



CE Credit Information

Credit provided by Corewell Health Southeast Michigan CME Department

This activity is approved for:

AMA PRA Category 1 Credit™

ANCC contact hours for nurses

ACPE continuing pharmacy education credit for pharmacists

ASWB social work continuing education

CDR continuing professional education units for Registered Dietitians and Dietetic Technicians

For full credit details, visit

<https://corewellhealtheast.cloud-cme.com/94784>

Disclosure of Relevant Financial Relationships

- **Kara Mizokami Stout, MD:** Speakers Bureau-Viatris (Relationship has ended).
- **Lauren Oshman, MD** (Planner): Stocks in publicly traded companies or stock options, excluding diversified mutual funds-Abbott, AbbVie, Johnson & Johnson, Merck & Co., Organon.

All other individuals involved with this activity have no relevant financial relationships with ineligible companies to disclose. Mechanisms were implemented to identify and mitigate relevant financial relationships with ineligible companies for all individuals in a position to control content of this activity.

CME/CE Questions?
CHEcme@corewellhealth.org

How to Receive CE Credits/Contact Hours

1. Text CE code **94784** to 833-256-8390 by **1 PM** on **7/20**

(Scan to open a text message)



2. Complete the **CE Evaluation** by **August 2, 2026**

Online at

Sign in > My CME > Evaluations and Certificates
Or via the free CloudCME mobile app – organization code *CorewellHealthEast*

Both steps must be completed to receive credit.

Insulin in Type 2 Diabetes: From Initiation to Optimization

Kara Mizokami-Stout, MD MSc

Assistant Professor | Division of Metabolism, Endocrinology and
Diabetes | University of Michigan



Disclosures

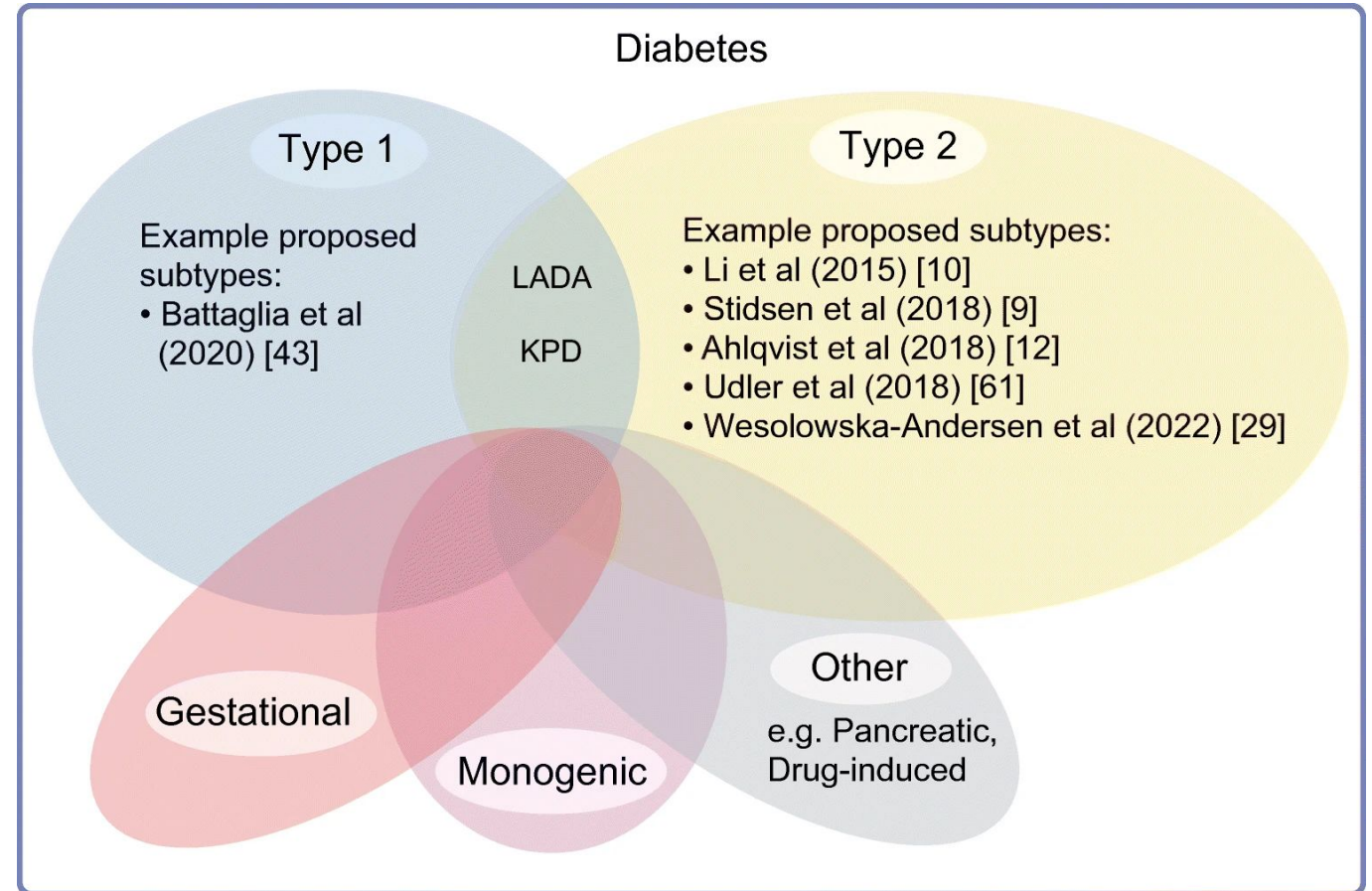
- I have no relevant disclosures related to this talk.

Objectives

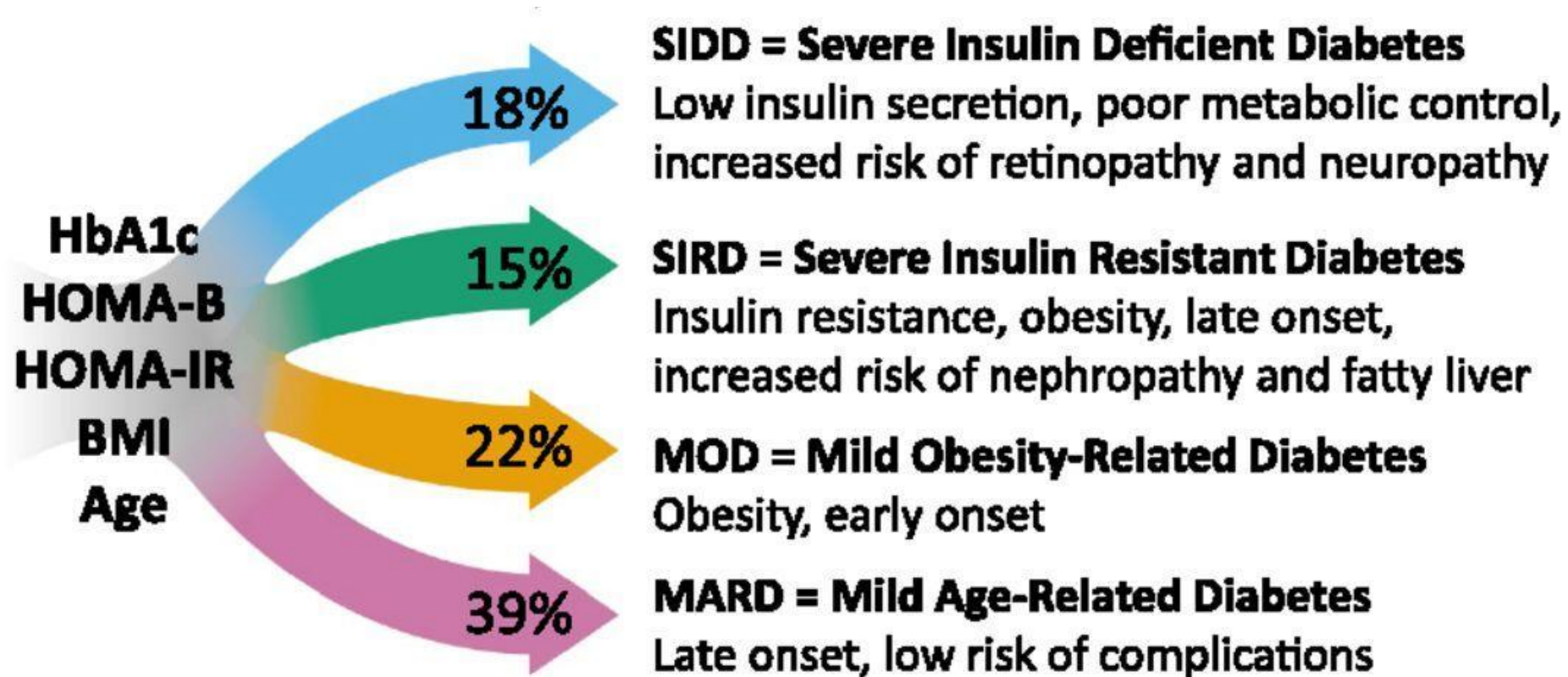
- **Describe which patient populations benefit from insulin therapy.**
- Discuss appropriate insulin regimens for different clinical scenarios:
 - Insulin initiation
 - Insulin titration
- Identify pitfalls and pearls for successful insulin use.
- Review advanced insulin delivery modalities.

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



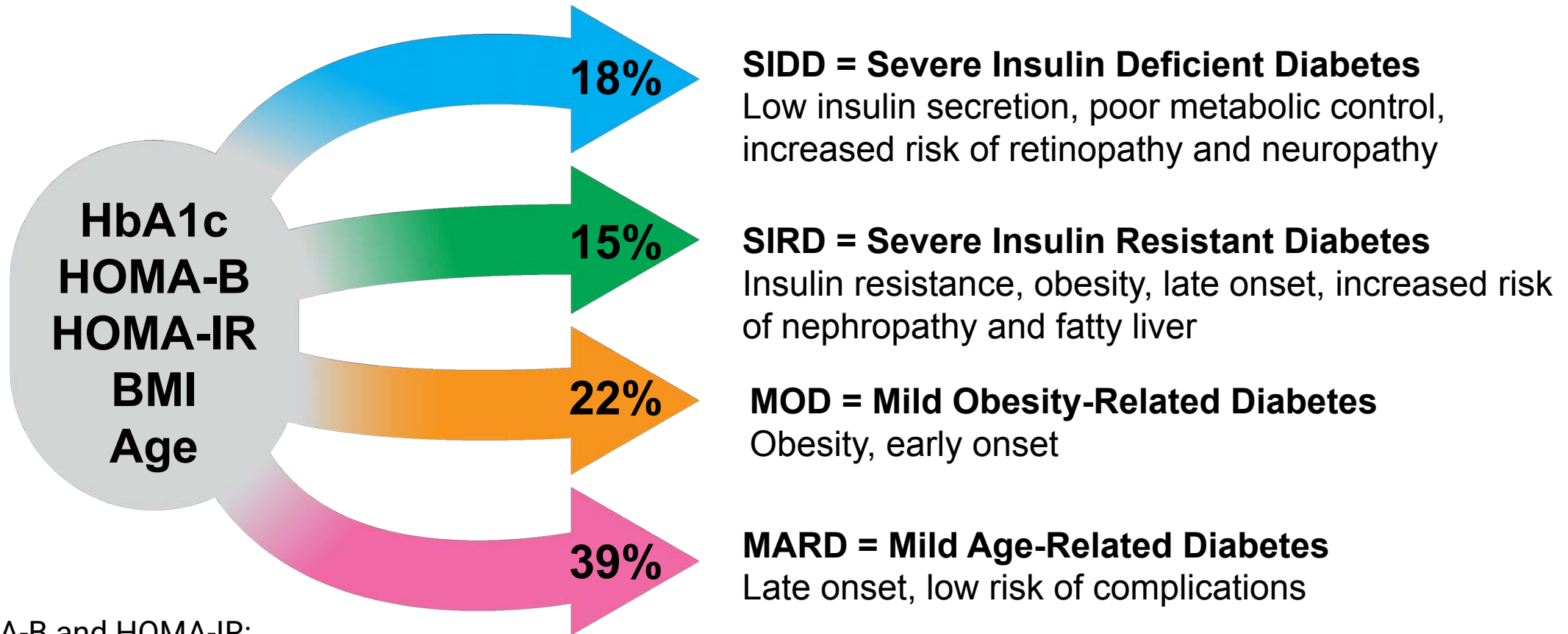
Type 2 Diabetes Heterogeneity



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

Ahlqvist E et al. Diabetes, 2020; 69(10):2086–2093.

Type 2 Diabetes (T2DM) Heterogeneity



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

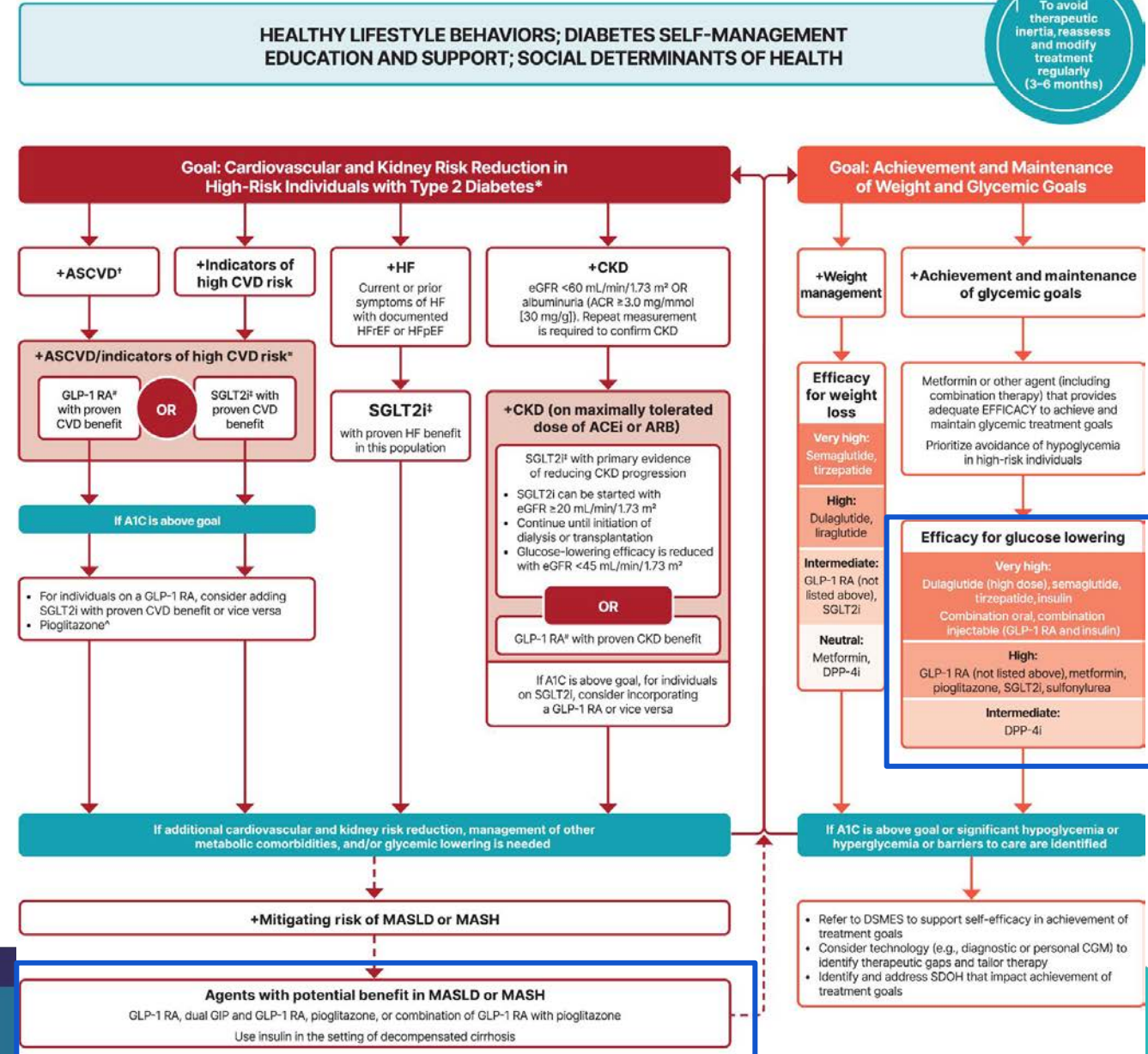
Ahlqvist E et al. Diabetes, 2020; 69(10):2086–2093.

American Diabetes Association Algorithm

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

American Diabetes Association (ADA)
Standards of Care in Diabetes, *Diabetes Care*,
2026; Supplement 1.

Use of Glucose-Lowering Medications in the Management of Type 2 Diabetes



Clinical Scenarios Where Insulin is Preferred

Table 2-Clinical scenarios in which starting basal insulin may be preferred in the era of the innovative medications such 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 (type 1 diabetes, latent autoimmune diabetes in adults)

Pregnancy

Lean, predominantly insulin-deficient T2DM

- including some elderly onset
- with excessive weight loss on other therapies

New-onset T2DM with marked hyperglycemia

Elevated glycated hemoglobin (HbA1c) not at target with other management

Intolerance of noninsulin therapies

Adapted from Bolli GB et al, *Diabetes Care*, 2025; 48(5):671-681.

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

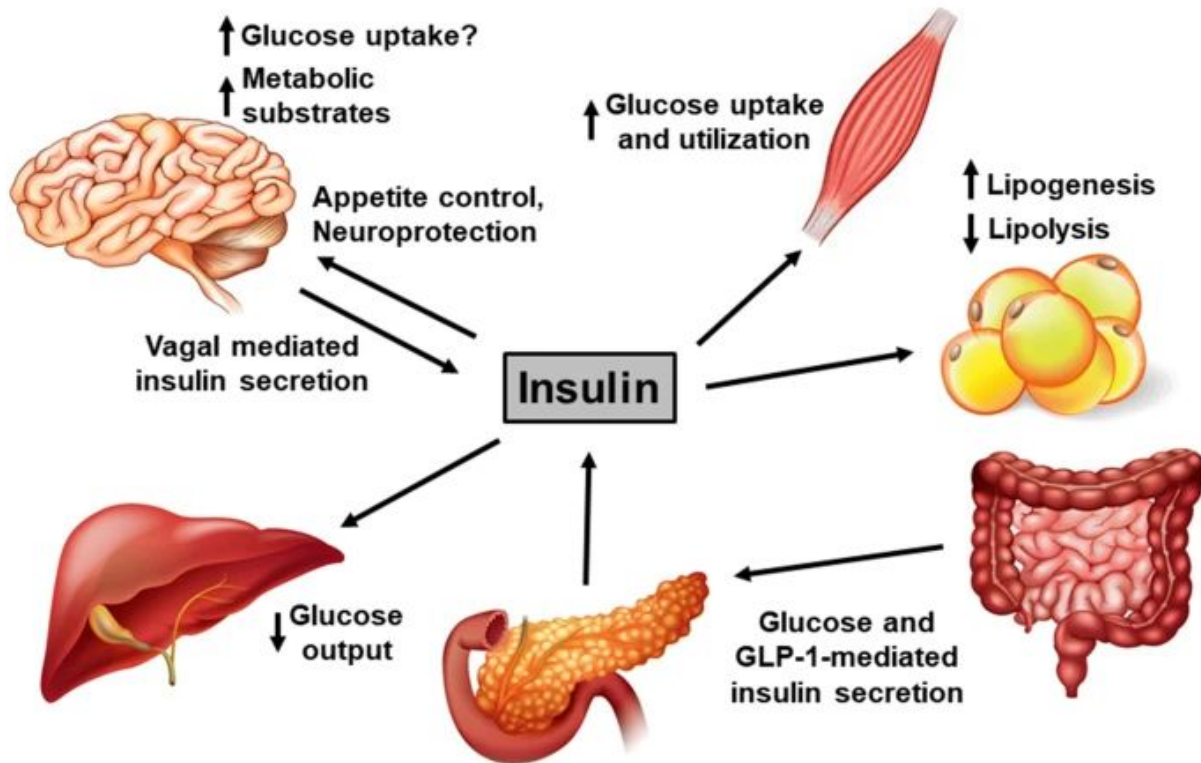
Bolli GB et al, *Diabetes Care*, 2025; 48(5):671-681.

Objectives

- Describe which patient populations benefit from insulin therapy.
- **Discuss appropriate insulin regimens for different clinical scenarios:**
 - Insulin initiation
 - Insulin titration
- Identify pitfalls and pearls for successful insulin use.
- Review advanced insulin delivery modalities.

Insulin Actions

Insulin action on multiple tissues



Basal Insulin:

- Insulin that is secreted overnight and between meals.
- It is secreted at low levels so it acts on more insulin sensitive tissues (liver and adipose tissue).

Bolus Insulin:

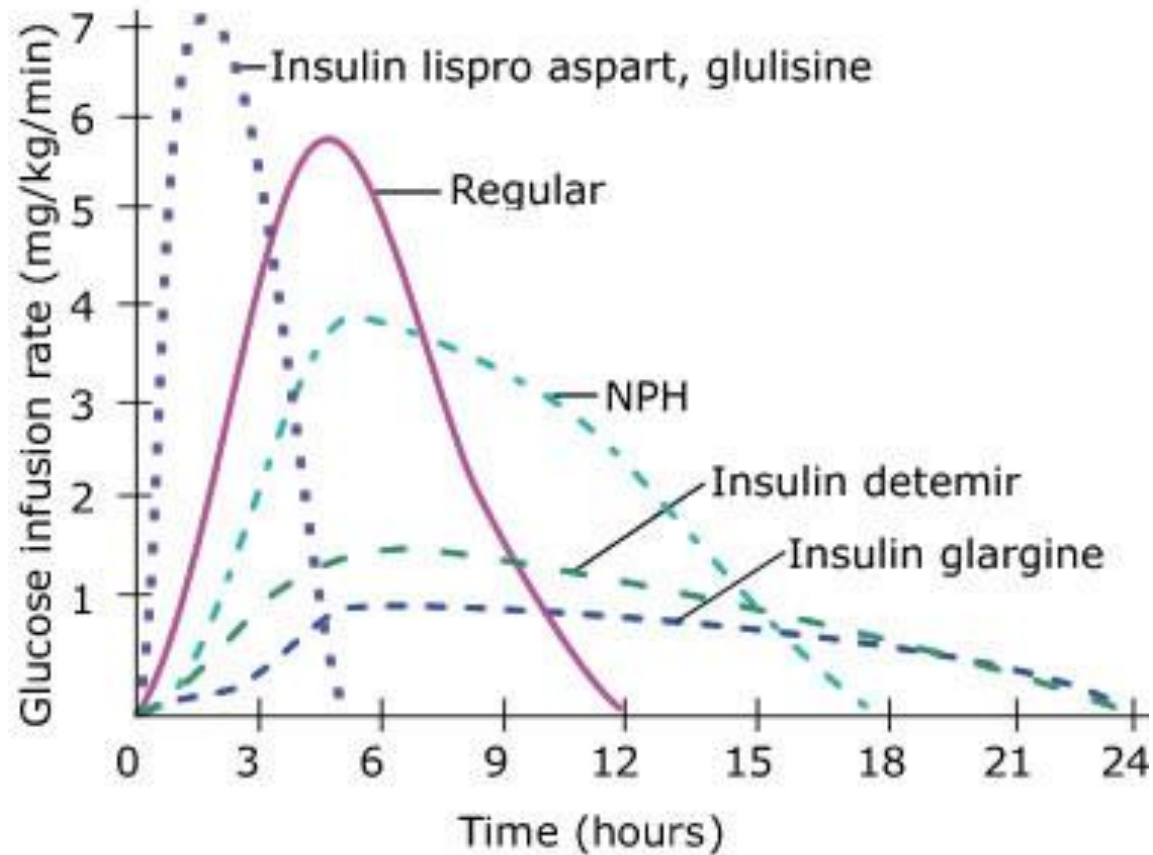
- Insulin that is secreted in response to a meal.
- It is secreted at higher levels so it acts on all tissues that uptake glucoses (liver, adipose, and skeletal muscle)

Tyagi A and Pugazhenth S. *Mol Neurobiol*, 2021; 58: 2672–2691.

Bolli GB et al. *Diabetes Care*, 2025; 48(5):671-681.

Activity Profiles of Different Types of Insulin

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



Commercially Available Insulins

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

Bolus
Insulins

Basal
Insulins

Case 1:

- 54 year old woman with an 18 year history of T2DM, chronic kidney disease (CKD) stage 3, and irritable bowel syndrome.
- She is currently on metformin ER 1000 mg daily and empagliflozin 25 mg daily.
- She has previously tried but not tolerated several incretin mimetics, sulphonylureas, and pioglitazone.
- Her hemoglobin A1c was previously in the 6-7% range for many years with her medications and following a low carb diet. More recently, she has had difficulty following carb restriction and reports higher blood sugars.



Image generated using ChatGPT

GLUCOSE STATISTICS AND TARGETS

Time CGM Active: **28 Days**
98%

Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	Targets % of Readings (Time/Day)
Target Range 70-180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.

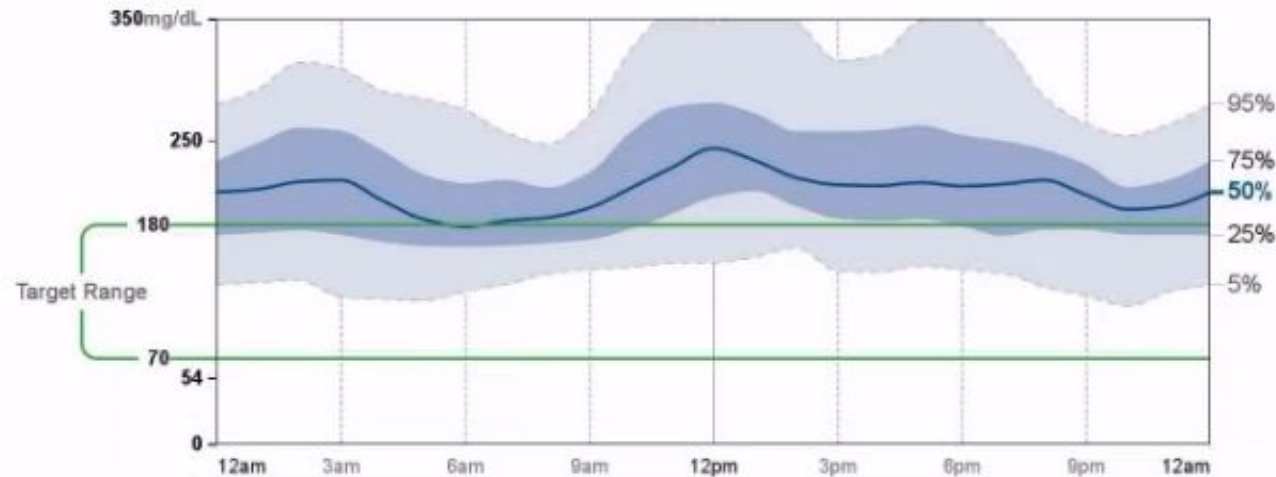
Average Glucose **212** mg/dL
Glucose Management Indicator (GMI) **8.4%**
Glucose Variability **25.5%**
 Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



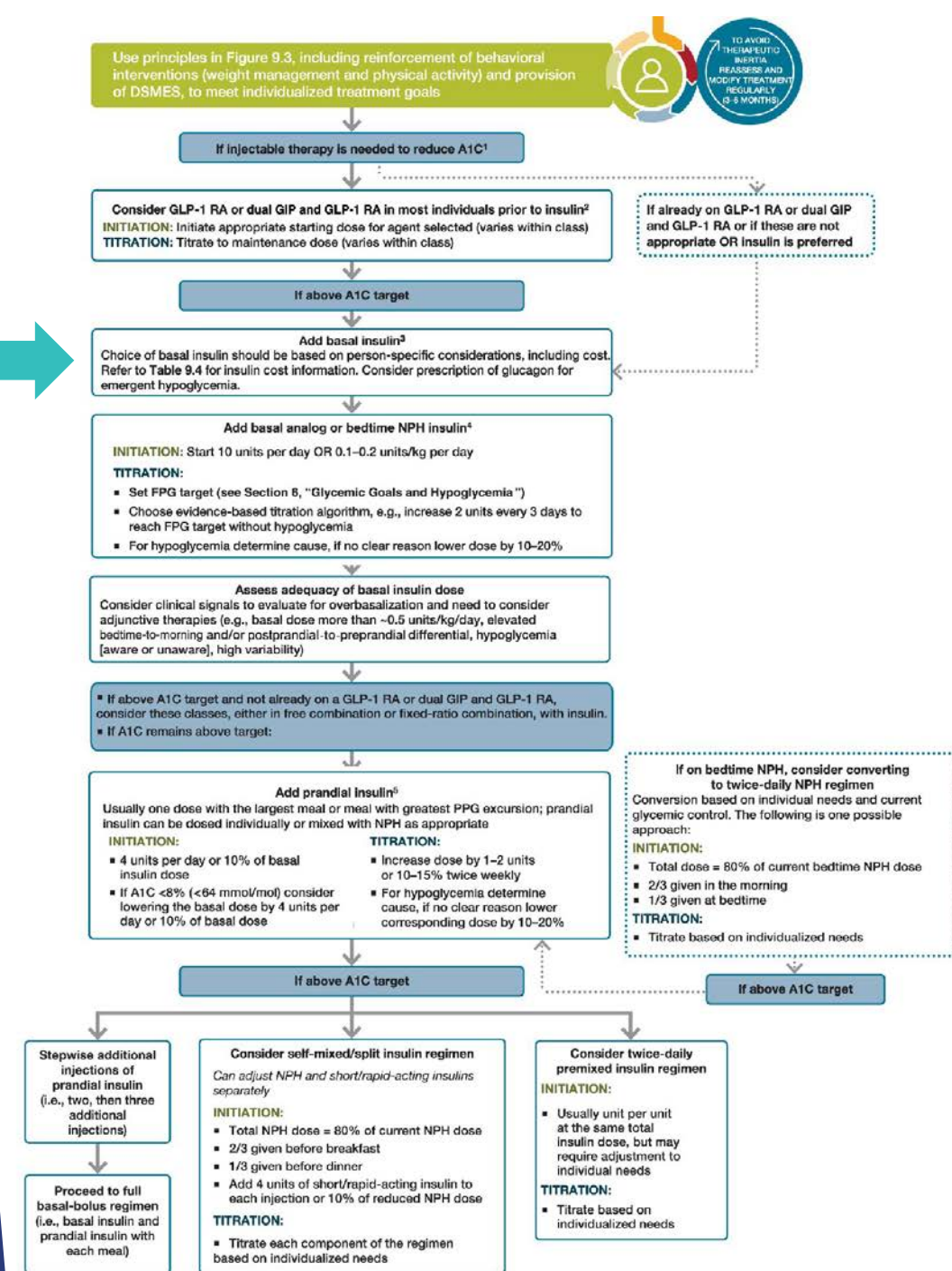
AMBULATORY GLUCOSE PROFILE (AGP)

AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if occurring in a single day.



American Diabetes Association Insulin Initiation Algorithm

American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2026; Supplement 1.



Basal Insulin Initiation and Titration

- 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. incretin mimetics/GLP-1 receptor agonists and SGLT2 inhibitors) help provide coverage for meal related excursions.



American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2026; Supplement 1.

Case 2:

- 62 year old man with a 20 year history of T2DM and coronary artery disease.
- He is currently on insulin glargine 24 units a day, metformin 1000 mg twice daily, empagliflozin 25 mg daily and tirzepatide 5 mg weekly (highest tolerated dose).
- His point of care HbA1c in clinic is 8.3%.



Image generated using ChatGPT

Overview

30 days



Glucose

Average Glucose

186 mg/dL

Time in Range



Target Range:
70-180 mg/dL

Sensor Usage

Days with CGM data

60%

18/30

Standard Deviation

49 mg/dL

GMI

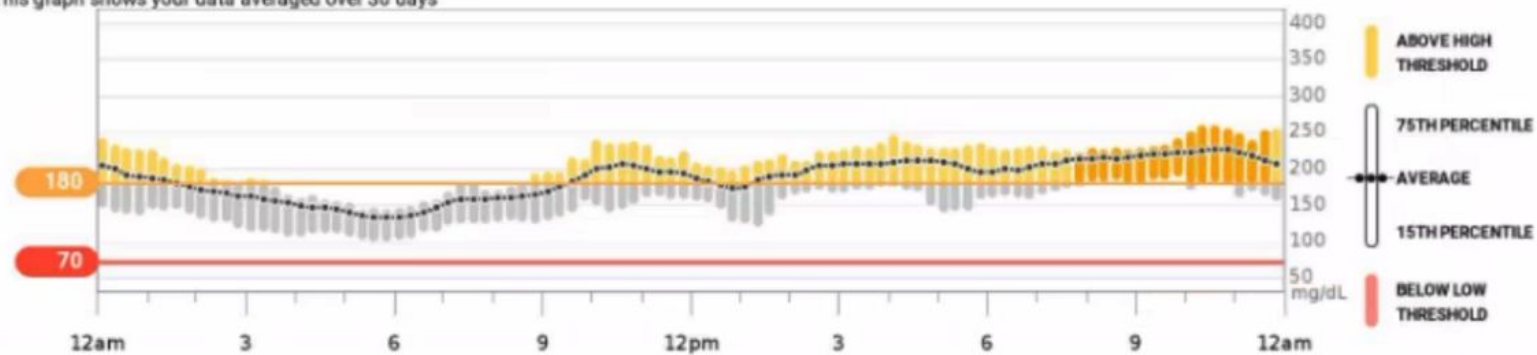
N/A

Avg. calibrations per day

0.1

Top Patterns

This graph shows your data averaged over 30 days



Basal/Bolus Insulin and Titration

- Total daily dose: 0.4–0.5 units/kg/day.
- 50% basal, 50% divided among meals.
 - Example:
 - Total daily dose: 48 units
 - Lantus 24 units
 - Humalog 8 units TID with meals
- Alternatively, start a flat 4 units with meals, especially if already on basal insulin.
- Can start with the largest meal or all meals.
- Titrate 10-15% or 1-2 units up to twice weekly based on postprandial glucoses.
- Can continue other agents particularly if there are weight or cardiorenal benefits.

American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2026; Supplement 1.

Fasting and Post-Prandial Glucose Targets for Non-Pregnant Adults

Table 6.3 Summary of glycemic goals for many non pregnant adults with diabetes

A1C	<7.0%
Fasting plasma glucose	80-130 mg/dL
Peak postprandial capillary plasma glucose (1-2 hours)	<180 mg/dL

American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2026; Supplement 1.

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

Bolli GB et al, *Diabetes Care*, 2025; 48(5):671-681.

MCT2D Insulin Initiation & Titration Tools

Getting Started with Insulin for Type 2 Diabetes

Your care team is recommending insulin to help manage your blood sugar. Beginning insulin should be a shared decision. Make sure you understand all your options, ask questions, and feel confident that this is a plan you and your care team chose together.

Two Main Types of Insulin

Long-Acting Insulin (Basal)
Helps keep your blood sugar stable between meals and overnight, even when you're not eating. Also called "basal," "fasting," or "background" insulin.
Typically dosed at night and is adjusted based on your morning (fasting) blood sugar levels.

Fast-Acting Insulin (Bolus)
Covers meals and corrections for blood sugar. Also called "bolus," "rapid-acting," "pre-meal," or "prandial" insulin.
Typically taken before meals and is adjusted based on the food you eat and your blood sugar levels.

Injection Timing

- **When:** Same time daily (within 2 hours).
- **If you forget:** Take dose within a few hours. If later than that, skip and take your normal dose the next day.

Learn How to Get Started with Long-Acting Insulin
When you are starting insulin, long-acting insulin is typically prescribed first. This insulin is based on your fasting blood sugar and is not related to your food intake.
Scan the QR code or visit the link to learn more.

Learn How to Get Started with Fast-Acting Insulin
Fast-acting insulin is usually started after long-acting insulin. Your doctor will recommend either:

- **Starting with One Meal**
This method adds fast-acting insulin slowly. You'll start with just one meal—usually the largest one of the day.
- **All Meals at Once**
This method starts fast-acting insulin for all meals.
Scan the QR code or visit the link to learn more.

Where to Inject Your Insulin
Many patients prefer to inject insulin in the abdomen. Talk to your care team about injecting into the fat in your arms, thighs or buttocks.

- Stay about two inches away from your belly button
- Rotate your injection sites each time—imagine there are clocks on either side of your belly button and choose a different "hour" for each dose
- Inject into fatty tissue, not muscle—you should be able to gently "pinch an inch"
- Regularly check your skin for scar tissue by feeling for firm or lumpy areas and avoid injecting there



Getting Started with Insulin for Patients with Type 2 Diabetes

Getting Started with Long-Acting Insulin for Patients with Type 2 Diabetes

You have been prescribed long-acting or basal insulin to help manage your blood sugar. This insulin is dosed based on your fasting (morning) blood sugar reading, regardless of what time of day you take your insulin.

Here's some information to help you adjust your dose safely, know what to do if you forget a dose, store your insulin, and other helpful tips.

Your Starting Insulin Dose
Take long-acting insulin once a day:
This may be glargine (other names include Lantus, Toujeo, Basaglar, or Semglee), or degludec (brand name Tresiba).

Your Starting Dose: Units

Take it once daily at the same time each day (ex. every evening)

How to Adjust Your Dose
Check your fasting blood sugar once each morning for three days in a row. Fasting blood sugar is the number you get first thing in the morning, before eating or drinking anything.

Blood sugar can vary from day to day, so focus on the overall pattern rather than a single number. After three days, use the instructions below to adjust your insulin based on where your blood sugars are mostly running.

If your readings vary widely from day to day, do not make changes yet. Instead, wait until you have three consecutive mornings with similar numbers, then follow the adjustment instructions.

Example Dose Adjustment

Fasting Morning Blood Sugar (3 days in a row)	Insulin Adjustment
⬆ Above 250 mg/dL	Increase by 4 units
⬆ 151–250 mg/dL	Increase by 2 units
✓ 90–150 mg/dL	Stay on the same dose
⬇ Below 90 mg/dL	Decrease by 2 units
⚠ Below 70 mg/dL with symptoms	Treat the low & contact care team

Follow dose recommendations from your care team, and contact them if you are having issues with your current dosing.

Getting Started with Long-Acting Insulin for Patients with Type 2 Diabetes

Getting Started with Fast-Acting Insulin for Patients with Type 2 Diabetes

Your care team may be adding fast-acting insulin (also called mealtime, prandial or rapid-acting insulin) to help control your blood sugar after meals. This is a normal next step when your long-acting insulin controls your morning (or fasting) blood sugar well, but your blood sugar still rises too high after eating.

Types of Fast-Acting Insulins

Insulin aspart	Novolog, Fiasp, NovoRapid and Trurapi
Insulin lispro	Admelog, Humalog and Lyumjev
Insulin glulisine	Apidra

Getting Started on Fast-Acting Insulin

1) **One meal approach** where you start with one meal and add more if needed.

2) **All meal approach** where you start with taking fast-acting insulin at all three meals.

One Meal Approach (Starting with one meal)
You start by taking a small dose before your largest meal (typically the meal that causes your blood sugar to rise the most). Your care team will tell you exactly how much to take.
Take your fast-acting insulin 15-20 minutes before your meal.
Adding a Second Meal and then a Third Meal (if needed)
If your blood sugar improves with insulin at one meal but remains high at other times of the day, your care team may recommend adding fast-acting insulin at a second meal and then a third meal as needed.

All Meal Approach (Starting with all meals)
You start by taking fast-acting insulin at all three meals from the beginning. Your care team will tell you exactly how much to take.
This may be recommended if your blood sugar stays high throughout the day, or if your A1c remains high despite using the maximum dose of long-acting insulin or other medications that target after-meal blood sugar.

In general, about half of your total daily dose of insulin is given as long-acting (basal) insulin, and the other half is divided between your three meals as fast-acting (prandial) insulin.



How to Adjust Your Dose
Always check your blood sugar in the morning, before your meals, and at bedtime.
Your care team will help you gradually adjust your insulin doses based on your blood sugar or continuous glucose monitor (CGM) readings.

Getting Started with Fast-Acting Insulin for Patients with Type 2 Diabetes

Available in the MCT2D Resource Library!

Case 3:

- 44 year old man, HbA1c of 14%, BMI 30 kg/m².
- Under his PCP's care, he was initiated on basal and bolus insulins. His PCP ordered a work-up for latent autoimmune diabetes of adulthood (LADA) and referred him urgently to Endocrinology. GAD-65 antibodies were noted to be negative. His initial C-peptide was low-normal at 0.8 ng/mL.
- He was evaluated in Endocrinology 3 months later. A point-of-care (POC) HbA1c was 6.2%. He was using insulin consistently and his self-monitored blood glucoses ranged from 91-134 mg/dL.
- A repeat C-peptide was checked and improved to 2.0 ng/mL (blood glucose 117 mg/dL) after the initial visit. Bolus insulin was discontinued and switched to injectable semaglutide.
- In follow-up with Endocrinology 4 months later, his point-of-care A1c was 5.6%. A C-peptide was rechecked and measured 4.6 ng/mL (blood glucose 123 mg/dL). Basal insulin was discontinued.
- A follow-up POC HbA1c measured 6.2% 6 months later.

Case 3:

- A 44-year-old man presented with an HbA1c of 14% and BMI of 29 kg/m².
- His PCP started basal-bolus insulin, ordered testing for latent autoimmune diabetes in adults, and urgently referred him to Endocrinology. GAD-65 antibodies were negative, and initial C-peptide was low-normal at 0.8 ng/mL.
- Three months later, his POC HbA1c had improved to 6.2%. He was using insulin consistently, with home glucose readings of 91–134 mg/dL. Repeat C-peptide increased to 2.0 ng/mL with glucose of 117 mg/dL. Bolus insulin was stopped, and injectable semaglutide was started.
- Four months later, his POC HbA1c was 5.6%, and C-peptide had increased to 4.6 ng/mL with glucose of 123 mg/dL. Basal insulin was discontinued. Six months later, his POC HbA1c remained controlled at 6.2%.



Image generated using ChatGPT

Latent Autoimmune Diabetes in Adults (LADA)

What is Latent Autoimmune Diabetes in Adults:

- Slowly progressive autoimmune diabetes in adults (age >30-35 years).
- Shares features of both Type 1 and Type 2 diabetes.
- Accounts for 2-12% of adult-onset diabetes.
- Has positive anti-GAD-65 antibodies (like Type 1 diabetes).

Why It Matters:

- Different prognosis and treatment approach than Type 2 diabetes.
- Earlier insulin requirements.
- Better β -cell preservation with appropriate therapy.

When to Suspect LADA - Clinical Red Flags

Consider LADA testing in adults with diabetes who have:

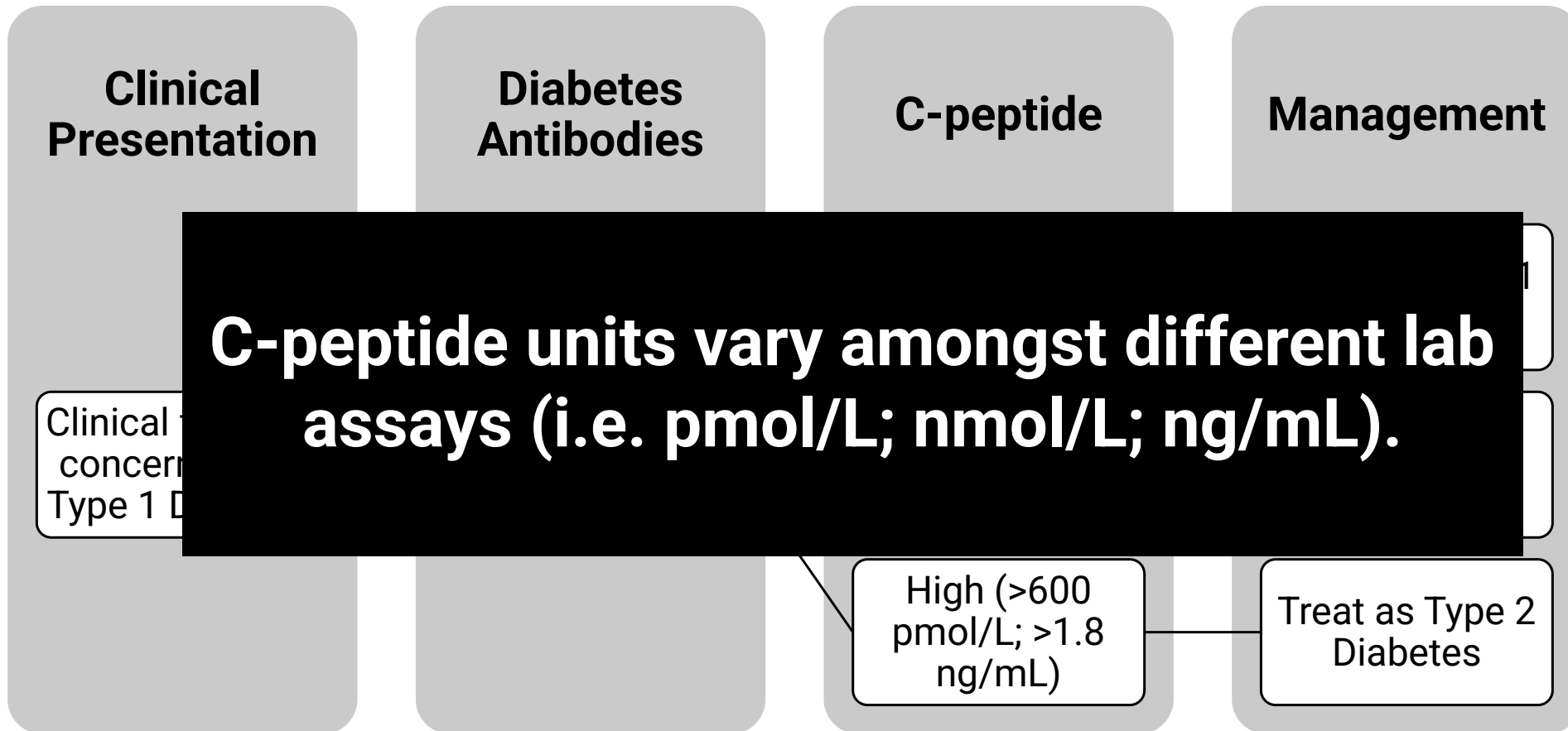
Patient Characteristics:

- Younger age at diagnosis (in 30s and 40s)
- Normal BMI or lean body habitus
- Absence of metabolic syndrome features
- Personal or family history of autoimmune disease

Clinical Course:

- Rapid progression to insulin requirement (within 6 months of diagnosis)
- Poor response to non-insulin diabetes medications
- Unexplained weight loss at diagnosis
- Difficulty achieving glycemic control despite adherence
- History of DKA with or without SGLT2 inhibitor use

Management Based on C-peptide Levels



American Diabetes Association Professional Practice Committee for Diabetes; 2. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes—2026. *Diabetes Care* 1 January 2026; 49 (Supplement_1): S27–S49.

Adapted from Raffaella Buzzetti, Tiinamaija Tuomi, Didac Mauricio, Massimo Pietropaolo, Zhiguang Zhou, Paolo Pozzilli, Richard David Leslie; Management of Latent Autoimmune Diabetes in Adults: A Consensus Statement From an International Expert Panel. *Diabetes* 1 October 2020; 69 (10): 2037–2047.

Objectives

- Describe which patient populations benefit from insulin therapy.
- Discuss appropriate insulin regimens for different clinical scenarios:
 - Insulin initiation
 - Insulin titration
- **Identify pitfalls and pearls for successful insulin use.**
- Review advanced insulin delivery modalities.

Insulin Use Pitfalls: Patients

- High out-of-pocket costs
- Stigma: Feelings of embarrassment, shame, and perceived judgement
- Fatalism: Insulin use means diabetes is “worse” and complications are inevitable
- Fear:
 - of needles and injections
 - of hypoglycemia
 - of weight gain

Management Strategies

Use “Older insulins,” biosimilars, coupons, and patient assistance programs may reduce out-of-pocket costs

In-Clinic Resources:

- Social work
- Diabetes education
- Diabetes psychologists
- Peer support programs
- Care navigators

Outside Resources:

- Community diabetes support groups
- Diabetes online communities
- Digital behavioral support programs

Galdón Sanz-Pastor A et al. *Front Endocrinol.* 2024;15:1366368.

Insulin Use Pitfalls: Clinicians

- Bias (conscious or unconscious)
- Clinical inertia
- Knowledge and confidence gaps
- Limited time and clinic resources

Galdón Sanz-Pastor A et al. *Front Endocrinol.* 2024;15:1366368.

Management Strategies

Don't demonize people for using insulin – multifactorial reasons for insulin use and all are valid

Clinically-oriented diabetes CME:

- MCT2D online resources
- Achieve Targets in Diabetes Care (ATDC; Keystone, CO; July 8-11, 2026)
- ADCES (Columbus, OH; August 7-10, 2026)
- ADA Clinical Update Conference (Houston, TX; Feb 5-7, 2027)

Diabetes is multidisciplinary – divide and conquer!

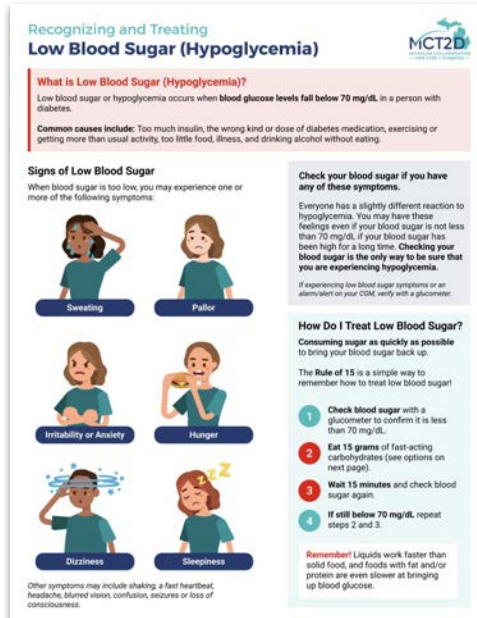
- Primary care clinicians
- Diabetes educators
- Clinical pharmacists
- Endocrinologists

Insulin Use Pearls

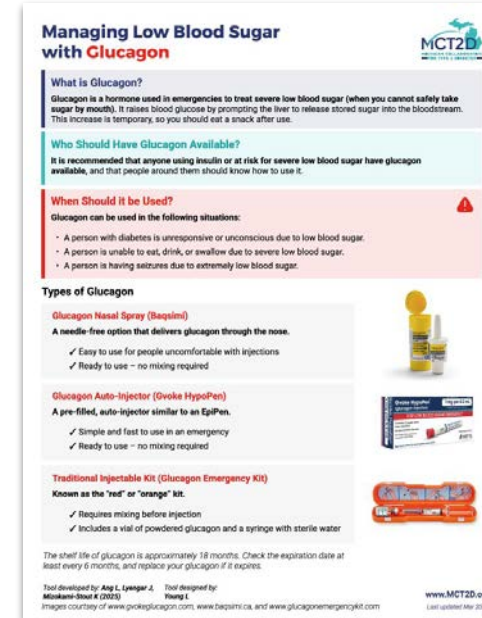
- **Insulin use may be *temporary*** to reduce glucose toxicity, always review need for de-escalation of insulin doses.
- **Avoid “overbasalization”:**
 - Basal insulin doses >0.5 units/kg
 - Drop in blood sugar of ≥ 50 mg/dL overnight or while fasting
- **Don't forget to prescribe administration tools:** needles, syringes, lancets, alcohol pads, glucometer, continuous glucose monitors, etc.
- All patients on insulin should be **counseled on identifying and treating hypoglycemia.**
- All patients on insulin **should also have a glucagon to treat severe hypoglycemia.**
- Be sure to counsel on **injection site rotation and periodically check skin for lipohypertrophy.**

American Diabetes Association (ADA) Standards of Care in Diabetes, *Diabetes Care*, 2026; Supplement 1.

MCT2D Tools for Hypoglycemia Management



Recognizing and Treating Low Blood Sugar (Hypoglycemia)



Managing Low Blood Sugar with Glucagon



Available in the MCT2D Resource Library!
Search “insulin”

Objectives

- Describe which patient populations benefit from insulin therapy.
- Discuss appropriate insulin regimens for different clinical scenarios:
 - Insulin initiation
 - Insulin titration
- Identify pitfalls and pearls for successful insulin use.
- **Review advanced insulin delivery modalities.**

Case 4:

- 70 year old woman with a 30 year history of type 2 diabetes, retinopathy, peripheral neuropathy, stage 3 CKD, CAD, and obesity.
- She is currently on: tirzepatide 5 mg weekly (max tolerated dose), dapagliflozin 10 mg daily, and glargine 60 units twice daily and lispro 30-34 units with meals (eats 3 meals per day) plus a correction scale.
- She reports discomfort with injections due to her large insulin doses but confirms she is using as prescribed.



Image generated using ChatGPT

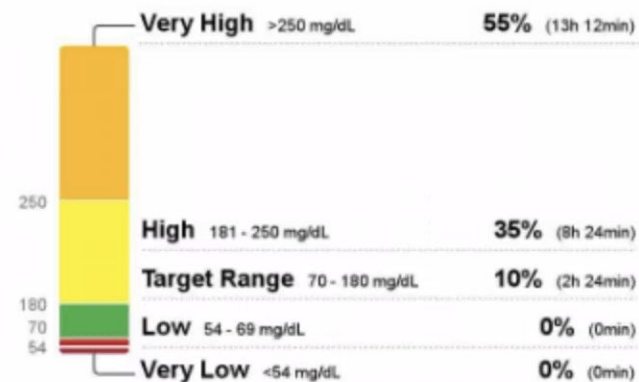
GLUCOSE STATISTICS AND TARGETS

TIME IN RANGES

Time CGM Active: 14 Days
81%

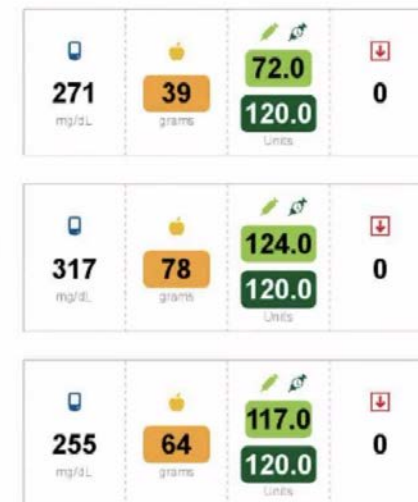
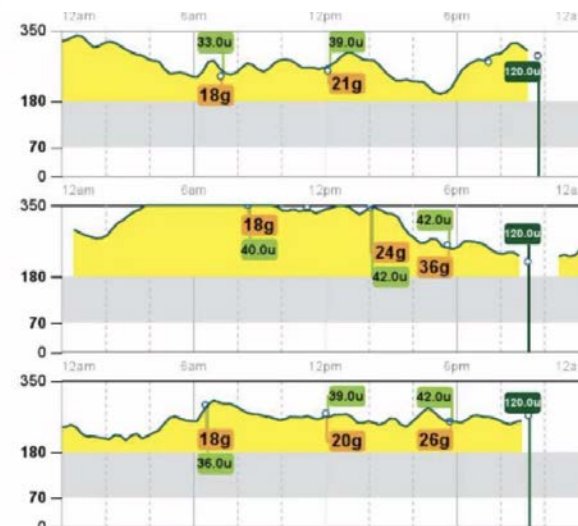
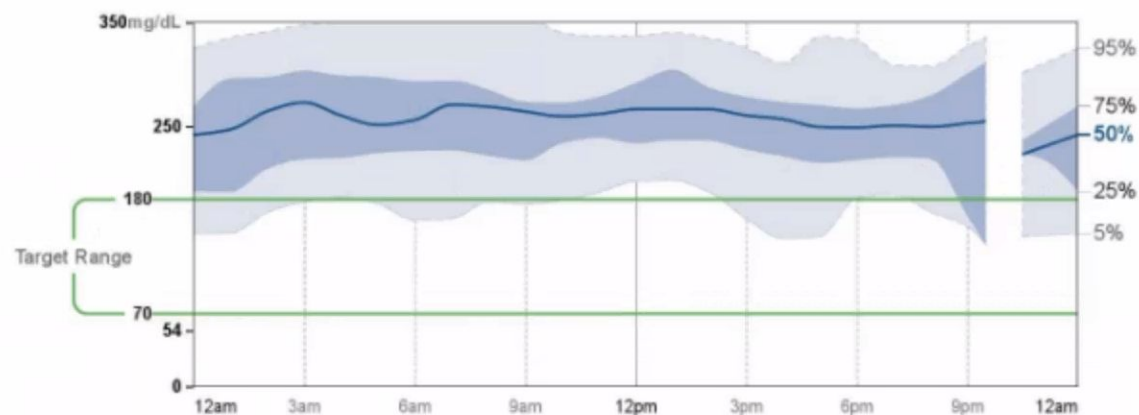
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	Targets % of Readings (Time/Day)
Target Range 70-180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

Average Glucose 254 mg/dL
Glucose Management Indicator (GMI) 9.4%
Glucose Variability 20.6%
Defined as percent coefficient of variation (%CV); target ≤36%



AMBULATORY GLUCOSE PROFILE (AGP)

AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if occurring in a single day.



Concentrated Insulins

When to consider using a concentrated insulin:

- When a single insulin injection **exceeds** the capacity of a single injection on an insulin pen.
- When total daily doses **exceed 200 units**.
- When individuals reports **discomfort with large insulin volumes**.
- When significant insulin **resistance is present** (insulin requirements > 2 units/kg/day).

Umpierrez et al, *Endocrine Practice*, 2020; 26(3):1-11.

Concentrated Insulins

U-200 and U-300 insulins:

- Directly interchangeable with U-100 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 Insulin

- U-500 is DIFFERENT from other concentrated insulins and cannot be readily interchanged.
- Only available as pens – no vials.
- High risk for hypoglycemia – consider referral to Endocrinology.



Case 5:

- 58 year old man with a 13 year history of T2DM.
- His current medications are: metformin, tirzepatide 10 mg weekly, insulin glargine nightly, insulin lispro with meals based on a carb ratio, and correction factor.
- He travels frequently for work. Meal times vary and are often on-the-go. As a result, he frequently forgets his lunch boluses.
- He is reluctant to wear diabetes devices. He has reluctantly agreed to use a CGM device after a severe hypoglycemic event a few years ago.

Overview

14 days |



Glucose

Average glucose

207 mg/dL

GMI

8.3 %

Time in Range

31% Very High
29% High
38% In Range
1% Low
1% Very Low

Sensor usage

Days with data
14/14 days

Time active
96%

Avg. calibrations per day
0.0

Standard deviation

79 mg/dL

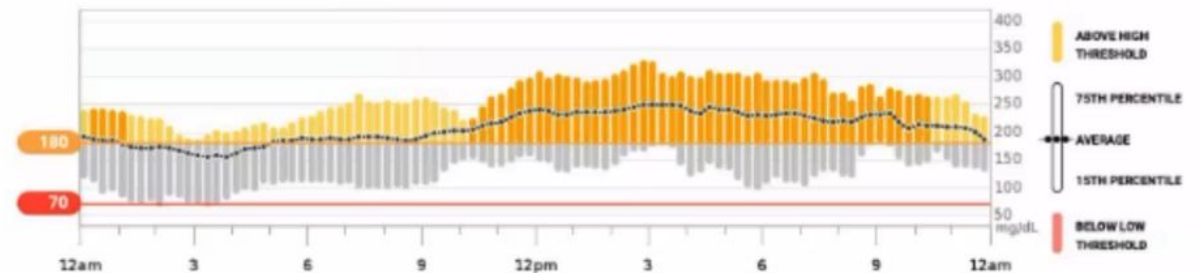
Coefficient of Variation

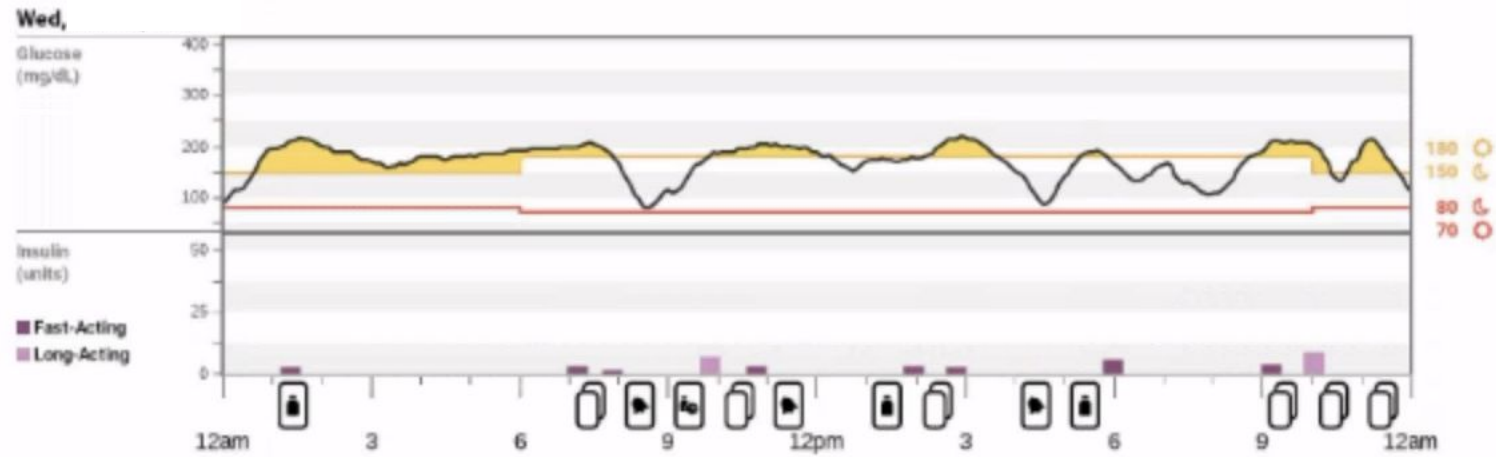
38.3 %

Target Range:
70-180 mg/dL

Top Patterns

This graph shows your data averaged over 14 days





1:21 AM [Pen] Fast-Acting 2.5 units	7:11 AM [Pen] Fast-Acting 3.5 units	7:34 AM High	7:52 AM [Pen] Fast-Acting 1.5 units
8:09 AM Fall Rate	9:51 AM [Pen] Long-Acting 7.0 units	10:44 AM High	10:46 AM [Pen] Fast-Acting 3.0 units
11:24 AM High	1:57 PM [Pen] Fast-Acting 3.5 units	2:29 PM High	2:49 PM [Pen] Fast-Acting 2.5 units
4:24 PM Fall Rate	5:59 PM [Pen] Fast-Acting 5.5 units	9:09 PM High	9:11 PM [Pen] Fast-Acting 4.0 units
10:03 PM [Pen] Long-Acting 9.0 units	10:24 PM Fall Rate	11:04 PM High	11:49 PM Fall Rate

Smart Pens and Pen Caps



InPen Smart Pen

- Only bolus insulins (pre-filled insulin cartridge)
- Automatic dose logging
- Integrated bolus calculator
- Alerts for missed doses and need for correction doses



BigFoot Pen Cap

- Fits on standard basal AND bolus insulin pens
- Automatic dose logging
- Integrated bolus calculator

<https://www.medtronicdiabetes.com>

<https://www.bigfootbiomedical.com>

Case 6:

- 70 year old man with a 40 year history of T2DM.
- Currently on metformin, empagliflozin, injectable semaglutide weekly, insulin degludec 26 units daily, and insulin lispro 8 units with meals plus a correction scale.
- He also reports discomfort with the frequent injections.
- He was referred to Endocrinology and advanced insulin modalities were discussed with him.
- After meeting with Diabetes Education, he elected to start on a CeQur disposable patch pump.

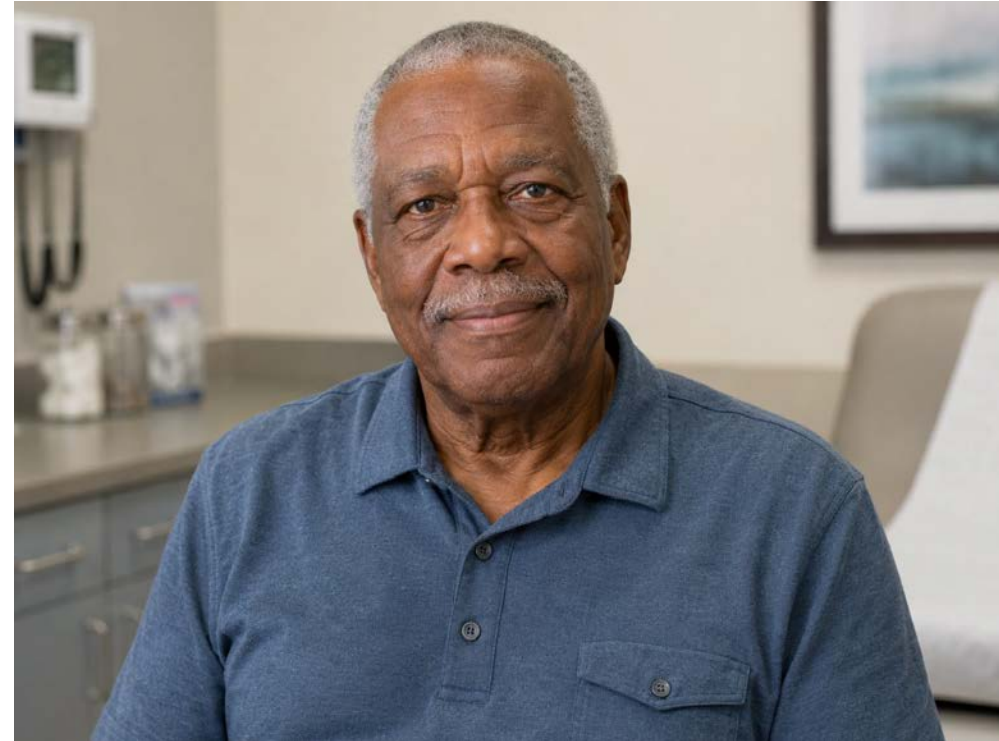


Image generated using ChatGPT

Before CeQur

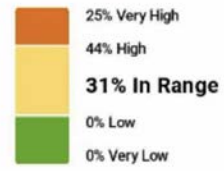
Average Glucose

215 mg/dL

Standard Deviation
58 mg/dL

GMI
8.5%

Time in Range



Target Range:
70-180 mg/dL

Sensor Usage

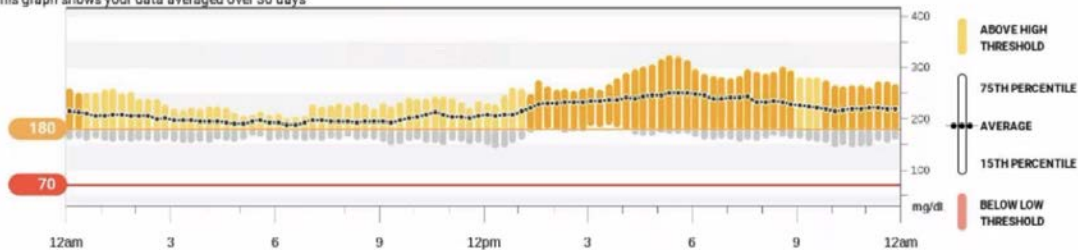
Days with CGM data
93%
28/30

Avg. calibrations per day
0.0

Top Patterns

- Patient had a pattern of nighttime highs**
Patient had a pattern of significant highs between 10:00 PM and 12:20 AM.
- Patient had a pattern of daytime highs**
Patient had a pattern of significant highs between 1:20 PM and 8:50 PM.
- Patient's best glucose day was October 20, 2022**
Patient's glucose data was in the target range about 63% of the day.

This graph shows your data averaged over 30 days



1 month after CeQur started

Glucose

Average Glucose

164 mg/dL

Standard Deviation
42 mg/dL

GMI
7.2%

Time in Range



Target Range:
70-180 mg/dL

Sensor Usage

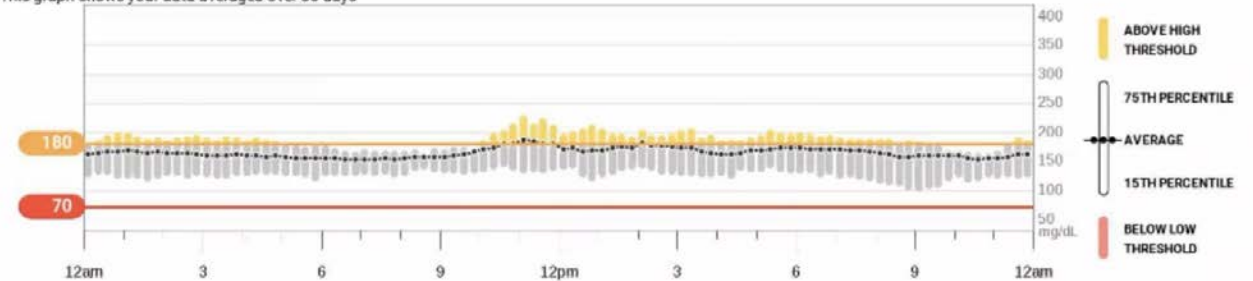
Days with CGM data
97%
29/30

Avg. calibrations per day
0.0

Top Patterns

best glucose day was January 7, 2023
glucose data was in the target range about 95% of the day.

This graph shows your data averaged over 30 days



Disposable Patch Pumps



V-Go

- Basal and bolus coverage
- Fill with bolus insulin only and basal is provided as continuous infusion
- Available in basal doses of 20, 30, and 40 units/day (holds up to 76 units)
- “Click” the device for boluses (1 click = 2 units)
- Replace device daily



CeQur

- Bolus coverage only (requires separate basal insulin injection)
- Fill with bolus insulin
- Holds up to 200 units of insulin
- “Click” the device for boluses (1 click = 2 units)
- Replace every 4 days (or sooner if needed based on insulin requirements)

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

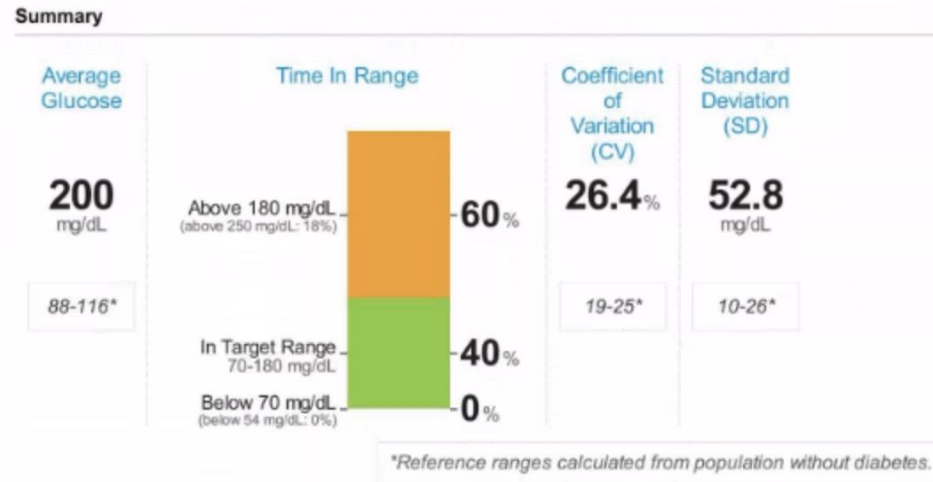
Case 7:

- 47 year old woman with a 14 year history of T2DM.
- She is currently on metformin, injectable semaglutide weekly, insulin degludec, and insulin aspart with meals (doses based on carb ratios).
- She has not tolerated other non-insulin antidiabetic agents including SGLT2 inhibitors, pioglitazone, or sulfonylureas.
- She has an active job and frequently forgets to bolus. She also has lows with activity.
- She was referred to Endocrinology for evaluation of an insulin pump.



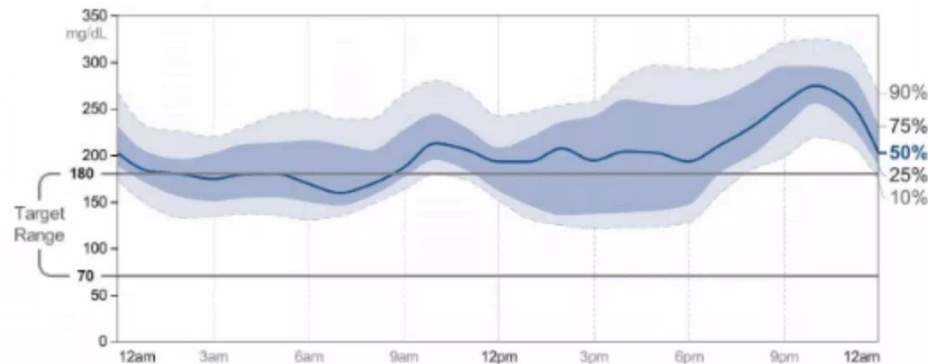
Image generated using ChatGPT

Before insulin pump



Ambulatory Glucose Profile

Curves/plots represent glucose frequency distributions by time regardless of date



4 months after insulin pump start

Overview

30 days



Glucose

Average Glucose

141 mg/dL

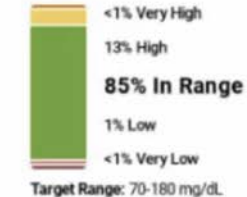
Standard Deviation

35 mg/dL

GMI

N/A

Time in Range



Sensor Usage

Days with CGM data

50%

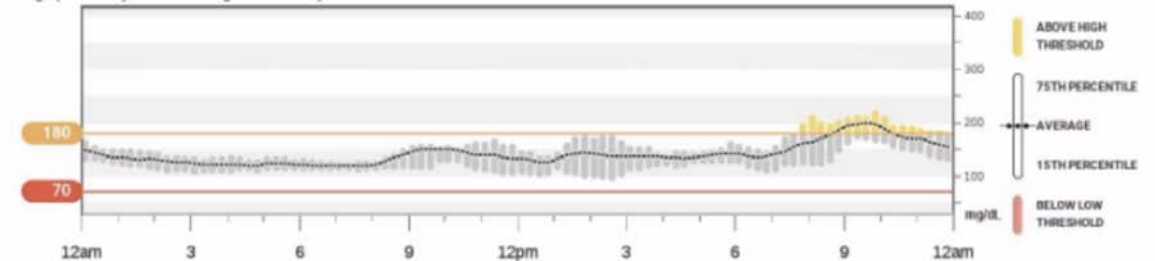
15/30

Avg. calibrations per day

0.0

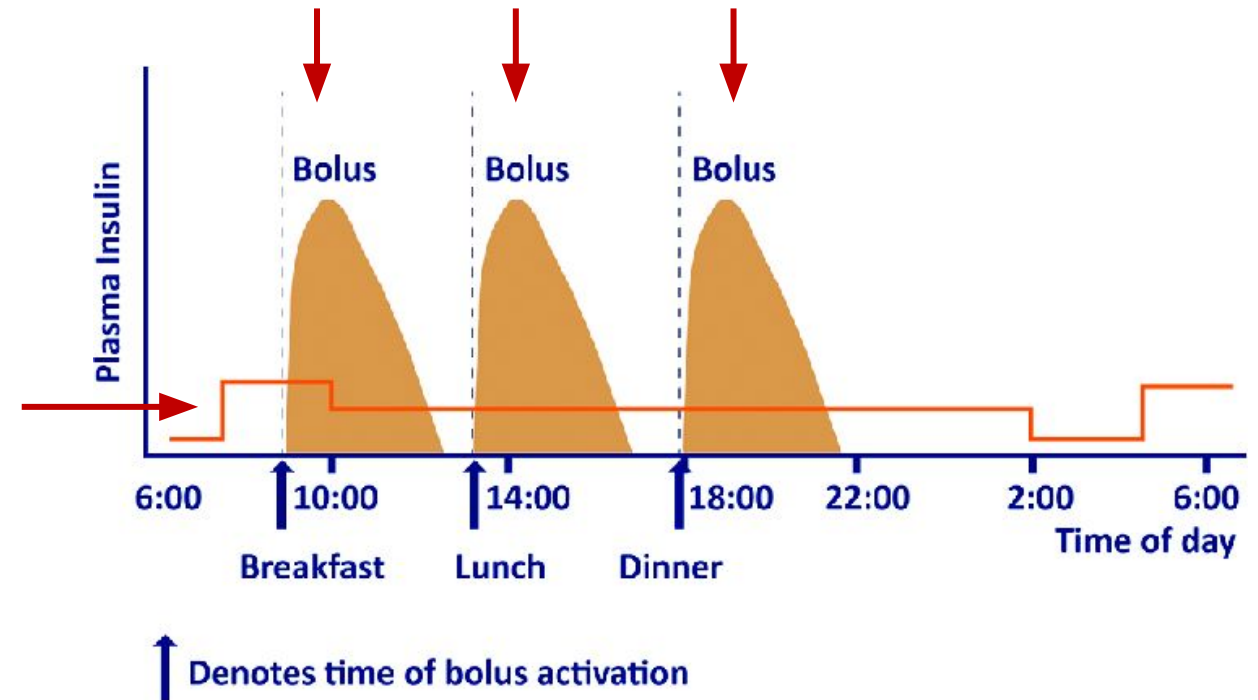
Top Patterns

This graph shows your data averaged over 30 days



Insulin Pumps: The Basics

- RAPID-ACTING insulin is contained in a cartridge or reservoir.
- Insulin is delivered subcutaneously via an “infusion site”.
- Delivers a continuous infusion of rapid acting insulin 24 hours a day → basal dose.
- Also delivers boluses of rapid acting insulin through certain times of the day (e.g. with meals) → bolus insulin.



Insulin Pump Settings

Basal rate setting

Bolus setting

Pump Profile settings - K1

✓ Active at upload

Time	Basal Rate (units/hr)	Correction Factor (units:mg/dL)	Carb Ratio (units:grams)	Target BG (mg/dL)
12:00 AM	0.550	1:55	1:10.0	110
4:00 AM	0.500	1:55	1:9.0	110
8:00 AM	0.650	1:50	1:8.5	110
10:00 AM	0.550	1:50	1:8.5	110
2:00 PM	0.650	1:50	1:8.0	110
6:00 PM	0.525	1:50	1:8.0	110
9:00 PM	0.600	1:55	1:8.0	110

Total Daily Basal: 13.675 units

Insulin Duration: 4 hr

Carbohydrates:On

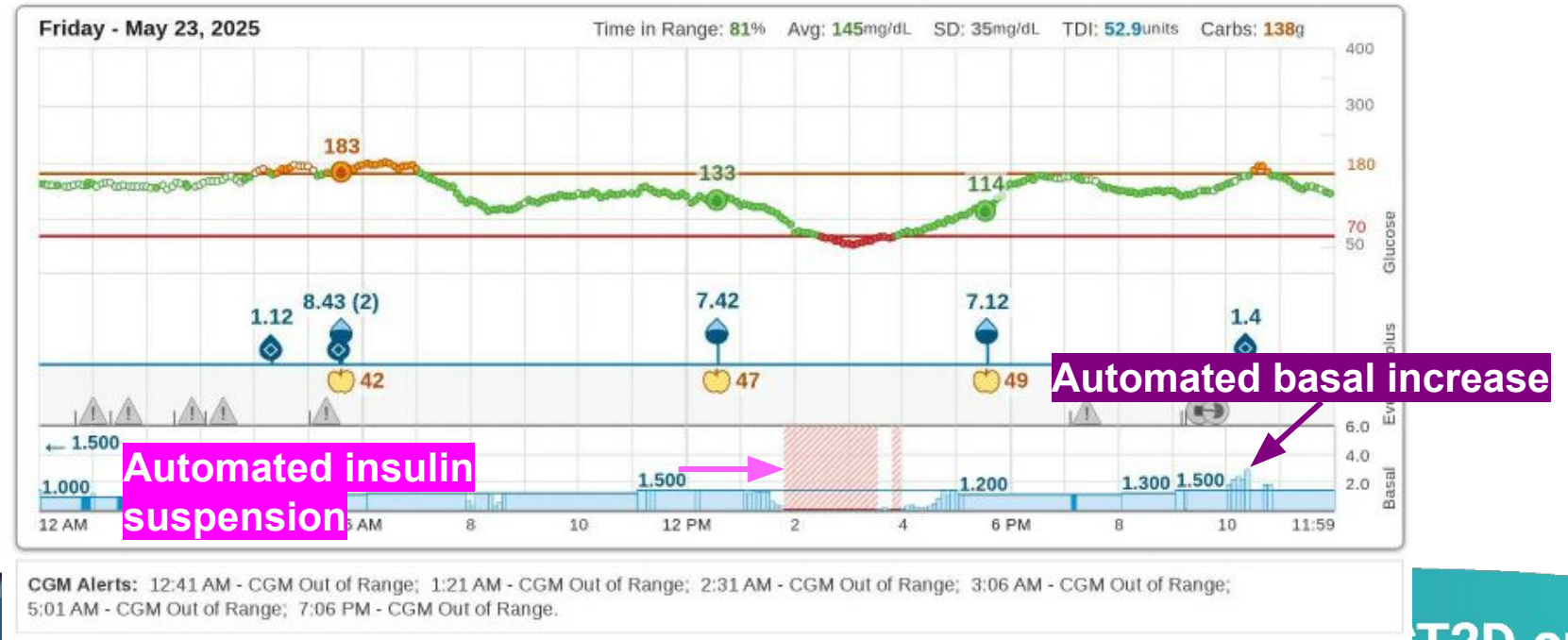
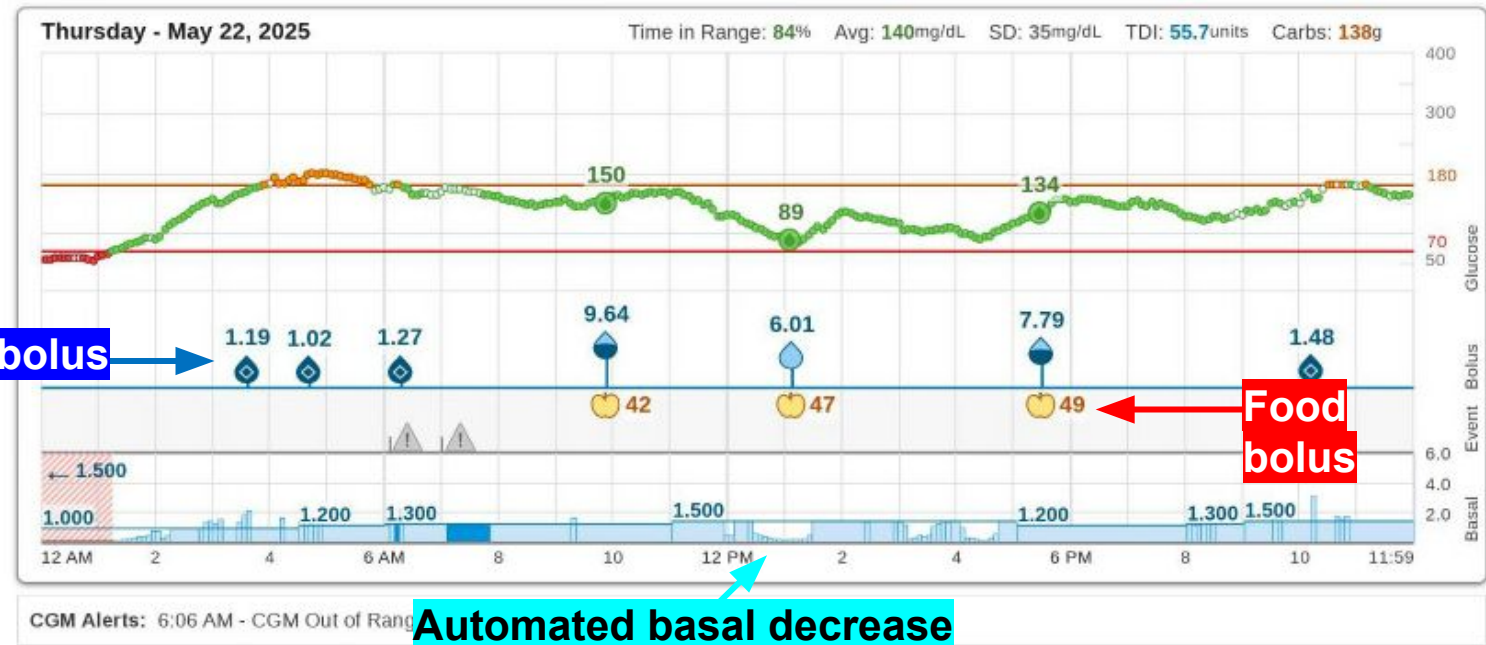
Automated Insulin Delivery (AID) Systems

- AID systems increase or decrease insulin delivery based on continuous glucose monitor (CGM) glucose levels to approximate physiologic insulin delivery.
- **3 components:**
 - ***Insulin pump*** to delivers insulin based on insulin pump settings
 - ***CGM*** to monitor glucose levels
 - ***Algorithm*** to augment insulin delivery above/below the pre-set insulin pump settings

Most Hybrid closed loop systems required users to bolus for meals and snacks.



Pump download



Commercially Available AID Systems



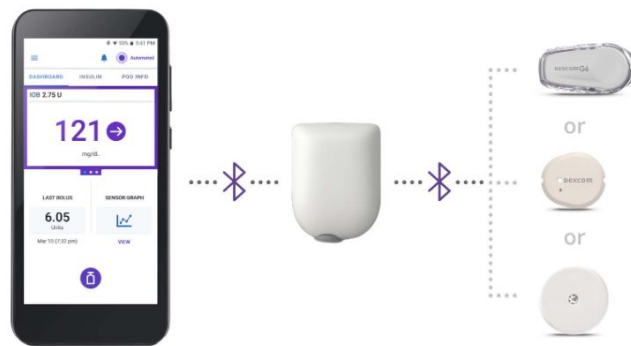
**Tandem t-slim X2
(Control IQ)**



**Tandem Mobi
(Control IQ)**



Medtronic 780G



Omnipod 5

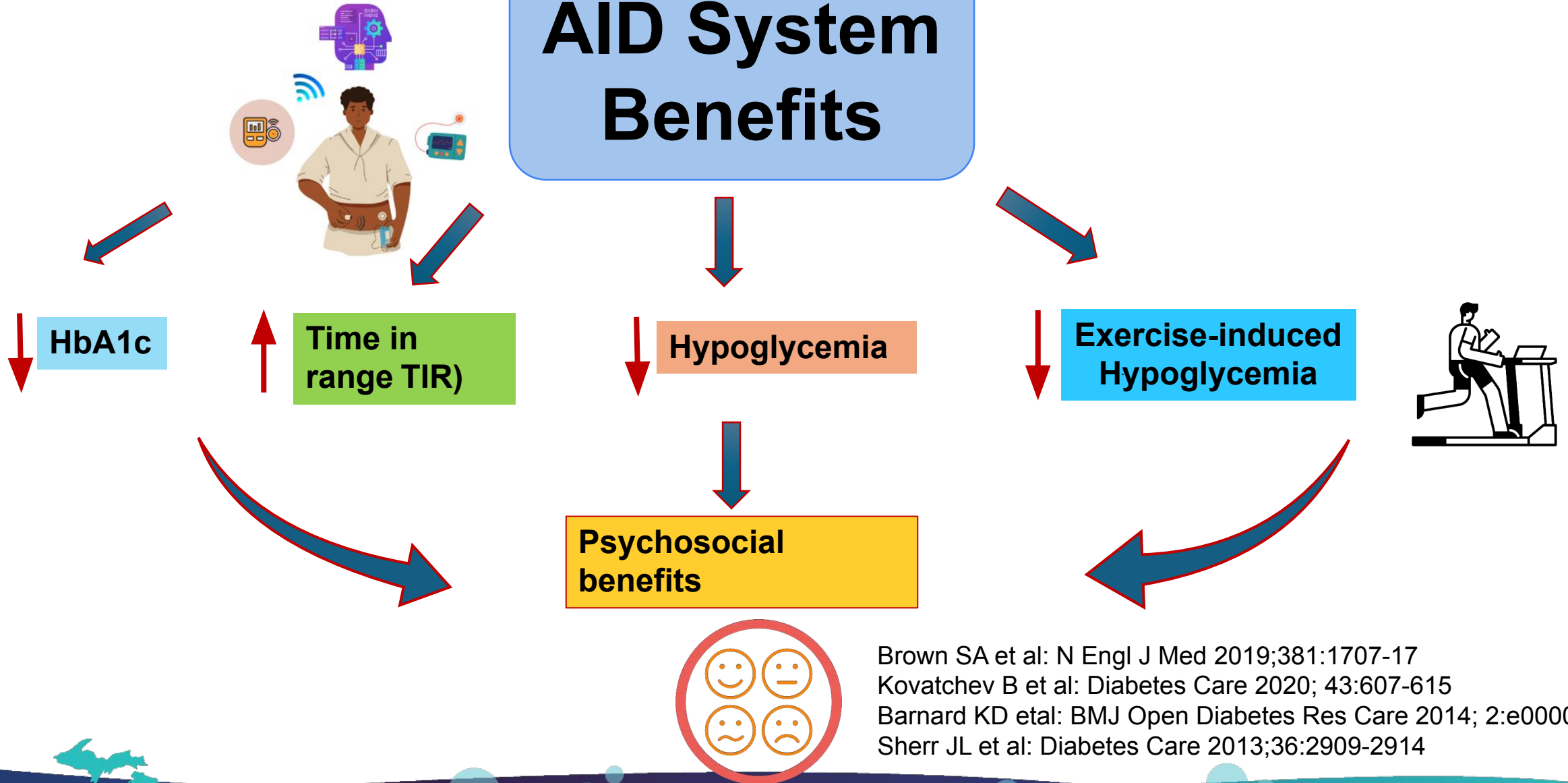


**Beta Bionics
iLet**



Sequel Twist

AID System Benefits



Brown SA et al: N Engl J Med 2019;381:1707-17
Kovatchev B et al: Diabetes Care 2020; 43:607-615
Barnard KD et al: BMJ Open Diabetes Res Care 2014; 2:e000025
Sherr JL et al: Diabetes Care 2013;36:2909-2914

AID System Myths...and Reality

- **AID systems take the work out of diabetes...**

AID systems “aid” self-management but they do not fully replace diabetes self-management.

- **AID systems “fix” diabetes...**

AID systems have many benefits but they only help if they are used effectively.

- **AID systems are only for type 1 diabetes...**

AID systems are routinely used for insulin-requiring type 2 diabetes and several are FDA-approved for this indication.

Setting up Realistic AID Expectations

- These are hybrid closed loop systems, meaning that patient input and **engagement is a necessity** for all devices:
 - Carb counting for most.
 - Exercise/activity mode initiation.
 - Placement of infusion sets every 2-7 days and CGM sensors every 7-15 days.*
 - Response to alerts and alarms.
- AID initiation typically **takes months with *multiple* referrals:**
 - Endocrinology: often books out 3+ months.
 - Nutrition: carb counting can be challenging and complex.
 - Diabetes education: pump setup and training, insurance approvals.
- **Technology failures *do* happen:**
 - Patients still need at least a basic understanding of self-management with insulin injections if the AID system fails or is not otherwise available.

Questions?

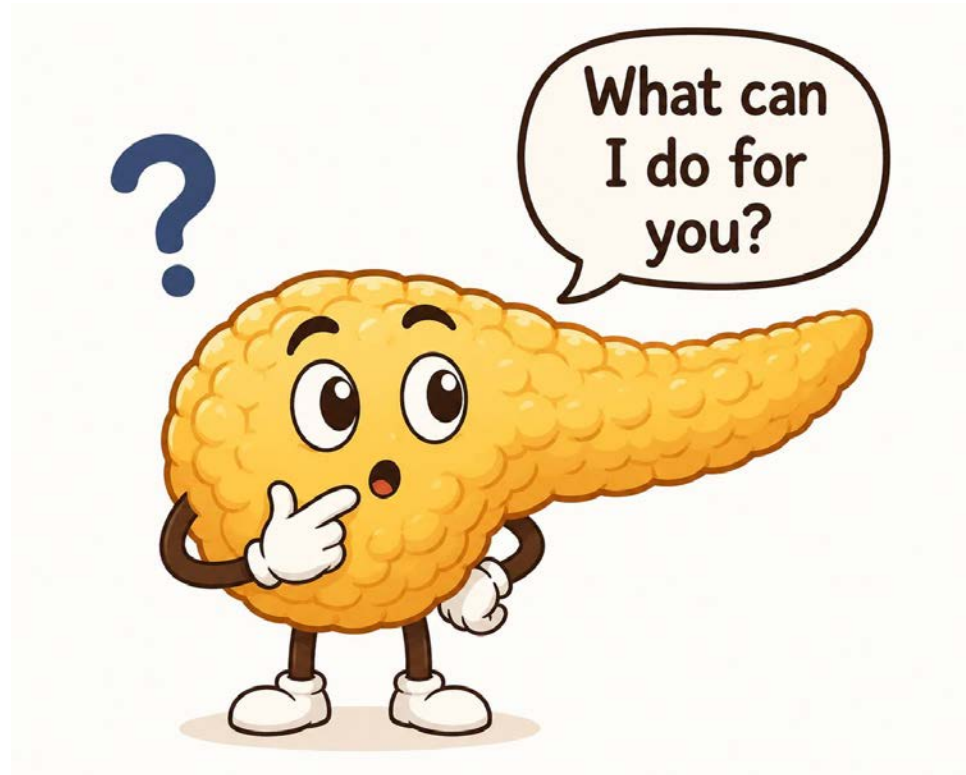


Image generated using ChatGPT