IV MAINTENANCE LINE

If **NOT** receiving PO intake or parenteral or enteral nutrition, piggyback insulin infusion into (choose one):

- Dextrose 5% and 0.9% sodium chloride (0.9% NaCl) IV at 100 mL/h
- Dextrose 5% and 0.45% sodium chloride (0.45% NaCl) IV at 100 mL/h
- D5W at 100 mL/h
- D10W at 50 mL/h
- Other: \_\_\_\_\_

### CAPILLARY BLOOD GLUCOSE MONITORING

#### Initial Capillary Blood Glucose Monitoring

- Capillary blood glucose (CBG) measurements less than 2.5 mmol/L or greater than 25 mmol/L should be verified with an arterial or venous or whole blood sample STAT
- Check CBG q 30 minutes for 1 hour upon initiation of insulin infusion

## Ongoing Capillary Blood Glucose Monitoring

Blood Glucose (mmol/L)	Monitoring frequency
Less than 4	q 15 minutes
4.1 to 5	q 30 minutes
5.1 to 10	q 60 minutes, THEN reduce to q 2 hours if no infusion rate change for 3 consecutive q 60 minute checks,
10.1 to 14	THEN reduce to q 4 hours if no infusion rate change for 3 consecutive q 2 hour checks
Greater than 14.1	q 60 minutes q 30 minutes

- If tube feeds or parenteral nutrition are stopped or decreased, change frequency of CBG monitoring to q 30 minutes for 3 hours and notify physician to consider initiating a dextrose containing intravenous solution

## INSULIN INFUSION RATE ADJUSTMENT

- Target blood glucose: 8 to 10 mmol/L
- Adjust rate of insulin infusion according to the chart below:

Current blood glucose (mmol/L)	Change in blood glucose since the prior reading					
	DECREASED BY			INCREASED BY		
	More than 1.5 mmol/L	0.6 to 1.5 mmol/L	0 to 0.5 mmol/L	0 to 0.5 mmol/L	0.6 to 1.5 mmol/L	More than 1.5 mmol/L
Less than 5	<b>HOLD INSULIN INFUSION</b> , implement hypoglycemia order set if blood glucose less than 4 mmol/L. Resume IV insulin infusion at X 0.25 of the previous rate when blood glucose is greater than or equal to 5 mmol/L.					
5.1 to 6	X 0.25	X 0.5	X 0.75	X 0.75	No change	X 1.25
6.1 to 8	X 0.5	X 0.75	No change	No change	No change	X 1.25
8.1 to 10	X 0.75	No change	No change	No change	X 1.25	X 1.5
10.1 to 12	No change	No change	X 1.25	X 1.25	X 1.5	X 2
12.1 to 20	No change	X 1.25	X 1.5	X 1.5	X 2	X 2
Greater than 20	<b>NOTIFY PHYSICIAN</b>					

Signature, Designation:	College License#:	Date:	Time:
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# SAMPLE HYPOGLYCEMIA CLINICAL ORDER SET

## Adult

Addressograph

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### DEFINITIONS:

**Mild hypoglycemia** = autonomic symptoms (trembling, palpitations, sweating, anxiety, hunger, nausea, tingling) and person has the ability to self-treat; generally capillary blood glucose 3.4 – 3.9 mmol/L.

**Moderate hypoglycemia** = autonomic and neuro-glycopenic symptoms (difficulty concentrating, confusion, weakness, drowsiness, vision changes, difficulty speaking, headache, dizziness, tiredness) and person has the ability to self-treat; generally capillary blood glucose < 3.4 mmol/L.

**Severe hypoglycemia** = person requires the assistance of another person and may be unconscious; generally capillary blood glucose < 2.8 mmol/L.

### TREATMENT:

#### Mild to moderate hypoglycemia:

15 grams of carbohydrate (CHO) as glucose or sucrose tablets. Customize ( \_\_\_\_ tablets) according to dextrose tablet stocked in hospital (**please preprint for your local institution to avoid prescriber needing to complete**).

Alternatives include 15 – 20 grams of glucose as glucose gel tube or 150 mL (2/3 cup) of juice or regular soft drink.

Retest capillary blood glucose in 15 minutes and repeat treatment if capillary blood glucose remains < 4.0 mmol/L.

For renal patients, glucose tablets are preferred.

#### Severe hypoglycemic (conscious):

20 grams of carbohydrate (CHO) as glucose or sucrose tablets. Customize ( \_\_\_\_ tablets) according to dextrose tablet stocked in hospital (**please preprint for your local institution to avoid prescriber needing to complete**).

Alternatives include 20 grams of glucose as glucose gel tube or 250 mL (1 cup) of juice or regular soft drink. Retest capillary blood glucose in 15 minutes and repeat treatment if capillary blood glucose remains < 4.0 mmol/L. For renal patients, glucose tablets are preferred.

Retest capillary blood glucose in 15 minutes and repeat treatment if capillary blood glucose remains < 4.0 mmol/L. For renal patients, glucose tablets are preferred.

#### Severe hypoglycemia (unconscious):

Call Code. If IV access available: 25 g IV glucose, given as 50 ml of D50W over 1 to 3 minutes. Repeat capillary blood glucose in 10 minutes and repeat IV glucose treatment if capillary blood glucose remains < 4.0 mmol/L. If no IV access available, give 1 mg glucagon SC or IM. Establish IV access. Repeat capillary blood glucose in 10 minutes and give IV glucose if capillary blood glucose remains < 4.0 mmol/L. A repeat dose of glucagon should not be given.

Once the hypoglycemia has been reversed with the fast-acting treatment described above, the person should eat their usual meal or snack to prevent repeated hypoglycemia. A snack including 15 grams CHO (4-6 crackers or 1 slice of bread) and a protein source (1 tbsp peanut butter or 1-2 oz cheese or meat) is recommended if a meal is more than one hour away. All cases of hypoglycemia should be documented. Repeated mild episodes or any severe hypoglycemic episode requires medical re-evaluation at the earliest possible opportunity.

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Date:

Time:

# SAMPLE INSULIN INFUSION CLINICAL ORDER SET

## Acute Coronary Syndrome: Initial Management

Addressograph

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### PATIENT POPULATION

- For newly admitted patients, with acute coronary syndrome within the preceding 24 hours, and a random blood glucose greater than 11 mmol/L
- Target blood glucose 7 to 10 mmol/L

### INVESTIGATIONS

On admission (if not already done in ER) ⇒ Blood glucose drawn by lab

Investigations Day 1 ⇒ HbA1c with first AM blood work

Daily Investigations ⇒ Daily serum potassium x 3 days

### DIABETES MANAGEMENT

- Discontinue all previous diabetic therapies, including insulin and oral antihyperglycemic agents
- Start initial glucose/insulin therapy once the patient has been admitted to the CCU/telemetry area
- Mix 50 units regular human insulin in 250 mL 0.9 % sodium chloride for 0.2 unit/mL
- If blood glucose greater than 11 mmol/L start IV insulin infusion at 5 units/h
- Bedside Blood Glucose check one hour after starting insulin/glucose infusion then go to Table 1

### TABLE 1:

Instructions for first Bedside Blood Glucose Monitor (BBGM) check one hour after starting insulin/glucose infusion.

Blood Glucose (mmol/L)	Infusion Rate Change	Bolus Dose	Repeat Blood Glucose
Greater than 11 mmol/L	No Change	–	1h, then go to Table 2
7 to 11 mmol/L	Decrease infusion to 4 units/h	–	1h, then go to Table 2
4 to 6.9 mmol/L	Decrease infusion to 3 units/h	–	1h, then go to Table 2
Less than 4 mmol/L	<ul style="list-style-type: none"> <li>• Decrease infusion to 2 units/h</li> <li>• Call physician managing diabetes</li> <li>• Follow hospital hypoglycemia protocol</li> </ul>	50 mL D10W IV	1h, then go to Table 2

TABLE 2:

Instructions for all Bedside Blood Glucose Monitor (BBGM) checks after the first hour.

Blood Glucose (mmol/L)	Infusion Rate Change	Bolus Dose	Repeat Blood Glucose
Greater than 15 mmol/L	Increase infusion by 1 unit/h	8 units regular human insulin IV	1h
11 to 15 mmol/L	Increase infusion by 0.5 units/h	-	1h
7 to 10.9 mmol/L	No change	-	2h
4 to 6.9 mmol/L	Decrease infusion by 1 unit/h	-	1h
Less than 4 mmol/L	<ul style="list-style-type: none"> <li>• Stop infusion</li> <li>• Call physician managing diabetes</li> <li>• Follow hospital hypoglycemia protocol</li> </ul>	50 mL D10W IV Repeat bolus q30minutes until blood glucose results greater than 7 mmol/L	q30 minutes until glucose greater than 7 mmol/L, then restart infusion at 1 unit/h less than the rate before infusion stopped

- Discontinue IV insulin infusion after 24 hours or, on the clinical order of physician managing diabetes.
- Thereafter, follow handwritten orders or subcutaneous insulin clinical order set; physician managing diabetes to complete.

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Date:

Time: