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## Perspectives In Practice

Achieving Glycemic Control in Special Populations in Hospital:  
Perspectives in Practice

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## ABSTRACT

Achieving and maintaining glycemic control in patients with diabetes admitted to hospital is challenging because of the many competing factors of nutrition, pharmacotherapy and other patient-related and systemic factors. For patients receiving enteral or parenteral feeding, eating irregularly or receiving glucocorticoid therapy, the challenges are even greater. The basic principles to follow when managing glycemia in these populations are as follows: 1) Recognition of those at risk for hyperglycemia; 2) frequent bedside glucose monitoring; 3) a proactive approach with routine insulin administration based on the predicted glucose patterns; 4) constant reassessment of the glycemic status and titration of the routine insulin accordingly.

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## R É S U M É

L'atteinte et le maintien de la régulation glycémique chez les patients souffrant de diabète qui sont admis à l'hôpital posent des difficultés en raison des multiples facteurs concurrents, de la pharmacothérapie, et des autres facteurs liés aux patients et des facteurs généraux. Chez les patients recevant une alimentation entérale ou parentérale, mangeant de manière irrégulière ou recevant un traitement par glucocorticoïdes, les difficultés sont encore plus importantes. Les principes de base à suivre lors de la prise en charge de la glycémie de ces populations sont les suivantes : 1) la détection de ceux qui sont exposés à un risque d'hyperglycémie; 2) la surveillance fréquente de la glycémie au chevet du patient; 3) une approche proactive de l'administration systématique de l'insuline selon les modèles de prédiction de la glycémie; 4) la réévaluation constante de l'état glycémique et par conséquent le dosage systématique de l'insuline.

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## Introduction

The Canadian Diabetes Association 2013 Clinical Practice Guidelines (1) provide recommended glycemic targets for people with diabetes admitted to hospital, which are consistent with those from other organizations (2). In the non-critically ill patients, recommended preprandial glucose targets are 5.0 to 8.0 mmol/L and random glucose targets of <10.0 mmol/L (1). However, achieving and maintaining those glycemic targets can be challenging due to a number of system- and patient-related factors (3). Certain populations within the hospital setting are particularly challenging when one attempts to achieve and maintain glycemic control because of their changing nutritional statuses or treatments. Specifically, these special populations include 1) patients on enteral or

parenteral feeds; 2) patients with variable eating patterns; and 3) patients taking glucocorticoids. Unfortunately, there is also a paucity of evidence to inform best practices for these populations, and research is required to answer management questions definitively (3). Until that research is done, it is still important to try to achieve glycemic control in these populations, and the use of the following basic principles will ensure the best results: 1) Recognition of those at risk for hyperglycemia; 2) frequent bedside glucose monitoring; 3) a proactive approach, with routine insulin administration based on the predicted glucose patterns; 4) constant reassessment of the glycemic status and titration of the routine insulin accordingly. This article focuses on providing practical tips for striving to achieve these goals.

## Patients on Enteral or Parenteral Feeds

Hyperglycemia is a common complication of both enteral (via nasogastric or gastric tube) and parenteral (total parenteral

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nutrition [TPN]) feeding in those with or without diabetes (4–6). In addition, the presence of hyperglycemia in those receiving enteral or parenteral feeding is associated with poor outcomes, including infections, renal failure and mortality (4,7–10). Although there are no prospective randomized controlled trials showing the benefits of intensive glycemic control in this population, some studies have shown benefits of a blood glucose target  $<8.3$  mmol/L (11,12), which would be consistent with the general glucose targets recommended by the Canadian Diabetes Association.

### Enteral feeding

There are 2 strategies for addressing hyperglycemia of enteral feeding: adjustment of the enteral feed carbohydrate content or use of pharmacologic therapy to lower the glucose levels (13). Any adjustment of the enteral feed carbohydrate content should be made in consultation with the dietitian who will take into account the nutritional needs of the patient, given that the proper use of enteral and parenteral feeds have been shown to improve certain clinical outcomes (14). Therefore, a person with diabetes should not be deprived of these benefits simply to improve glycemic control. In terms of pharmacologic therapy to lower the glucose levels, to date, there has been only 1 published randomized controlled trial of insulin regimens for enteral feeding (15). This open-label, randomized controlled trial of 50 non-critically ill hospitalized patients on enteral feeding compared sliding-scale regular insulin (SSRI) alone to the combination of basal insulin (glargine) plus SSRI. The SSRI group received regular insulin subcutaneously every 4 to 6 hours, according to bedside glucose monitoring. The combination group was started on 10 units of glargine insulin once daily, which was titrated daily until targets were achieved. For those who were already on insulin when entering the study, the usual dose of basal insulin was continued. In addition, the combination group received SSRI as needed. The glucose target for both groups was 5.6 to 10.0 mmol/L, while avoiding hypoglycemia. After a mean duration of participation of 6 days, no differences in glycemic measures were noted between the groups. However, 48% of the SSRI group required rescue insulin therapy with neutral protamine Hagedorn (NPH) to address persistent hyperglycemia. There was no difference between the groups for hypoglycemia or total daily insulin (27 units or 0.33 units/kg). Therefore, this small, randomized controlled study proved that most patients receiving enteral feeding require basal insulin to manage glycemia effectively and that it can be done safely in this population.

### Practical tips

Patients receiving continuous enteral feeding are at high risk for developing hyperglycemia. Since the feeding is usually continuous, it makes sense to provide continuous insulin coverage. However, when there are interruptions in the feeding, the insulin coverage must be adjusted or glucose must be provided to compensate for this. Intravenous insulin is an effective way to do this (16), but it may not be practical in most institutions, outside of a critical care setting. Therefore, the suggested approach to hyperglycemia in a patient receiving enteral feeding is the following:

1. Monitor bedside glucose every 4 to 6 hours
2. In consultation with a dietitian, determine whether any changes can be made to the type of enteral nutrition to adjust the carbohydrate content safely
3. Start routine basal insulin
  - a. If the patient is on insulin at home, then continue the usual basal dose
  - b. If the patient is naive to insulin, there are 2 ways to determine the appropriate starting dose

- i. Start at 50% of the estimated total daily insulin requirement (0.5 units/kg) and then titrate daily until the target has been achieved
- ii. Start at 10 units of basal insulin and then increase daily by 50% of the amount of correction dose insulin required in the prior 24 hours (15) until the target has been achieved

4. Start correction dose bolus insulin algorithm subcutaneously to avoid escalating hyperglycemia and to provide information on the amount of titration required of the routine dose of basal insulin
5. Ensure continued communication with the team to adjust the insulin doses as nutritional status changes (i.e. change in feed type or interruption of feeds)
  - a. If feeds are interrupted, consider starting an intravenous dextrose infusion to compensate and increase frequency of monitoring and/or consider reducing the next dose of basal insulin, depending on when the feeds will be resumed (Appendix figure 1).

### Appendix 1. Case example of insulin dosing for enteral feeding.\*

A 72-kg man with type 2 diabetes who was naive to insulin was started on continuous enteral feeds and was found to have hyperglycemia.

Estimated total daily insulin requirement  
 $= (0.5 \text{ units/kg}) \times 72 \text{ kg}$   
 $= 36 \text{ units}$

#### Options for starting dose of routine basal insulin:

- a. Total daily insulin  $\times$  50% = basal requirement =  $36 \times 50\% = 18$  units
  - i. 18 units of long-acting basal analogue insulin (determir or glargine) subcutaneously once daily, OR
  - ii. 9 units of intermediate-acting basal insulin (N or NPH) subcutaneously every 12 hours, OR
  - iii. 18 units to be given intravenously at  $18/24 = 0.8$  units per hour
- b. Order 10 units of basal insulin subcutaneously

#### Titration of routine basal insulin:

Increase the routine basal insulin by 50% of the dose of correction insulin required on the previous day. For example:

Day 1: 10 units of correction insulin was required  
 Day 2: Increase the dose of routine basal insulin by 5 units ( $10 \text{ units} \times 50\%$ )

#### Provide adjustments in the case of feeding interruptions:

- a. Stop all basal insulin and use correction insulin scale only
- b. provide source of glucose as needed depending on type and timing of basal insulin administration prior to the feed interruption

\*See text for complete management.

### Parenteral feeding

Although the use of parenteral feeding (TPN) has been shown to be cost-effective for reducing adverse clinical outcomes in patients with a number of conditions, including critical illness, pancreatitis, burns and abdominal surgery (6), it is also associated with significant hyperglycemia, which has been linked with increased mortality and other complications (4,7–9). A recent multicentre study in Spain of 605 non-critically ill patients receiving TPN showed that those with mean blood glucose levels  $>10$  mmol/L were 5.6 times more likely to die than those with mean blood glucose levels  $<7.8$  mmol/L (17). To limit the hyperglycemia in TPN, as with enteral feeding, the 2 strategies to consider include alteration of the carbohydrate content of the TPN solution or use of insulin to control the glucose levels. The carbohydrate used in TPN is glucose and in

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