

Therapeutic Transitions: When, Why, and How to Introduce Insulin in Type 2 Diabetes

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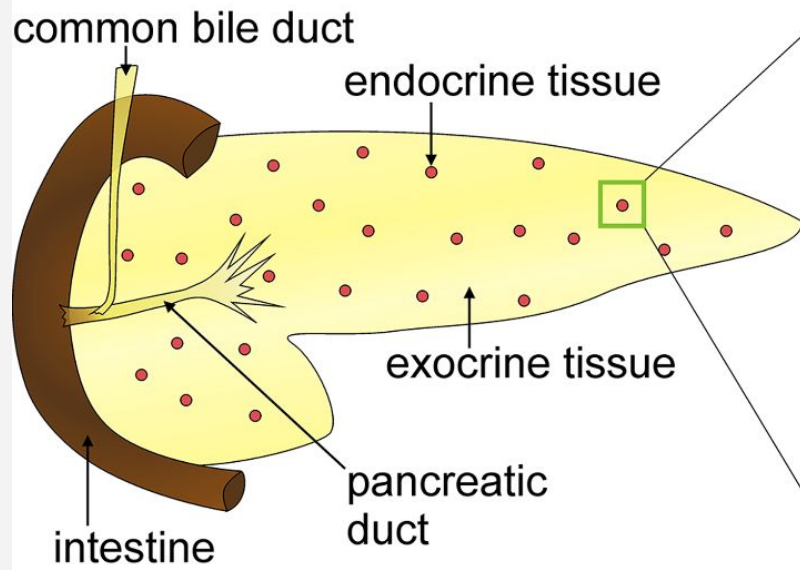


Objectives

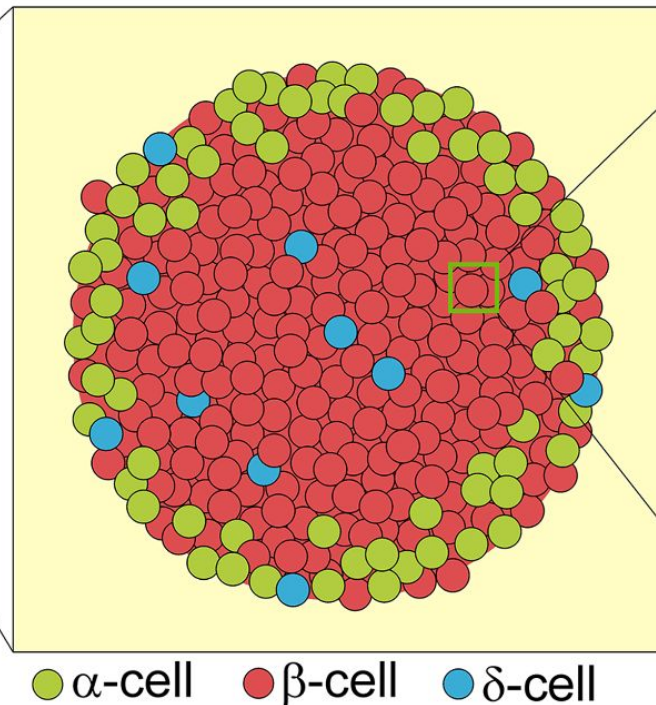
- **Explain the pathophysiological rationale for insulin in type 2 diabetes.**
- Review the indications, timing, and clinical decision-making processes involved in initiating insulin.
- Summarize core insulin principles and provide practical strategies for designing effective insulin regimens.
- Outline key patient counseling points to support successful insulin initiation in individuals new to therapy.

Review of the Pancreas

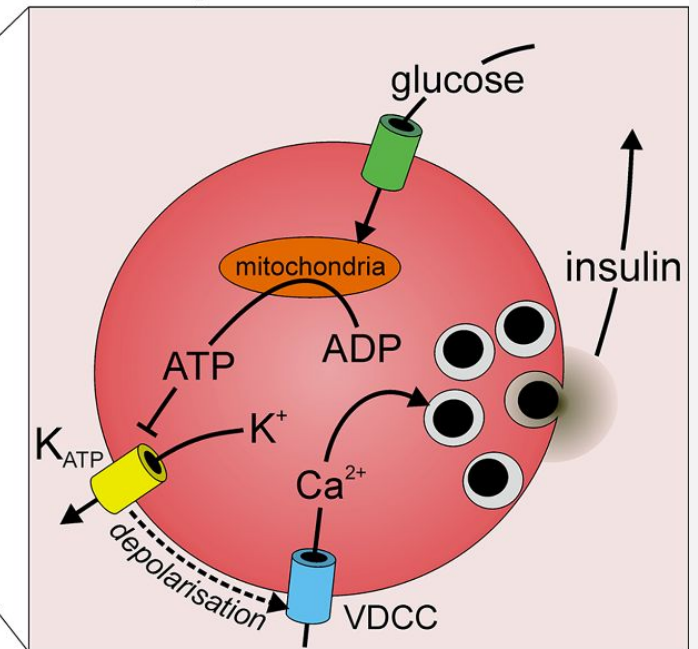
the pancreas



the islet



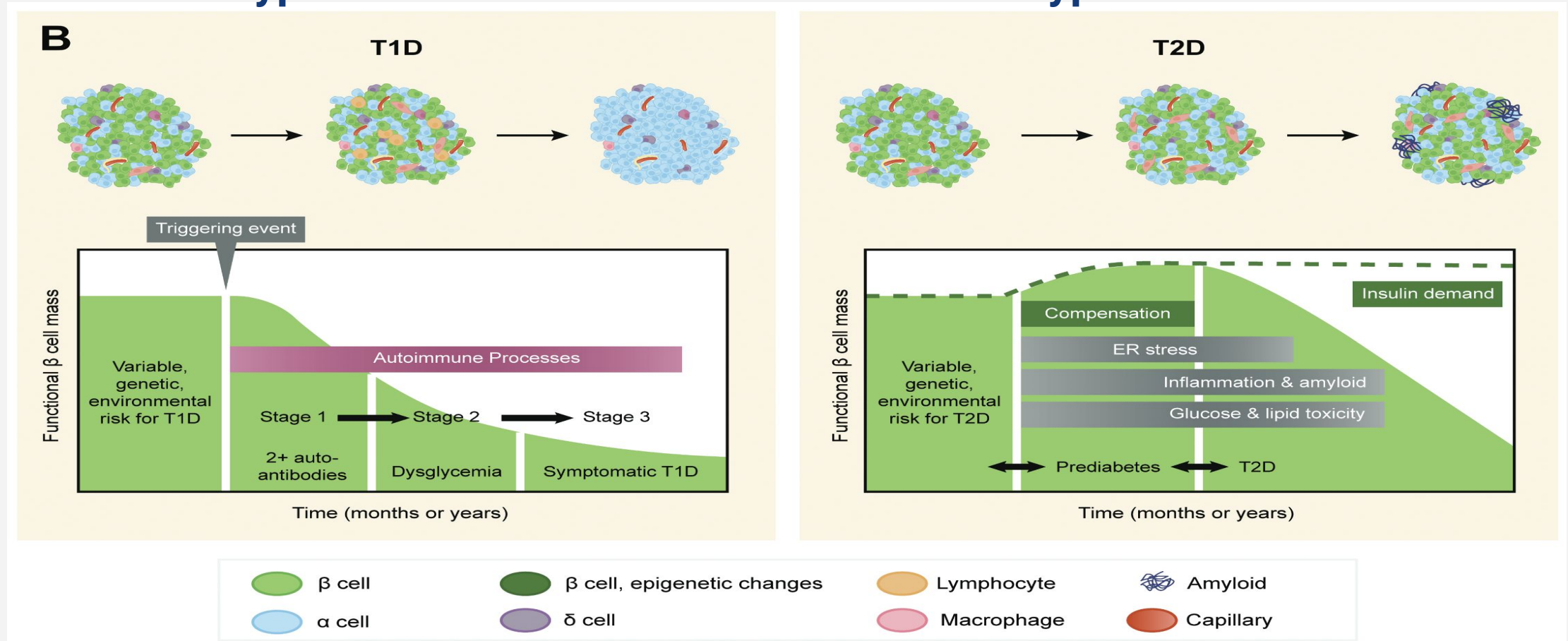
the β-cell



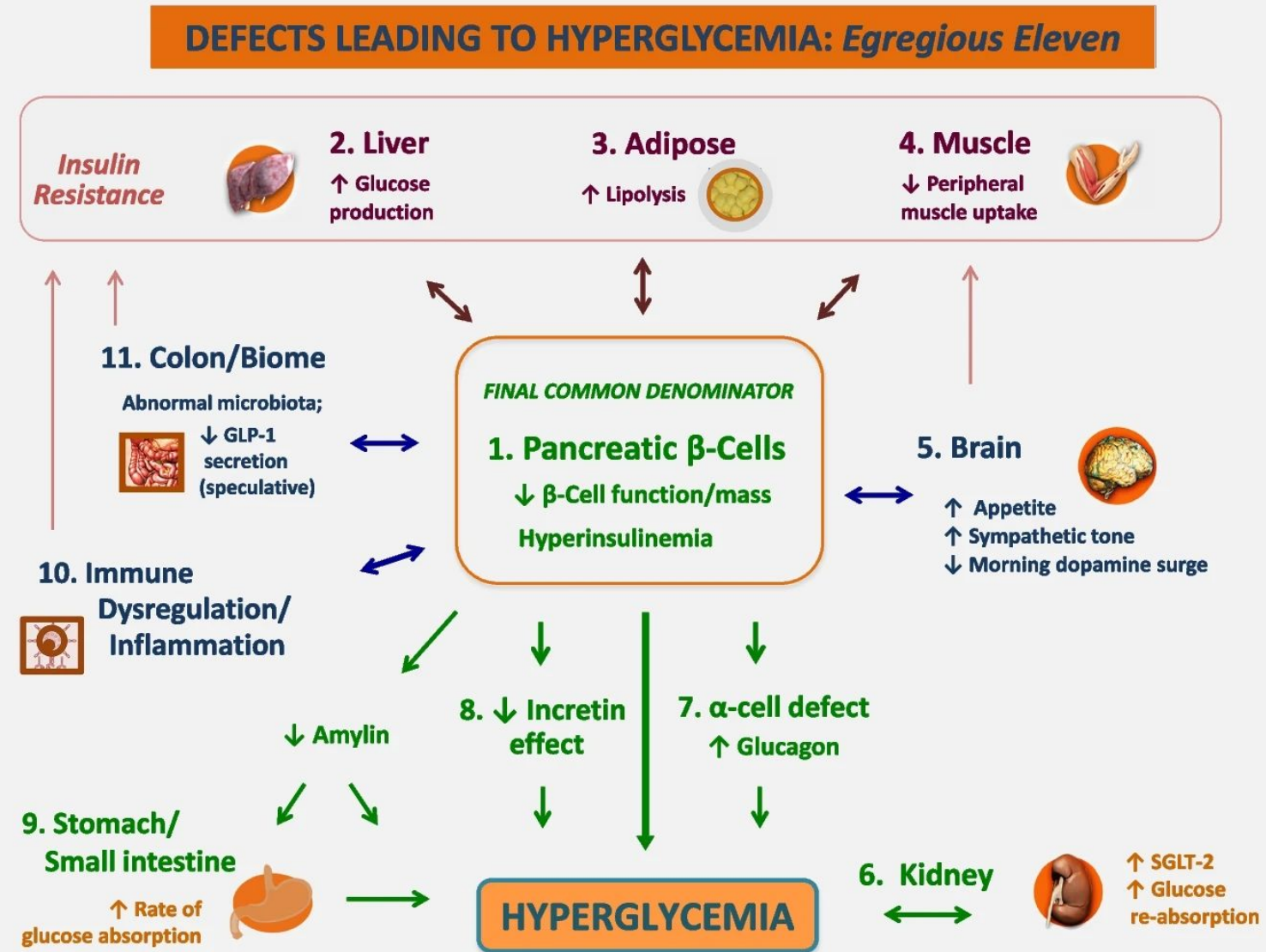
Mechanisms of Islet Dysfunction

Type 1 Diabetes

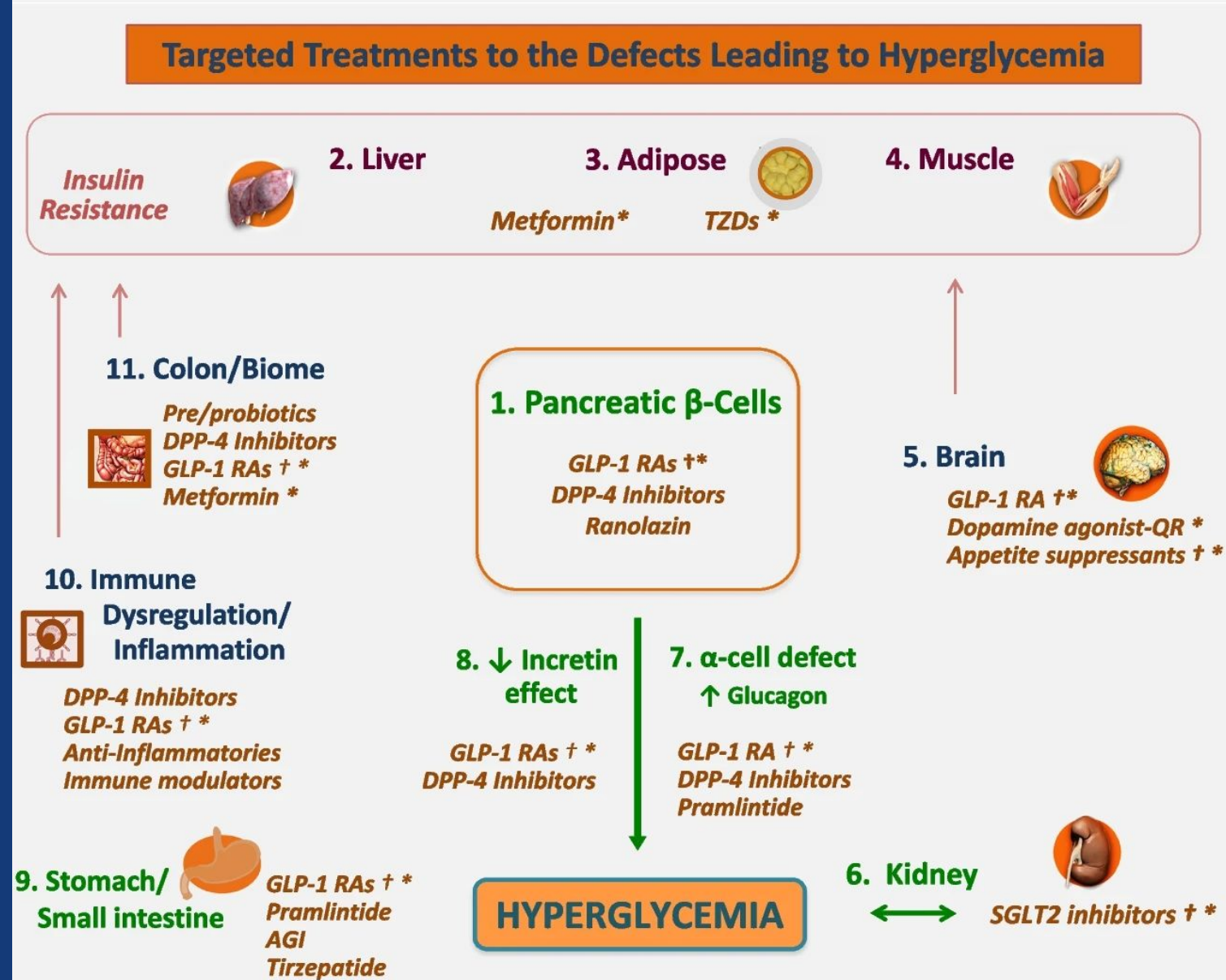
Type 2 Diabetes



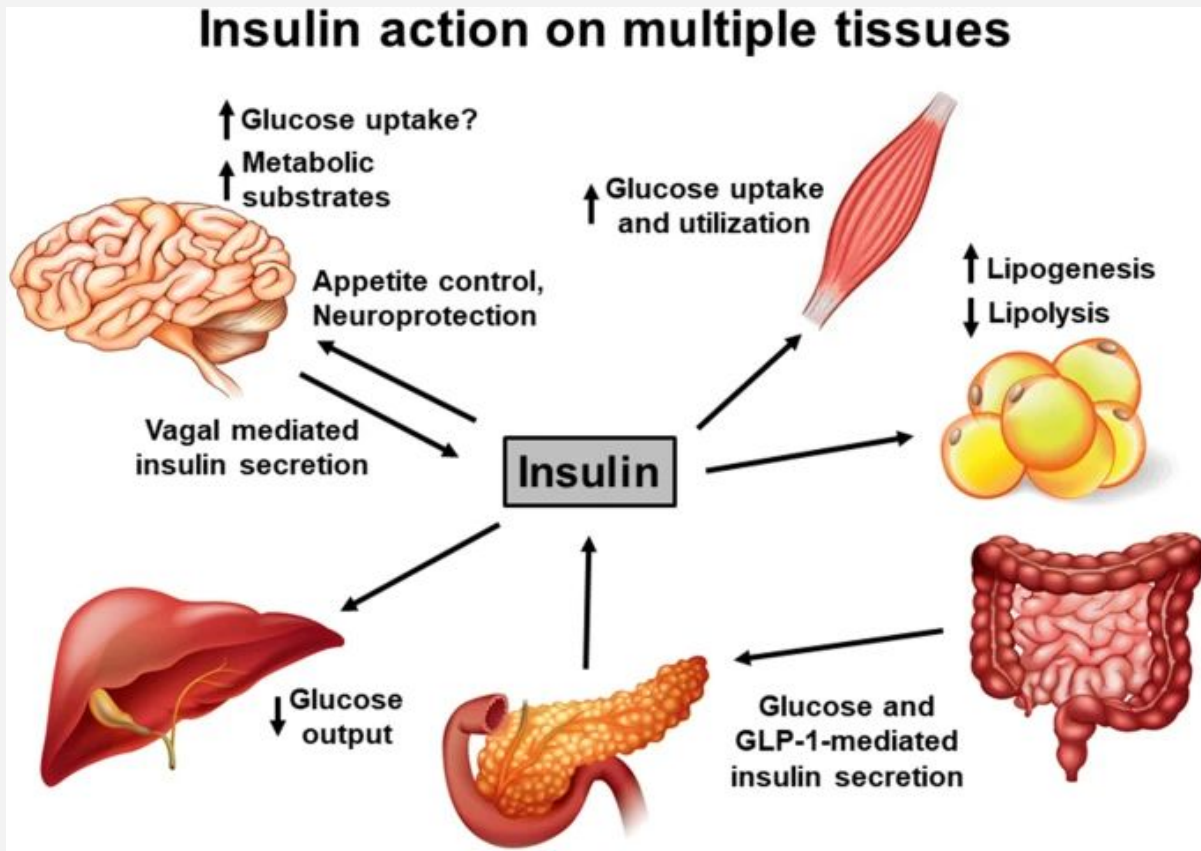
Type 2 Diabetes (T2DM) Pathogenesis: “Egregious Eleven”



Type 2 Diabetes Targeted Therapies



Insulin Actions



Basal Insulin:

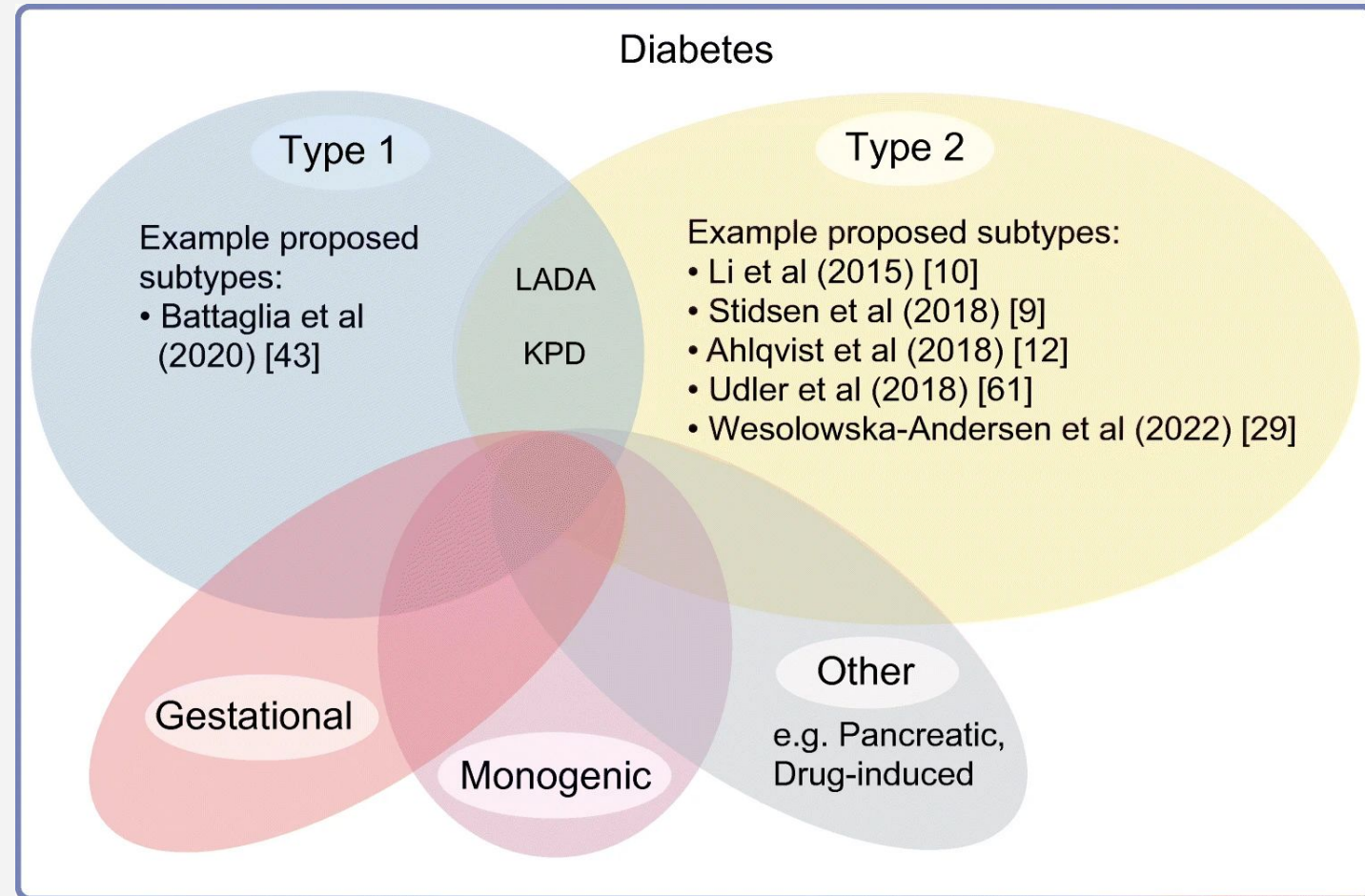
- Insulin secreted overnight and between meals
- Secreted at low levels → acts on more insulin sensitive tissues (liver and adipose tissue)

Prandial Insulin:

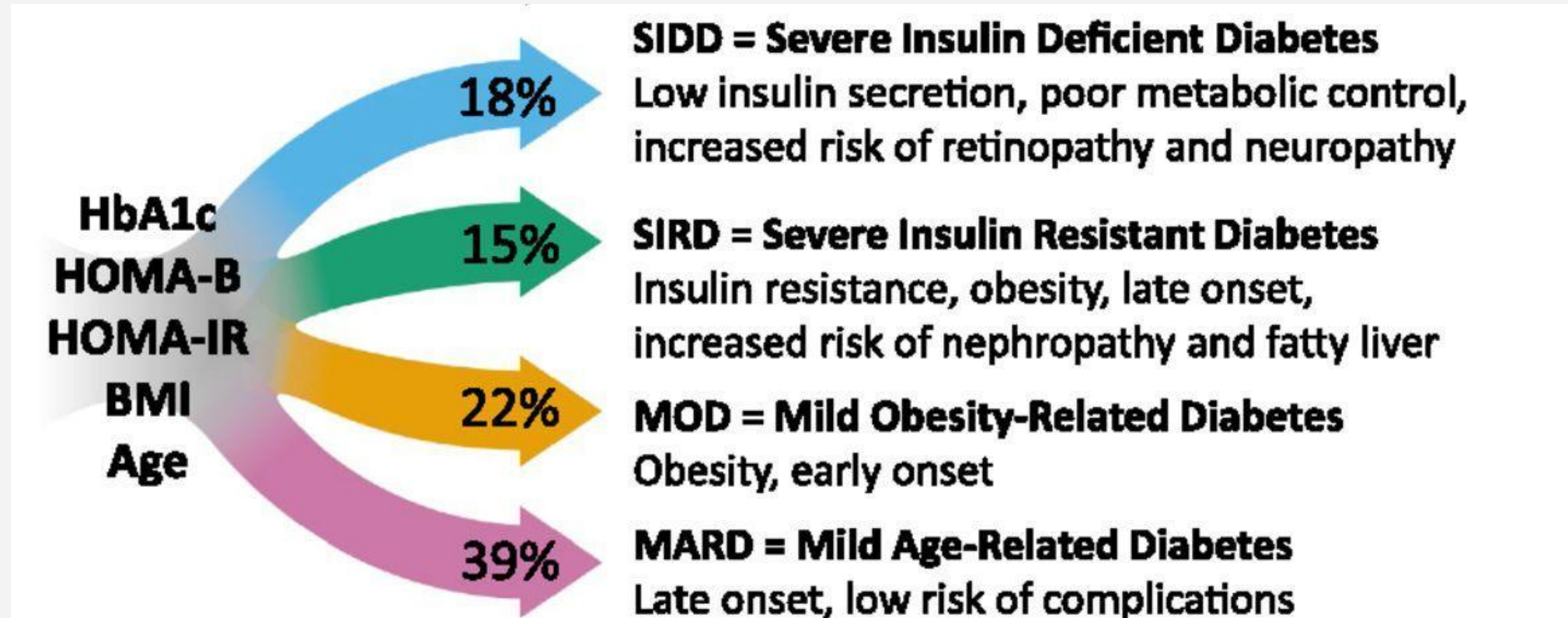
- Insulin secreted in response to a meal
- Secreted at higher levels → acts on liver, adipose, and skeletal muscle

Diabetes Classification

- Type 1 diabetes (90-95%)
- Type 2 diabetes (5-10%)
- Hybrid:
 - Latent Autoimmune Diabetes of Adults (LADA)
 - Ketosis Prone Diabetes (KPD)
- Due to other causes:
 - Monogenic diabetes (MODY)
 - Pancreatogenous diabetes
- Gestational diabetes
- “Type 5” diabetes



Type 2 Diabetes Heterogeneity



HOMA-B and HOMA-IR:
measures of insulin secretion and resistance

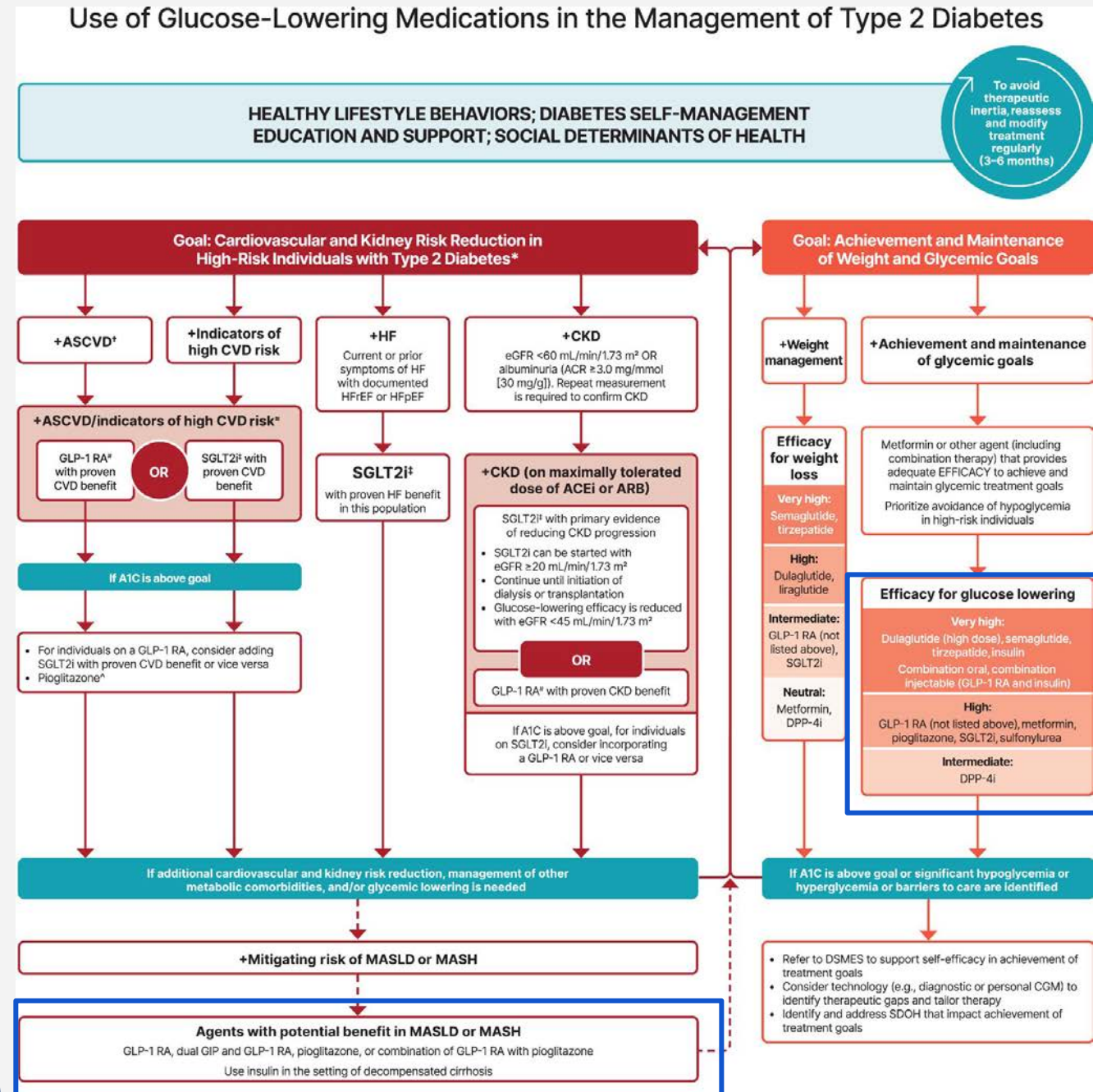
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- **Review the indications, timing, and clinical decision-making processes involved in initiating insulin.**
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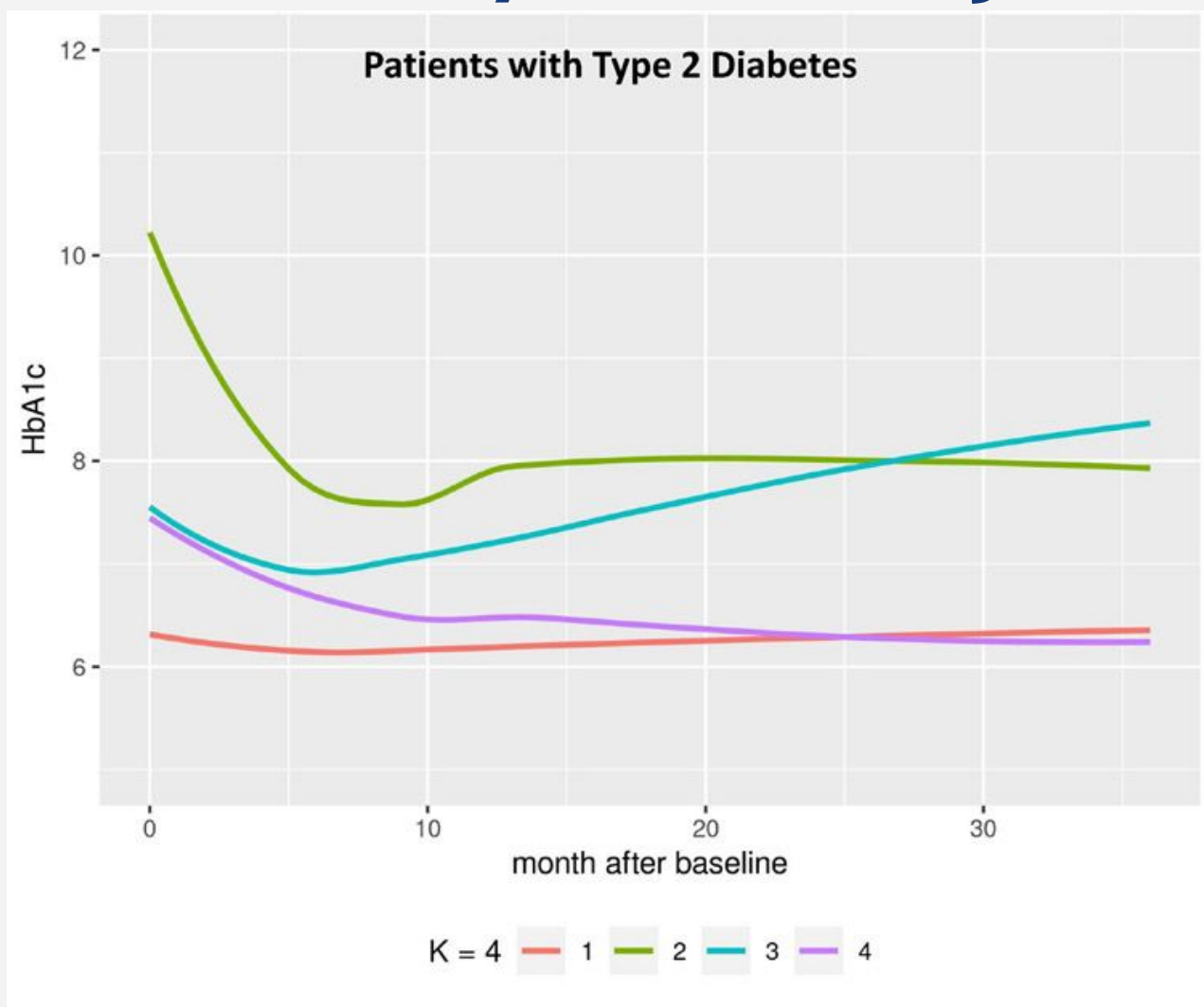
American Diabetes Association Algorithm

- Focus first on cardiorenal indications and weight-reduction.
- If further glycemic-lowering is needed, insulin can be considered:
 - Symptoms of hyperglycemia.
 - A1c $\geq 10\%$.
 - Blood glucose ≥ 300 mg/dL

American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2025; Supplement 1.



T2DM Glycemic Trajectories



HbA _{1c} Trajectory	Baseline Mean % (SD)	Year 1 Mean % (SD)	Year 2 Mean % (SD)	Year 3 Mean % (SD)
¹ N=80,760 (67.72%)	6.33 (0.56)	6.14 (0.44)	6.21 (0.51)	6.29 (0.54)
² N=20,804 (17.44%)	10.39 (2.16)	7.92 (1.65)	8.07 (1.84)	8.06 (1.93)
³ N=11,892 (9.97%)	7.59 (1.04)	6.98 (0.62)	7.46 (0.90)	8.18 (1.01)
⁴ N=5,800 (4.86%)	7.57 (0.95)	6.62 (0.58)	6.39 (0.54)	6.24 (0.49)

**Nearly 30% of T2DM patients
do not achieve target HbA1c
goals by 3 years**

Clinical Scenarios Where Insulin is Preferred

Table 2—Clinical scenarios in which starting BI may be preferred or not preferred in the era of the innovative medications, GLP-1RA and SGLT2i

Preferred

- ➡ Metabolic emergencies (hyperosmolality, ketoacidosis)
- ➡ Acute or variable hyperglycemia (sick days, steroid therapy, trauma, major surgery, stress)
- ➡ Patient preference
- ➡ Comorbidities (kidney and liver failure, cancer, chemotherapy)
- ➡ Autoimmune pathogenesis (LADA)
- ➡ Pregnancy
- Lean, predominantly insulin-deficient T2DM
 - including some elderly onset
 - with excessive weight loss on other therapies
- New-onset T2DM with marked hyperglycemia
- HbA_{1c} not at target with other management
- ➡ Intolerance of noninsulin therapies (including GLP-1RA, SGLT2i)
- Possibility that patient may have T1DM

- Acute hyperglycemia, including diabetes emergencies
- Patient preference (side effects, out-of-pocket costs)
- Other comorbidities (renal, hepatic)
- Pregnancy

Clinical Scenarios Where Insulin is Preferred

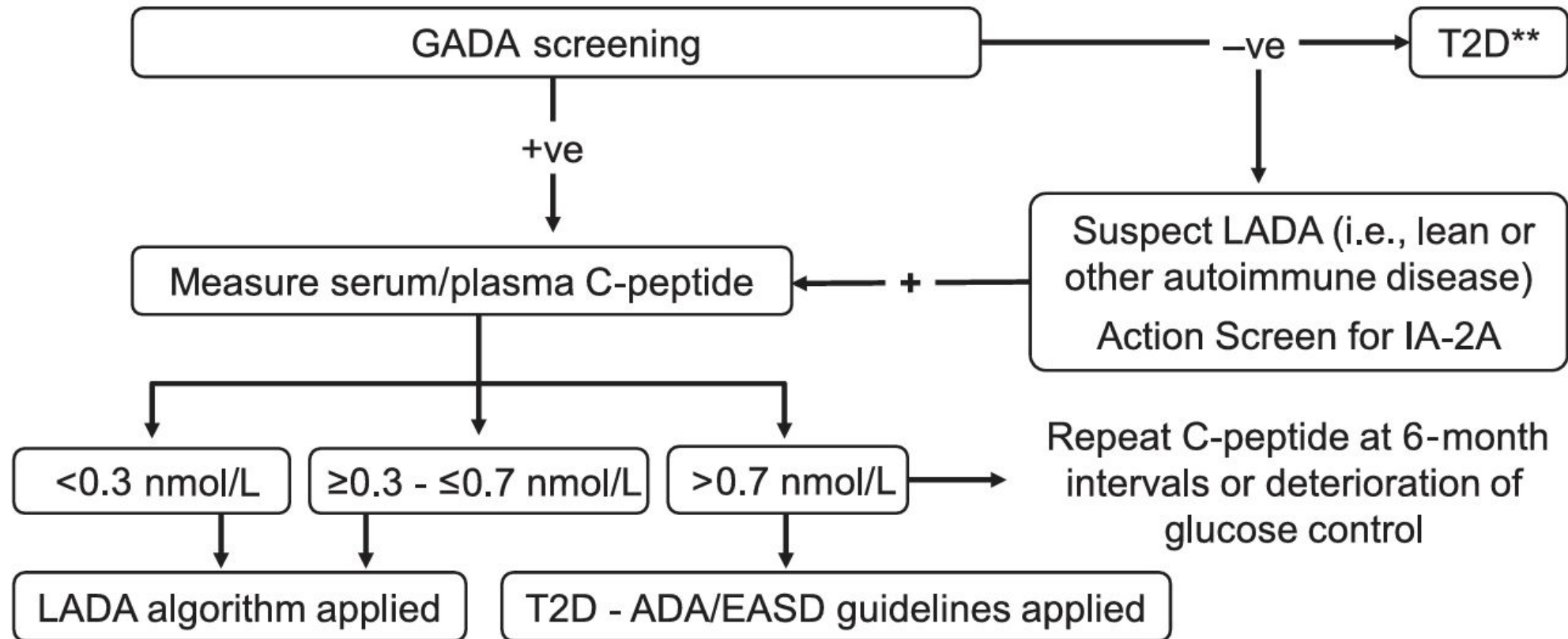
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- Insulin is the preferred medication if latent autoimmune diabetes of adults (LADA) or type 1 diabetes suspected.

Differentiating T2DM from LADA



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- Insulin is the preferred medication if latent autoimmune diabetes of adults (LADA) or type 1 diabetes suspected.
- Lean individuals or concern for excess weight loss.

Clinical Scenarios Where Insulin is Preferred


























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- ➡ Possibility that patient may have T1DM

- Insulin allows improvement of β -cell function so can be considered in new diagnosis to induce T2DM remission.
- Not meeting glycemic goals with other first-line therapies.

Combination Insulin + Non-Insulin Therapies

	individual medications			combinations	
	BI	GLP-1RA	SGLT2i	BI + GLP-1RA	BI + SGLT2i
FPG					
Postprandial PG					
HbA _{1c}					
Weight					
Hypoglycemia					

Abbreviations:

FPG = fasting plasma glucose; Postprandial PG = postprandial plasma glucose; BI = basal insulin

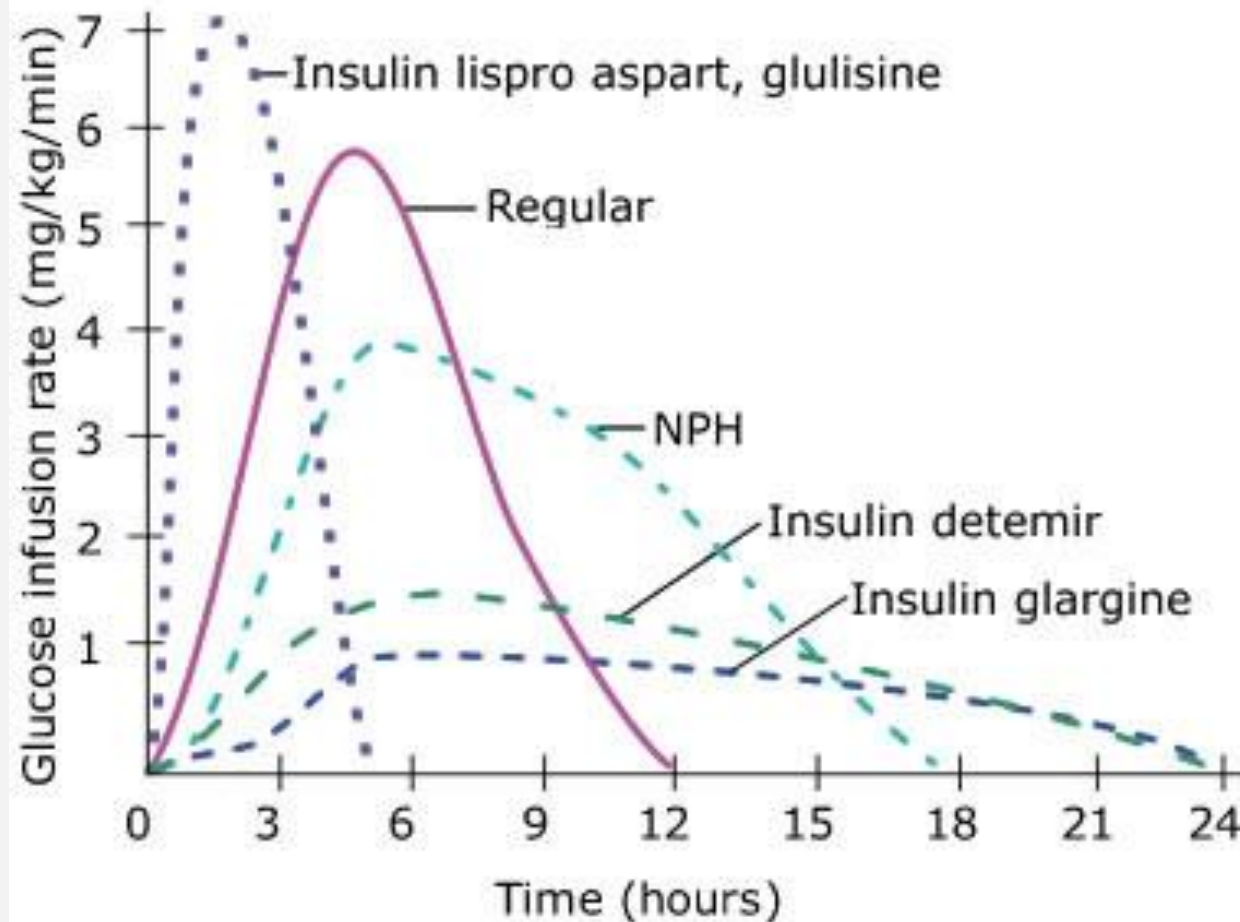
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Insulin Fundamentals

Duration	Generic Name	Brand Name(s)
Rapid-acting	Lispro Aspart Glulisine	Humalog, Admelog NovoLog, Fiasp Apidra
Short-acting	Regular Insulin	Humulin R, Novolin R
Intermediate-acting	NPH (Neutral Protamine Hagedorn)	Humulin N, Novolin N
Long-acting	Glargine Detemir	Lantus, Basaglar, Toujeo Levemir
Ultra long-acting	Degludec	Tresiba

Activity Profiles of Different Types of Insulin



All insulin units are equal – what changes is *how fast* and *how long* they work!

Insulin Fundamentals

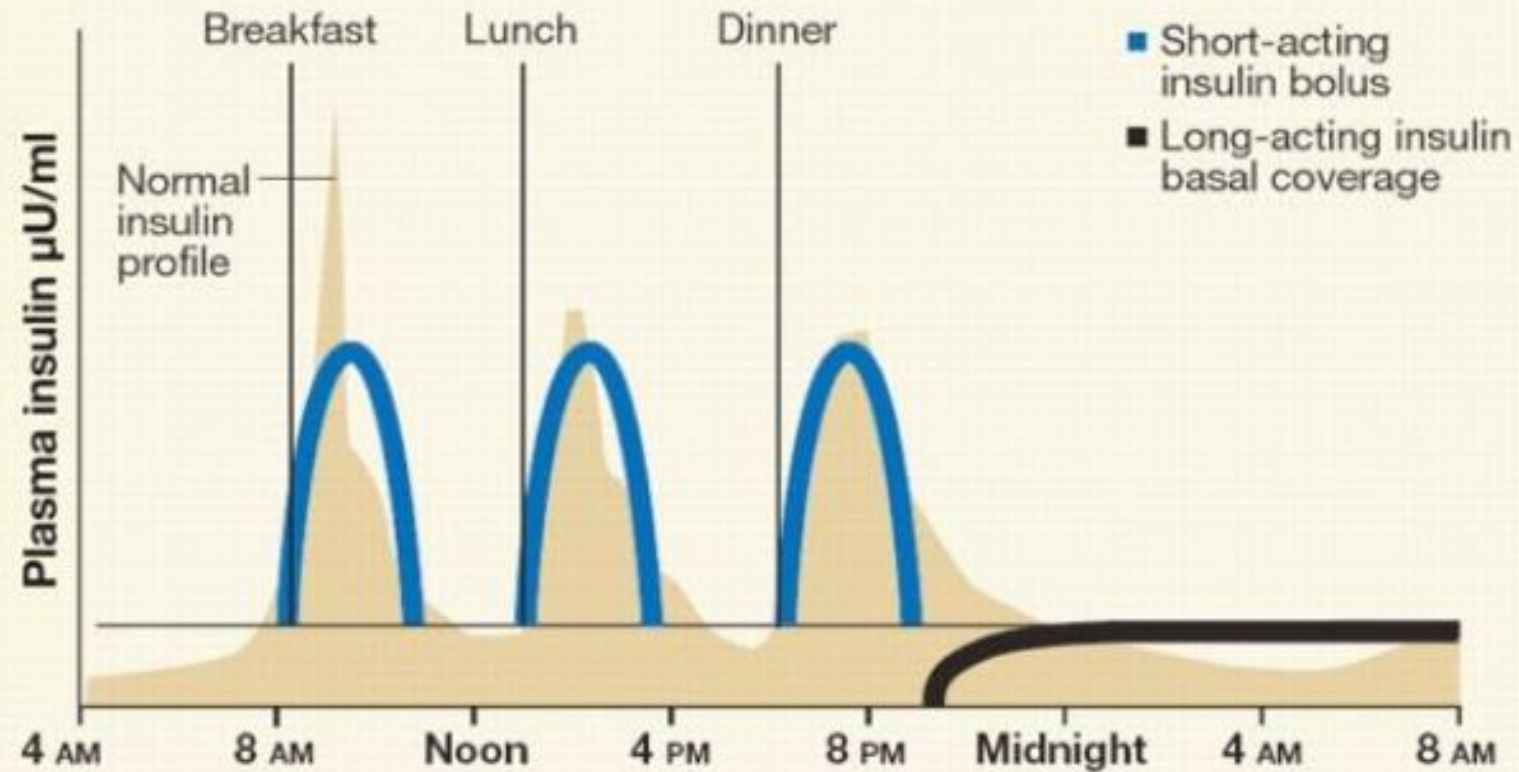
Quick tips for U-200 & U-300 insulins:

- They deliver the correct *unit* dose (you don't need to "dose adjust" for patients) — it's just less fluid volume per injection.
- Only available as **pens** — no vials.



U-500 is DIFFERENT from other concentrated insulins and cannot be interchanged readily—use extreme caution when prescribing!

Basal/bolus regimen mimics normal insulin profile



Types of Regimens in T2DM

Basal Only or Basal “Plus”

- Start with **0.1–0.2 units/kg/day** or a flat 10 units
- Adjust 2–4 units every 3–7 days based on fasting glucose
- Use of other agents (e.g. GLP-1, SGLT-2i) help provide coverage for meal related excursions

Basal-Bolus

- Total daily dose: **0.4–0.5 units/kg/day**
- 50% basal, 50% divided among meals.
- Example Lantus 24units, Humalog 8units TID with meals
- Can continue other agents particularly if there are cardiac or renal benefit

Let's do a case

Mr. Johnson, 58 years old



- Mr. Johnson is a 58-year-old man with type 2 diabetes who presents for follow-up.
- He is currently taking **U-200 Tresiba** at a dose of **110units once per day**
- He is also on Metformin 100mg BID, Ozempic 1mg/week, Jardiance 25mg per day
- His most recent **A1c is 9.1%**, despite good adherence.
- He checks his **blood sugar once a day in the morning**, and readings are typically **90–130 mg/dL**.
- No significant hypoglycemia reported.
- On review of his logs, his fasting blood sugars are controlled, limited readings in the evening but generally >250mg/dl

Let's do a case

Mr. Johnson, 58 years old



What would you do next to improve Mr. Johnson's diabetes management?

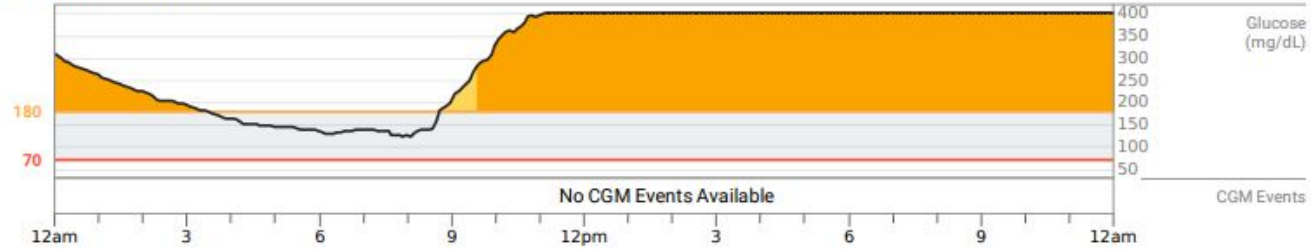
- His fasting glucose is fine
- Increasing basal further will not fix the high HbA1c.
- Likely **post-prandial hyperglycemia** is contributing to his elevated A1c.

Basal Heavy

Tue, Jun 4, 2024



Mon, Jun 3, 2024



Sun, Jun 2, 2024



Next step:

- Reduce his basal insulin to avoid over-basalization
- Introduce bolus (mealtime) insulin for better after-meal control.
- Optimize diet (always!)

Total Daily Dose (units) = Sum of all the patient's insulin dosages during the day including both basal and bolus (meal + correction)

Next step:

- Reduce his basal insulin to avoid over-basalization
- Introduce bolus (mealtime) insulin for better after-meal control.
- Optimize diet (always!)

Total Daily Dose 110units/day

Reduce Tresiba to 55-60units once per day

Add Humalog 10-20units three times per day with meals

Add Humalog scale 4:50 > 150mg/dl

Take Home Message: When fasting sugars are good but A1c remains high, it's time to add bolus — not up the basal.

Let's do a another case

Ms. Smith, 64 years old



- Ms. Smith is a 64-year-old woman with type 2 diabetes diagnosed 8 years ago.
- She has been on **metformin, GLP-1 receptor agonist, and SGLT2 inhibitor** for the past year.
- Despite good adherence, her **A1c remains elevated at 9.8%**.
- She also reports frequent nausea and GI upset with her GLP-1, leading her to skip doses.
- Home blood glucose monitoring shows **fasting readings between 190–250 mg/dL**.
- She is motivated to improve her control but is frustrated that oral medications haven't been enough.

Let's do a another case

Ms. Smith, 64 years old



- She has **inadequate glycemic control** on maximized non-insulin therapies.
- **Intolerance** to GLP-1 limits escalation
- There are other options that could be added up unlikely to bring down the HbA1c 2.8% to get to goal

Next step:

- Start **basal insulin** — typically begin with **10 units once daily** or **0.1–0.2 units/kg/day**.
- Titrate upward based on fasting blood sugars 2-4units every 3–7 days.

How do you counsel your patients when you start insulin?

Objectives

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Counseling Your Patient

Where and how to inject

Timing

Insulin storage

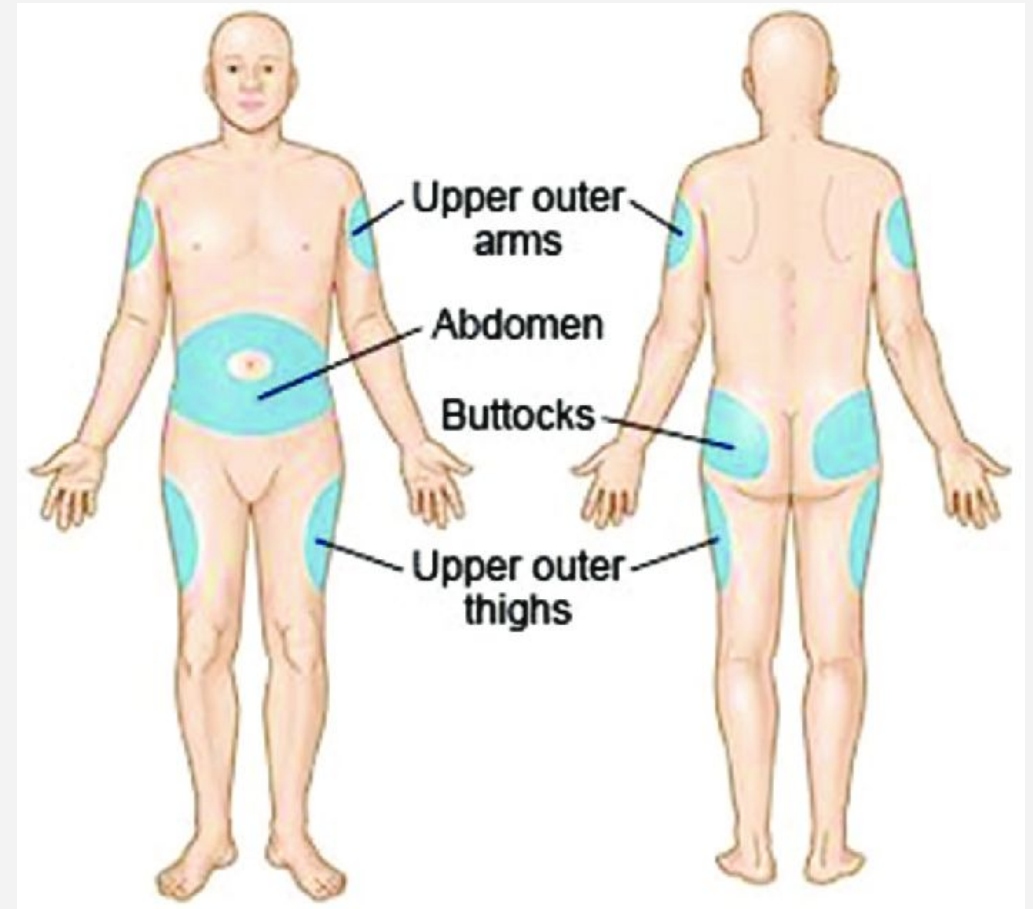
Treating low sugars

When to call

Counseling Your Patient

Insulin is injected into the subcutaneous fat layer

Rotate to avoid overusing any particular spot



Timing

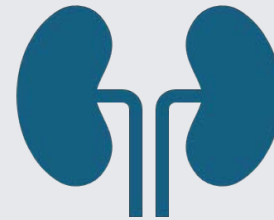


Long-acting insulin

Traditionally injected at night but the best time to take it is when you will remember!

Should be given around the same time every day (+/- 2 hours)

Doesn't matter if you recently took short-acting



Short-acting insulin

Paired with the meal. Ideal is 20 minutes BEFORE the meal but right at the start if acceptable

If they forget they can take it up to 30-60 min late, if they remember later than that it is normally best to wait for next meal and get back on schedule

Storage

Unused pens should be kept in the refrigerator (36-46F)

Unopened insulin is good until its expiration date

Open or in-use pens or vial should be kept at room temperature for max 28 days

After 28 days, partially used pens/vial should be discarded - even if there is leftover insulin

Insulin should never be frozen

Do not store in car – it can get too hot (>86F)

Treating Low Sugars

- Follow the “15-15 rule”
Have 15g carbs SIMPLE, recheck in 15 minutes
- Don't overtreat



Examples of 15g carb
FOUR glucose tabs
4 ounces juice
Pkg fruit snacks
Fun-size skittle
1 glucose gel

Treating Low Sugars

- Prescribe glucagon - but remind them they need to train someone else to use it! They will not be giving to themselves.
- Gvoke (epi-pen style) or Baqsimi (nasal spray) are most popular.



When To Call

Check-in 1-2 weeks after starting insulin

If giving a basal titration scale I typically set a “max” of 0.5units/kg that they should not exceed without calling

If sugar is <70mg/dl, treat the low then call the office

If sugar is >350mg/dl twice in a row call the office

*Starting insulin can be
life-changing, but it
doesn't have to be
overwhelming*

Advanced Insulin Delivery Devices

Smart Pens and Pen Caps



InPen Smart Pen



BigFoot Pen Cap

<https://www.medtronicdiabetes.com>
<https://www.bigfootbiomedical.com>

Patch Pumps



V-Go



**CeQur
(bolus insulin only)**



**Omnipod
Dash**

<https://www.go-vgo.com>
<https://myceqursimplicity.com>



Medtronic 780G



Omnipod 5

Automated Insulin Delivery Systems



**Tandem T-slim
X2 and Mobi**



Beta Bionics iLet

<https://www.tandemdiabetes.com>
<https://www.omnipod.com>
<https://www.betabionics.com>

Resources

- **Insulin affordability:**
 - <https://diabetes.org/tools-resources/affordable-insulin>
- **Insulin pens and glucagon formulations:**
<https://www.adces.org/education/danatech/insulin-medicine-delivery/find-compare-delivery-devices>
- **Injection technique:**
<https://www.adces.org/education/danatech/insulin-medicine-delivery/insulin-medicine-delivery-101/learning-to-inject>
- **Insulin storage and disposal:**
<https://diabetes.org/health-wellness/medication/insulin-storage-and-syringe-safety>
- **Diabetes guidelines and consensus statements:**
 - **American Diabetes Association:** https://diabetesjournals.org/care/issue/48/Supplement_1
 - **American Association of Clinical Endocrinology:**
[https://www.endocrinepractice.org/article/S1530-891X\(23\)00034-4/fulltext](https://www.endocrinepractice.org/article/S1530-891X(23)00034-4/fulltext)

Questions