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A Review of Optimized Insulin Regimens used in Long-Term Care Facilities and Residential Homes

Focus on Sliding Scale versus Supplemental Scale

Insulin is vital for patients with Type 1 Diabetes and has become the gold standard for Type 2 Diabetes patients whose insulin resistance has gradually been replaced with insulin deficiency.

But what factors assist in contributing to improved glucose control and reduction of long term complications?

The list includes lifestyle management, proper medication regimens including refined insulin analogues; knowledge of insulin pharmacodynamics (onset of action, peak and duration of action); improved insulin injection technique with engineered small fine needles. Management of diabetes Type 1 and Type II requires multiple adjustments in medications along the years to help the person with diabetes achieve optimum control - thus complication "prevention." CDA Clinical Practice Guidelines 2013 introduced an additional chapter, which reviews diabetes in the elderly. There is no doubt that no matter the age, healthy elderly persons with diabetes should be treated to achieve the same glycemic, blood pressure and lipid targets as younger people with diabetes to prevent long-term complications. ¹ These targets become less rigid for those residents who are frail and dependent on others for activities of daily living where it is essential to prevent wide variations in blood glucose levels, preventing hyperglycemia and hypoglycemia and preserving quality of life. ^{1 2}

As per *Individualizing Diabetes Care for Long-Term Care Residents: A Guidebook*, the suggested therapeutics targets are:

<ul style="list-style-type: none"> • Dependent • Mobile • Good Cognition • Relatively long-life expectancy 	<ul style="list-style-type: none"> • A1C \leq 7.5% • BP < 130/90 mmHg • LDL \leq 2.0 mmol/L
<ul style="list-style-type: none"> • One or Two Person Assist • Using mobility aids • Cognitively Impaired • Short Life Expectancy • Multiple disease stated 	<ul style="list-style-type: none"> • A1C \leq 8.5% • Avoid hypoglycemia and severe hyperglycemia • Avoid intrusive monitoring • Symptom Control • BP < 150/90 mmHg



Care Plans require fixing the glycemic targets and keep the well-being of your resident in mind as an individual.

From one group to another there is consensus to individualize the glycemic target to minimize short-term complications with fasting and pre-prandial meal blood glucose ranging from 5.0 to 12.0 mmol/L thus the importance of reviewing the glycemic targets with the prescriber/clinician.

Summary of Recommendations for the Older Resident and the Frail/Older Resident²

	Older Resident		Frail/Older Resident	
	A1c (%)	Fasting Blood Glucose	A1c	Fasting Blood Glucose
European Diabetes Working Group 2011	7 % to 7.5%	6.5 to 7.5 mmol/L	7.6% to 8.5%	7.6 to 9 mmol/L
CDA 2008 , Revised 2013	7% or lower. *	4.0 to 7.0 mmol/L	Up to 8.5%	5.0 to 12.0 mmol/L Fasting and pre-prandial meal
Diabetes in Older Adults 2012	7.5% to 8.0%	5.0 to 8.3 mmol/L	Less than 8.5%	5.5 to 10.0 mmol/L

The Clinical Frailty Scale is often used to determine the level of frailty of individuals over 65 years old. ⁴

* Goals can be less stringent in those with multiple comorbidities, high levels of functional dependency or limited life expectancy

Hypoglycemia²

The most important issue to address when attempting to achieve treatment targets in the elderly population is to prevent hypoglycemia as much as possible even if that means higher blood glucose. Cognitive dysfunction in the elderly has also been identified as a significant risk factor for the development of severe hypoglycemia. Beta Blockers, which are commonly prescribed for the elderly may blunt the early symptoms of hypoglycemia (neurogenic or adrenergic symptoms) which include: trembling, palpitations, sweating, anxiety, hunger, nausea, tingling. This puts the patient at risk of severe hypoglycemia (blood glucose \leq 2.8mmol/L) with neuroglycopenic symptoms: confusion, weakness, drowsiness, vision changes, difficulty speaking, dizziness, headache.

Regimens

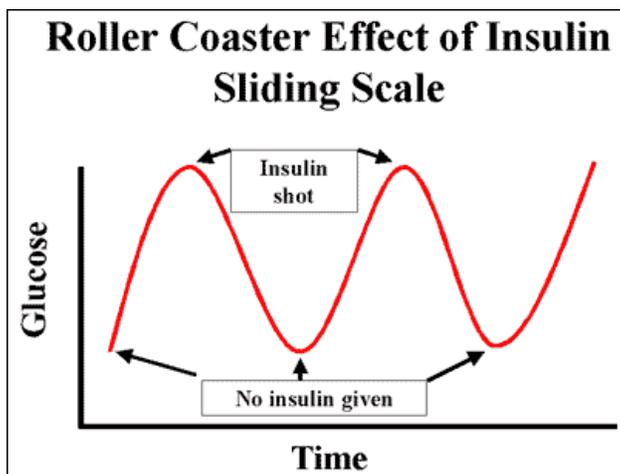
Best practice guidelines now recommend the use of structured insulin regimens with three components:

- Basal insulin
- Meal time insulin
- Supplemental Insulin

Supplemental Insulin is a newer concept also known as correction dose. When insulin is required, regimens combining these components have been shown to reduce fluctuations and increase the number of days residents maintain acceptable blood glucose levels.

Basal -bolus -supplemental insulin requires the health care providers to recognize hypoglycemia and understand treatment of hypoglycemia.

→ Basal insulin = background insulin for the day → Bolus insulin= prandial (pre meal) insulin



Supplemental insulin adds rapid or short acting insulin (usually rapid insulin) to an existing regimen that includes basal/bolus insulin, or basal insulin with or without oral medications.² It discourages the use of two different Rapid acting insulin (ex. Apidra as pre-meal insulin and NovoRapid as supplemental insulin).

The sliding scale is defined as a reactive approach rather than a proactive approach. It is a practice where the health care provider gives rapid-acting insulin or short-acting insulin multiple times a day based on blood glucose levels. This practice puts the resident at risk of hypoglycemia and hyperglycemia leading to roller coaster's values. According to the 2012 update of the *Beers List of Potentially Inappropriate Medications for Frail/Older Residents* the use of sliding scale is to be avoided.⁵ It is best to consider starting the resident on a Basal insulin at 0.1 unit/kg/day (5 to 10 units) or calculate the daily dose of the sliding scale and start at 50% dose of a Basal insulin.

Regimens	
Oral Medications	Metformin*, DPP-4 inhibitors* (sitagliptin, linagliptin, satagliptin), gliclazide*, meglitinide (Gluconorm)**
Basal Insulin + Oral Medications	Lantus, Levemir, NPH + Oral Medications
Basal / Plus + Oral Medications	Basal/ Rapid or Short Acting Insulin*** at ONE meal only+ Oral Medications
Basal /Bolus + Oral Medications	Basal/ Rapid or Short Acting Insulin*before each meal + Metformin
Basal + Oral Medications + Supplemental Scale	Basal + Oral medications + Rapid or Short Acting Insulin* as supplemental scale ****
Basal /Plus + Supplemental Scale	Basal/Plus + Rapid or Short Acting Insulin * as supplemental scale ***

*Oral medications dosages require adjustment according to the resident's renal function.¹

**Gluconorm is safe in the elderly and can be used in all stages of CKD

***Rapid-Acting insulin is preferred to short-acting insulin because of its quickest onset of action (15 minutes versus 30 minutes) and the fact it can also be administered while the resident is eating or right after his/her meal in case of unpredictable appetite.

****The supplemental insulin should be the same type as the bolus insulin so usually a rapid acting analogue (Apidra, Humalog, NovoRapid)

Two scenarios

1. Resident with Basal Insulin only (Lantus Solostar 16 units at 2000hrs) may require supplemental dose of bolus insulin prior to meals to maintain blood glucose level under 10mmol/L.
2. Resident with Basal Insulin (Lantus 40 units at 2000hrs) along with meal time insulin (NovoRapid FlexTouch 12 units before breakfast, 12 units before lunch and 10 units before supper) may require supplemental dose of insulin to maintain pre-meal blood glucose levels < 10mmol/L)

Insulins Available in Canada

Class	Drug	Onset	Peak	Duration
Rapid acting Insulin Analogue	Aspart (NovoRapid) Glulisine (Apidra) Lispro (Humalog)	10-15 min.	60-90 min	3-5 h.
Short-acting Human Insulin	Regular Insulin (Humulin R &Novolin ge Toronto)	30 min.	2-3 h.	6.5 h.
Intermediate acting Human Insulin	Humulin N Novoin ge NPH	1-3 h.	5-8 h.	Up to 18 h.
Long-acting basal Insulin Analogue	Detemir (Levemir) Glargine (Lantus)	90 min	Not applicable	16-24 h. 24 h.
Mixed Regular/NPH human insulin	Humulin 30/70 Novolin ge 30/70, 40/60, 50/50	30 min	One part peaks at 2-3h and the other part peaks at 5-8 h	Up to 18 h.
Mixed Insulin Analogue	Lispro/Lispro protamine (Humalog Mix 25, Humalog Mix 50) Biphasic Insulin Aspart (Novomix 30)	10-15 min	One part peaks at 60-90 min. and other part peaks at 5-8h.	Up to 18h.

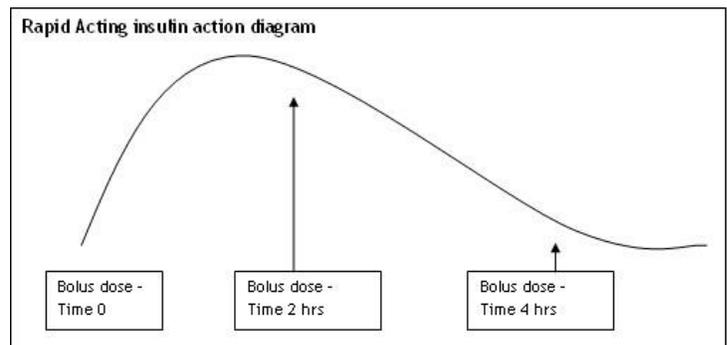
Insulin works based on onset of action, peak of action and duration of action.

Example:

Rapid acting Insulin Analogue (Humalog, NovoRapid or Apidra)

- Starts: 10-15 minutes
- Peaks at: 1 to 1.5 hours
- Out of your body: 3 to 5 hours

At 2 hours approximately 50 to 60 per cent of the bolus dose is used. There is still about 40 to 50 per cent of the dose remaining to lower blood sugars.³



Blood Glucose Monitoring

Optimizing glucose levels provides a foundation for a better quality of life. Glucose testing helps detect hypoglycemia and prolonged hyperglycemia. The frequency of blood glucose monitoring should be determined on an individual basis. The frequency of blood glucose monitoring depends on the type of diabetes, treatment used, nutritional intake, exercise, and any changes in health status.

The definition of hypoglycemia is less than 4.0 mmol/L. The definition of prolonged hyperglycemia will depend on the individualized targets for a particular resident. In most cases, blood glucose values of 14.0 mmol/L or higher for more than one value may be used to describe prolonged hyperglycemia.

When residents are discharged from the hospital and re-admitted to the home the supplemental scale should be in most circumstances discontinued while blood glucose testing continues to be done prior to each meal and at bedtime for a period of 3-4 days. Bedtime blood glucose reading is 2 ½ to 3 hours after supper. Give any evening snacks AFTER the blood glucose reading is taken. If using supplemental scale insulin, avoid the use of rapid and short acting bolus insulin at bedtime.

Ensure that orders for increases in blood glucose testing and/or supplemental insulin dose are temporary and reviewed frequently, at least weekly.

Instances where increased testing is required ²

- Illness
- Infection such as urinary tract infection (UTI)
- Post-Surgery
- Falls
- Change in nutritional intake
- Behavioural changes
- Change in diabetes medications, especially sulphonylureas, gliclazide, glyburide (not recommended in elderly population) OR insulin
- Oral steroids such as prednisone or dexamethasone

A brief review of the use of Supplemental Scale versus Sliding Scale as of September 25, 2015

Basal	15
Basal & Suppl.	2
Basal Plus	2
Basal Plus & Suppl.	0
Basal Bolus	1
Basal Bolus & Suppl.	3
Mix Insulin (Ex. Novolin ge 30/70)	7
Sliding Scale	1

Total Residents: 330

36 residents receive medication in the form of oral anti hyperglycemic agents to control diabetes and

31 residents receive Insulin with or without oral anti hyperglycemic agents to control diabetes

Suppl.=Supplemental Scale Insulin

In Short

Supplemental Scale is used in circumstances where the resident with diabetes, already on insulin (Basal alone, Basal/Plus or Basal/Bolus), may require supplemental dose of rapid-acting insulin before meals.

Suggest using the correct terminology (supplemental Dose or Correction Dose). Do not use the term sliding scale in lieu of supplemental dose

A sliding scale is a bolus insulin or PRN rapid or short acting insulin prescribed in the absence of routine insulin: Sliding Scale causes wider variation in blood glucose than supplemental Scale

Supplemental Scale should include blood glucose testing before each meal to determine the need for additional bolus insulin to address the glucose load from the upcoming meal.

Supplemental Scale is temporary and to be used with caution.

Always adjust current therapy by incorporating data from the supplemental scale usage.

Supplemental Scale should be avoided at bedtime, remembering that many blood glucose tests at bedtime are in fact a postprandial supper value which will be naturally higher.

Avoid Hypoglycemia with healthcare provider knowledge of recognition and management of hypoglycemia

Residents at risk of hypoglycemia should have ready access to an appropriate source of glucose at all times.

Although it may be recommended to hold rapid acting or short acting insulin when the resident is not eating, Basal Insulin should not be held especially in Type I Diabetes.

References

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