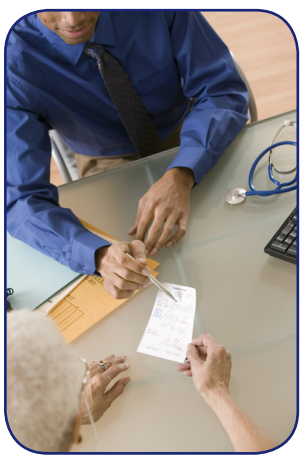
Canadian Agency for Drugs and Technologies In Health

Guide to Starting and Adjusting Insulin for Type 2 Diabetes*



www.cadth.ca

Supporting Informed Decisions

Many people with **type 2** diabetes need insulin therapy. A variety of regimens are available. Here are some tips when discussing insulin therapy:[1]

- Discuss insulin early to change negative perceptions (e.g., how diabetes changes over time; insulin therapy as a normal part of treatment progression).
- To encourage patient buy-in, it may be more strategic initially to begin with a regimen that will be the most acceptable to the patient even if it may not be the clinician's first choice (e.g., pre-mixed instead of basal-bolus regimen).[2]
- Provide information on benefits (e.g., more "natural" versus pills, dosing flexibility).
- Consider suggesting a "trial" (e.g., for one month).
- Compare the relative ease of using newer insulin devices (e.g., pen, smaller needle) versus syringe or vial.
- Ensure patient is comfortable with loading and working a pen (or syringe).
- Link patient to community support (e.g., Certified Diabetes Educator [CDE] for education on injections and monitoring; nutrition and physical activity counselling).
- Show support — ask about and address concerns.[2]

Consider initiating insulin if…[3]

- Oral agents alone are not enough to achieve glycemic control **or**
- Presence of symptomatic hyperglycemia with metabolic decompensation **or**
- A1C at diagnosis is ≥ 9%.
- ✦ Timely adjustments to and/or additions of antihyperglycemic agents should be made to **attain target A1C** within **6 to 12 months.**[3]

Standard target blood glucose (BG) goals for type 2 diabetes:[3]

Before meals	4 to 7 mmol/L
Two (2) hours after meals	5 to 10 mmol/L (5 to 8 mmol/L, if A1C targets are not being met)
A1C	≤ 7% (Less stringent A1C goals are appropriate for some individuals†)

†Consider age of patient, prognosis, level of glycemic control, duration of diabetes, presence of diabetes complications or comorbidities, risk for and ability to perceive hypoglycemia.[3]

Two-step process to insulin therapy:

1. Select an initial regimen and starting dose (Tables 1 to 3).
2. Make adjustments (Table 4).

Table 1: Select Initial Regimen[2]

Three Primary Insulin Regimens:	Consider as Initial Regimen if Patient:
Background (basal) insulin* (added to oral agents) CADTH key message: *NPH recommended as first line.*[4]	• Is feeling overwhelmed; is fearful of injections • Has mostly elevated fasting BG
Premixed insulin*	• Is opposed to more than 2 injections a day; has consistent mealtimes and food intake • Has elevated fasting and/or post-meal BG
Background (basal) and mealtime (bolus) insulin* CADTH key message: *Basal: NPH recommended as first line.* *Bolus: Regular insulin suggested as first line.*[4]	• Desires tight control and a flexible schedule • Has elevated fasting and/or post-meal BG

BG = blood glucose.
* **Discontinue Actos (pioglitazone) or Avandia (rosiglitazone).**[5] Maintain or consider adding metformin. If hypoglycemia develops, consider reducing dose or discontinuing secretagogue.[3]

Table 2: Select a Starting Dose[2]

Type of Regimen	Dosing	Examples
Background (basal) insulin* (added to oral agents) • Start with one dose at bedtime	Starting dose: 5 to 10 units (0.1 to 0.2 units/kg/daily)[6]	Starting dose 10 units at bedtime ↑ dose by 1 unit every 1 night until FBG = 4 to 7 mmol/L[6]
Premixed insulin* • Start with 2 doses: before breakfast and before supper	Starting dose: 5 to 10 units twice daily (0.1 to 0.2 units/kg twice daily)[6]	**10** units ac breakfast **10** units ac supper ↑ breakfast dose by **1** unit every **1** day until pre-supper BG = **4 to 7** mmol/L ↑ supper dose by **1** unit every 1 day until FBG = **4 to 7** mmol/L[6]
Background (basal) and mealtime (bolus) insulin* • Calculate background and mealtime doses • Initially, mealtime insulin dose is divided evenly between meals	Calculate TDI dose as 0.3 to 0.5 units/kg, then distribute as follows: • 40% TDI as basal insulin at bedtime • 20% TDI as bolus insulin prior to each meal[6]	**For an 80-kg person:** TDI = 0.5 units/kg = 0.5 x 80 TDI = 40 units **Basal insulin** = 40% of TDI = 40% x 40 units Basal insulin = 16 units **Bolus insulin** = 60% of TDI = 60% x 40 units Bolus = 24 units = 8 units with each meal[6]

ac = should be given before eating; BG = blood glucose; FBG = fasting blood glucose; TDI = total daily insulin. *** Discontinue Actos (pioglitazone) or Avandia (rosiglitazone).** Maintain or consider adding metformin. If hypoglycemia develops, consider reducing dose or discontinuing secretagogue.

Table 3: Insulin Type/Product*[1]

		Form	Onset	Peak	Duration	$/15 ml	Covered by PDP? (Y/N)
Rapid-Acting*							
ILis	Humalog	v,c,p	10 to 15 min	60 to 90 min	3.5 to 6 h	52 to 67	
IAsp	NovoRapid	v,c				54 to 70	
Glulisine	Apidra (New, not part of CADTH review)	v,c,p				48 to 62	
Short-Acting†							
	Humulin R	v,c	0.5 to 1 h	2 to 3 h	5 to 10 h	40 to 52	
	Novolin ge Toronto	v,c				41 to 52	
Intermediate-Acting or NPH							
	Humulin N	v,c,p	2 to 4 h	4 to 10 h	12 to 18 h	40 to 50	
	Novolin ge NPH	v,c				41 to 52	
Pre-mixed (Regular† or Rapid*)/Intermediate							
	Humulin 30/70	v,c	0.5 to 1 h	2 to 12 h	14 to 18 h	40 to 51	
	Novolin ge 30/70	v,c				41 to 52	
	Novolin ge 40/60, 50/50	c					
	Humalog: Mix 25, Mix 50	c,p				64	
	NovoMix 30	c				61	
Long-Acting							
IDet	Levemir	c	1 h	6 to 8 h	16 to 24 h	135	
IGlar	Lantus	v,c,p	>2 to 4 h	None	20 to 24 h	105	

c = cartridge; h = hour; min = minutes; p = pen; PDP = public drug plan; v = vial. * Should be given immediately before eating. † Should be given 30 minutes before eating[6].
CADTH reports available at www.cadth.ca.

Table 4: Monitor BG Level and Adjust Insulin*[2,6,7]

Background (Basal) Insulin **CADTH key message:** *Self-monitoring of blood glucose should be individualized; up to 14 times per week is sufficient for most of these patients.*[7]	Target FBG: 4 to 7 mmol/L[6] • Patient should self-titrate by increasing the dose by 1 unit every night until FBG target is achieved. • When FBG is achieved, the patient should remain on that dose until reassessed by diabetes team. • If fasting hypoglycemia occurs, the dose of bedtime basal insulin should be reduced by 10% (e.g., by 2 units in a person taking 20 units of bedtime basal insulin, so down to 18 units). • If daytime hypoglycemia occurs, reduce the oral antihyperglycemic agents (especially secretagogues). Note: When basal insulin added to oral agents is not enough to achieve glycemic control, bolus insulin should be added.[6]
Premixed insulin† **CADTH key message:** *Self-monitoring of blood glucose should be* ***individualized****.*[7]	Target fasting and pre-supper BG: 4 to 7 mmol/L[6] • Patient can self-titrate by increasing the breakfast dose by 1 unit every day until the pre-supper BG is at target. • Patient can self-titrate by increasing the supper dose by 1 unit every day until the FBG is at target. • Beware of hypoglycemia post-breakfast or post-supper. Stop increasing the dose if this occurs. • When target BG levels are achieved, the patient should remain on that dose until reassessed by diabetes team.[6] Note: Patient should adjust only one insulin at a time (i.e., breakfast or supper dose).
Background (basal) and mealtime (bolus) insulin† **CADTH key message:** *Self-monitoring of blood glucose should be* ***individualized****.*[7]	Target FBG or pre-meal BG: 4 to 7 mmol/L Target 2-hr post-prandial BG: 5 to 10 mmol/L[6] • Adjust the dose of the basal insulin to achieve the target FBG. • Adjust the dose of the bolus insulin to achieve the 2-hr post-prandial BG.[6]

BG = blood glucose; FBG = fasting blood glucose; hr = hour. * Ensure that BG data are accurate. † **Discontinue Actos (pioglitazone) or Avandia (rosiglitazone).** Maintain or consider adding metformin. If hypoglycemia develops, consider reducing dose or discontinuing secretagogue.

Tips for Insulin Dose Adjustment:[8]

1. Fix the lows first and highs later. Once the lows are gone, rebound hyperglycemia is often eliminated.
2. Adjust insulin dose by 5% to 10% per week or 1 or 2 units at a time to prevent hypoglycemia.
3. Adjust one insulin at a time. Begin with the insulin that will correct the first problem blood glucose of the day.
4. If unexplained morning hyperglycemia is occurring, determine the cause before adjusting therapy.

   Ask the patient to check his or her blood glucose at 3:00 a.m. for **several** nights:

   - If blood glucose is **less** than 4 mmol/L, this suggests a **Somogyi Effect** (unrecognized nocturnal hypoglycemia that the patient sleeps through, resulting in rebound hyperglycemia).
   - If blood glucose is **above** 4 mmol/L, this suggests the **Dawn Phenomenon** (fasting hyperglycemia due to growth hormone being released in the early hours of the morning) or an insufficient overnight dose of insulin.[9]

Tips for Insulin Dose Adjustment:[8] (continued)

5. Nightmares, restless sleep, headache on waking, and wet pillow or sheets may be signs of sleeping through an episode of hypoglycemia.
6. Postprandial targets are helpful when assessing the bolus (meal) insulin. Assessing postprandial glucose control provides information to determine which insulin needs adjusting (the bolus or the basal insulin). The goal is to achieve postprandial glucose levels of 5 to 10 mmol/L without lows between meals.
7. Sliding Scale Insulin: This practice is generally discouraged. Consider using a basal/bolus and supplemental (correction) insulin regimen.[8]
8. It is difficult to obtain optimal control without occasional, mild episodes of hypoglycemia.[9]

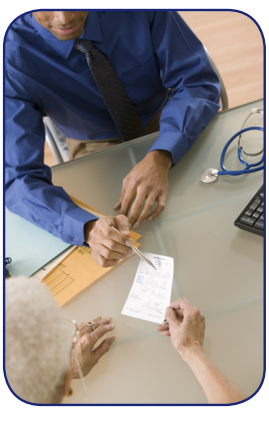
Additional Resources:

Insulin Simulation Instructional System (ISIS) (www.simation.us/pro/isis/)

References

1. Saskatchewan's academic detailing program. *Insulin management: evidence, tips & pearls* [Internet]. Ottawa: Canadian Agency for Drugs and Technologies in Health (CADTH); 2009. (RxFiles). [cited 2009 Jan 12]. Available from: http://www.cadth.ca/media/pdf/compus_IA_RX_File_2-sided.pdf Adapted from RxFiles drug comparison charts. 7th ed., www.RxFiles.ca.
2. *Guide to starting and adjusting insulin for type 2 diabetes*. Minneapolis (MN): International Diabetes Center at Park Nicollet; 2008. Report No.: 2058-830
3. Canadian Diabetes Association. *Can J Diabetes* [Internet]. 2008 [cited 2010 Jan 27];32(suppl 1):i-S201. Available from: http://www.diabetes.ca/files/cpg2008/cpg-2008.pdf
4. Singh SR, et al. Efficacy and safety of insulin analogues for the management of diabetes mellitus: a meta-analysis. *CMAJ*. 2009 Feb 17;180(4):385-97.
5. Canadian Pharmacists Association. *e-CPS: Compendium of pharmaceuticals and specialties* [database on the Internet]. Ottawa: The Association; c2007. [cited 2010 Mar 22].
6. *Type-2 diabetes insulin initiation & titration suggestions: Insulin prescription* [Internet]. Toronto: Ontario College of Family Physicians; 2007. [cited 2009 Jan 12]. Available from: http://www.ocfp.on.ca/English/OCFP/Communications/CurrentIssues/Insulin/default.asp?s=1
7. Canadian Agency for Drugs and Technologies in Health. *Optimal therapy recommendations for the prescribing and use of blood glucose test strips* [Internet]. Ottawa: The Agency; 2009 Jul. [cited 2009 Jul 31]. (Optimal therapy report; vol. 3 no. 6). Available from: http://www.cadth.ca/media/pdf/compus_BGTS_OT_Rec_e.pdf
8. Jin M, et al. *Insulin management: Evidence, tips & pearls* [Internet]. Saskatoon: RxFiles Academic Detailing Program; 2009 Feb. [cited 2010 Jan 12]. Available from: http://www.rxfiles.ca/rxfiles/uploads/documents/CHT-Diabetes-Insulin-ManagmentTool.pdf
9. Dr. Robyn Houlden, Division of Endocrinology, Queen's University, Kingston, ON: personal communication, 2010, Mar.

Canadian Agency for Drugs and Technologies in Health
600-865 Carling Avenue, Ottawa, Ontario, K1S 5S8
613-226-2553 • www.cadth.ca



To see more publications and tools on self-monitoring of blood glucose, please visit our website:

www.cadth.ca/smbg

www.cadth.ca

Supporting Informed Decisions