

Rapid Fire CGM Interpretation For Efficient And Effective Patient Care

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Taking Control Of Your Diabetes 501c3

Our Only Important Disclosures To Report For This Presentation*...

**We both have been living with Type 1
Diabetes since the age of 15.**

*** Steve Edelman serves on the board of directors of Senseonics**

CGM Is And Has Been The Standard Of Care For Patients With Type 1 Diabetes*

*We both predict it will be the standard of care
For ALL patients with type 2 diabetes

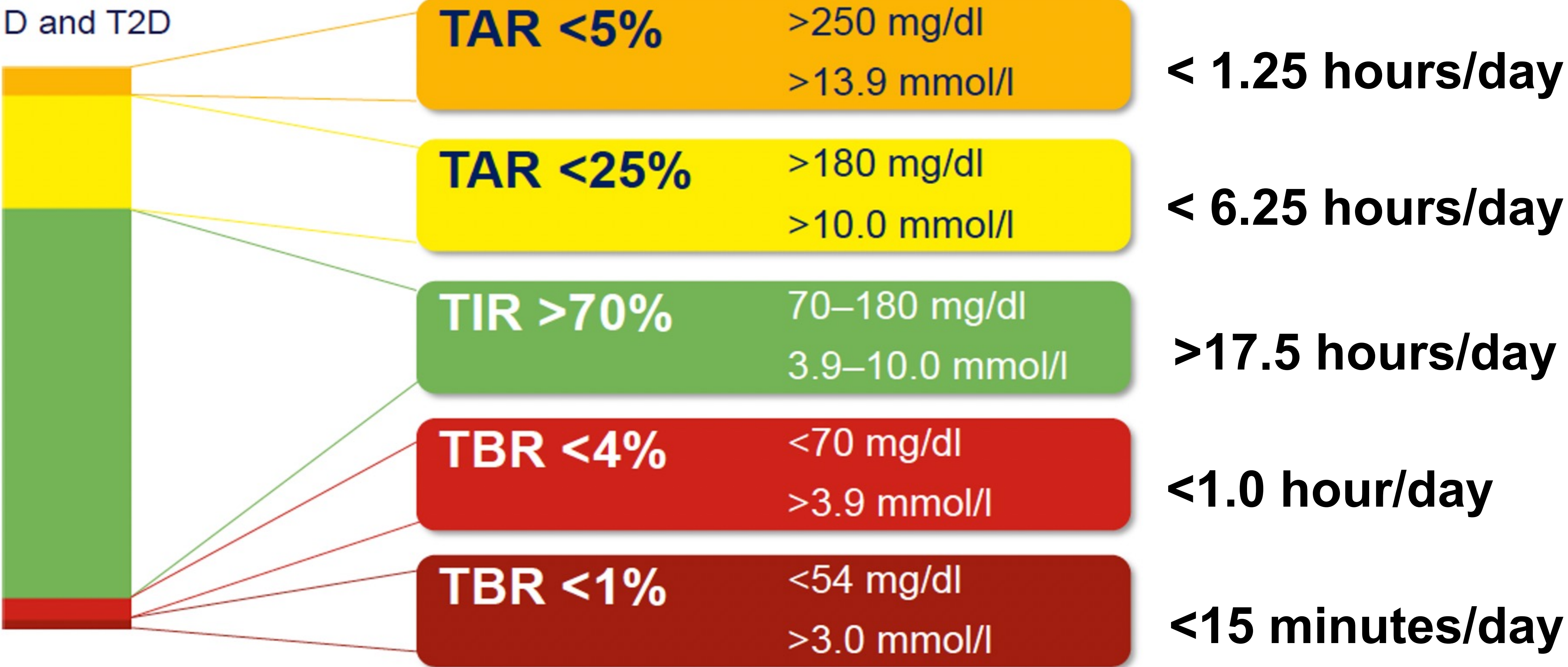
1. CGM allows for Time In Range Values and other important metrics
2. CGM metrics allows for the most accurate way to evaluate long term diabetes control: GMI vs A1c
3. CGM allows for an efficient and focused way to identify and treat problems with glycemic control
4. CGM is the backbone of hybrid and closed loop automated insulin delivery (AID) systems

It Is All About “Time In Range” Keeping the Glucose Levels Between 70 and 180 mg/dl

1. 1st priority for your patients is getting a CGM, setting their alerts and **educating them to respond to the trend arrows**.
2. Bolus calculations are more than just the carbohydrates and static glucose readings.
3. In addition to getting the A1c below 7%, try to reduce the daily glucose fluctuations (SD < 50mg/dl and CV < 36%)
4. The insulin regimen should mimic what happens in a non-diabetic state (pump/HCL vs. MDI)

CGM TIR Targets for Most with T1D and T2D (1% represents 15 minutes)

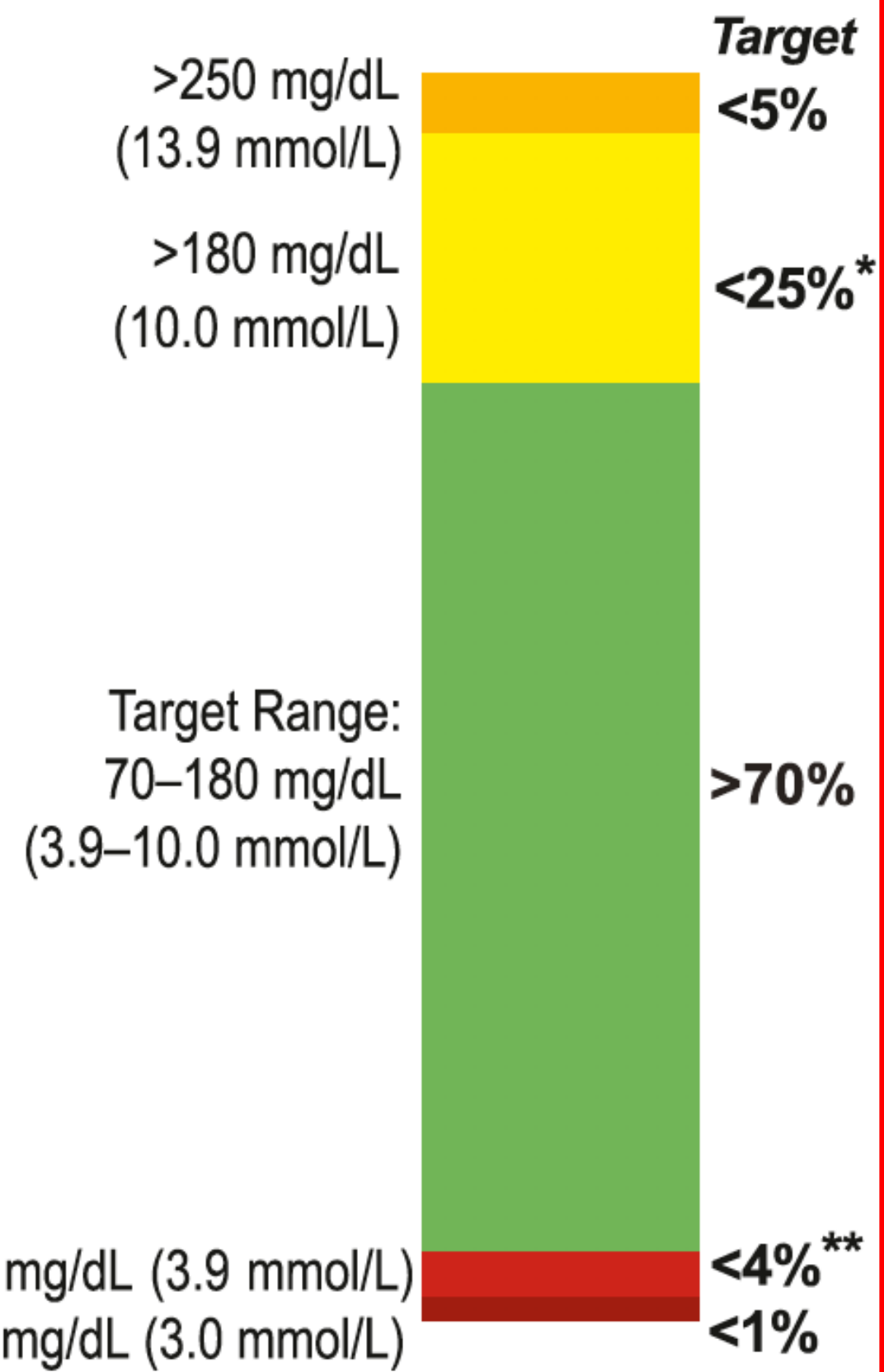
T1D and T2D



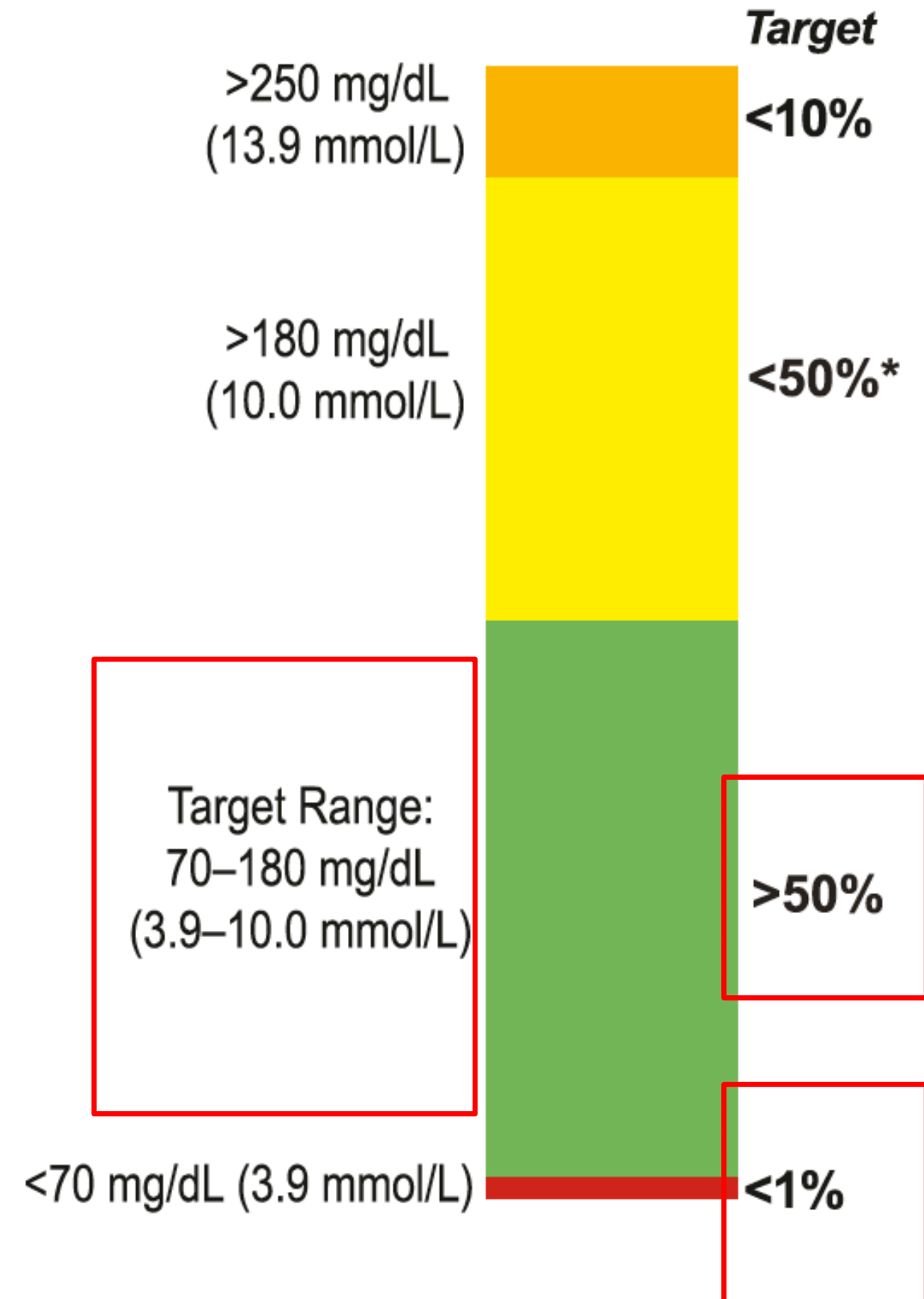
High risk individuals (with complications or comorbidities & pregnancy) have different targets
Battelino T, Danne T, Bergenstal RM, et al. Diabetes Care 2019;42:1593-1603

Consensus on Time in Range Targets

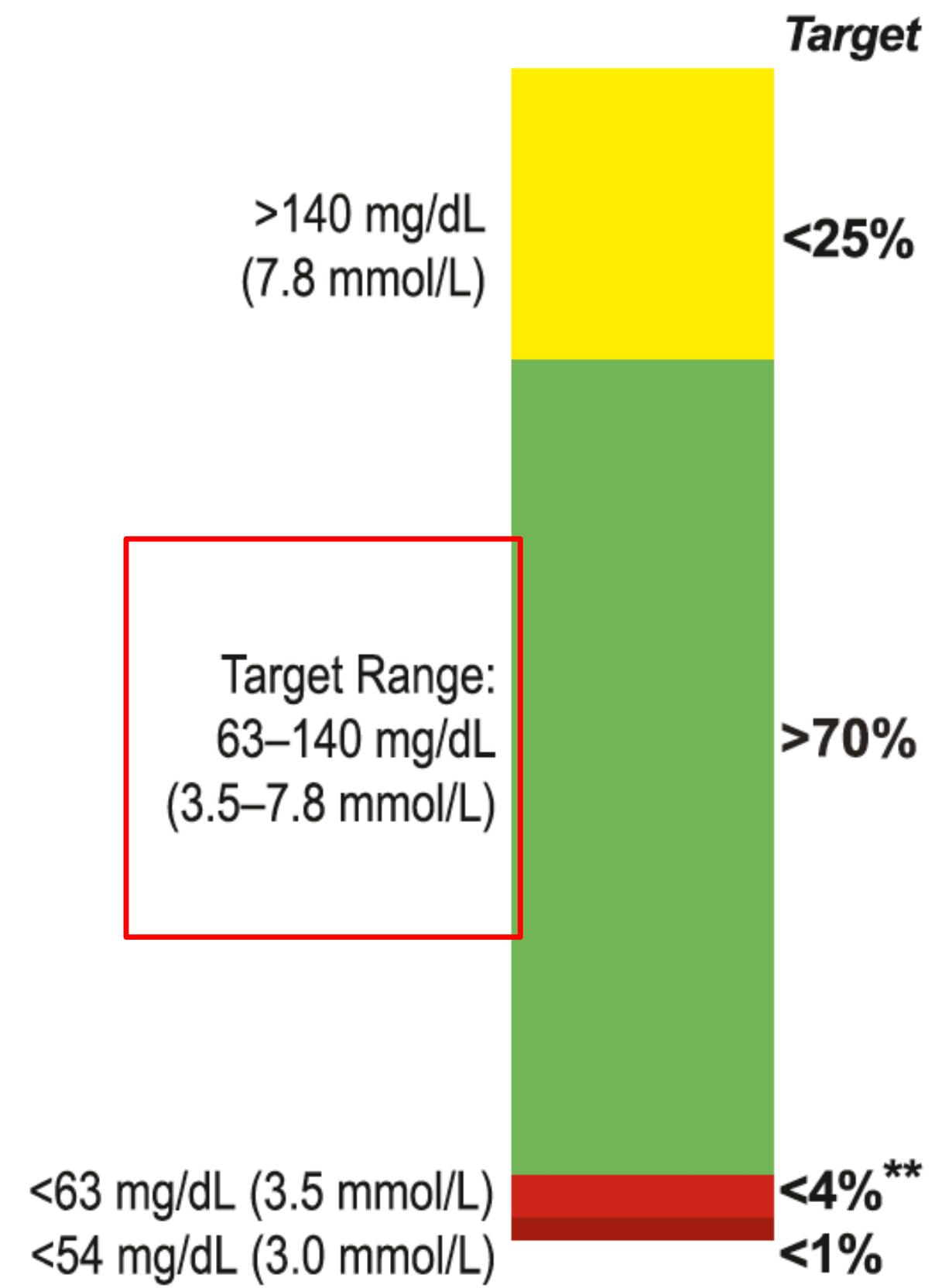
Type 1^a & Type 2 Diabetes



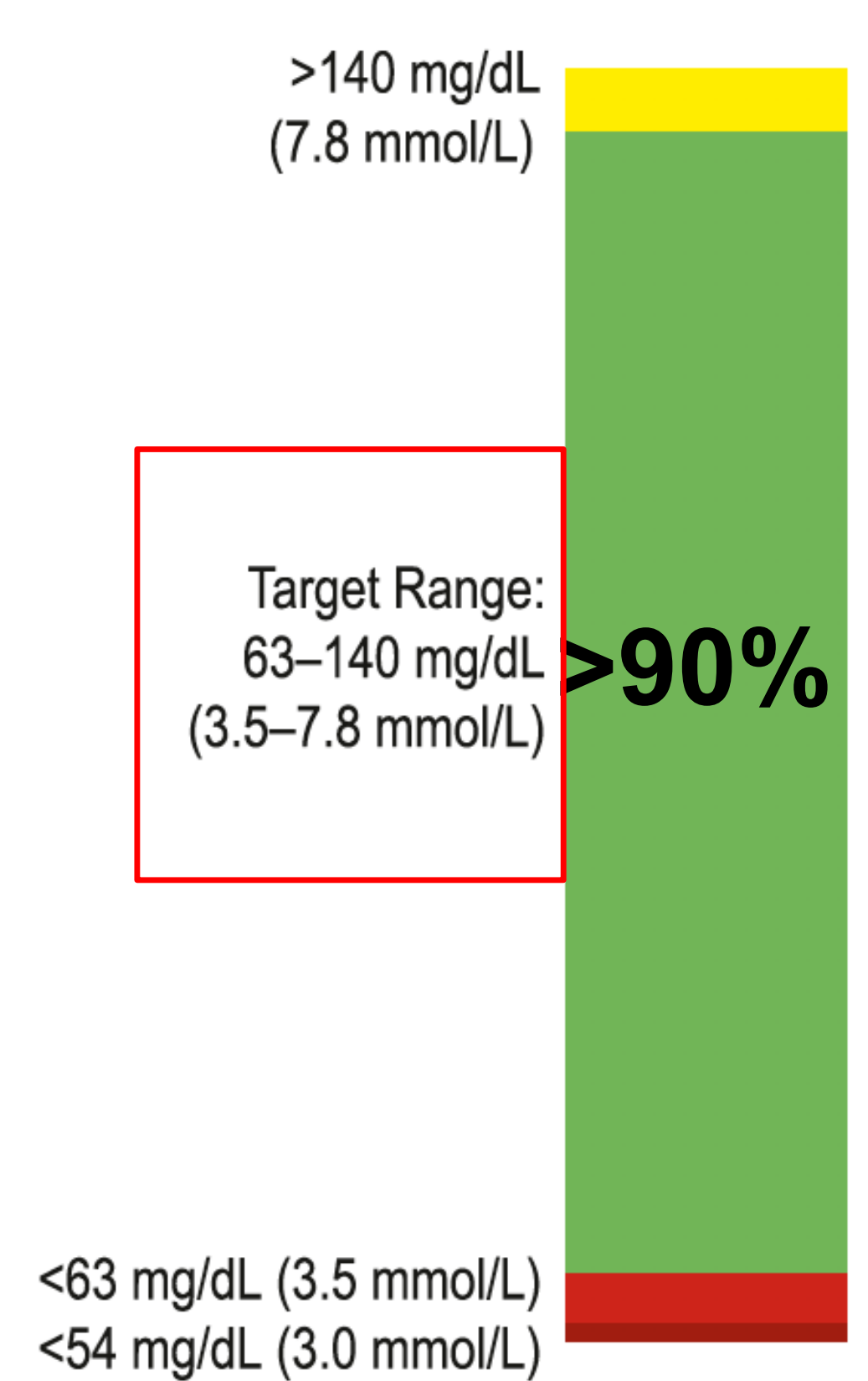
Older/High-Risk: Type 1 & Type 2 Diabetes



Pregnancy: Type 1 Diabetes[†]



Pregnancy: Gestational & Type 2 Diabetes[§]



Reviewing CGM Overview

Be Methodical!



1. Review the CGM download together with the patient, explain what you are observing
2. Look at average glucose and estimated A1c (GMI)
3. Look at the SD (standard deviation) goal less than 50mg/dl or CV (coefficient of variation) goal less than 36%
4. Look at Time in Range (TIR) goal $> 70\%$

Reviewing CGM Overview continued

5. Look at time below range (TBR) goal < 4% (<1% below 55mg/dl)
6. Look at the 24-hour glucose profile to see when highs and lows occur as well as variability
7. Review alert settings on the CGM (most providers do not look at these!)
8. Look at individual days to tease out particular problem areas if needed

Your Patients Need to Understand the importance of Trend Arrows And Alerts/Alarms

- Trend arrows are extremely important for behavior modification and dosing insulin
- Alerts and alarms, when set correctly, will help improve TIR, GMI and Glycemic variability

30 days

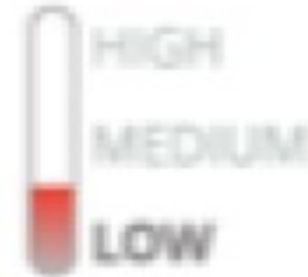
Wed Feb 1

9.0 %

Estimated A1C

212

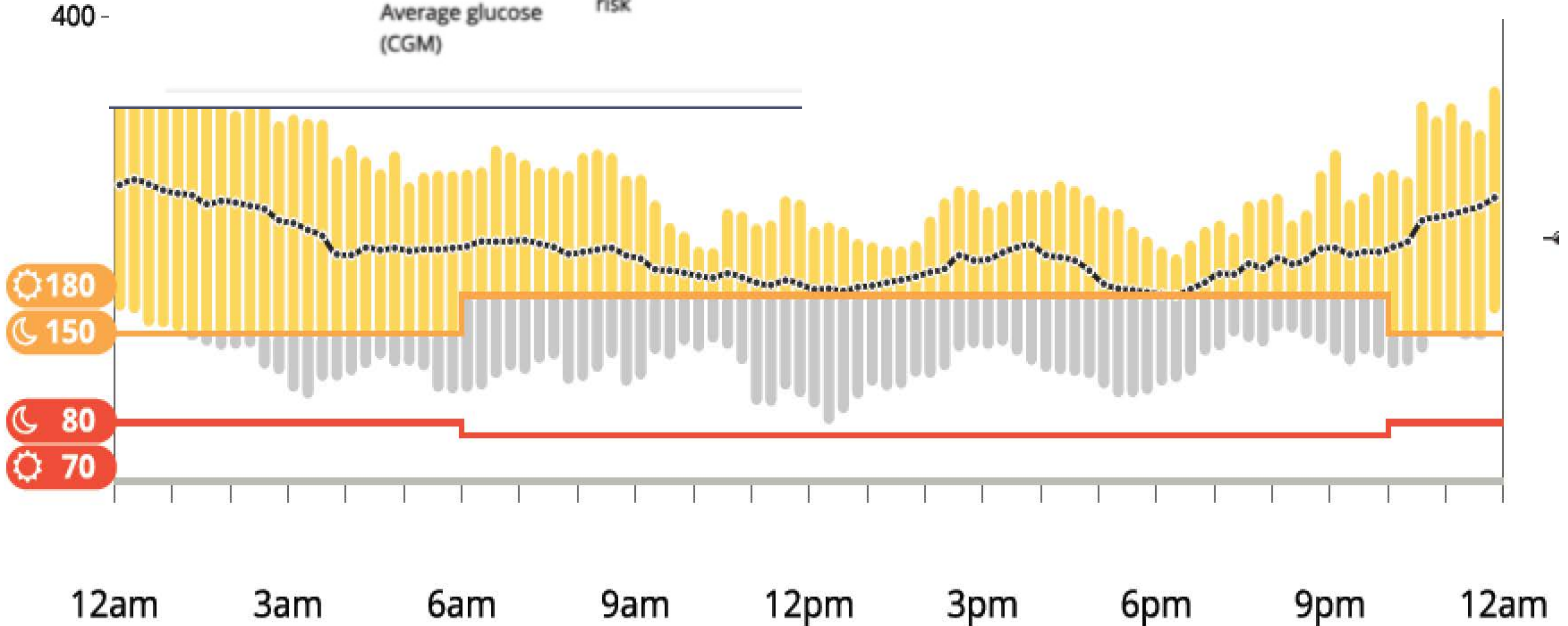
mg/dL
Average glucose
(CGM)



Hypoglycemia
risk

Alert Settings for Device

Low Alert	80 mg/dL
High Alert	390 mg/dL
Fall Rate Alert	3 mg/dL/min
Rise Rate Alert	3 mg/dL/min
Out of Range Alert	20 min



“Alerts And Alarms Are Your Friends”


- Spend time with your patients on lowering the upper alert to below 180mg/dl (i.e. 150 mg/dl) during the day. Set a 2nd scheduled for nighttime with a higher level to avoid alarm fatigue.
- Change the alert sound to a more palatable sound (not the factory set one)
- Lowering the upper alert will improve the time in range by ~10% with the caveat that the patients knows how to respond to trend arrows

Alert Settings for Device

Schedule for the daytime and night

General

Low	On	75 mg/dL
Low Repeat	On	30 min
High	On	150 mg/dL
High Repeat	On	30 min
Fall Rate	Off	
Rise Rate	Off	
Urgent Low	On	55 mg/dL
Urgent Low Repeat	On	30 min
Urgent Low Soon	On	
Urgent Low Soon Repeat	On	30 min
Signal Loss	Off	




Scheduled - Night

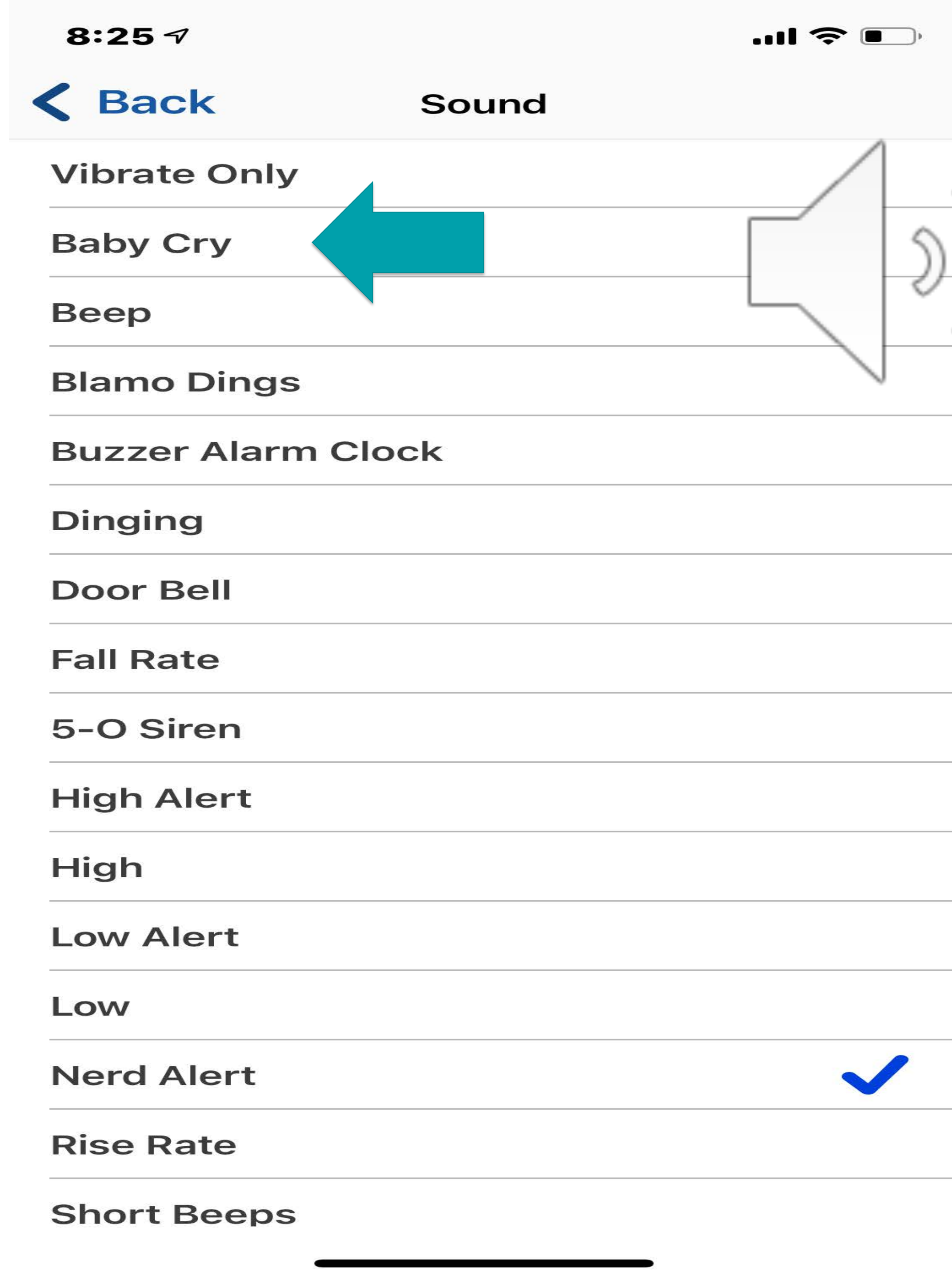
Status: **On**

Sun, Mon, Tue, Wed, Thu, Fri, Sat
10:00 PM - 7:00 AM

Low	On	70 mg/dL
Low Repeat	On	30 min
High	On	180 mg/dL
High Repeat	Off	0 min
Fall Rate	Off	
Rise Rate	Off	
Urgent Low	On	55 mg/dL
Urgent Low Repeat	On	30 min
Urgent Low Soon	On	
Urgent Low Soon Repeat	On	30 min
Signal Loss	Off	



Pick An Alert Sound That Does Not Drive You Crazy



Using CGM Trend Arrows To Help Dose Insulin?

When we asked 300 successful CGM users with type 1 and type 2 Diabetes what the MOST useful feature of CGM was, they said:

- **Real-time trend arrows**
- **Real-time high and low alert**

The LEAST useful feature of CGM was:

- **Retrospective downloads**

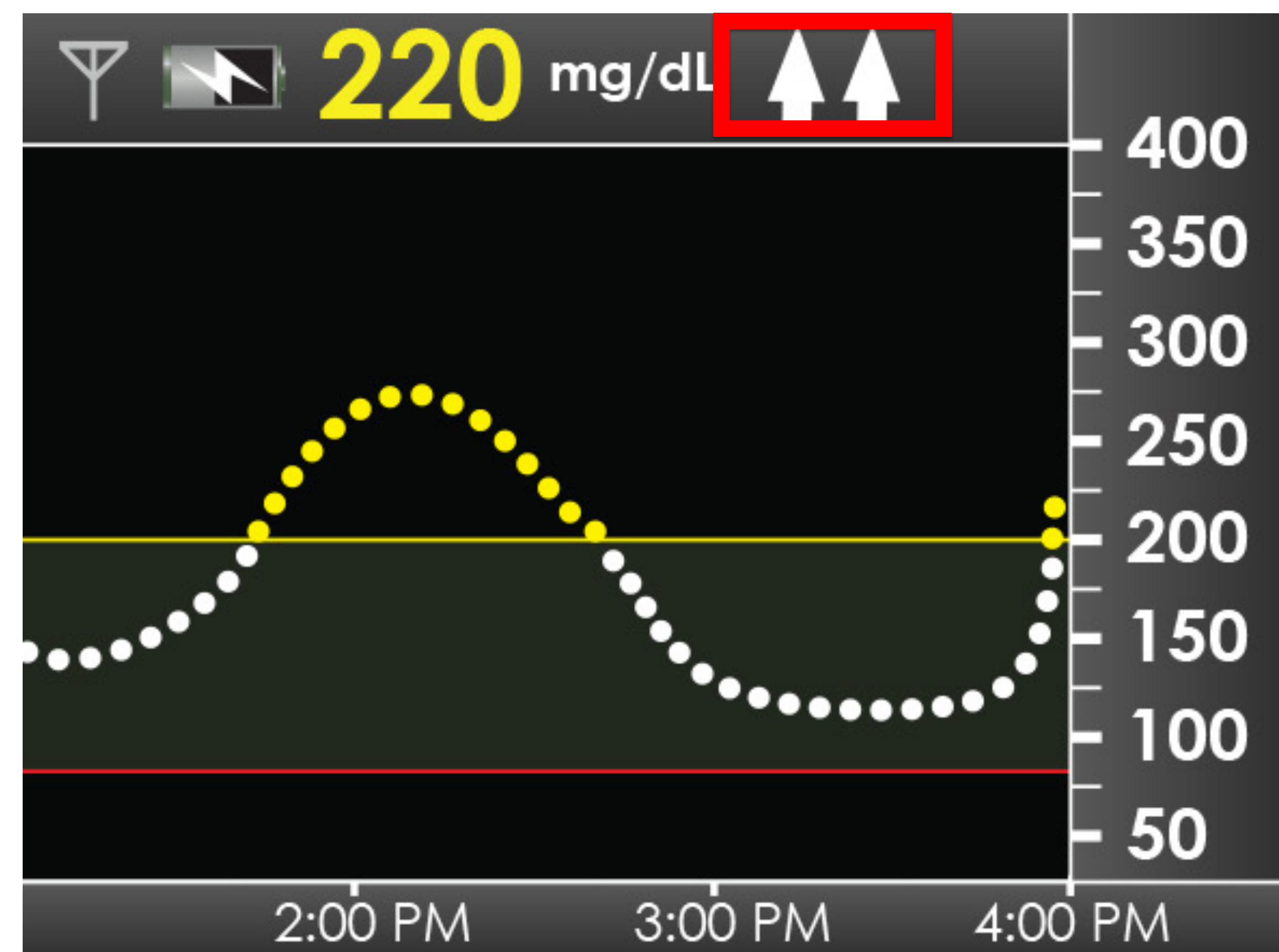
Mean Change in Insulin Dose Based on Trend

Arrows: **Survey of 300 CGM Users**








~3.0 units



~6.8 units





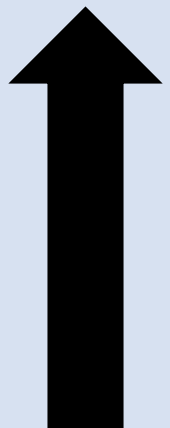
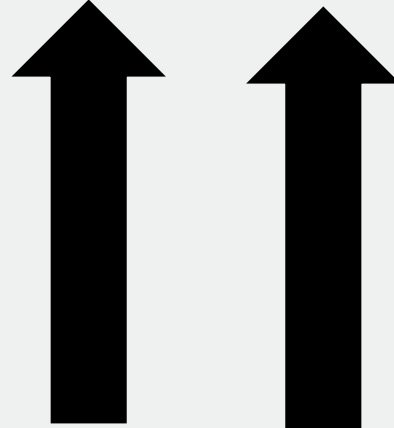
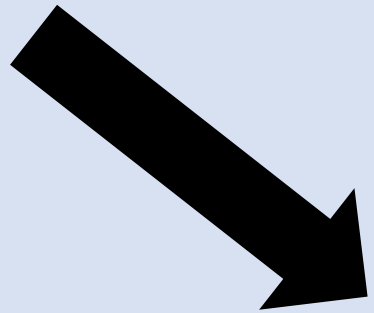

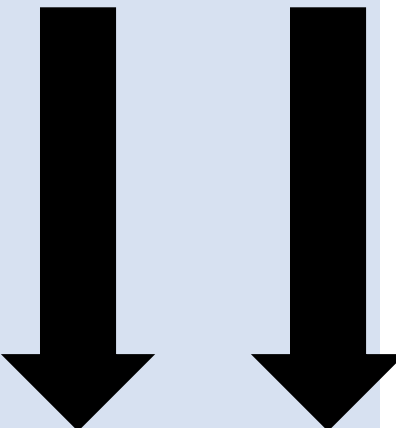
How CGM and Trending Information Can Affect Dosing Decisions

	<p>Constant: Your glucose is steady (not increasing/decreasing more than 1mg/dL each minute)</p> <p>~3.0 units</p>	No change in calculation
	<p>Slowly rising: Your glucose is rising 1-2mg/dL each minute</p>	
	<p>Rising: Your glucose is rising 2-3 mg/dL each minute</p>	140% Mean Increase
	<p>Rapid Rising: Your glucose is rising more than 3 mg/dL each minute</p> <p>~6.8 units</p>	
	<p>Slowly Falling: Your glucose is falling 1-2 mg/dL each minute</p>	48% Mean Decrease
	<p>Falling: Your glucose is falling 2-3 mg/dL each minute</p>	
	<p>Rapid falling: Your glucose is falling more than 3 mg/dL each minute</p> <p>~1.5 units</p>	
no arrow	<p>Not rate of Change Information: The receiver cannot calculate how fast your glucose is rising or falling</p>	

Using Trend Arrows to Adjust Insulin Dose

Example 30-minute anticipated glucose value

The user can adjust their current glucose value according to the trend arrows to estimate the value in 30 minutes

 <p>Glucose is not increasing or decreasing >1mg/dl (0.06 mmol/l) per minute</p> <p>No adjustment: Dose for current glucose value.</p>	 <p>Glucose increasing 1-2 mg/dl (0.06-0.11 mmol/l) per minute</p> <p>Adjust UP: Current value plus 50 mg/dl (Actual Range: 30-60 mg/dl)</p>	 <p>Glucose increasing 2-3 mg/dl (0.11-0.17 mmol/l) per minute</p> <p>Adjust UP: Current value plus 75 mg/dl (Actual Range: 60-90 mg/dl)</p>	 <p>Glucose increasing >3 mg/dl (0.17 mmol/l) per minute</p> <p>Adjust UP: Current value plus 100 mg/dl (Actual Range: 90-150 mg/dl)</p>	 <p>Glucose decreasing 1-2 mg/dl (0.06-0.11 mmol/l) per minute</p> <p>Adjust DOWN: Current value minus 50 mg/dl (Actual Range: 30-60 mg/dl)</p>	 <p>Glucose decreasing 2-3 mg/dl (0.11-0.17 mmol/l) per minute</p> <p>Adjust DOWN*: Current value minus 75 mg/dl (Actual Range: 60-90 mg/dl)</p>	 <p>Glucose decreasing >3 mg/dl (0.17 mmol/l) per minute</p> <p>Adjust DOWN: Current value minus 100 mg/dl (Actual Range: 90-150 mg/dl)</p>
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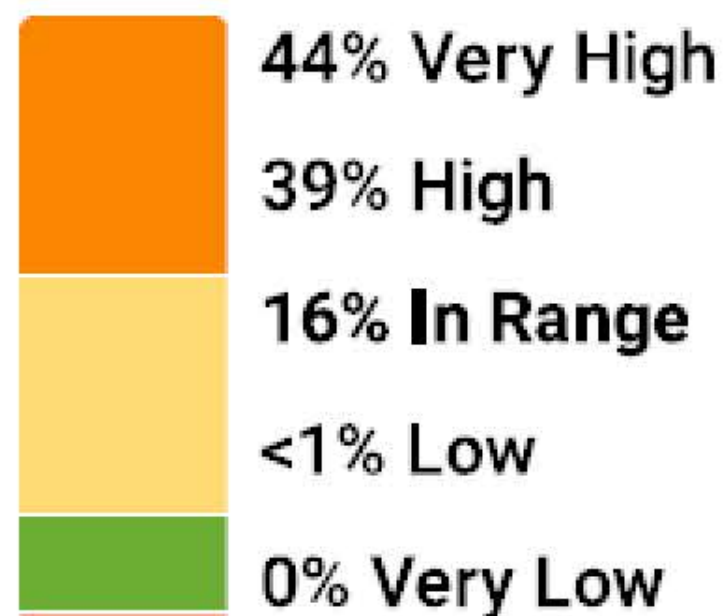
The most conservative response to **down arrows is to delay insulin administration until the trend arrow turns horizontal.*

*This is **one example** as there are several available scales for predictive measurements and insulin dosing, taking into account individual insulin sensitivity*

Average Glucose

237 mg/dL

Time in Range



Sensor Usage

Days with CGM data
90%
27/30

Case 1

Standard Deviation

67 mg/dL

GMI

9.0%

Target Range:

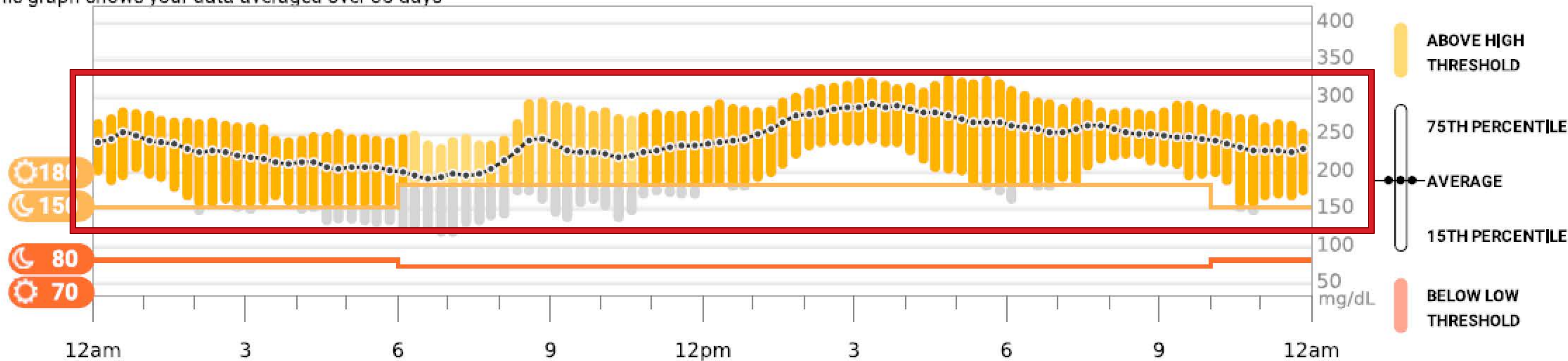
Day (6:00 AM - 10:00 PM): 70-180 mg/dL
Night (10:00 PM - 6:00 AM): 80-150 mg/dL

Avg. calibrations per day

0.6

Top Patterns

This graph shows your data averaged over 30 days




Case 1: Summary

- 56yo businesswoman with a “busy schedule” on MDI
- Average glucose, GMI, SD, TIR and TAR all looking extremely high (few lows)
- Her 24-hour profile looks fairly flat, without major ups and downs, but at a high level
- She is above 180 mg/dl 73% of the time or over 18 hours a day on average

Alert And Alarm Settings

Alert Settings for Device

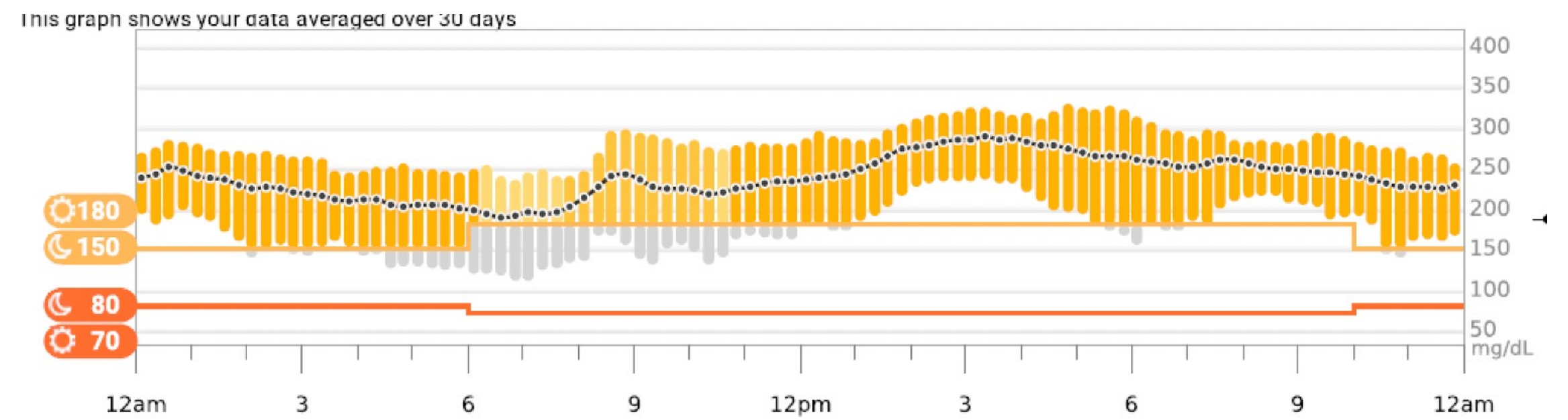
General



Low	On	80 mg/dL
Low Repeat	Off	0 min
High	On	200 mg/dL
High Repeat	Off	0 min
Fall Rate	Off	
Rise Rate	Off	
Urgent Low	On	55 mg/dL
Urgent Low Repeat	On	30 min
Urgent Low Soon	On	
Urgent Low Soon Repeat	On	30 min
Signal Loss	On	20 min

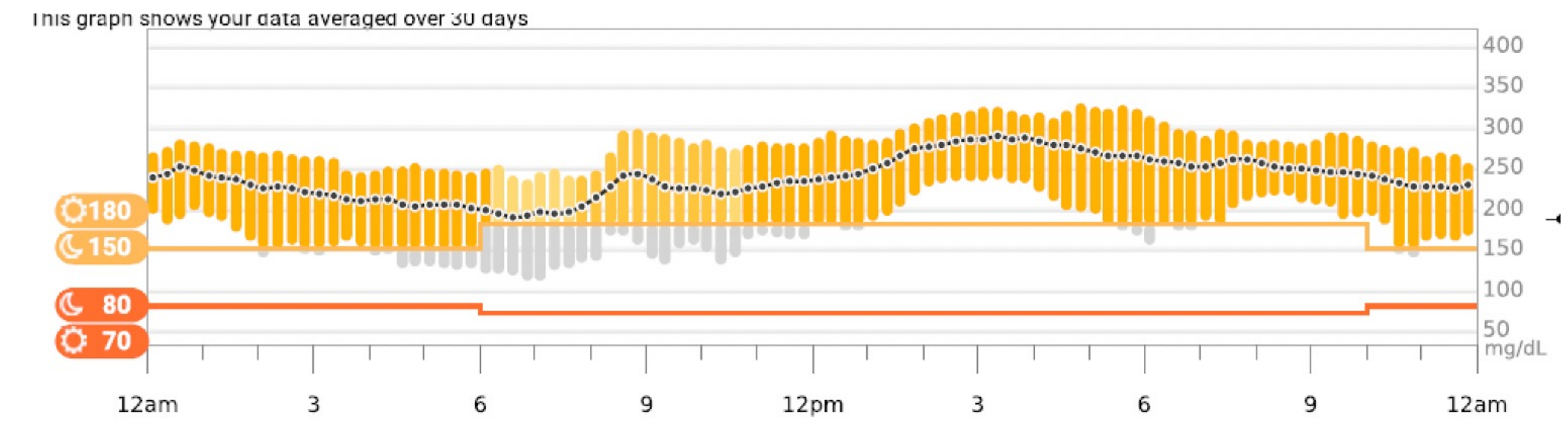
- Her A1c has been over 9% for 12 years
- Moderate non-proliferative DR
- Mild microalbuminuria with upper normal GFR and UA/CR
- Very stubborn about making changes
- Very bright businesswoman where her job comes first
- 4 daughters without diabetes

Case 1: Therapeutic Interventions



1. Lower her high alert to 150 during the day and second set of alerts with a higher level at night
2. Turn on her repeat high alert for 90 minutes
3. Spend time to explain how to react to the high alerts including looking at the trend arrows.
4. Spend time to get her interested in the different hybrid closed loop systems (Tandem CIQ/Mobi, Omnipod 5 and especially the iLET)

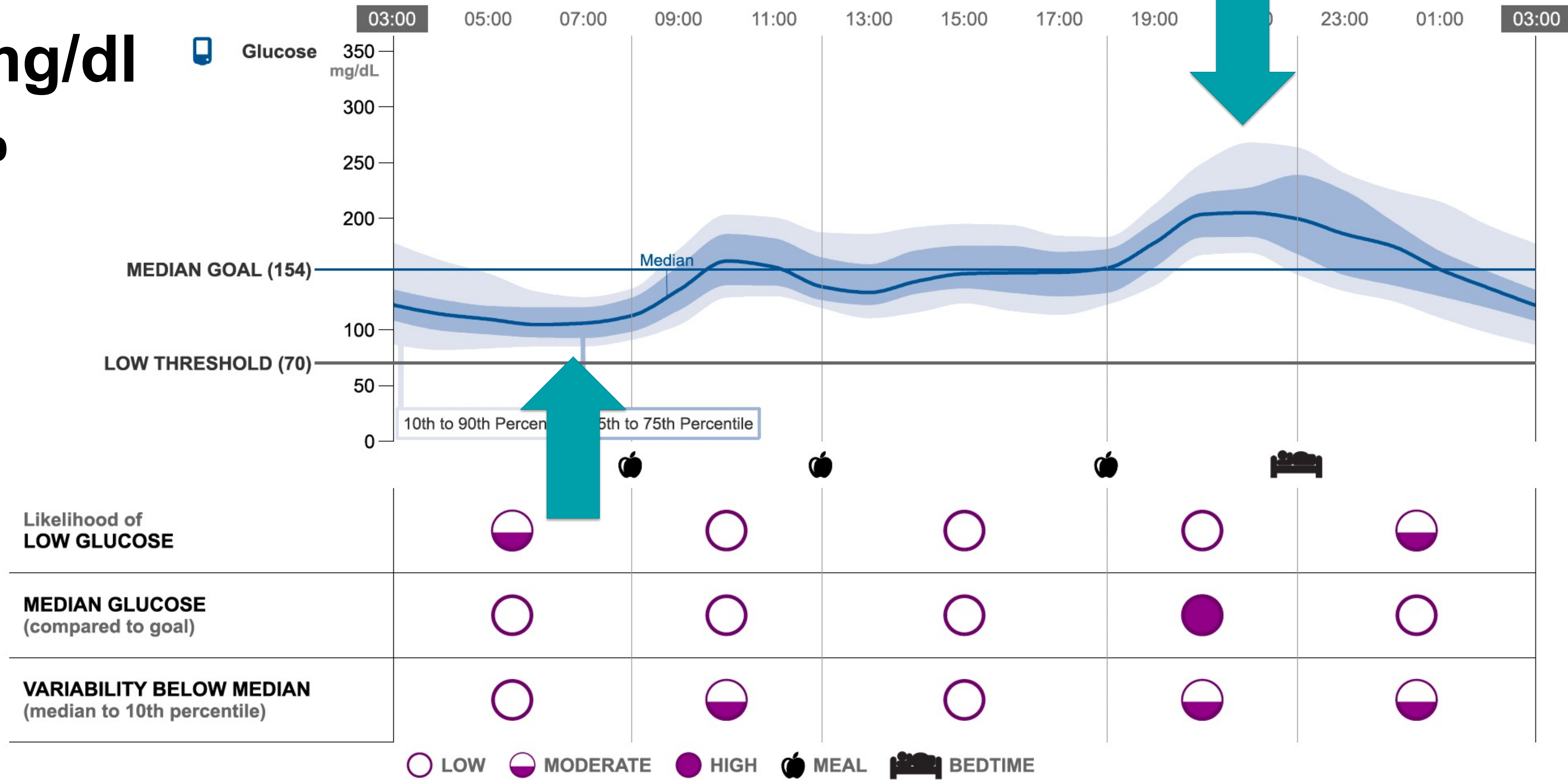
Case 1: Therapeutic Interventions cont.



5. Seriously refer her to a clinical psychologist specializing in diabetes. She has been relatively lucky in terms of not having more serious complications up until now.
6. Discuss screening her 4 daughters for autoantibodies
7. Make sure she has an easy to use glucagon pen

Case 2

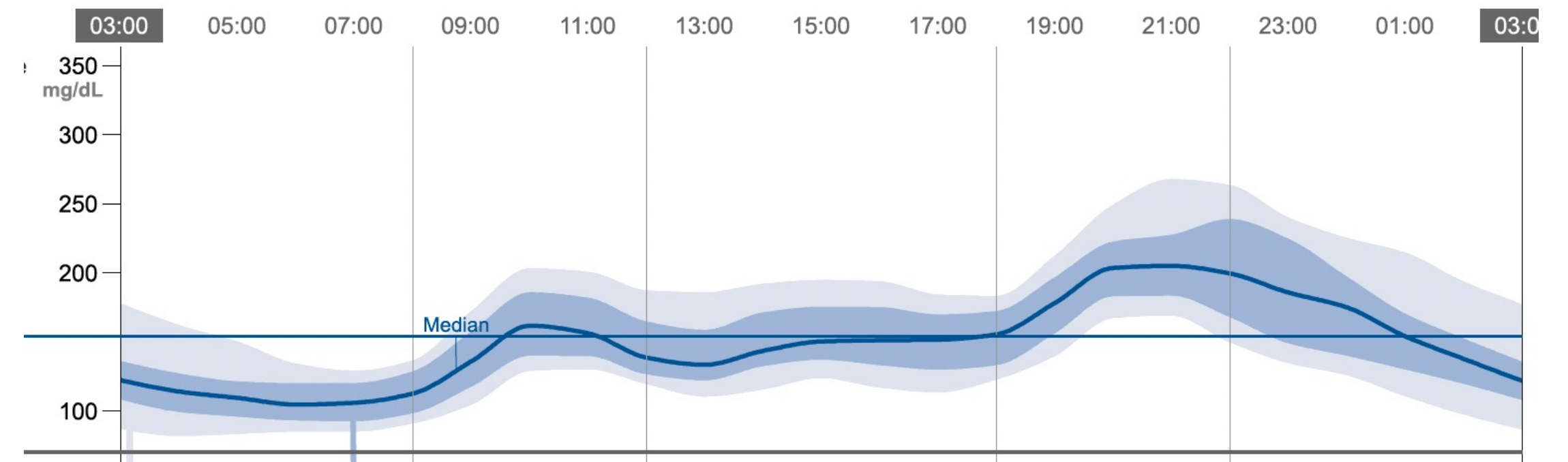
Ave. 173mg/dl
GMI 7.9%
CV 39%
TIR 63%
TBR 5%



Case 2: Summary

- 84-year-old retired physician with T2D for 30 years also with chronic kidney disease (stage 3b) on MDI
- He is on insulin glargine at night (20 units), dapagliflozin 10 mg qAM and liraglutide 1.2 mg qAM
- CGM metrics show spikes after dinner and low overnight and first thing in the morning

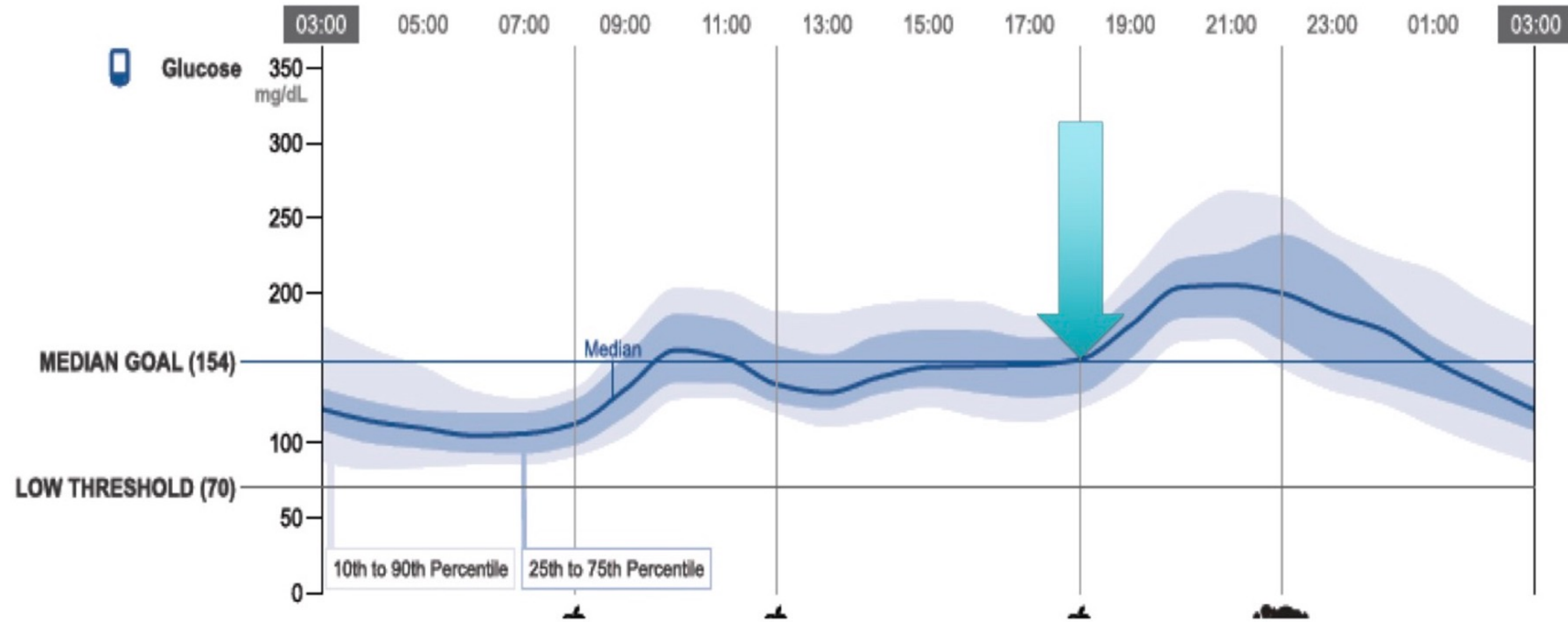
Case 2 : Therapeutic Interventions



1. Start 5 units of RAI at dinner and titrate up depending on the bedtime values (review trend arrows)
2. Take the RAI 20 to 30 minutes before eating
3. Switch insulin glargine to the morning and reduce the dose by 10% to avoid overnight lows
4. Set the low alert at 80 mg/dl or above (repeat q15 mins)
5. Make sure he has a glucagon preparation and his wife knows how to use it.

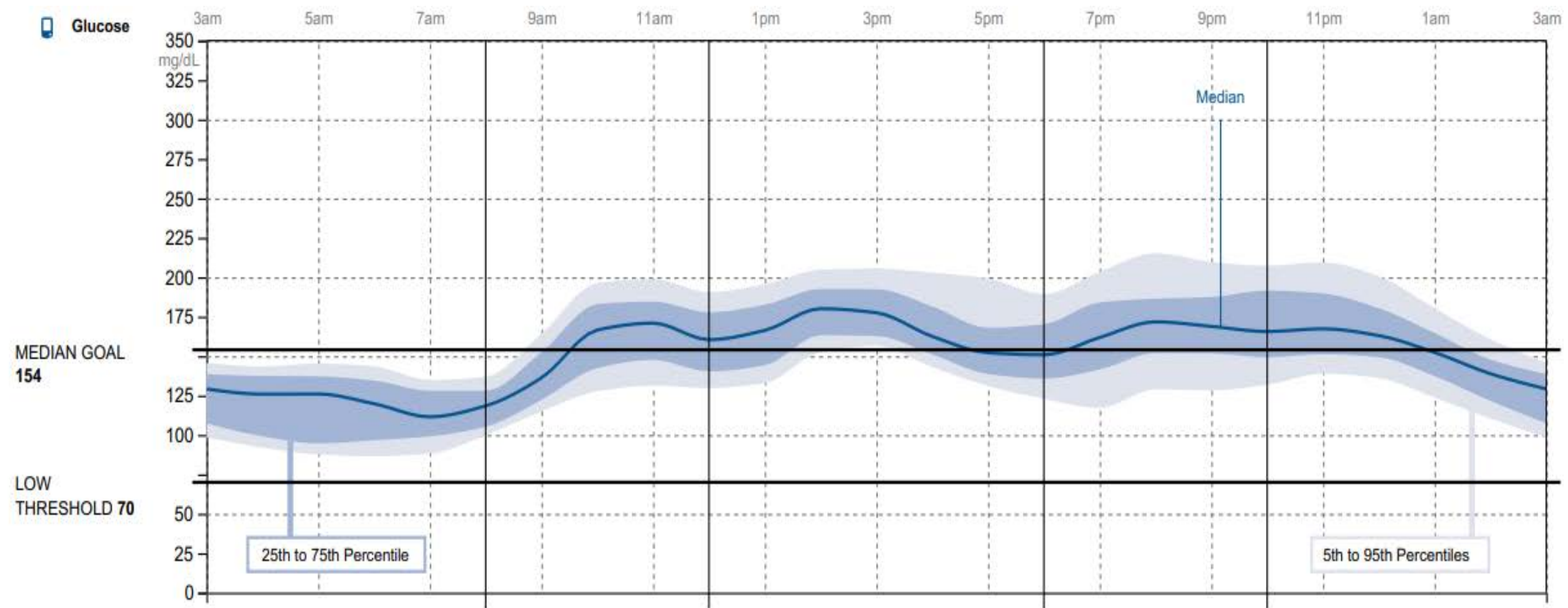
CGM Data

Before



Initiated
a single
dose
rapid-
acting
insulin at
dinner

After



CGM Metrics Post Changes

GLUCOSE STATISTICS AND TARGETS

January 20, 2021 - February 2, 2021 14 Days

% Time CGM is Active **87%**

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.	

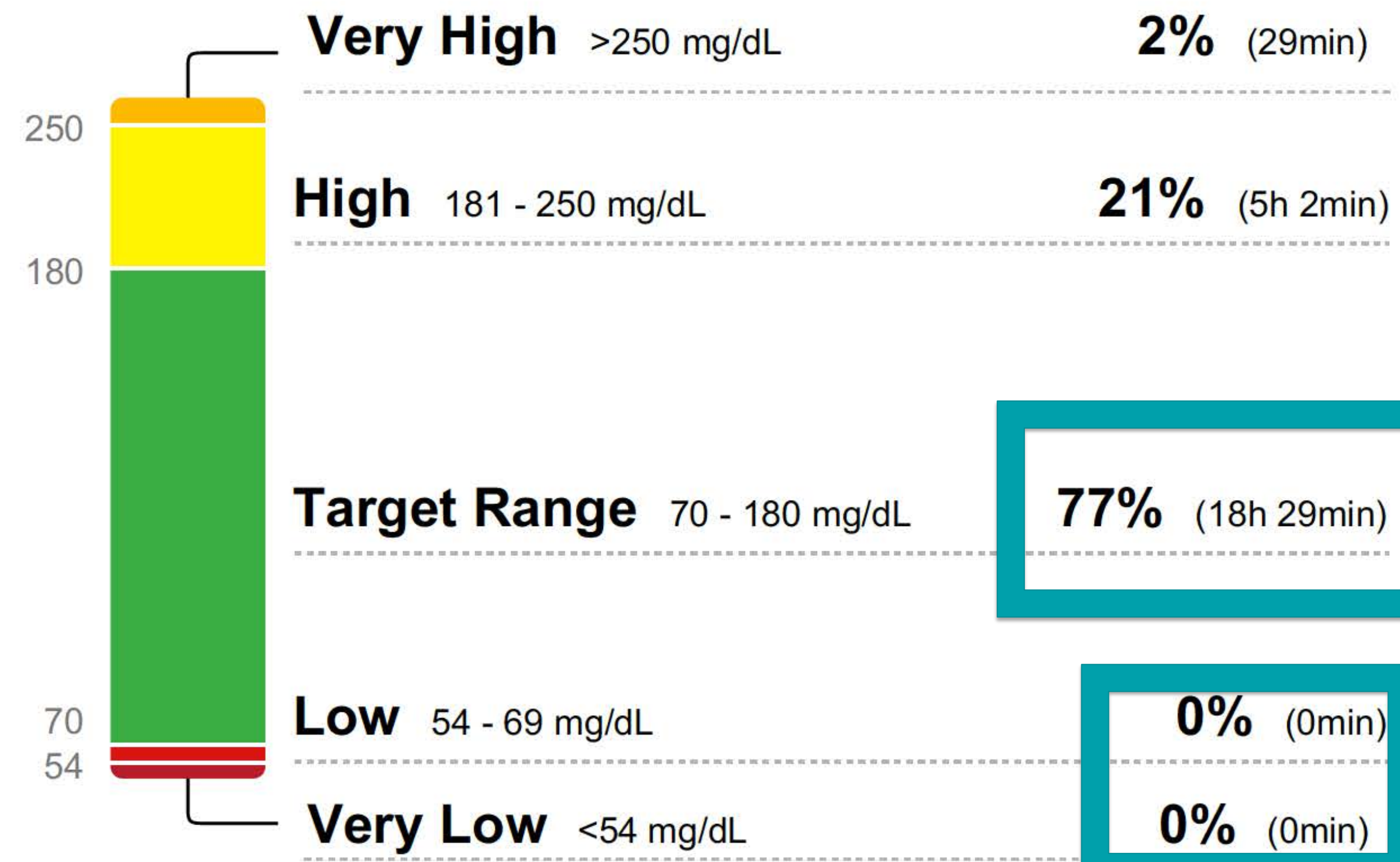
Average Glucose **155** mg/dL

Glucose Management Indicator (GMI) **7.0%**

Glucose Variability **23.9%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



Case 2 Summary

- The CGM data showed the most important problem area
- One shot of a rapid acting insulin with a single meal is not uncommon in type 2 diabetes
- Timing of insulin injections is important
- Always consider over basalinization and proactively reduce the basal insulin when addressing post meal spikes

Overview

14 days | Sat Jul 22, 2023 - Fri Aug 4, 2023

Case 3



Glucose

Average Glucose

96 mg/dL

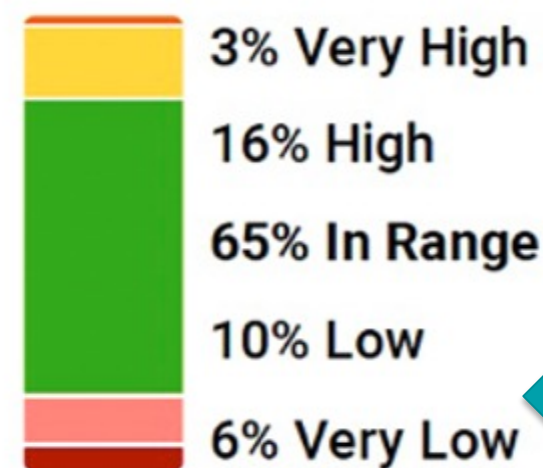
Standard Deviation

32 mg/dL

GMI

5.6%

Time in Range



Target Range:

Day (6:00 AM - 10:00 PM): 65-130 mg/dL
Night (10:00 PM - 6:00 AM): 65-115 mg/dL

Sensor Usage

Days with CGM data

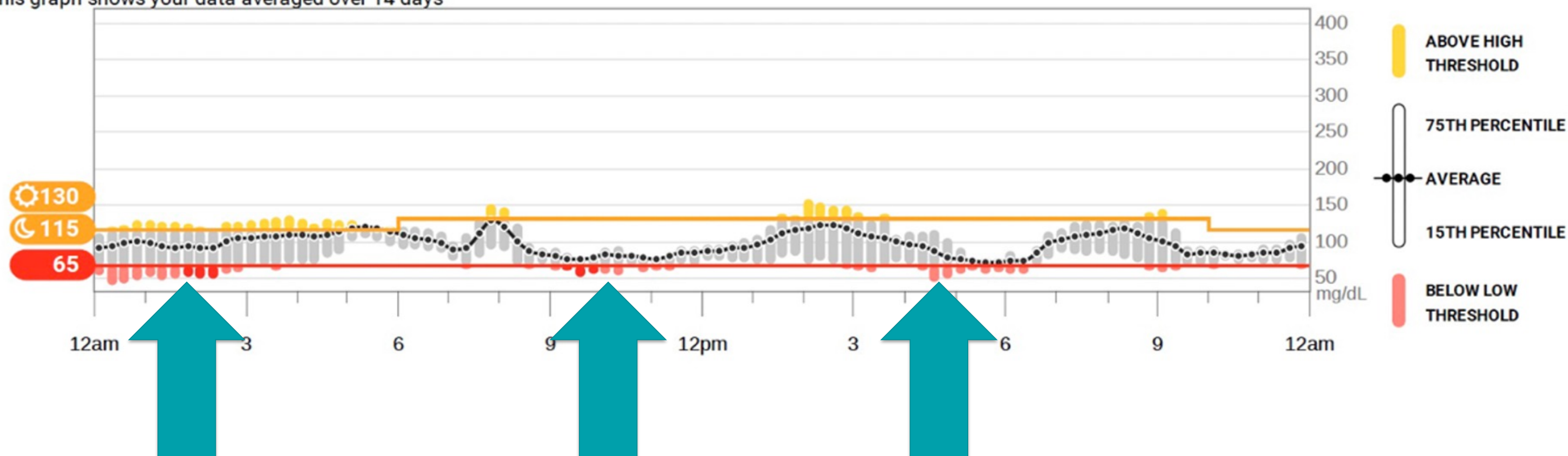
93%

13/14

Avg. calibrations per day

0.0

This graph shows your data averaged over 14 days



Case 3 summary: 72-year-old woman diagnosed with T1D at the age of 40

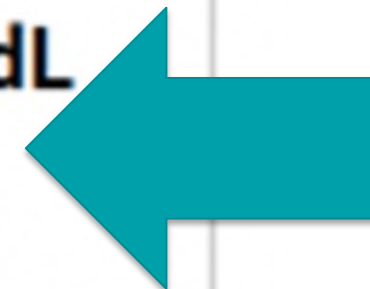
- 1. Average glucose, GMI, SD, TIR and TAR all looking "OK"**
- 2. TBR is extremely high.**
- 3. She is below 70mg/dl 4 hours a day on average**
- 4. She is below 55 mg/dl 90 minutes a day on average**

Alert And Alarm Settings

Alert Settings for Device

General

Low	On	60 mg/dL
Low Repeat	Off	0 min
High	On	170 mg/dL
High Repeat	Off	0 min
Fall Rate	Off	
Rise Rate	Off	
Urgent Low	On	55 mg/dL
Urgent Low Repeat	On	30 min
Urgent Low Soon	On	
Urgent Low Soon Repeat	On	30 min
Signal Loss	On	20 min



- She has a history of hypoglycemic unawareness
- Multiple paramedic calls and ER/hospital visits
- She is on a Tandem CIQ
- Very stubborn about making changes

Case 3: Therapeutic Interventions

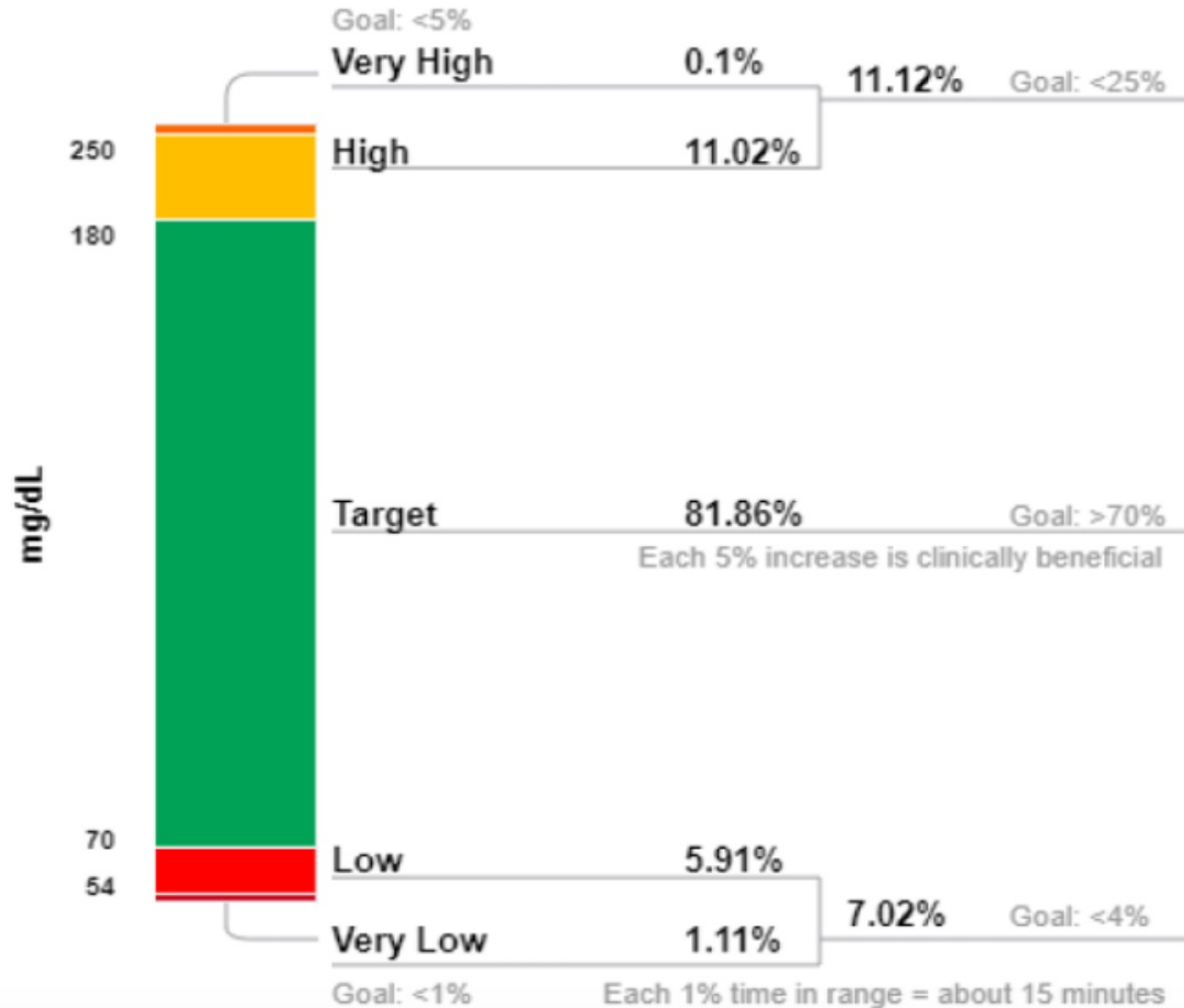
1. Raise her low alert to 90 or 100 mg/dL so she can catch lows before they occur.
2. Turn on her repeat low alert (which goes off every 15 minutes) and her rapid fall alert
3. Raise her sensitivity factor and lower her basal rate
4. Seriously refer her to a clinical psychologist specializing in diabetes.
5. Make sure she has an easy-to-use glucagon kit and teach her husband when and how to use it.

Case 4

AGP Report: Continuous Glucose Monitoring

Time In Range

Goals for Type 1 and Type 2 Diabetes



DOB: May 03, 2001

14 Days: Mar 13 2023 - Mar 26 2023

Eversense Wear Time: 98.88 %

Glucose Metrics

Average Glucose 125 mg/dL

Goal: <154 mg/dL

Glucose Management Indicator (GMI) 6.3%

Goal: <7 %

Glucose Variability 32.85%

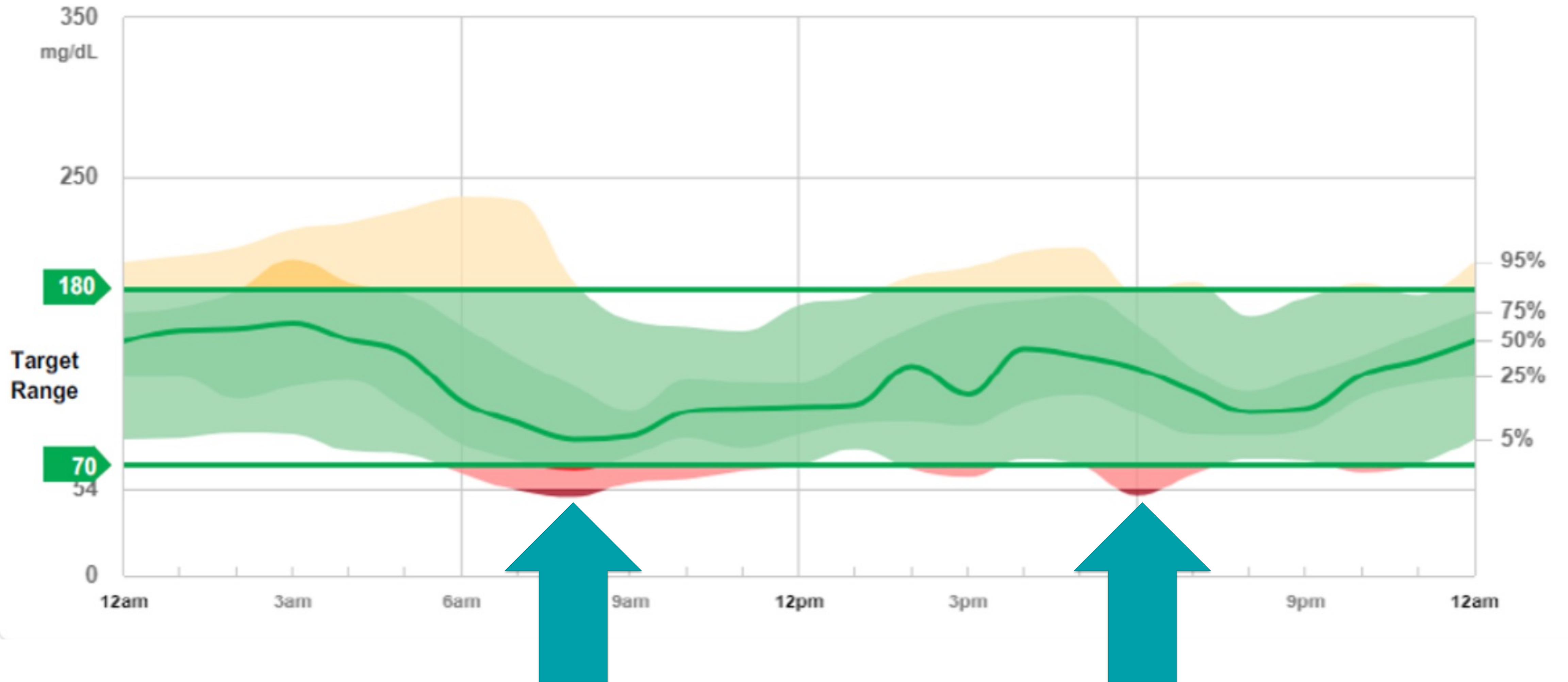
Defined as percent coefficient of variation

Goal: ≤ 36 %

Case 4 Continued

Ambulatory Glucose Profile

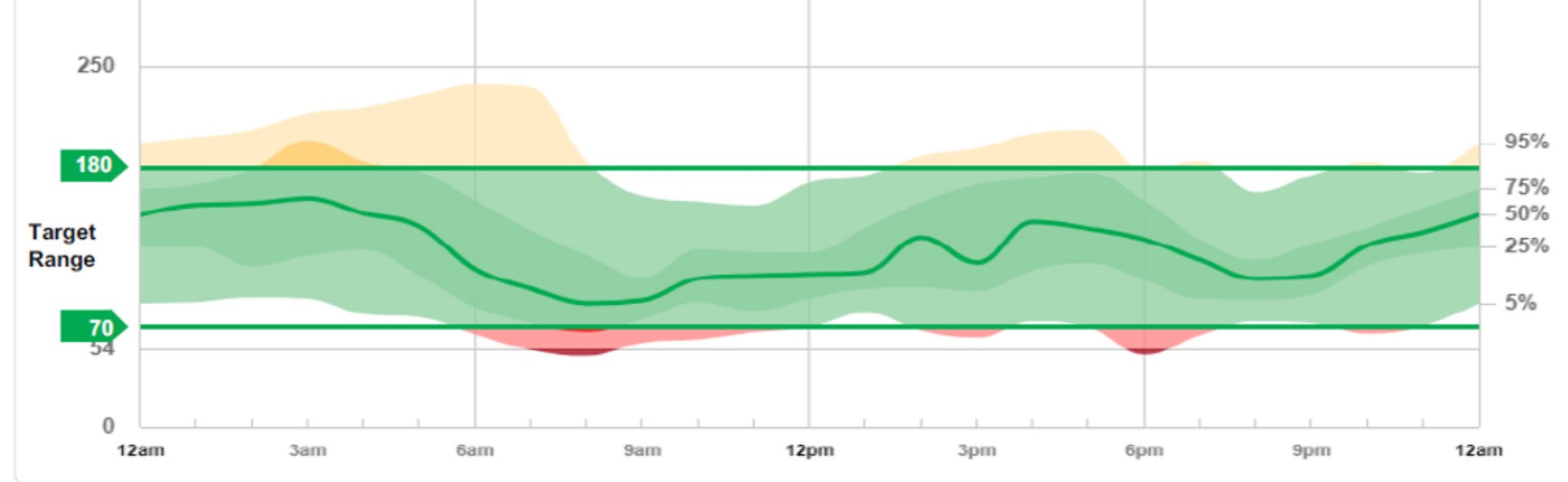
AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if they occurred in a single day.



Case 4: Summary

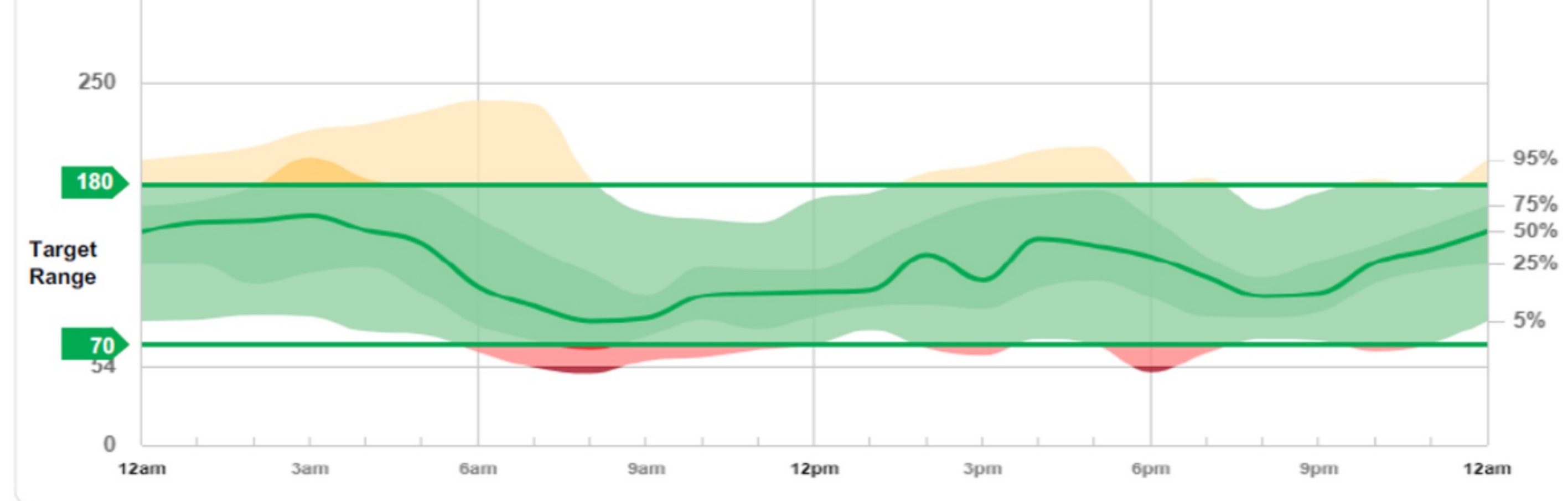
- 22-year-old male with T1D since the age of 7 on MDI
- Works as a scuba diving instructor at a Club Med resort
- Conducts two dives a day (early morning and evening) When low his Eversense vibrates under water up to 33 feet.

Case 4: Therapeutic Interventions



- Reduce basal dose by 5 to 10%
- If meals are within 2 to 3 hours before the dives, reduce the meal bolus by ~20 to 30% (consider Inhaled Insulin pre meals to reduce the insulin action tail)
- Give appropriate pre-exercise meals/snacks (protein/fat/carbs)

Case 4: Therapeutic Interventions cont.



- Educate co-workers on recognizing and treating hypoglycemia (glucagon pen)
- Test first and second-degree relatives for autoantibodies

Glucose

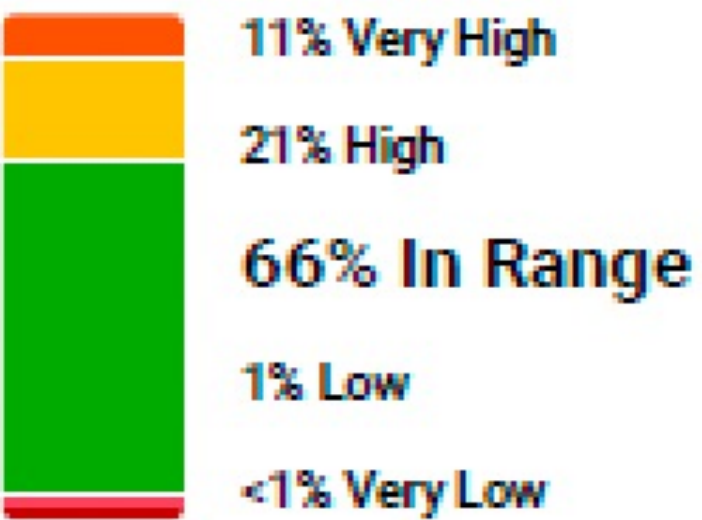
Average Glucose

162 mg/dL

Standard Deviation
67 mg/dL

GMI
7.2%

Time in Range



Target Range:
70-180 mg/dL

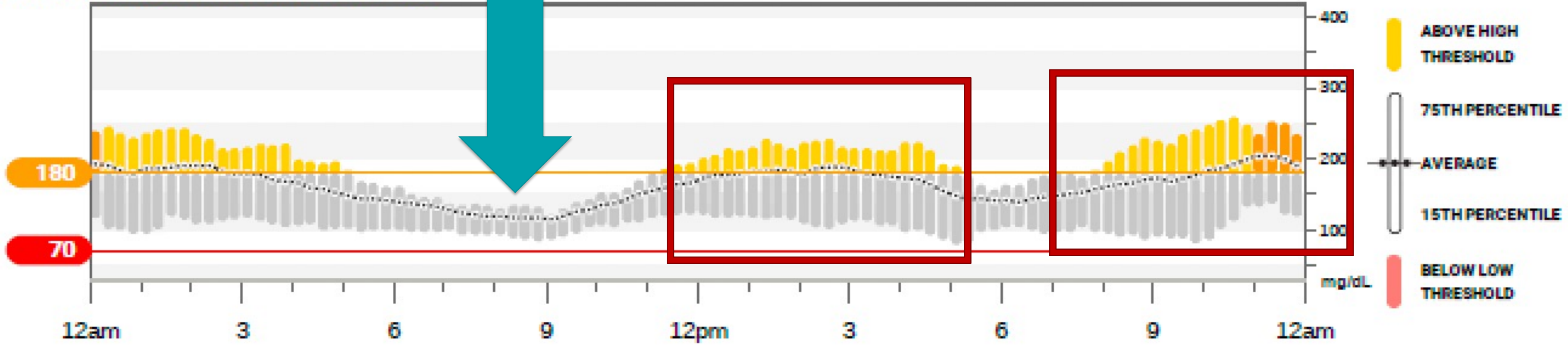
Sensor Usage

Days with CGM data
100%
30/30

Avg. calibrations per day
0.1

Top Patterns

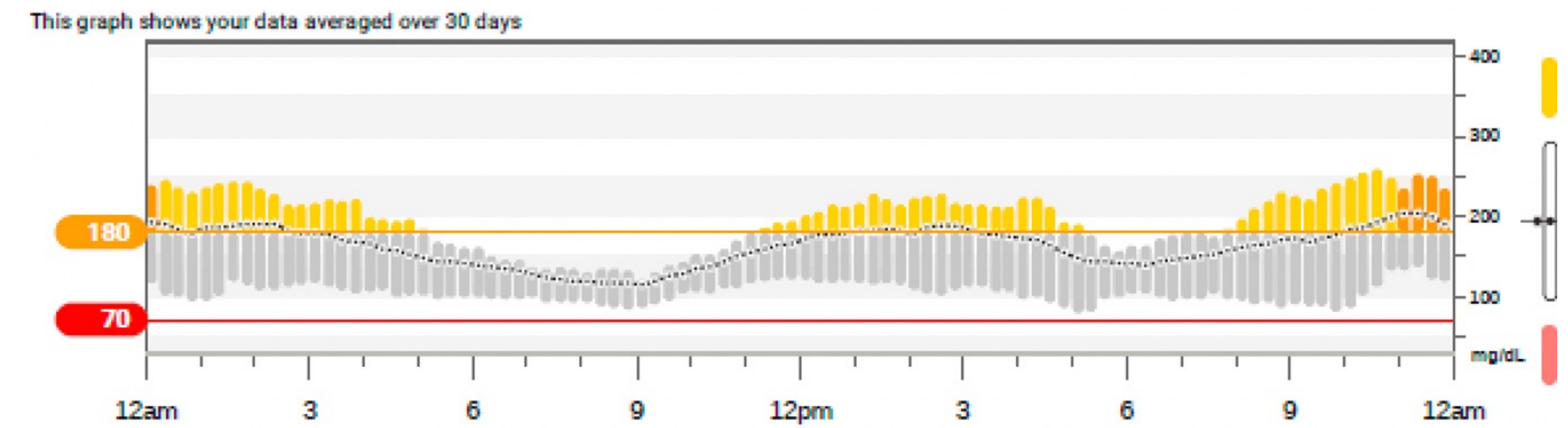
This graph shows your data averaged over 30 days



Case 5: Summary

- 28yo female with T1D since childhood. Struggles with insulin resistance (~100 units/day)
- On a hybrid closed loop system
- Reasonable control but could do a little better
- Hypos NOT a problem
- Main issue is spikes/viability after meals and late-night eating

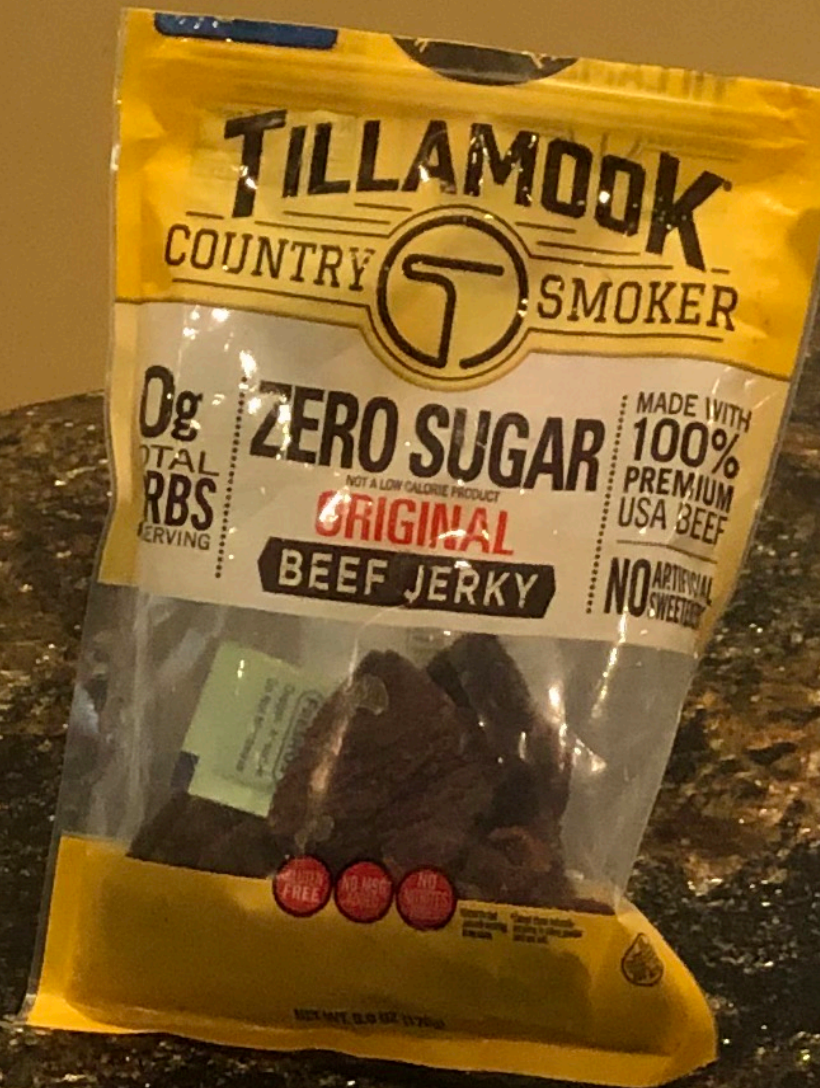
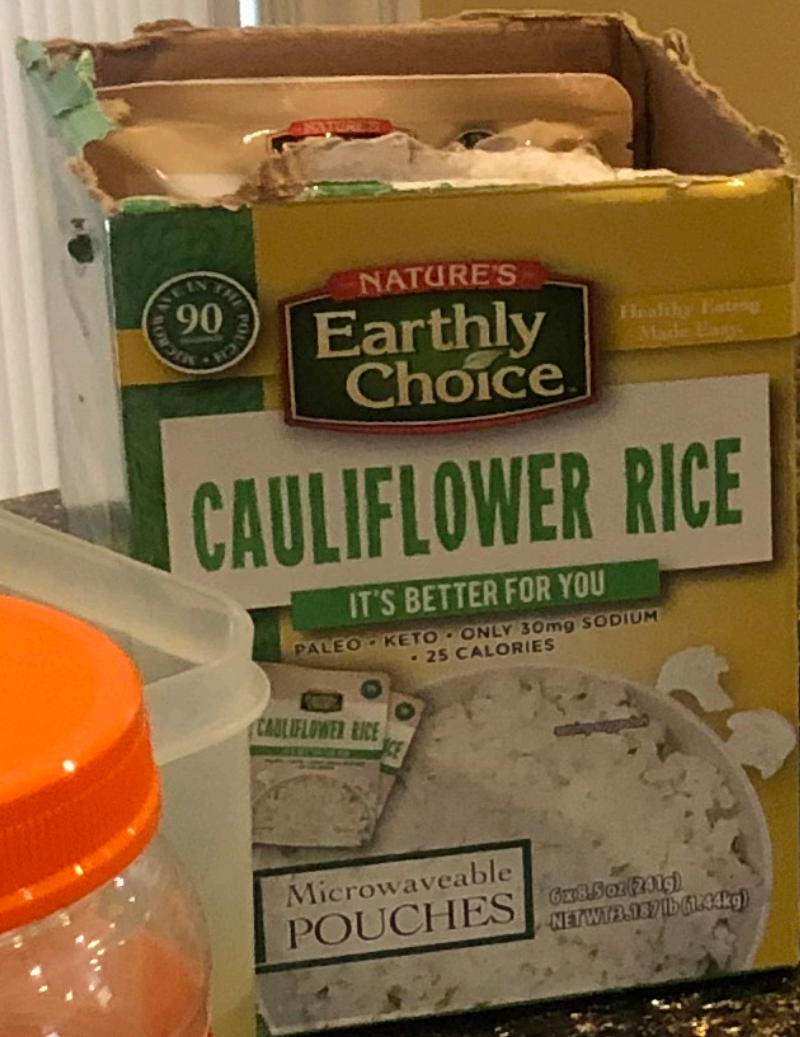
Case 5: Therapeutic Interventions



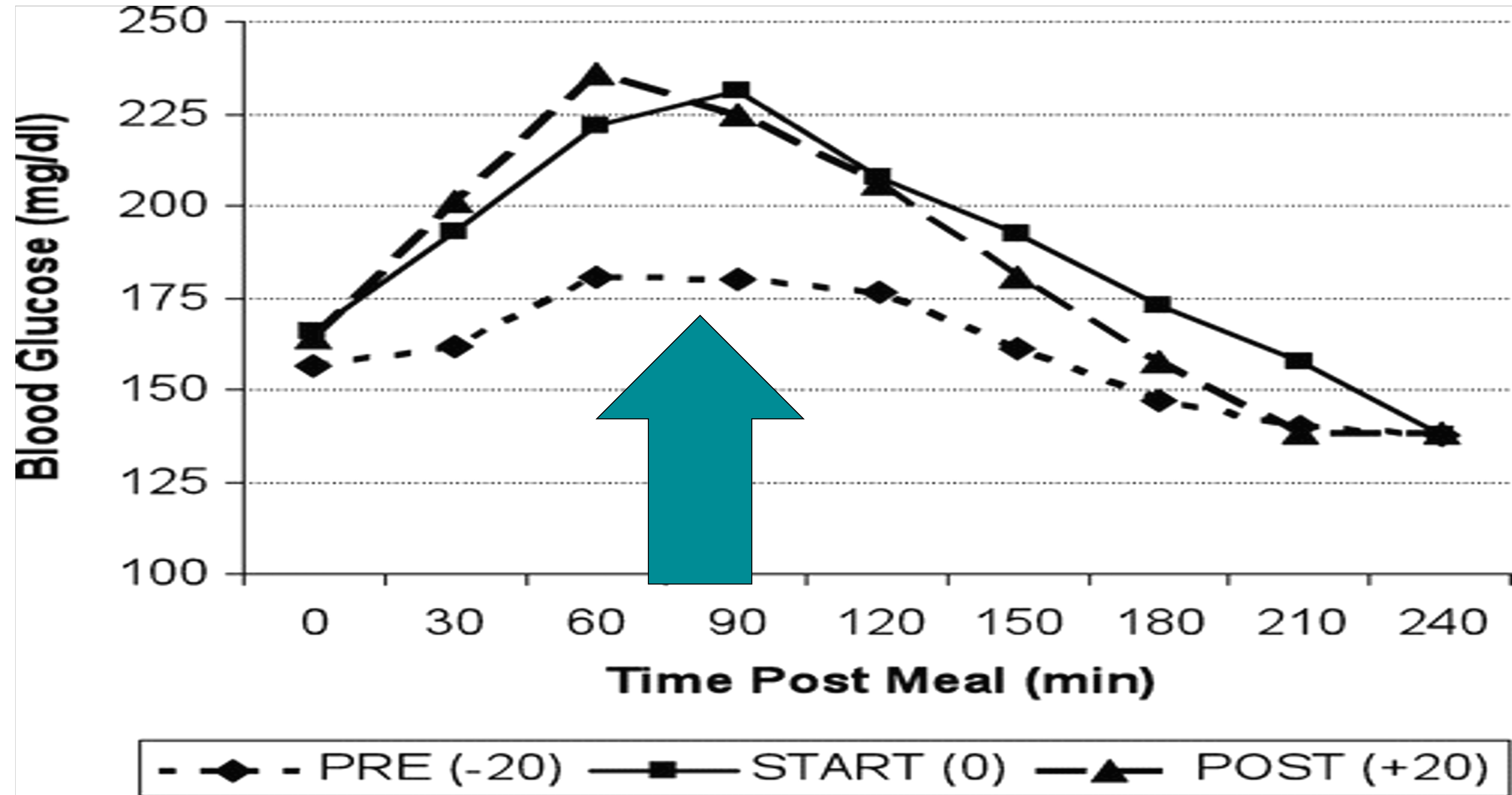
- Discuss techniques to reduce post prandial spikes (timing of insulin, Afrezza, reduce carbs, post meal exercise, etc.)
- Give appropriate pre snack boluses
- Adjust the insulin to carbohydrate ratio
- Suggest low carb snacking options

Case 5: Therapeutic Interventions continued

- Discuss screening relatives for autoantibodies
- Make sure she has an unexpired easy to use glucagon preparation

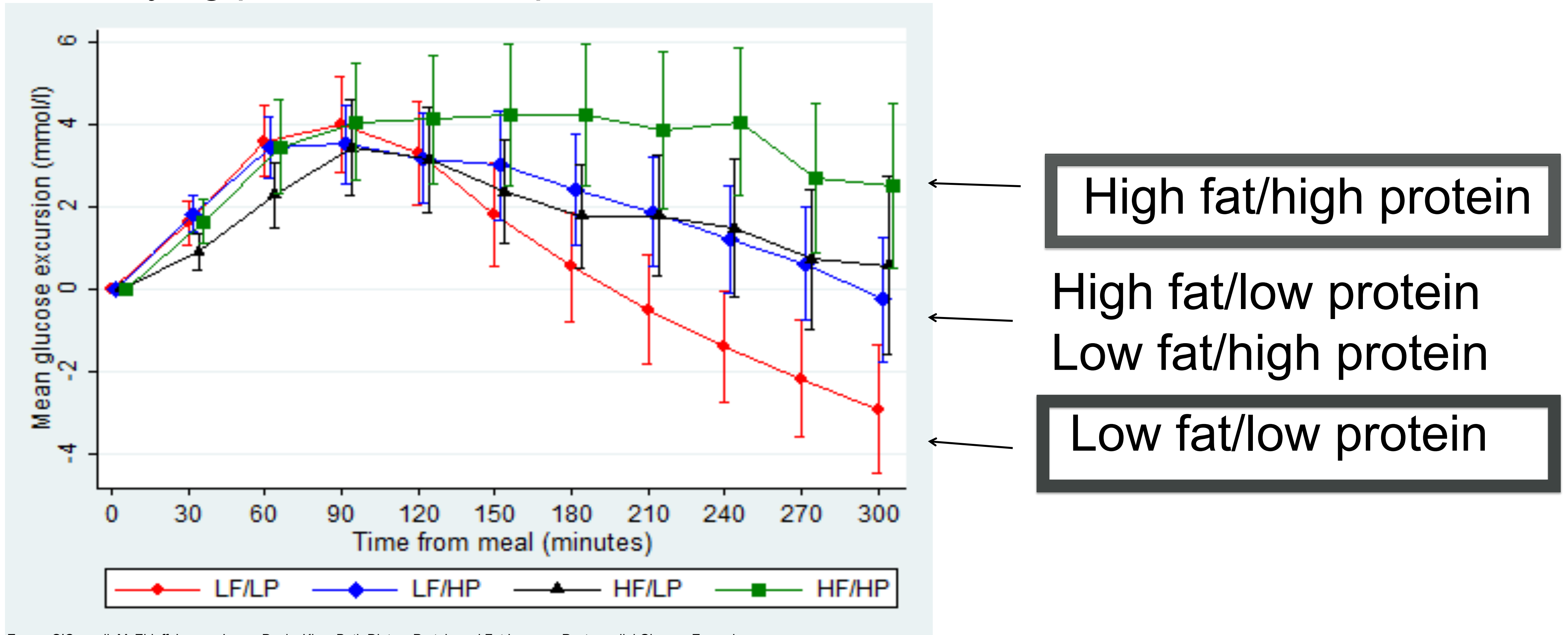


Postprandial Glucose bolus at -20/0/+20 mins



Both Dietary Fat and Protein Increase Post Meal Glucose Concentrations

Four test breakfasts with identical carbohydrate content, but varying protein and fat quantities: same insulin dose



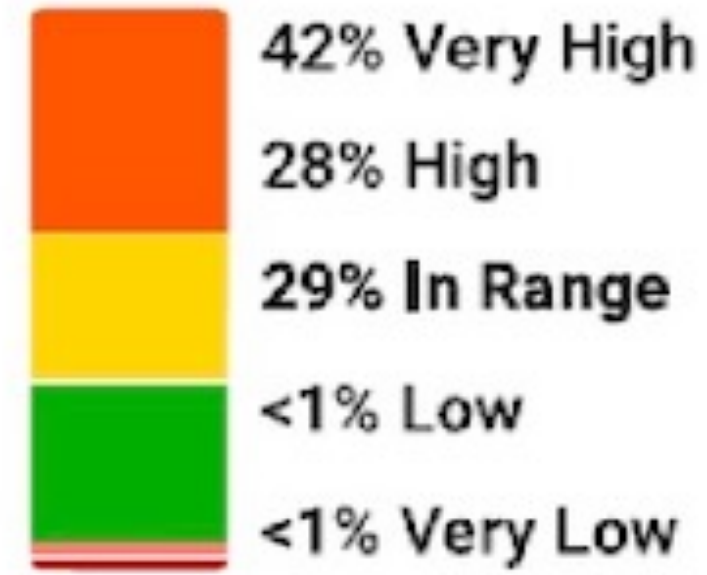
Case 6

Glucose

Average Glucose

241 mg/dL

Time in Range



Sensor Usage

Days with CGM data

93%

28/30

Standard Deviation

86 mg/dL

GMI

9.1%

Target Range:

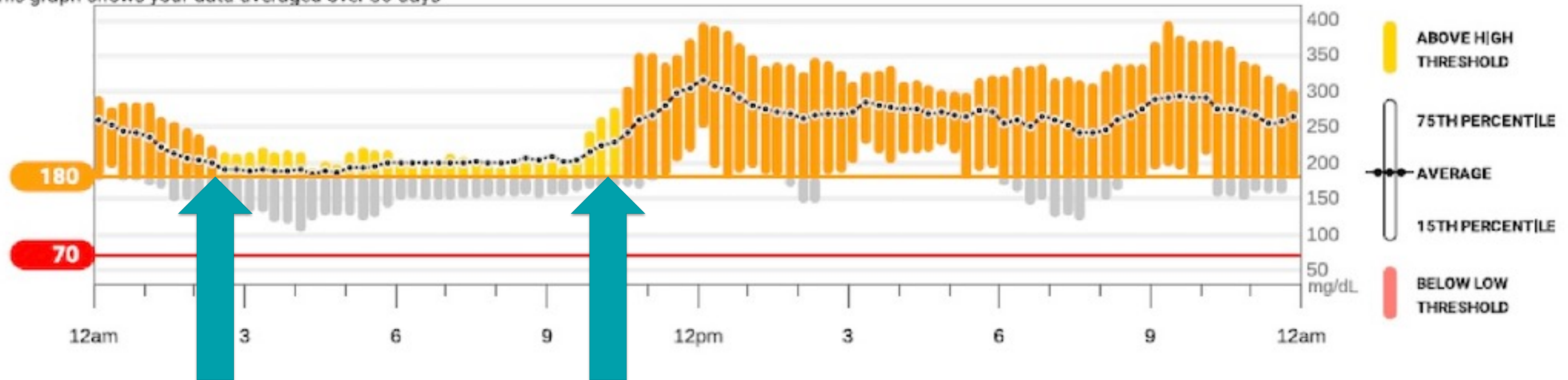
70-180 mg/dL

Avg. calibrations per day

0.0

Top Patterns

This graph shows your data averaged over 30 days



Case 6: Summary

- 24-year-old woman with a 4-year history of T1D
- Wears an Omnipod pump that does not have AID
- Markedly elevated ave. glucose, GMI, standard deviation and time above range (TAR)
- Only 29% TIR with few lows (upper alert set at 250)
- Does very well between 230 AM and 930 AM
- Every morning after waking she goes to Starbucks and drinks a large ***Matcha Green Tea Latte*** (45 grams of simple carbs and 320 calories)

Case 6: Therapeutic Interventions

- Lower her upper alarm level to 180 mg/dL so she can give a correction dose to improve her TIR (trend arrow education)
- Make her correction factor – or insulin sensitivity factor – more aggressive for when she makes a correction (currently 1:40 above 100mg/dl)
- Try to make her own Matcha drink at home using Splenda or Stevia

Case 6: Therapeutic Interventions cont.

- Figure out the carbs for the Starbucks drink when she does go there for it, and take her fast-acting insulin (i.e. 1 unit for every 10 grams of carbs) at least 20-30 minutes before consuming it
- Definitely try Afrezza instead of RAI and start off with 8 units minimum
- Discuss auto-antibody testing, glucagon and HCL systems

Case 7

- 75-year-old male with type 2 diabetes and CKD stage 2B with a GFR of 25-30 (IC/Cr over 300 mg/g)
- He is on basal insulin, dapagliflozin (Farxiga) and finerenone (Kerenda)
- 93% TIR with few lows (upper alert set at 250)
- **His physician was puzzled why his laboratory A1c was 4.9% and was also worried about hypoglycemia, especially at night**
- He prescribed a CGM and asked him to wear it for one month.

Case 7

AGP Report

July 11, 2023 - August 7, 2023 (28 Days)

GLUCOSE STATISTICS AND TARGETS

July 11, 2023 - August 7, 2023

28 Days

Time CGM Active:

73%

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

145 mg/dL

Glucose Management Indicator (GMI)

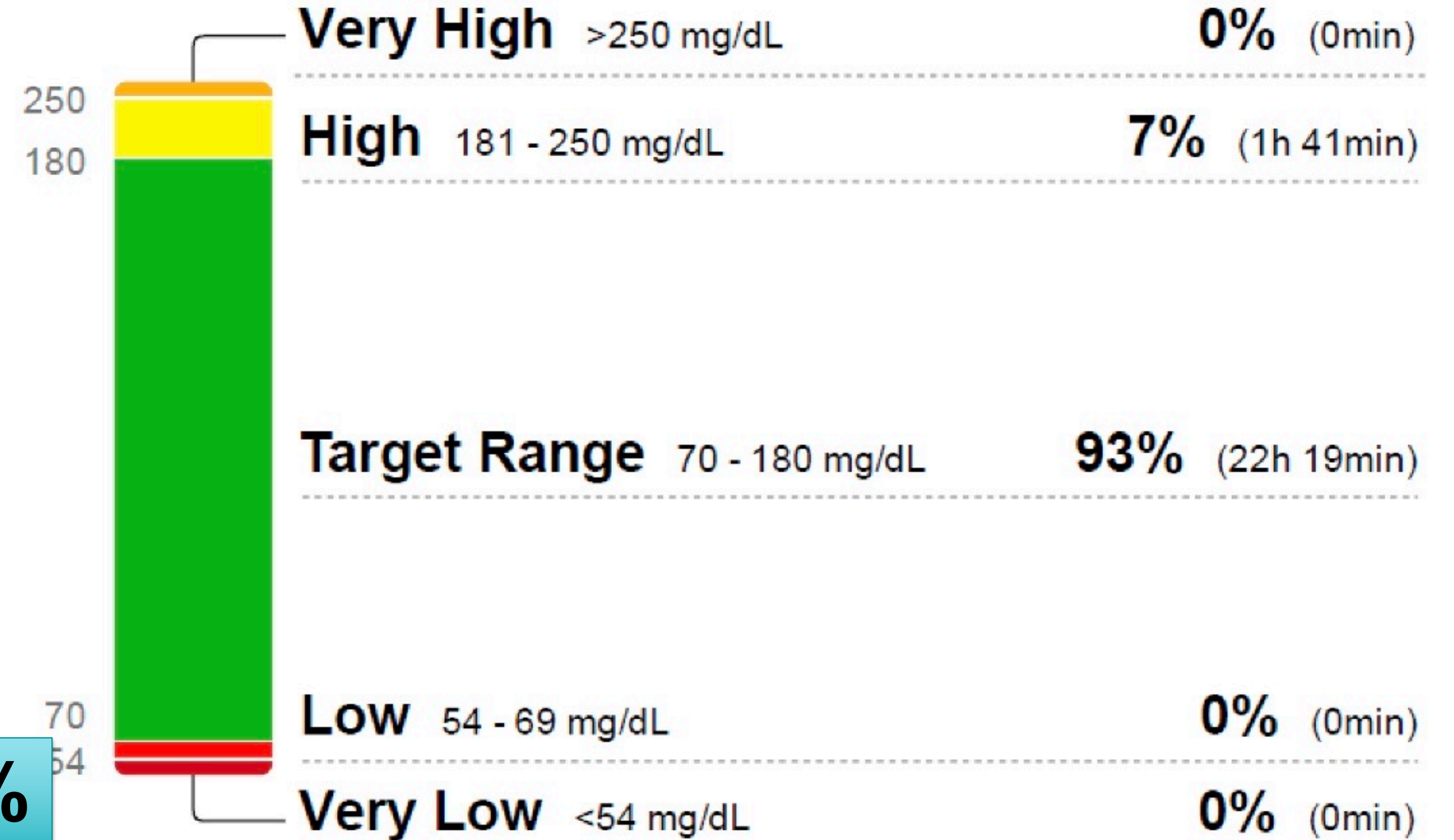
6.8%

6.8%

Glucose Variability

15.2%

TIME IN RANGES



Case 7

What Conditions Make The A1C NOT Accurate!

Hematologic conditions

- Anemia
- Accelerated erythrocyte turnover
- Thalassemia
- Sickle cell disease
- Reticulocytosis
- Hemolysis

Physiologic States

- Aging
- Pregnancy

Drugs/Medications

- Alcohol
- Opioids
- Vitamin C
- Vitamin E
- Aspirin
- Erythropoetin
- Dapsone
- Ribavirin

Disease States

- HIV infection
- Uremia
- Hyperbilirubinemia
- Dyslipidemia
- Cirrhosis
- Hypothyroidism*

Medical Therapies

- Blood transfusion
- Hemodialysis

Miscellaneous

- Glycation rate
- Protein turnover
- Race and ethnicity
- Laboratory assay
- Glycemic Variability
- Smoking
- Mechanical heart valves
- Exogenous testosterone?

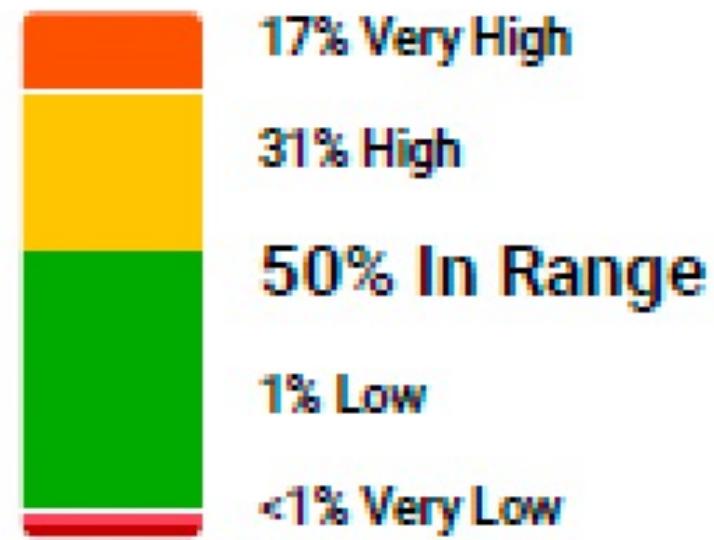
Case 8

Glucose

Average Glucose

188 mg/dL

Time in Range



Target Range:
70-180 mg/dL

Sensor Usage

Days with CGM data

50%

7/14

Standard Deviation

74 mg/dL

GMI

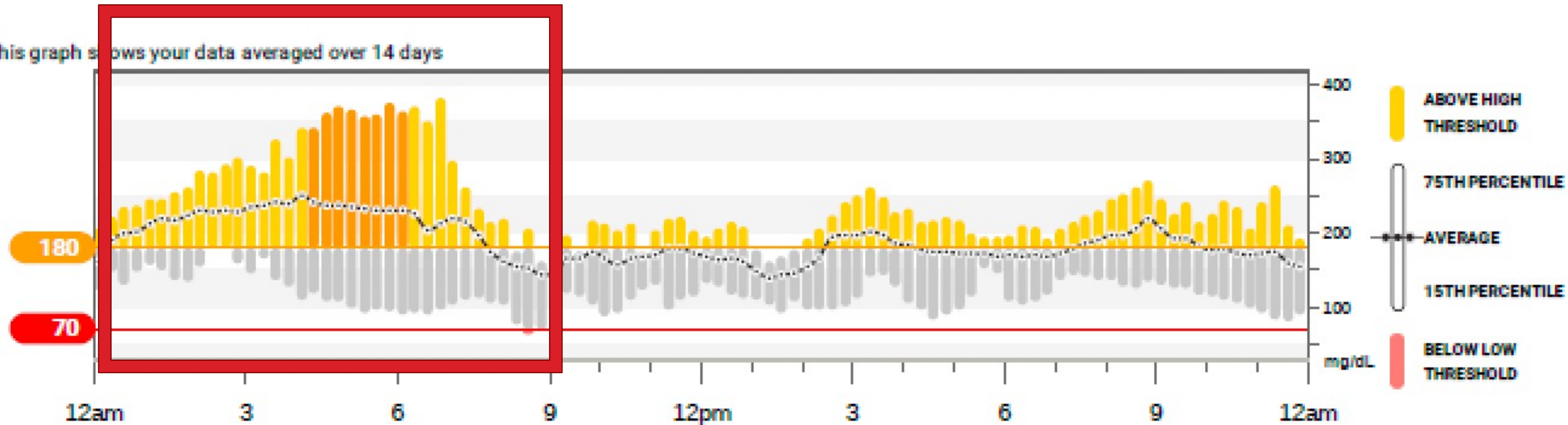
N/A

Avg. calibrations per day

0.0

Top Patterns

This graph shows your data averaged over 14 days



Pop Quiz: What is this patient's profession?

A. Emergency Room Physician



B. Law enforcement officer

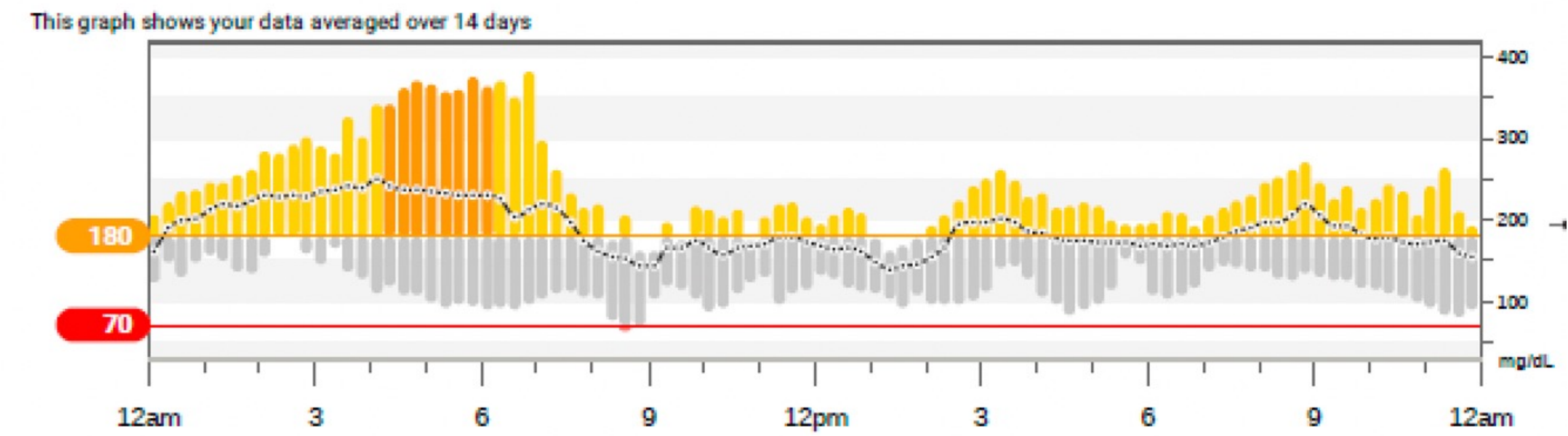
C. Bartender

D. Stripper in a night club

Case 8: Summary

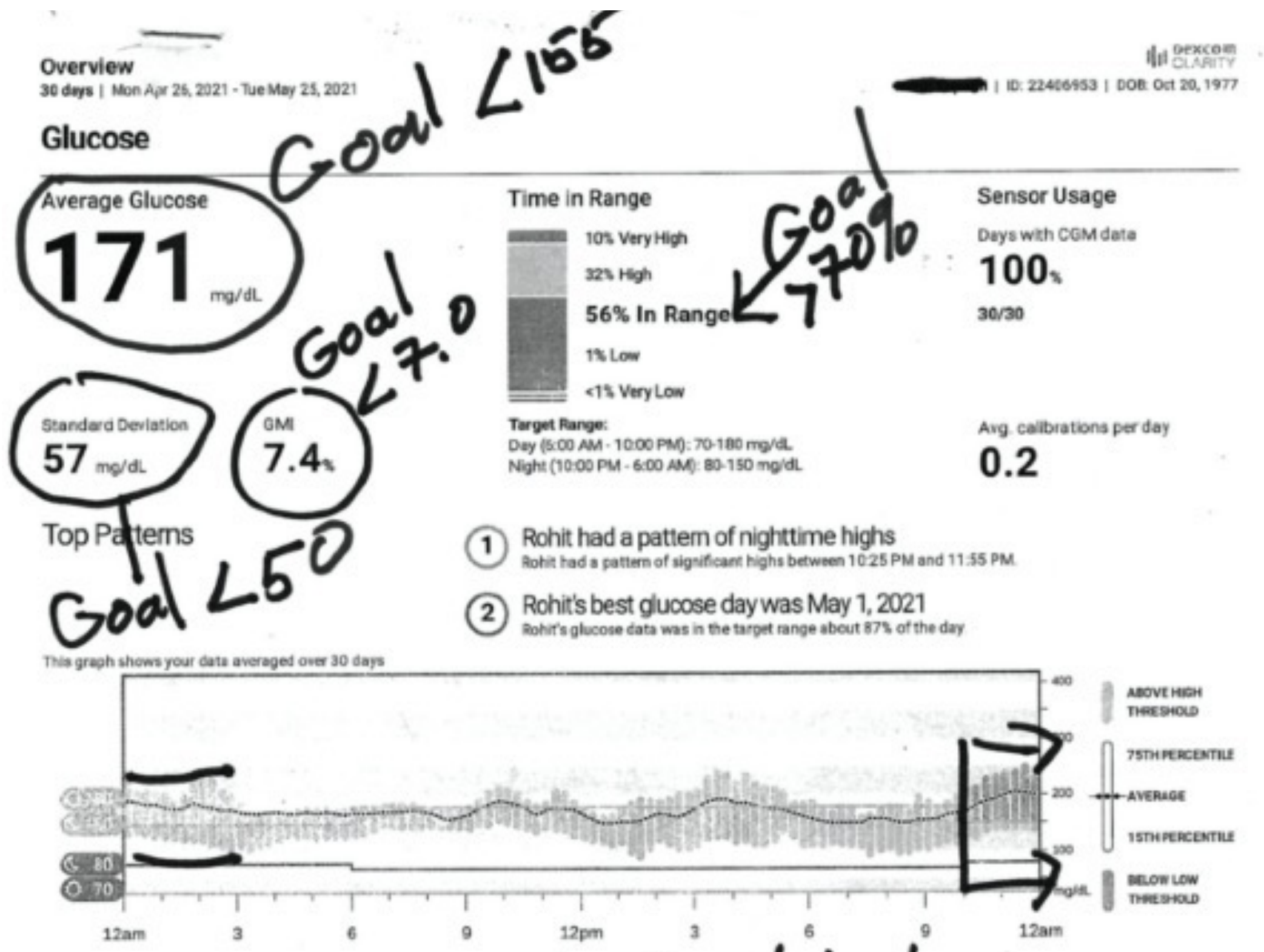
- 40yo male with T1D. Works as an ER physician with frequent night shifts
- Super erratic schedule when at work
- On a hybrid closed loop system
- Very hard on himself about his control given he is an MD

Case 9: Therapeutic Interventions



- Work on transitioning to a day shift with more regular breaks
- Review alerts and alarms (esp. repeat high and low alerts)
- Consider lowering his ISF or CF over night
- Discuss screening relatives for autoantibodies

Go Over The CGM Download Together: Write down notes and give to the patient



- Try to go to bed between 140-180 with \rightarrow trend
- bolus for snacks after dinner

Summary

- Be methodical when reviewing the CGM download
- Pay attention to the alerts and alarm settings
- Spend time educating your patients on how to respond to the trend arrows
- Focus on the most important abnormality: elevated glucose values, hypoglycemia and/or excessive variability (make the appropriate adjustments)
- Review the CGM download with your patient together (you will be surprised what you learn!)