

# MOVING PAST YOUR COMFORT ZONE IN INSULIN-REQUIRING DM

## Insulin, Technology, and More



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# PRESENCE OF T1DM IN THE US

- Age <20: 2.15 per 1000
- 40% of T1DM cases occur in people older than 30 years of age
- LADA prevalence is ~9% in patients with T2DM
  - account for 2% -12% of all cases of diabetes in adult population
  - 4% to 14% of patients diagnosed with T2DM are positive autoantibodies

CDC. Prevalence of Diagnosed Diabetes. Accessed online 2/20/2023 at <https://www.cdc.gov/diabetes/data/statistics-report/diagnosed-diabetes.html>

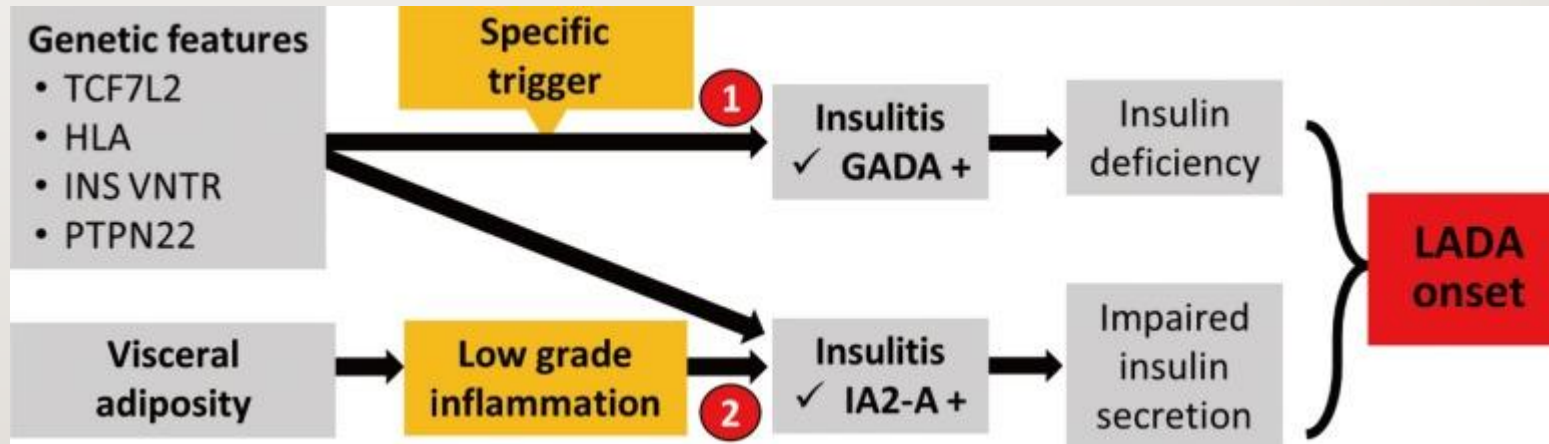
JDRF. Type 1 diabetes facts. Accessed online 2/20/2023 at <https://www.jdrf.org/t1d-resources/about/facts/>

Lawrence JM, Divers J, Isom S, et al. Trends in Prevalence of Type 1 and Type 2 Diabetes in Children and Adolescents in the US, 2001-2017. JAMA. 2021;326(8):717-72

Pozzilli P, Pieralice S. Latent Autoimmune Diabetes in Adults: Current Status and New Horizons. Endocrinol Metab (Seoul). 2018 Jun;33(2):147-15

# DIAGNOSING LATENT AUTOIMMUNE DIABETES (LADA)

- Adult age of onset (>30 years);
- Presence of any islet cell autoantibody
- Absence of insulin requirement for at least 6 months after diagnosis
- Slower onset than typical T1DM

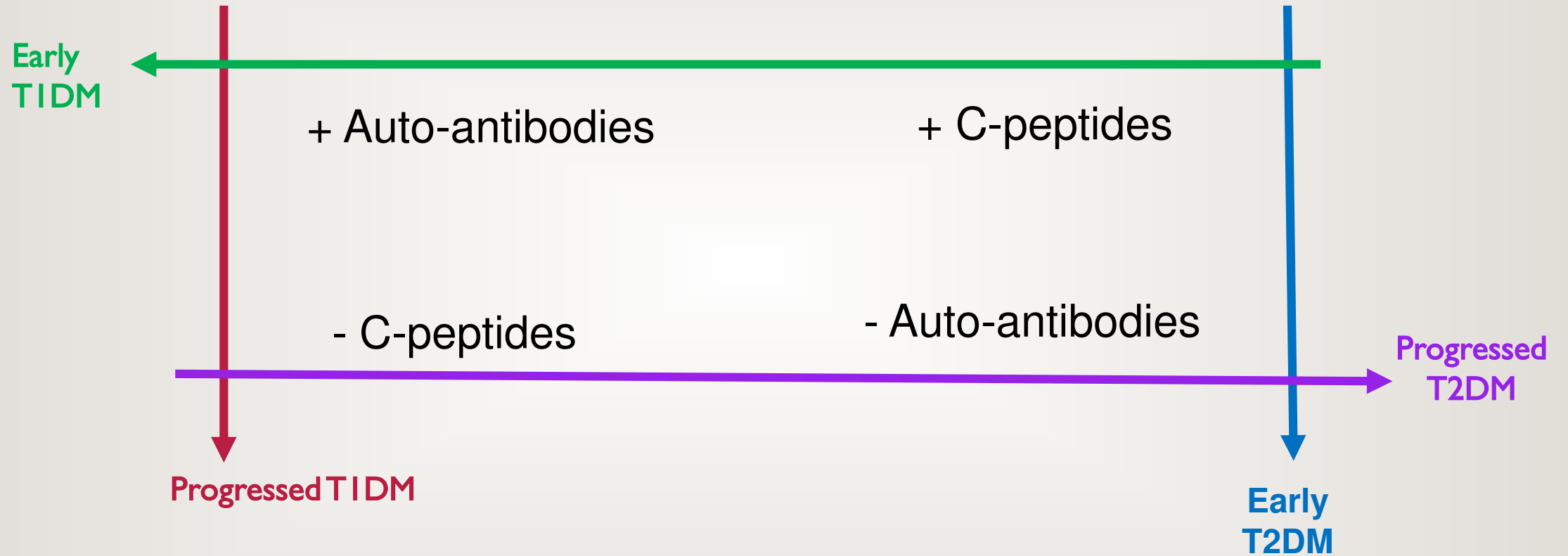


## Development of LADA

# Differences in Clinical and Genetic Features between LADA and T2DM

	LADA	T2DM
Age at diagnosis	>30 Years	Adulthood (rarely before)
Family history of diabetes	Negative or positive	Frequently positive
HLA susceptibility	Increased	Mild increased
Onset	Subclinical (rarely acute)	Silent/subclinical
Rate of long-term complications at diagnosis	Low	High
Risk of acute complications at diagnosis	Low	Mild increased
C-peptide levels at diagnosis	Decreased but still detectable	Normal to increased
Autoimmunity	Mild increased	Absent
Ketosis	Rare	Rare
Insulin resistance	Increased/no change	Increased
β-Cell function	Decreased	Increased or normal
Insulin requirement	>6 Months after diagnosis	Absent or years after diagnosis
Body mass index	Normal (rarely overweight or obese)	Overweight or obese
Cardiovascular risk	Increased	Increased
Lipid profile	Normal to hypertriglyceridemia	Frequently hypertriglyceridemia and/or hypercholesterolemia

# Comparative findings in T1DM & T2DM



# CASE 1: Leo

- **41 y/o:** Here for “check up” (*airline mechanic-rotating shifts*)
- **Reports:** fatigue, ED, unintentional 20 lbs weight loss past month, “peeing a lot,”
- **Family HX:** Mother- T2DM, obese, HTN/HLD; Father-CVD—MI at 54; Sister-obesity; no autoimmunity
- **Recent LABS:** **A1C 10.1%**
  - LDL-C 114 mg/dL
  - **Triglycerides 320 mg/dL**
  - **GFR 50;**
- **EXAM:** BMI 35.1 (253 lbs) ; BP 144/86 HR: 78
- **RX:** atorvastatin, HCTZ, enalapril, ASA (for years)-Compliant?

**FBG: lab was 283**  
**BG in clinic is 401**  
**Neg ketones**

Would you put him on  
INSULIN?

**WHY?**

Is there insulin resistance?

Anything else you would give him?

# INSULIN CHOICE IN T2DM

- Metformin & basal insulin
- Basal insulin & bolus insulin (with or without metformin)
- Basal insulin + GLP-I RA (with or without metformin)
- Basal and others?

More on Leo later



# WHEN TO GO WITH INSULIN ?

When hyperglycemia is severe, especially with:

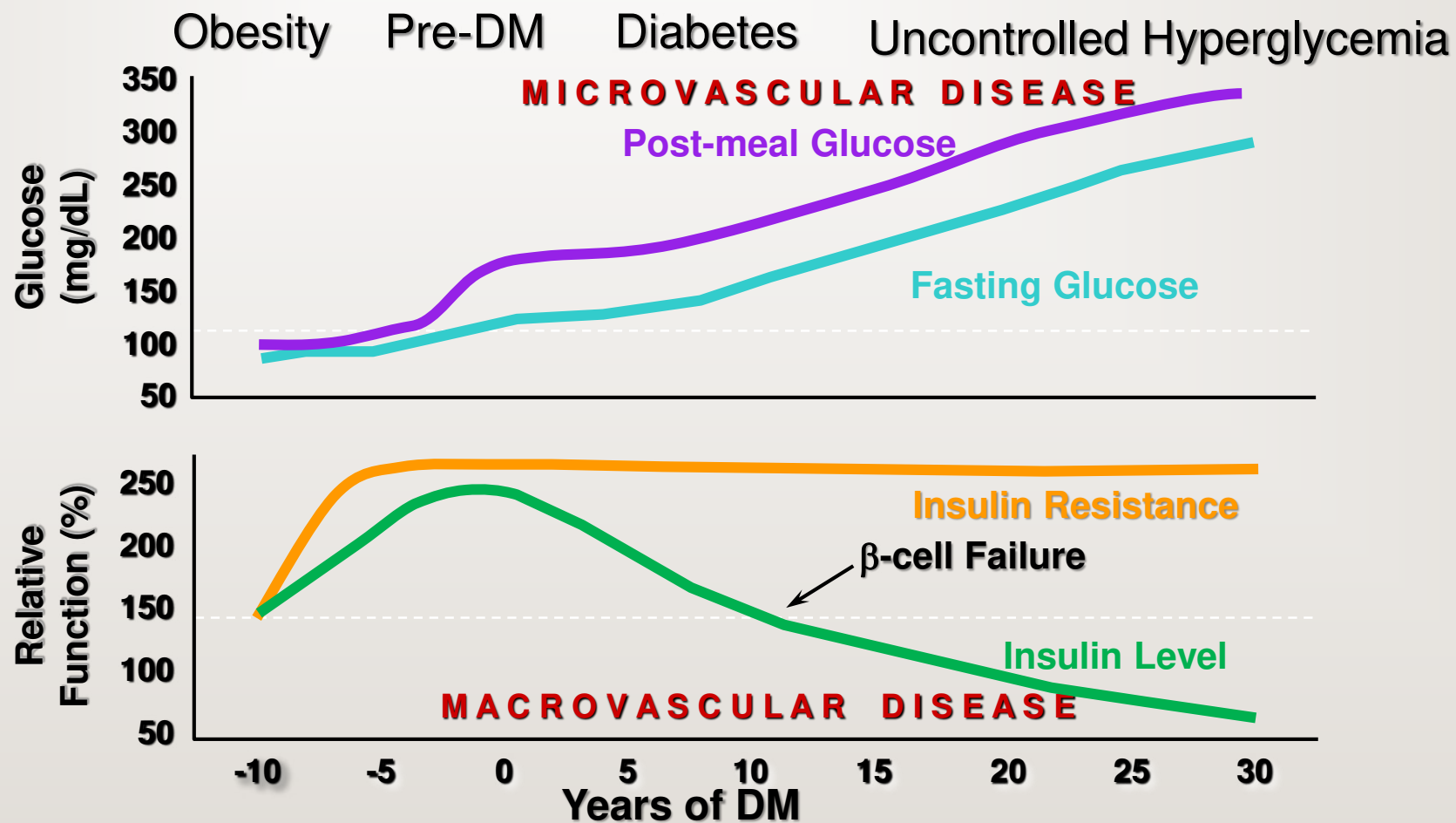
- Symptoms of hyperglycemia (eg, headaches, trouble concentrating, polyuria, polydipsia, blurred vision)
- Catabolic features (eg, weight loss or ketosis)

When there has been failure to lower BG with 3 anti-diabetes meds

When morbidities preclude other medications

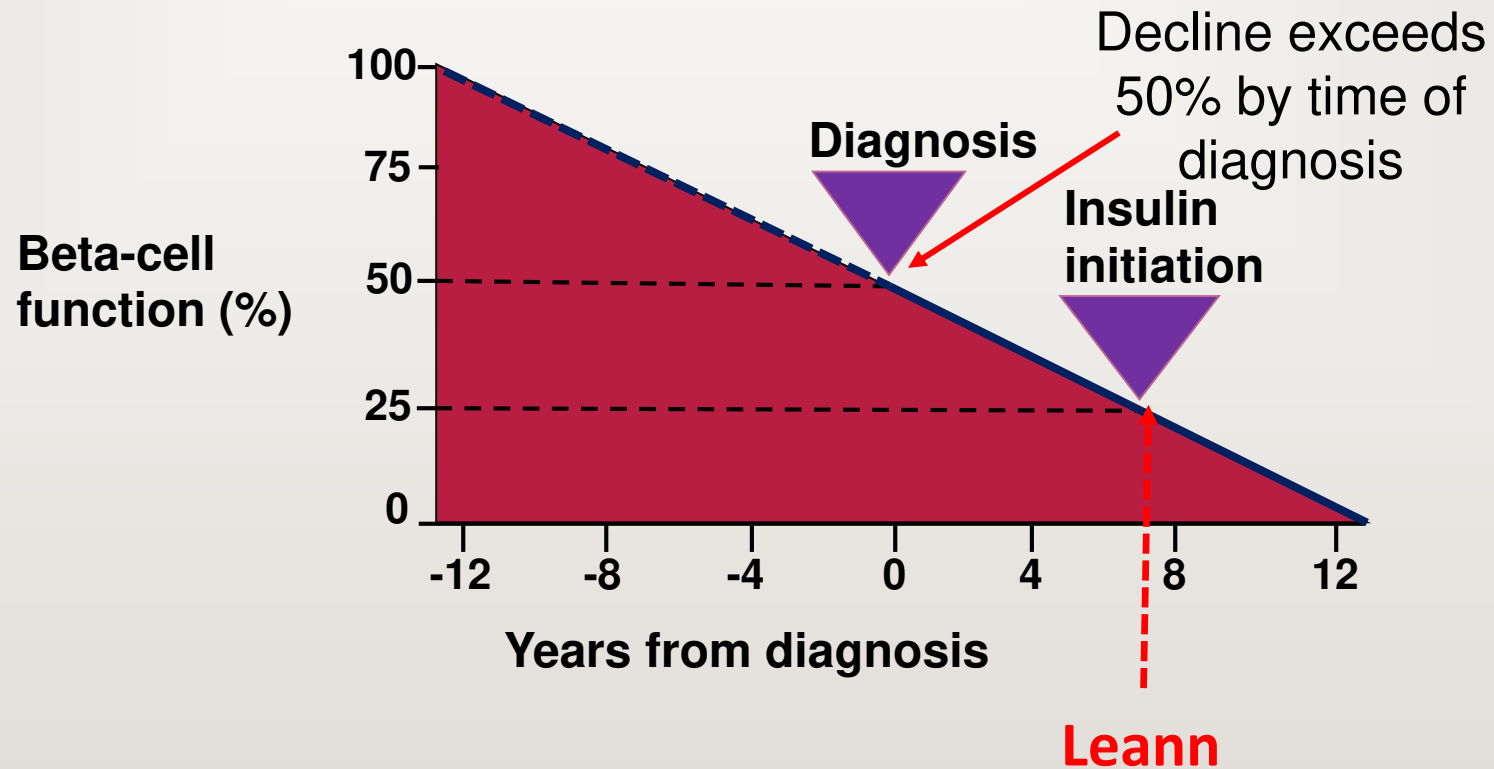
T1DM with significant Insulin deficiency

# REMINDER OF WHAT WE'RE UP AGAINST IN T2DM



# WHY BASAL INSULIN IN TYPE 2 DIABETES?

## Beta-cell Function Declines as T2DM Progresses



# INSULIN IS USEFUL FOR ACHIEVING BG CONTROL IN T2DM

## At diagnosis

- Benefit especially likely in:
  - Treatment-naïve individuals with hyperglycemic symptoms and A1C > 9%
  - Latent autoimmune diabetes in adults (LADA)
  - Individuals with CVD risk

## In combination with non-insulin agents

- Recommended for use in combination with most other major classes of anti-diabetes agents
- Combinations reduce glycemic variability compared with insulin-only regimens

## In long-duration disease

- Loss of  $\beta$ -cell function is inevitable as T2DM progresses
- With appropriate adjustment, insulin can be used in any patient (including those with comorbidities that preclude the use of other agents)

## CASE 2: LEANN

- 48 year old female, married, secretary (good support)
- **Dx:** T2DM x 5 years; **worse glycemic control for the past 2 years**
- **A1C:** 8.7% (was 6.3-7.2%)
  - **HX:** HLD, HTN, OA, Hashimoto's thyroiditis, GFR 64, UACR 39
  - **BMI:** 33.1 (down 4% weight past year)
- **Currently on these 3 diabetic agents –**
  - Metformin 2000 mg (3 yrs)
  - Liraglutide (Victoza) 1.8 mg/d (2 years)
  - Empagliflozin (Jordiance) 10 mg/d (2 years)

**Why is her A1C rising?**

# LEANN'S GLUCOSE LOG

DAY	BB	AB	BL	AL	BD	AD
SUN	142	185				
MON			162	192		
TUE					140	199
WED	163	219				
THU			148	195		
FRI					139	203
SAT	153	194				
SUN			155	243		
MON					158	186
TUE	157	183				
WED			146	182		
THU					163	231
FRI	169	201				

# WHAT DO YOU THINK?

- Is her A1C acceptable for her at this time?
- Are her fasting blood glucose levels acceptable?
- Are her post prandial glucose levels acceptable?
- What other blood sugars do you want to see
- What labs do you need to see?
- What is her likely diagnosis?
- Should you change her non-insulin meds?
- Should you start insulin

# LEANN'S GLUCOSE LOG

DAY	BB	AB	BL	AL	BD	AD
SUN	142	185				
MON						
TUE						199
WED	163					
THU						
FRI						203
SAT	153					
SUN						
MON						186
TUE	157	183				
WED			146	182		
THU					163	231
FRI	169	201				

## LEANN RECAP

- 52 years old
- 8-year Hx of T2DM; 2 years poor control
- Hx: HLD, HTN, GFR 42, OA
- Ht/Wt: 5'10"/233 lb; BMI: 33.4
- A1C = 8.7%
- On glipizide, metformin, GLP-I



**Leann's “insulinopenic”—time for insulin**

**So how do you start insulin?**

**First understand it.....**

# FACTORS LIMITING USE OF BASAL INSULIN IN PRIMARY CARE PRACTICES

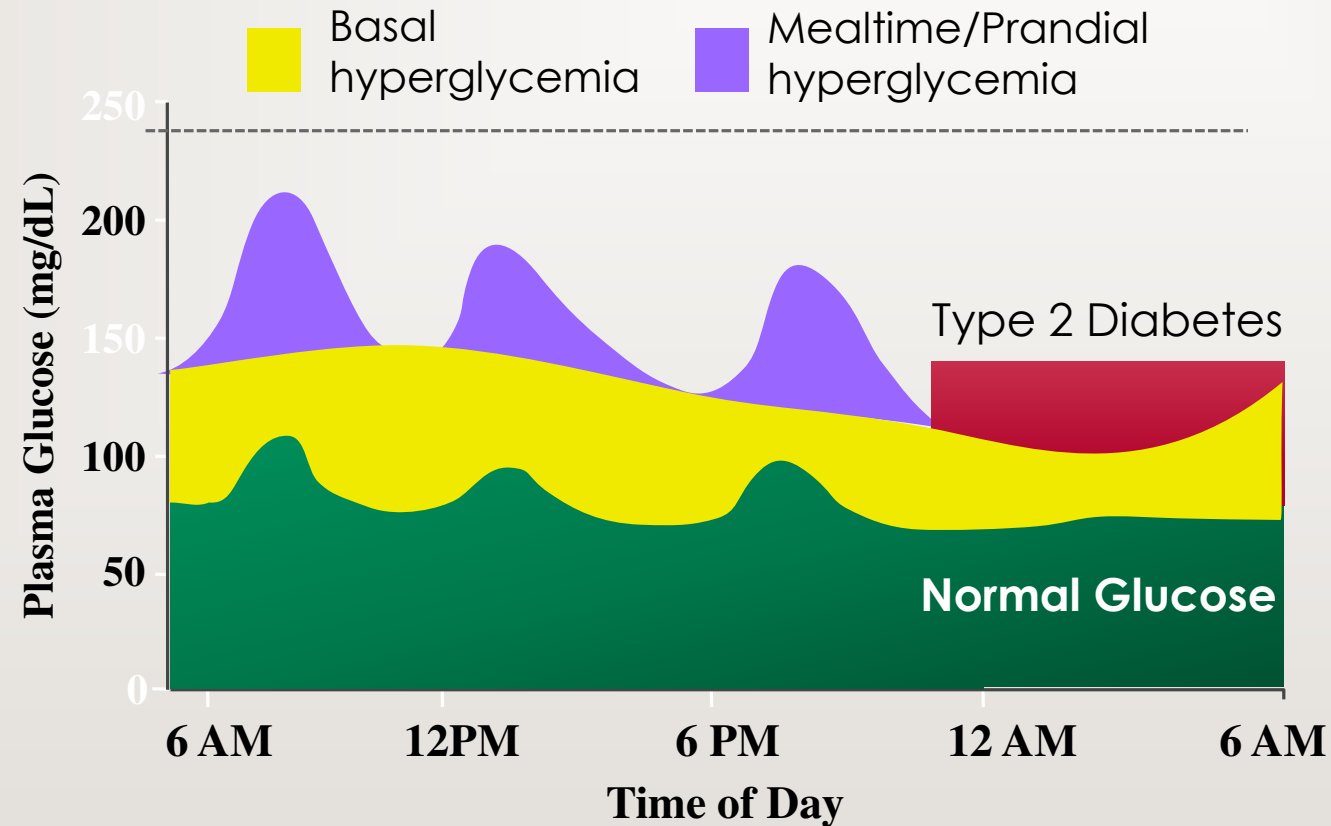
## Patient-level factors

- Questions about efficacy
- Concerns about hypoglycemia, weight gain and Needles!
- Loss of independence
- Perception of the need for insulin as a personal failure or cause of death
- Think they we become addicted to insulin

## Clinician-level factors

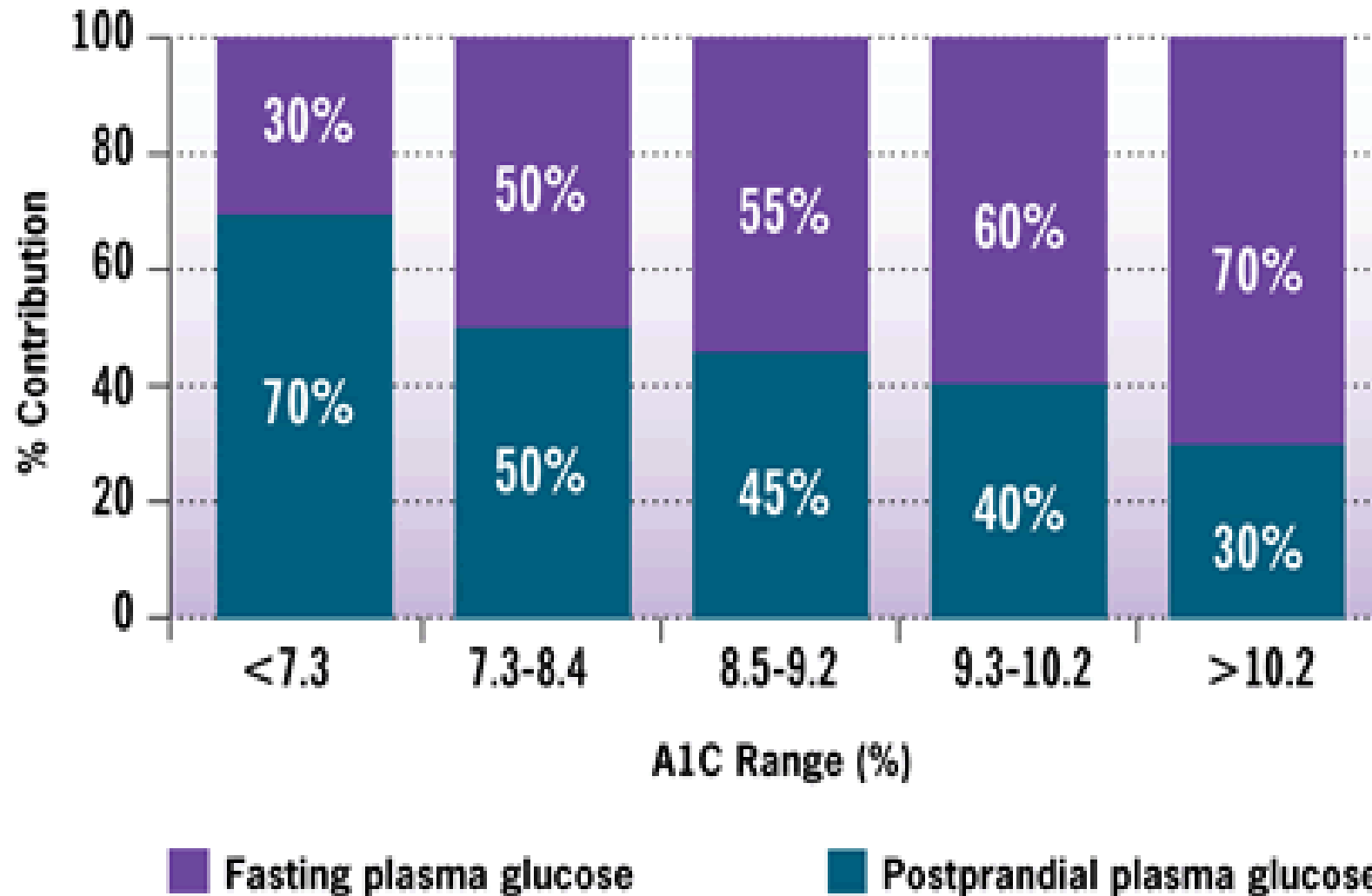
- Clinical inertia, which may reflect:
  - Confusion about the next medication
  - Misperceptions about risks and side effects
  - General hesitancy to escalate treatment
  - Belief that patients won't accept injection therapy
- Patient education/training too time consuming
- Number of available and emerging insulins with seemingly complex titration schedules

# PATIENTS WITH DIABETES HAVE BASAL AND PRANDIAL HYPERGLYCEMIA



Basal-bolus insulin mimic endogenous insulin

## FYI: BASAL (FASTING) vs PRANDIAL glucose contribution to the A1C



# INSULIN & INSULIN COMBO OPTIONS



**Don't delay use**

- **Rapid-acting (PRANDIAL)**
  - Regular
  - Lispro
  - Aspart
  - Glulisine
  - Fiasp
- **Intermediate-acting**
  - Human NPH
- **Long-acting (BASAL)**
  - Glargine U100 and U300 (Trujecto)
  - Basaglar U100 (bioidentical to Glargine)
  - Detemir
  - Degludec U100 and U200
- **Pre-mixed**
  - NPH/Regular (70/30)
  - Aspart mix (70/30)
  - Lispro mixes (75/25 and 50/50)
- **Concentrated**
  - Regular U-500
- **Basal/GLP1-RA fixed-dose combinations**
  - Degludec/liraglutide
  - Glargine/lixisenatide

# COMMON INSULIN REGIMENS

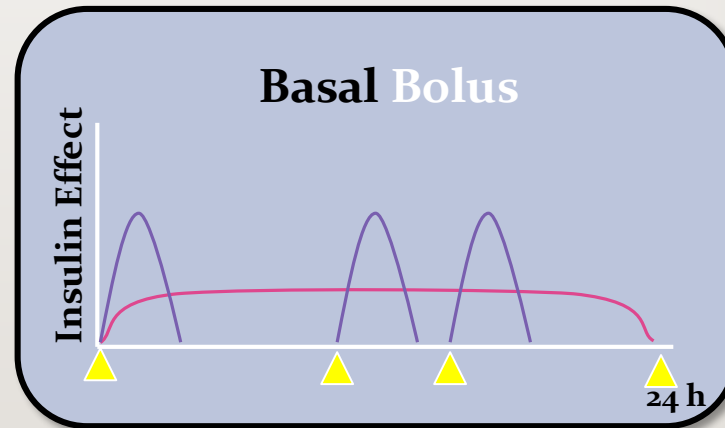
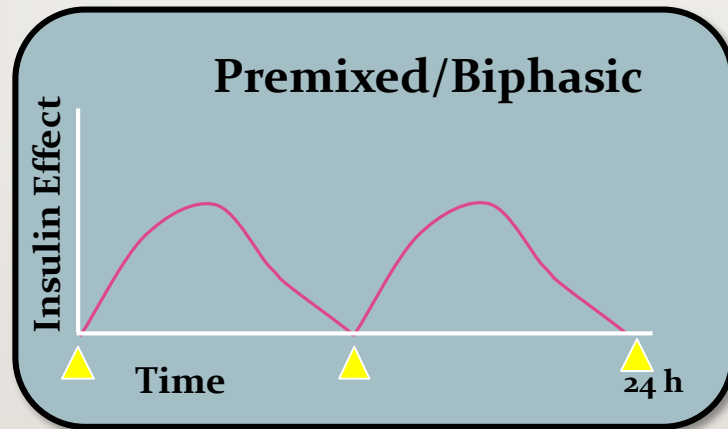
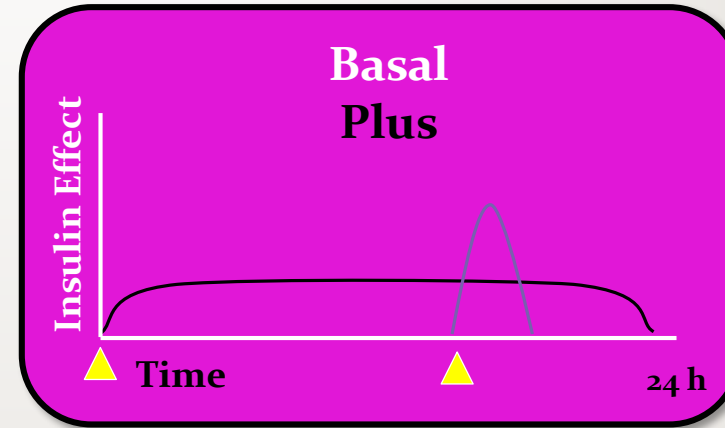
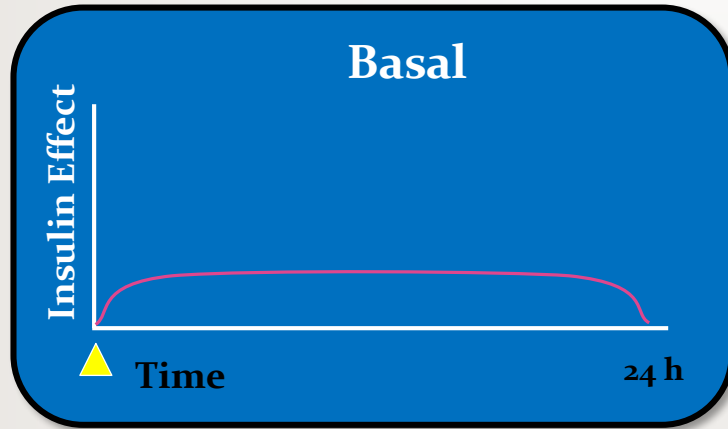
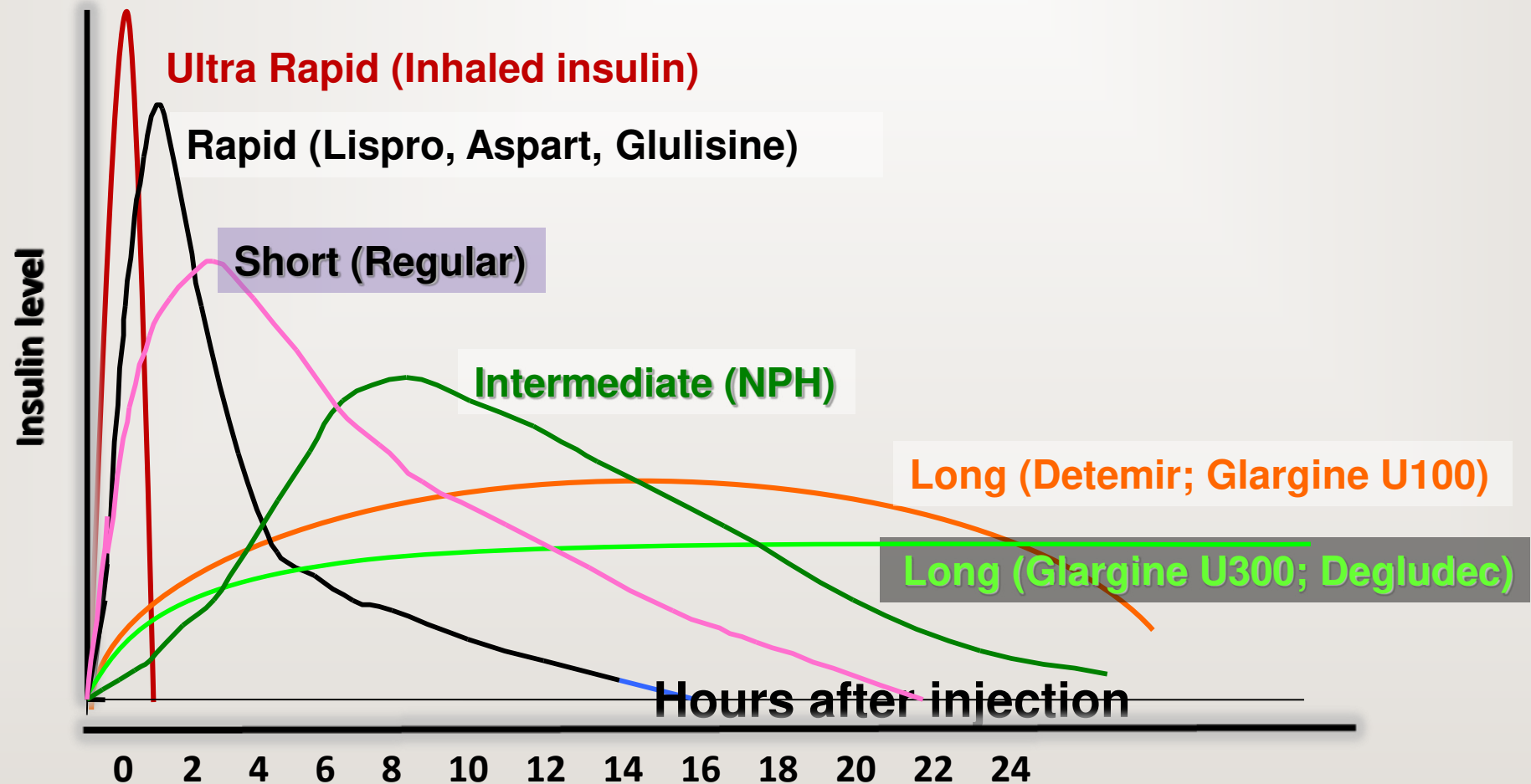


Image created by speaker

# INSULIN PHARMACOKINETICS



Hirsch IB. *N Engl J Med*. 2005;352(2):177.  
Afrezza (insulin human) inhalation powder PI. MannKind Corporation; 2014.  
Riddle MC et al. *Diabetes Care*. 2014 Oct;37(10):2755-62.  
Zinman B et al. *Diabetes Care*. 2012 Dec;35(12):2464-71.

# BASAL INSULINS USED IN THE U.S.

Name		Form	Time of Action* (h)			Comments
Generic	Brand		Onset	Peak	Duration	
Intermediate-acting ('Basal')						
NPH	Humulin N Novolin N	Human	1-2	4-12	10-16	Increased risk of hypoglycemia when compared to analog insulin. Pregnancy (category B)- safe.
Long-acting ('Basal')						
Detemir U-100	Levemir	Analog	1-2	Relatively peakless	24	
Glargine U-100	Lantus/ Basaglar	Analog	1-2	Relatively peakless	24	
Glargine U-300	Toujeo	Analog	6	Relatively peakless	>24	Glucose-lowering effect of glargine U-300 is lower than equivalent dose of glargine U-100. Pregnancy category <b>(Glargine- C; Degludec- C; Detemir- B)</b>
Degludec U-100, U-200	Tresiba	Analog	1-2	Relatively peakless	≥42	

**\*Dose dependent (except glargine U-300, degludec)**

Lepore M, et al. *Diabetes*. 2000;49:2142-2148. Plank J, et al. *Diabetes Care*. 2005;28:1107-1112. Heise T, et al. *Diabetes*. 2004;53:1614-1620. Porcellati F, et al. *Diabetes Care*. 2007;30:2447-2452. Porcellati F, et al. *Diabetes Care*. 2007;30:1261-1263. Hirsch IB. *N Engl J Med*. 2005;352(2):174-183. Meneghini L, et al. *Diabetes Obes Metab*. 2007;9(6):902-913. Lantus [package insert] Bridgewater, NJ: sanofi-aventis US LLC; March 2015. Levemir [package insert]. Princeton, NJ: Novo Nordisk US; February 2015. Toujeo [package insert]. Bridgewater, NJ: sanofi-aventis US LLC; February 2015. Tresiba [package insert]. Plainsboro, NJ: Novo Nordisk Inc.; September 2015. Nasrallah S, et al. *Clin Med Insights Endocrinol Diabetes*. 2012;5:31-37.



# Intermediate-acting insulin

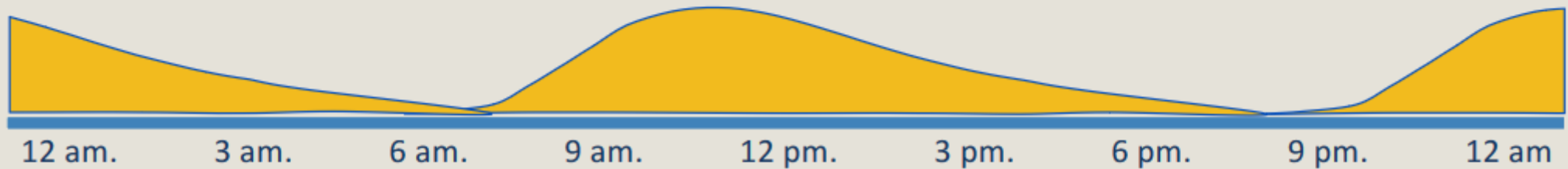
## Intermediate acting insulin

Onset: 1-3 hours

Peak: 6-12 hours

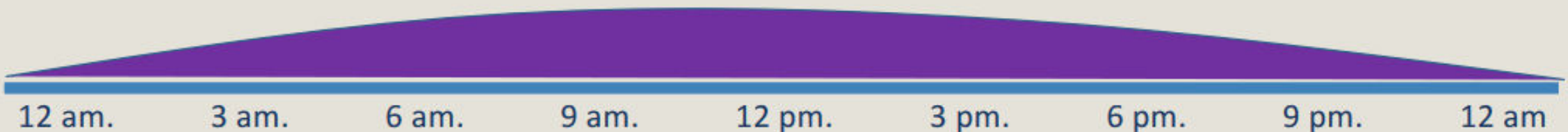
Duration: 12-24 hours

NPH (Novolin N, Humulin N, Relion N)



# Long-acting Insulin

Long acting insulin	Onset	Peak	Duration
Detemir Levemir	0.8-2 hrs	3.2-9.3	Up to 24 hrs
Glargine Lantus;Basaglar/Semglee	1-2 hrs	Peakless	Up to 24 hrs
Glargine U-300 Toujeo	30-90 min	Peakless	Over 24 hrs
Degludec Tresiba	30-90 min	Peakless	Over 24 hrs
Degludec U-200 Tresiba U-200	30-90 min	Peakless	Over 24 hrs



# WHEN DO I USE NPH?

- When that is all that is available (cost/coverage)
- Great for steroid induced hyperglycemia
  - Give with the dose of oral prednisone
- Caution with hypoglycemia 6-8 hours post administration
- Best give with dinner or bedtime with a snack of carb/protein

## RATIONALE FOR CONCENTRATED/ LOW VOLUME INSULIN (U-500)

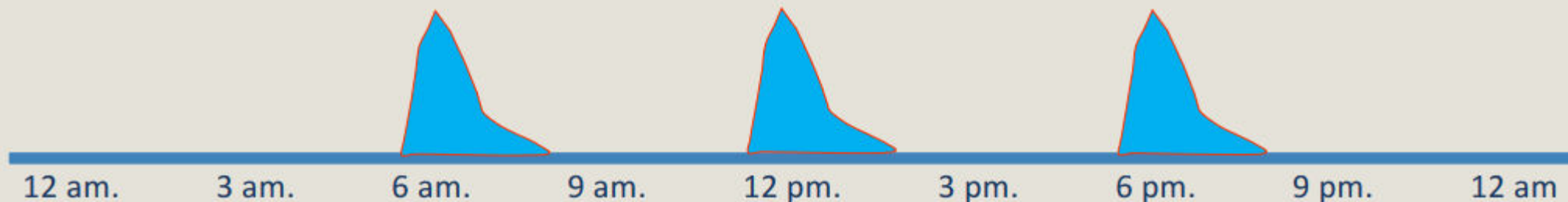
- If daily insulin needs are  $>200$  u/d
- Physically too large a dose for single SQ injection
- Multiple injections needed to deliver a single dose
- Non-adherence to multiple injections
- Discomfort
- Unpredictable absorption

# PRANDIAL INSULINS USED IN THE U.S.

Name		Form	Time of Action* (h)			Meal Timing (min)
Generic	Brand		Onset	Peak	Duration	
Rapid-acting ( ‘Bolus’ or ‘Prandial’ )						
Aspart	Novolog	Analog	< 0.25	1-3	3-5	-5 to -10
Glulisine	Apidra	Analog	< 0.25	0.7-3	3-5	-15 to +20
Lispro (U-100, U-200)	Humalog	Analog	< 0.25	0.5-1.5	3-6	-15 to immediately after
Insulin Inhalation	Afrezza	Human	< 0.25	0.5-1.5	2.7	0
Short-acting ( ‘Bolus’ or ‘Prandial’ )						
Regular	Humulin R Novolin R	Human	0.25-1.25	1.5-3.5	8	-30

# Rapid-acting Insulin activity

Rapid acting insulin	Ultra rapid acting insulin
Onset: 15-20 min	Onset: 2.5 min
Peak: 30-90 min	Peak: 30-90 min
Duration: 3-5 hours	Duration: 3-5 hours
Lispro, (Humalog, Humalog U-200)	Lispro aabc (Lyumjev)
Aspart, (Novolog)	Aspart nicotinomide (FiAsp)
Glulisine (Apidra)	



With meals

# Fast acting insulin

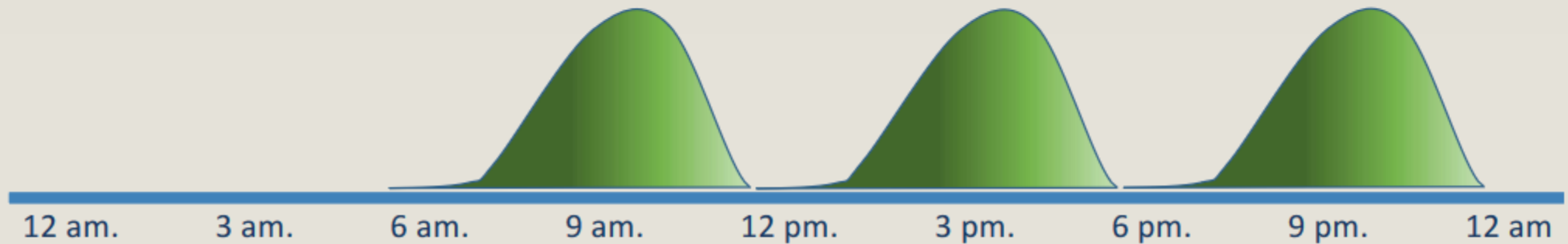
## Short acting insulin

Onset: 1 hour

Peak: 2-4 hours

Duration: ~6 hours

Regular (Novolin R, Humulin R, Relion R)



**FYI:**  
**Insulin costs have risen**  
**Approximately 200%**  
**since 2002!**



<http://www.reuters.com/article/us-health-diabetes-cost-idUSKCN0X22B1>



# CONCEPTS OF BASAL-BOLUS

- **Basal Insulin: 50% of daily needs**
  - Controls fast, between meal and nighttime glucose
- **Bolus insulin: 50% of daily needs**
  - Controls mealtime glucose
  - 10% to 20% of total daily insulin requirement at each meal
- **Correction bolus (sensitivity factor)**
  - Additional insulin needed (usually pre-meal)
  - Often used to correct for fasting hyperglycemia

# STARTING BOLUS INSULIN

- Choose a target blood glucose
- Calculate total daily dose: typically start ~ 0.5 units/kg
- Divide the total daily dose into ~50% basal and ~50% bolus
- Ex: patient weight is 60 kg
  - So  $0.5 \text{ un/kg} = 30 \text{ units}$
  - 50% of that is 15
  - So 15 units given once daily of bolus insulin

## TO USE A CORRECTION BOLUS OF SHORT-ACTING INSULIN

- **Calculate a correction/sensitivity factor=**
  - 1700 divided by total daily dose (TDD) = initial correction factor
  - **Example:** total daily dose (TDD) = 50 units
  - $1700/50 = 34$
  - So 1 units will drop blood sugar by approx. 34 points
  - So if the patient's blood sugar is 188 (goal is <120)
  - Then 2 units of bolus insulin will drop the sugar by 68 points  
(2 units x 34) to bring sugars down to 120
    - $188-68 = 120$

## CALCULATING CORRECTION BOLUS (SENSITIVITY FACTOR)

- Calculated by dividing 1600-1800 by total daily dose (TDD) of insulin needed
  - i.e., TDD is 50;
- $1600 \div 50 = 30$ ; so 1 unit drops BG by 30 mg/dl

# TO USE BOLUS COVERAGE OF CARB INTAKE

- Typically can give 1 unit per 15 gm carbs for T1DM or 1/10 grams of carbs for T2DM
- To be more accurate: **Calculate an insulin to carbohydrate ratio (ICR)**
  - $450/\text{total daily dose (TDD)} = \text{ICR}$
- So TTD is 50 units
  - $\text{ICR} = 450/50 = 6 \text{ units}$
  - So give 1 units per every 6 gms of carbs

# A SIMPLE WAY TO START BASAL INSULIN

- **May continue DM agent(s) at same dosage**
  - Such as metformin, TZD, GLP-1ra, SGLT2i
  - Stop or decrease insulin sulfonylureas...(
  - Add single, evening insulin dose (0.1 - 0.2 U/kg)
  - Ave: 10 - 20 units
  - Glargine u-100/, Detemir, Degludec or NPH

**Increase insulin dose every 2-4 days as needed (4 days with longer basals)**

- Increase 3 - 5 U if FBG >150 mg/dL
  - Increase 1 - 2 U if FBG = >110,<150 mg/dL
- **Treat to target FBG (usually 100-140 mg/dL)**

## **EXAMPLE: PATIENT ON 20 UNITS GLARGINE EVERY EVENING:**

- FBG is averaging 158 over past 3 days (or 2 -4 days)
  - Add 4 units to basal dose
  - Now on 24 units
- FBG now averaging 145 over past 3 days:
  - Add 2 units to the 24 unit basal dose
  - Now on 26 units
  - If still no change, keep adding 2 units every 3 days)
- FBG now averaging 112—STAY ON THE DOSE THAT GOT THEM THERE
- (If staying over 200—I will use 5-7 unit incremental changes)

# BACK TO LEANN

- After a conversation to explain reason to initiate insulin, the patient agrees
- **HOW MUCH BASAL INSULIN?**
  - *A reasonable dose is 20 units*
- **Continue oral agents ? /GLP-1 (caution – must eat with her glipizide SO I would cut dose 50% or stop it)**
  - Her GLP-1 may help beta cells & CVD risks
- BG monitoring continues
- Reinforce therapeutic lifestyle changes
- Ongoing Diabetes Education

**TIP: check c-peptide**



# LEANN'S GLUCOSE LOG AFTER 1 WEEK

DAY	BB	AB	BL	AL	BD	AD
SUN	134				152	
MON	138					
TUE	140				163	
WED	130					
THU	152				175	
FRI	169					
SAT	136				142	
SUN						

# LEANN: INSTRUCTIONS

- Basal insulin is increased to 25 units daily
- **Patient is advised to increase basal 2-4 units q week until most fasting values are 100-120 mg/dL**
- Call if any hypoglycemic episodes
- *Continue metformin & GLP-1*
- BG monitoring continues
- Reinforce therapeutic lifestyle changes
- Ongoing Diabetes Education

# BTW:WHEN TO STOP TITRATING BASAL INSULIN

- Based on individualized glucose target
  - (eg. fasting AM glucose  $< 100$  mg/dL or fasting glucose 100-130 mg/dL)
- When total insulin dose exceeds 0.5 units/kg/day
- Glucose variability in the AM, between meals
- Nocturnal hypoglycemia (one low is one too many)

## LEANN: 6 MONTHS LATER

- Basal insulin is titrated and is now taking 34 units daily
- Weight has increased 5 lbs despite diet efforts
- Physical activity: walking 30 minutes 3 times per week
- A1c 7.2%, no hypoglycemia
- *Glucose results indicate that FBS at treatment goal, post-prandial BG remain elevated*
- Now the dilemma—what to do next ?

# Leann's Blood Glucose Log

DAY	BB	AB	BL	AL	BD	AD
SUN	102					227
MON	121		144	170	167	
TUE	98					192
WED	88	154				
THU	107		134			188
FRI	111					
SAT	143		144		112	
SUN	132			189		234
MON	122	154			134	
TUE	117	143				
WED	147				123	207
THU	109		123			
FRI	76	154				188

# WHAT TO DO WITH LEANN

- ⦿ **Based on BG will add rapid acting insulin to dinner (her biggest meal)**
- ⦿ **Cut back her PM basal by 20% (monitor FBG) (Why?)**
- ⦿ **Keep metformin & GLP-1—perhaps switch to semaglutide or tirzepatide**
- ⦿ **Consider bolus at dinner if needed?**
- ⦿ *Review Hypoglycemia prevention and treatment*
  - ⦿ Physical Activity & ETOH effects of lowering BG
- ⦿ Blood Glucose Monitoring
- ⦿ Diabetes Education

# LEANN NOW

- ⦿ The patient is now taking 28 units of basal insulin between 9-10 pm
- ⦿ FPG range = 100-140 mg/dL mostly (no lows)
- ⦿ Post-meal glucose = 130–170 mg/dL
- ⦿ *She adjusts her meal time insulin if she exercises or eats more/less carbohydrates*
- ⦿ She verbalizes how to treat low BG
- ⦿ Weight down 12 lbs to 222
- ⦿ A1c 6.7-7.2%

## **BACK TO LEO—I MONTH LATER**

- **Started at 20 units glargine at first meeting**
- **Increased every 3 days until FBS at averaged 100-130--- now on 38 units**
- Also on Metformin xr 2000 mg
- Says he is taking his Metformin & insulin faithfully
- But working unsuccessfully on his diet---craves junk food



# Leo's blood glucose log

DAY	BB	AB	BL	AL	BD	AD	BT
SUN	106				166		203
MON							
TUE	110		155		143		
WED							
THU	129		132	191			
FRI							
SAT	156	204			184		
SUN							
MON	122		156		177	222	
TUE							
WED	141		150		162	239	
THU							
FRI							

## OPTIONS FOR LEO

- Increase his basal insulin more?
- Add prandial bolus insulin at a larger meal?
- Start a GLP-1ra?
- Start a combination basal-GLP-1ra?
- Switch to a premix basal-bolus insulin?
- If started on a GLP-1 would you cut back the basal insulin?

**Avoid over-basalizing the patient!!**

# CONSIDERATIONS FOR GLP-1RA OR GLP-1RA/GIP

- Can use in patients with DKD
- Robust A1C decrease
- Duration of action
  - Short-acting: 2 – 5 h
  - Long-acting: 12 h to several days
- Would help with hunger control
- May help him lose weight
- Beta cell protection
- CVD risk reduction

# ANOTHER OPTION

## BASAL INSULIN/GLP-1 RA COMBINATIONS

**Degludec/liraglutide**  
(Xultophy 100/3.6)

- Once a day at any time, about the same time of day

**Glargine/lixisenatide**  
(Soliqua 100/33)

- Once a day < 1 hr before the largest meal

# AVAILABLE PREMIXED/BIPHASIC INSULINS

Product	Onset, h	Peak, h	Effective Duration, h
<b>Human biphasic insulin</b>			
<b>70% NPH/ 30% regular</b>	<b>0.5-1</b>	<b>Dual</b>	<b>10-16</b>
<b>Analogue biphasic insulin</b>			
<b>75% NPL/ 25% lispro</b>	<b>&lt; 0.25</b>	<b>Dual</b>	<b>10-16</b>
<b>50% NPL/ 50% lispro</b>	<b>&lt; 0.25</b>	<b>Dual</b>	<b>10-16</b>
<b>70% aspart protamine/ 30% aspart</b>	<b>&lt; 0.25</b>	<b>Dual</b>	<b>15-18</b>

## CONSIDERATIONS WITH PREMIX COMBO INSULIN/GLP

- Still require twice daily dosing
- Require 10 hours between doses
- Must wait 15-30 minutes after injecting to eat
- NOTE: Leo is erratic in his eating patterns

# HOW IS LEO 5 MONTHS LATER?

- Weaned off glargine as semaglitide was ramped up
- And he Lost 35 lbs! reduced hunger
- Doing more walking when not working or sleeping
- FBG: averaging 96-129
- PPBG: averaging 138-160
- A1C: 67%; TGs down to 101!! (C-peptide 4.2 --high)
- LEO LOVES YOU!



# WHY WILL BLOOD GLUCOSE VARY?

- Weight change
  - Reduced food intake regardless of weight loss
  - Activity change
  - Stress, pain, not sleeping well
  - Medications i.e. steroids, some abx, etc
  - Menstrual cycle, pregnancy, postpartum, breast feedin

**Technology has changed everything**

# Continuous glucose monitoring



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# POINTS ABOUT CGM

- Sensor plus reader or smartphone app
- Measures interstitial glucose through a sensor placed just under skin or implanted
- Glucose measured every 1-5 minutes
- Can be owned/managed by the patient (personal) or by the practice (professional).

# APPROPRIATE PATIENTS FOR PERSONAL CGM

- Diagnosed diabetes
- On insulin
- Not achieving goals
- Able to make treatment decisions based on results
- Frequent hypoglycemia or hypoglycemia unawareness
- Difficulty with finger sticks
- Medicare coverage criteria
- Insulin injections 3x a day
- Insulin regimen requires frequent adjustment based on results
- Office visit every 6 months

# WHICH PATIENTS ARE BEST FOR PROFESSIONAL CGM?

- Do not qualify or cannot use personal CGM
  - Trial personal CGM
  - Newly diagnosed Type 2
  - Hypoglycemia concerns
  - Tool to individualize education



# WHAT TO LOOK FOR ON CGM DATA

- **Number of days CGM is worn** 14 days is recommended
- **Percentage of time CGM is active** 70% of data from 14 days is recommended
- **Mean glucose Glucose Management Indicator (GMI)** the estimated A1C (eA1C) uses an updated formula for converting CGM-derived mean glucose to estimate of current A1C.
- **Coefficient of Variation (CV)** measure of **glycemic variability**. A CV of less than or equal to 36% is acceptable, >36% is considered unstable and intervention is needed.
- **Very High Time Above Range (TAR)** % of readings and time >250 mg/dl
- **High Time Above Range (TAR)** % of readings and time 181-250 mg/dl
- **Time In Range (TIR)** % of readings and time 70-180 mg/dl
- **Low Time Below Range (TBR)** % of readings and time 54-69 mg/dl
- **Very Low Time Below Range (TBR)** % of readings and time <54 mg/dl



# CGM examples

## AGP

14 days | Sat Jan 7, 2023 - Fri Jan 20, 2023

### Time in Ranges

Goals for Type 1 and Type 2 Diabetes

Each 5% increase in the Target Range is clinically beneficial.  
Each 1% time in range = about 15 minutes per day



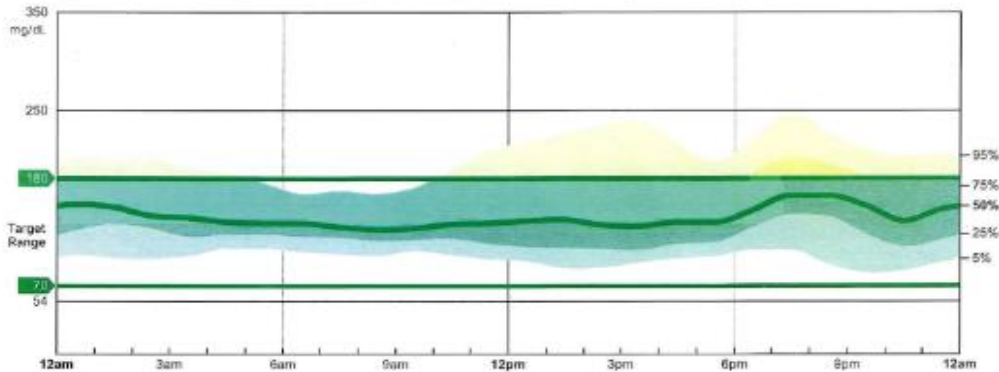
Target Range: 70-180 mg/dL Very High: Above 250 mg/dL Very Low: Below 54 mg/dL

### Glucose Metrics

Average Glucose	144 mg/dL
Goal: <154 mg/dL	
GMI	6.8%
Goal: <7%	
Coefficient of Variation	23.1%
Goal: <36%	
Time CGM Active	96.1%

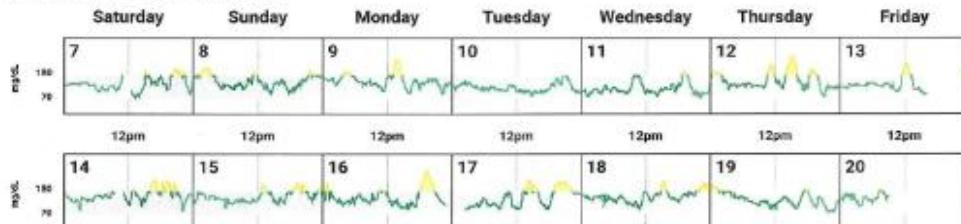
### Ambulatory Glucose Profile (AGP)

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



### Daily Glucose Profile

Each daily profile represents a midnight-to-midnight period.



## AGP Report: Continuous Glucose Monitoring

### Time in Ranges

Goals for Type 1 and Type 2 Diabetes



Test Patient DOB: Jan 1, 1970

14 Days: August 8-August 21, 2021

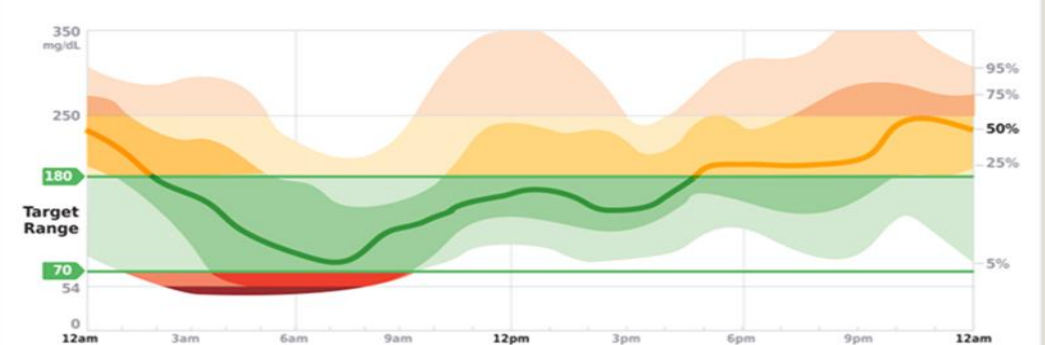
Time CGM Active: 100%

### Glucose Metrics

Average Glucose	175 mg/dL
Goal: <154 mg/dL	
Glucose Management Indicator (GMI)	7.5%
Goal: <7%	
Glucose Variability	45.5%
Defined as percent coefficient of variation	
Goal: <36%	

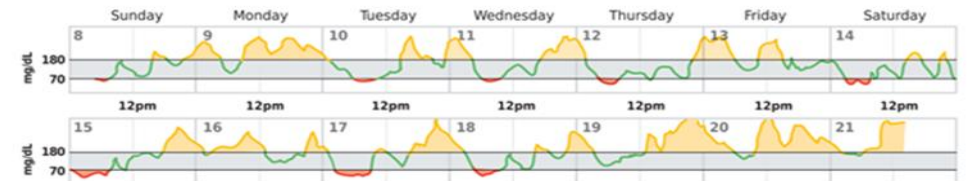
### Ambulatory Glucose Profile (AGP)

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



### Daily Glucose Profiles

Each daily profile represents a midnight-to-midnight period.





## Overview

14 days | Sat Jan 7, 2023 - Fri Jan 20, 2023

## Glucose

Average Glucose

**144** mg/dL

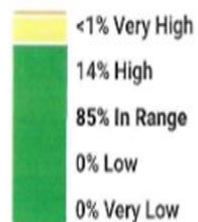
Standard Deviation

**33** mg/dL

GMI

**6.8**%

Time in Range



Target Range:  
70-180 mg/dL

Sensor Usage

Days with CGM data

**93**%  
13/14

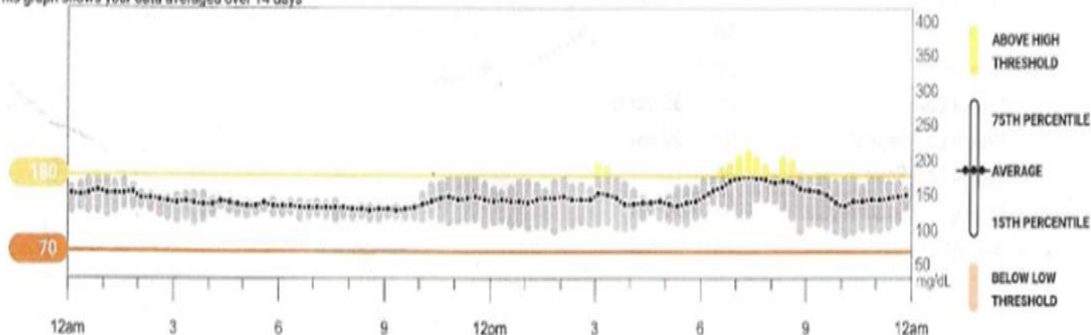
Avg. calibrations per day

**0.0**

## Top Patterns

**best glucose day was January 10, 2023**  
glucose data was in the target range about 100% of the day.

This graph shows your data averaged over 14 days



## Pro

Session 1 | Wed Dec 29, 2021 - Sat Jan 8, 2022

## Glucose

Average Glucose

**183** mg/dL

Standard Deviation

**55** mg/dL

Coefficient Of Variation

**30**%

Time in Range



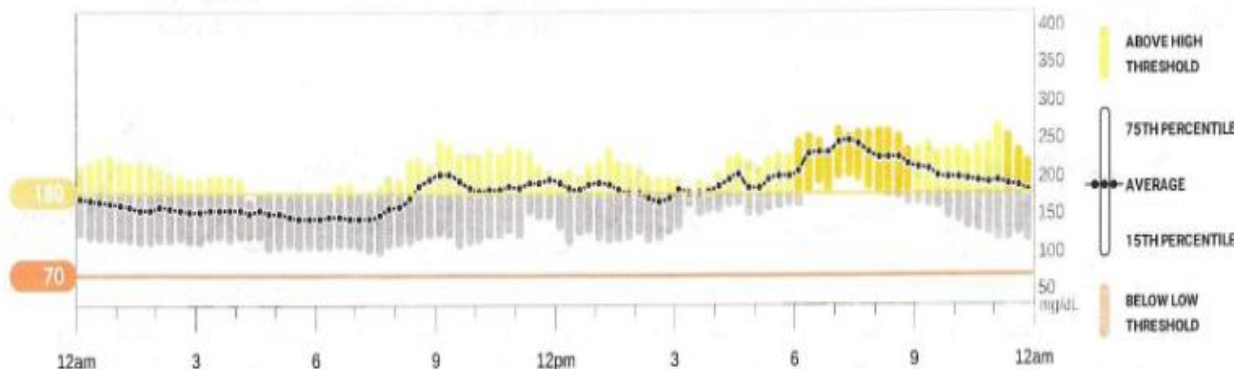
Target Range:  
70-180 mg/dL

Sensor Usage

Days with CGM data

**90**%  
9/10

## Pro Session Trends



# CGM coding

SERVICE	CODE	MEDICARE (2022)	PRIVATE PAYER (2021 average)	FREQUENCY
Personal CGM Initiation	<b>CPT95249</b>	\$59.87	\$128	Once per device
Professional CGM	<b>CPT95250</b>	\$151.57	\$309	Once per month
CGM Interpretation	<b>CPT95251</b>	\$35.30	\$97	Once per month

Modified from <https://provider.dexcom.com/coding>

# Insulin Pumps



Allows for micro-dosing every 5 minutes  
Better BG control

# So, how ya doing?



[www.reddit.com/r/reactiongifs](http://www.reddit.com/r/reactiongifs)

# Okay, for let's stop for awhile

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