guide to

Starting and Adjusting Insulin

for Type 2 diabetes

7th Edition

International Diabetes Center

Tips for Discussing Insulin Therapy with Patients with Type 2 Diabetes

- Be positive—Emphasize that insulin therapy is often a normal part of treating a progressive disease.
- Be sure to refer patient for diabetes education to learn about taking insulin, checking glucose (essential) and making lifestyle changes, including healthy eating.
- Note that a continuous glucose monitoring (CGM) device can be useful for managing diabetes especially with insulin.
  - If using CGM data, determine need for action based on glucose management indicator (GMI) or time in range (TIR). GMI is a measurement that tells what an approximate lab A1C is likely to be. GMI is based on hundreds of CGM results.
- Talk about risk for hypoglycemia. See Step 4 on page 4.

When to Start Insulin

A1C, GMI or TIR	Action
A1C or GMI ≥ 12%, or TIR < 10%, and/or fasting or random glucose is > 350 mg/dL	Start insulin
A1C or GMI < 12%, or TIR ≥ 10%, and patient is clinically unstable; *Example*: moderate/large ketones, signs of dehydration or extreme symptoms of hyperglycemia	Start insulin
A1C or GMI < 12%, or TIR ≥ 10%, with elevated glucose and patient is clinically stable and has medical need for rapid glucose improvement; *Example*: pre/postsurgery, infection or steroid-induced hyperglycemia	Strongly consider starting insulin
A1C or GMI < 12%, or TIR ≥ 10%, and clinically stable; however, glucose above target for 3 months on clinically effective dose of one or more noninsulin therapies	Consider starting insulin or GLP-1 Receptor Agonist (RA)

For newly diagnosed patients: If clinically stable and A1C or GMI ≥ 12%, or TIR < 10%, but have high intake of sugar-sweetened beverages (> 36 ounces or three 12-ounce cans per day), if patient willing to eliminate sugar-sweetened beverages, start noninsulin therapy and re-evaluate need for insulin within 1 to 2 weeks.

Glycemic Goals and Targets

Glycemic Goals	Standard Targets	Modified Targets
Fasting and premeal glucose	70–130 mg/dL	90–150 mg/dL
1–2 hrs postmeal glucose	< 180 mg/dL	< 200 mg/dL
A1C or GMI	< 7%	< 8%
TIR (70–180 mg/dL)	> 70%	> 50%

Use modified targets if one or more of the following considerations apply:

- Decreased life expectancy or frail elderly
- Cognitive disorder
- Psychosocial barrier
- Other medical concern, such as cardiovascular disease, stroke or end-stage renal disease

Step 1. Select Initial Regimen

Insulin Regimens	Clinical Considerations and Patient Factors
Background (basal) insulin	• Simple regimen desired (can add to GLP-1 RA) • Fasting glucose elevated and limited postmeal glucose rise • A1C or GMI within 2 percentage points of target
Background and mealtime (basal bolus) insulin: 1 or 2 meals	• Use as initial insulin start or transition from background insulin • Gradual approach to all-meals regimen if needed and fewer injections desired • Fasting and at least 1 postmeal glucose elevated
Background and mealtime insulin: all meals	• Flexibility with mealtimes desired • Fasting and most postmeal glucose elevated • Option to use insulin-to-carb ratio • A1C or GMI ≥ 12% and TIR < 10%
Premixed insulin	• Opposed to more than 2 injections per day • Has consistent mealtimes and carbohydrate intake • Fasting and most postmeal glucose elevated • A1C or GMI ≥ 12% and TIR < 10%

Step 2. Calculate Starting Insulin Dose

See Table 1 beginning on page 7 for types of insulin.

Insulin Regimens	A1C or GMI < 9%, or TIR ≥ 30%	A1C or GMI ≥ 9%, or TIR < 30%
Background insulin: 1 dose taken same time daily	0.1 units/kg (or 10 units)	0.2 units/kg (or 20 units)
Background insulin: 1 dose taken same time daily and mealtime insulin: 1, 2 or all meals	0.1 units/kg (or 10 units) background ***and*** 0.1 units/kg mealtime, distributed 1/ 3 per meal (or 3–4 units/meal)	0.2 units/kg (or 20 units) background ***and*** 0.2 units/kg mealtime, distributed 1/ 3 per meal (or 6–7 units/meal)
Premixed insulin	0.1 units/kg (or 10 units) before morning meal ***and*** 0.1 units/kg (or 10 units) before evening meal	0.2 units/kg (or 20 units) before morning meal ***and*** 0.2 units/kg (or 20 units) before evening meal

Considerations

- Reduce insulin dose by 0.05 units/kg/day if eGFR < 30 ml/min.
- If patient is reducing carbohydrate intake (eg, reducing portion sizes and making healthier choices), use 0.1 units/kg/day for insulin dose calculations.
- If stopping noninsulin medication(s) (e.g., stopping sulfonylurea), increase total daily dose of insulin by 0.1 units/kg/day.
- For clinically unstable and/or severely insulin resistant patients (*Example:* BMI > 35 kg/m^2), use 0.3 units/kg or 30 units for each of the insulin calculations shown above.

Step 3. Address Noninsulin Therapy when Starting Insulin

- Start or maintain metformin unless contraindicated
- If taking sulfonylurea (SU), consider discontinuing when starting background insulin and discontinue for all other insulin regimens
  - If discontinuing SU, increase total daily dose by 0.1 units/kg/day to account for less endogenous insulin secretion
- Discontinue or reduce dose of thiazolidinedione (TZD)
- Consider maintaining DPP-4 inhibitor, GLP-1 RA and/or SGLT2 inhibitor if patient experienced positive response and no financial barriers

Step 4. Explain Hypoglycemia Risk and Treatment

- Hypoglycemia is glucose < 70 mg/dL
- Symptoms may include feeling shaky, sweaty, hungry or irritable
- Always carry a carbohydrate food or beverage
- Teach glucagon administration. Nasal glucagon (preferred), prefilled glucagon pen and glucagon injection kit are available
- Follow the "Rule of 15 to Treat Lows":
  1. Treat with 15 grams of carbohydrate (*Example:* 4 glucose tablets, 5–6 crackers or ½ cup fruit juice)
  2. Recheck glucose 15 min after treatment to ensure glucose ≥70 mg/dL
  3. If glucose < 70 mg/dL after 3 treatments, call primary care clinician or 911

Step 5. Provide Nutrition and Insulin Recommendations

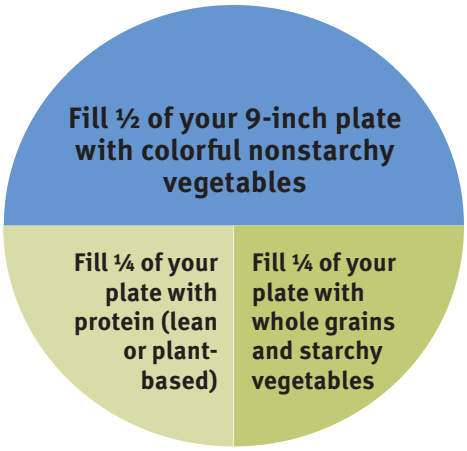
American Diabetes Association guidelines recommend a visit with a registered dietitian nutritionist when initiating an insulin regimen.

Insulin Regimens	Meals
Background insulin	Aim for 3 meals a day and follow "General nutrition recommendations" on page 5
Background and mealtime insulin	• Focus on consistent carbohydrate intake with fixed mealtime dose • If desired and able to count carbohydrate, advance to insulin-to-carb ratio • Take mealtime insulin 15 minutes before meal (or 30 minutes before if on Regular insulin)
Premixed insulin	• Establish 3 consistent mealtimes and eat consistent carbohydrate intake • Do not skip meals • Take injection 15 minutes before meal (or 30 minutes before if on Regular insulin) • With activity, add a small carbohydrate snack if needed to prevent hypoglycemia • Works best if no more than 10–12 hours between morning and evening meals

Step 5. Provide Nutrition and Insulin Recommendations – continued

General nutrition recommendations

- Eliminate sugar-sweetened beverages if patient willing. Choose calorie-free beverages with a focus on water.
- Minimize added sugars, emphasize nonstarchy vegetables; choose whole, unprocessed foods and whole fruit instead of juice more often.
- Use 9-inch plate and fill ½ with nonstarchy vegetables (such as leafy greens, carrots, broccoli, bell peppers and green beans), ¼ with protein and ¼ with whole grains and/or starchy vegetables (such as corn, green peas and potatoes).
- Snacks are not needed. If hungry, choose a small, healthy option.



Step 6. Adjust Insulin Based on Glucose Monitoring Data

To adjust insulin based on CGM data, please reference the Clinician CGM Guided Management (CCGM) resource.

Insulin Regimens	Adjustment
Background insulin (added to noninsulin therapy)	• Check fasting glucose each morning. If more than half of fasting glucose values are: • ≥ **200 mg/dL,** increase total daily dose (TDD) 0.1 units/kg/day until **more than half** of fasting glucose < 200 mg/dL, not to exceed 0.6 units/kg day • < **200 mg/dL** but not in target, use Table 2 on page 8 • Add mealtime insulin or GLP-1 RA if either of the following occurs (see also Table 3 beginning on page 8): • TDD reaches 0.6 units/kg/day and glycemic targets not met • Pattern of **bedtime-to-morning-meal** (also called *bed-to-breakfast*) drop of more than 50 mg/dL as result of too-high background insulin dose
Background and mealtime insulin: 1, 2 or all meals	Check glucose fasting, plus before and 1–2 hrs after meals when mealtime insulin administered. If more than half of glucose values are: • ≥ **200 mg/dL,** increase TDD 0.1 units/kg/day; add half to background and distribute remaining half equally among meals • < **200 mg/dL but not in target,** use Table 2 on page 8 to adjust • **Fasting glucose:** Adjust background dose • **Before midday or evening meal glucose:** Adjust previous meal dose, or if glucose is intermittently low throughout the day, reduce background dose • **Pre- to postmeal glucose change:** Adjust that meal's mealtime insulin • **Rise in glucose > 50 mg/dL:** Increase dose 10% • **Drop in glucose:** Decrease dose 10%

Step 6. Adjust Insulin Based on Glucose Monitoring Data – continued

Insulin Regimens	Adjustment
Premixed insulin	Check glucose fasting and before evening meal each day. Check before midday meal and bedtime occasionally. If more than half of glucose values are: • **≥ 200 mg/dL,** increase TDD 0.1 units/kg/day equally among doses • **< 200 mg/dL but not in target,** use Table 2 on Page 8 to adjust • **Fasting glucose:** Adjust pre-evening meal dose • **Pre-evening meal glucose:** Adjust premorning meal dose

Considerations if using fingerstick glucose checks

- Check more often during treatment adjustment.
- Make insulin adjustments 1–2 times/week to get most glucose in individualized target range.
- Ensure glucose data is accurate and assess adherence to insulin regimen.
- Advise patient to check glucose if suspect hypoglycemia and before driving.

Table 1. Insulin Action Times

Type of Insulin	Generic Names	Brand Names	Onset	Peak	Duration
Background (Basal) Insulin					
Intermediate-acting	NPH	Humulin® N Novolin® N ReliOn®/Novolin® N	2–4 hrs	4–8 hrs	10–16 hrs
Long-acting	Glargine Detemir	Basaglar® Semglee® Lantus® Levemir®	2 hrs	Steady most of the day	Up to 24 hrs
Longer-acting	Glargine U-300 Degludec U-100/U-200	Toujeo® Tresiba®	Over 6 hrs Over 9 hrs	No peak	Up to 36 hrs Up to 42 hrs
Mealtime (Bolus) Insulin					
Rapid-acting	Aspart Lispro-aabc Lispro U-100 Lispro U-100/U-200 Glulisine Aspart	Fiasp® Lyumjev® Admelog® Humalog® Apidra® NovoLog®	10 min 15 min 15 min	1–2 hrs	3–5 hrs
Short-acting	Regular (R)	Humulin® R Novolin® R ReliOn®/ Novolin® R	30–45 min	2–3 hrs	4–8 hrs
Short-acting concentrated	Regular U-500	Humulin® R U-500 U-500 Kwik Pen® R	30–45 min	4–8 hrs	20–22 hrs
Rapid-acting inhalation powder	Insulin human	Afrezza®	10–15 min	45–75 min	2–3 hrs
Premixed Insulin					
Intermediate-acting and rapid-acting insulin	Lispro protamine/Lispro Aspart protamine/Aspart	Humalog® Mix 75/25 Humalog® Mix 50/50 NovoLog® Mix 70/30	15 min	1–2 hrs (with moderate effect next 8 hrs)	10–16 hrs
Intermediate-acting and short-acting insulin	NPH/Regular	Humulin® 70/30 Novolin® 70/30 ReliOn®/Novolin® R 70/30	30–45 min	2–3 hrs (with moderate effect next 8 hrs)	10–16 hrs

Table 2. Adjust Insulin for Pattern of High or Low Glucose

	Glucose Level	Adjustment
Fasting and premeal targets	< 70 mg/dL 2 or more times within 7 days	Decrease dose by 10%
	70–130 mg/dL	No change
	> 130 mg/dL 3 or more times within 7 days	Increase dose by 10%
Postmeal targets	>180 mg/dL 1–2 hours postmeal or > 50-point rise in glucose from premeal to postmeal, 3 or more times within 7 days	Increase prior mealtime insulin dose by 10%

Use this table for pattern adjustment only

If more than half of glucose values are ≥ 200 mg/dL, increase TDD 0.1 units/kg/day and distribute across insulin regimen.

Table 3. Therapy Options in Addition to Background Insulin

Medication Option	Action
GLP-1 RA	• Consider adding GLP-1 RA instead of starting mealtime insulin. When adding GLP-1 RA, if A1C or GMI: • A1C or GMI ≤ 8% or TIR > 50%, reduce background dose by 20% • A1C or GMI > 8% or TIR ≤ 50%, maintain current background dose
Stepwise approach (adding 1 or 2 mealtime insulin doses)	• Give mealtime dose equivalent to 10% of background dose (background multiplied by 0.1): • Before 1 or 2 meals ***and*** • Subtract this number of units from background dose ***Example:*** 60 units background x 0.1 = 6 units added before 1 meal and subtracted from background dose, or 6 units added before each of 2 meals and 12 units subtracted from background dose. See Step 6 on pages 5-6 to adjust insulin dose.
Background and mealtime insulin: all meals (moving to mealtime insulin: all meals)	• Determine: • TDD of current regimen ***and*** • Redistribute TDD 50% background and 50% mealtime equally (as possible) among 3 meals ***Example:*** • **Current regimen** 60 units background + 20 units at dinner = 80 units TDD • **New regimen** 80/2 = 40 units background + 40 units mealtime distributed among three meals (such as 13 units/13 units/14 units). See Step 6 on pages 5-6 to adjust insulin dose.

Table 4. Move from Background Insulin to Premixed Insulin

Medication Option	Action
Premixed insulin	• If A1C or GMI is ≤ 8%, or TIR > 50%, give 50% TDD before morning meal and 50% before evening meal • If A1C or GMI is > 8%, or TIR < 50%, increase TDD by 10% and give 50% before morning meal and 50% before evening meal • If one meal is larger, divide TDD 40/60 or 60/40 ***Example patient with A1C 8.5%:*** • **Current regimen —** 100 units background • **New regimen:** 100 units x 1.1 = 110 units 110/2 = 55 units before morning meal and 55 units before evening meal. See Step 6 on Pages 5–6 to adjust insulin dose.

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