DIABETES IN THE MODERN ERA: MORTALITY RISK, TECHNOLOGY ADVANCES, AND IMPLICATIONS FOR UNDERWRITING

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October 19, 2025

LEARNING OBJECTIVES

- Summarize the latest data on diabetes-related mortality trends in Type 1 and Type 2 diabetes.
- Evaluate the impact of advanced diabetes technologies (continuous glucose monitors [CGMs], insulin pumps, hybrid closed-loop systems) on patient outcomes and mortality risk.
- Discuss key clinical indicators that predict risk beyond A1c, including glycemic variability and time-in-range metrics.
- Identify how technology adoption should modify underwriting approaches for applicants with diabetes.
- Apply updated mortality risk stratifications to real-world case examples.

DIABETES TREATMENT IS EVOLVING

New meds

- SGLT2 inhibitors, GLP agonists

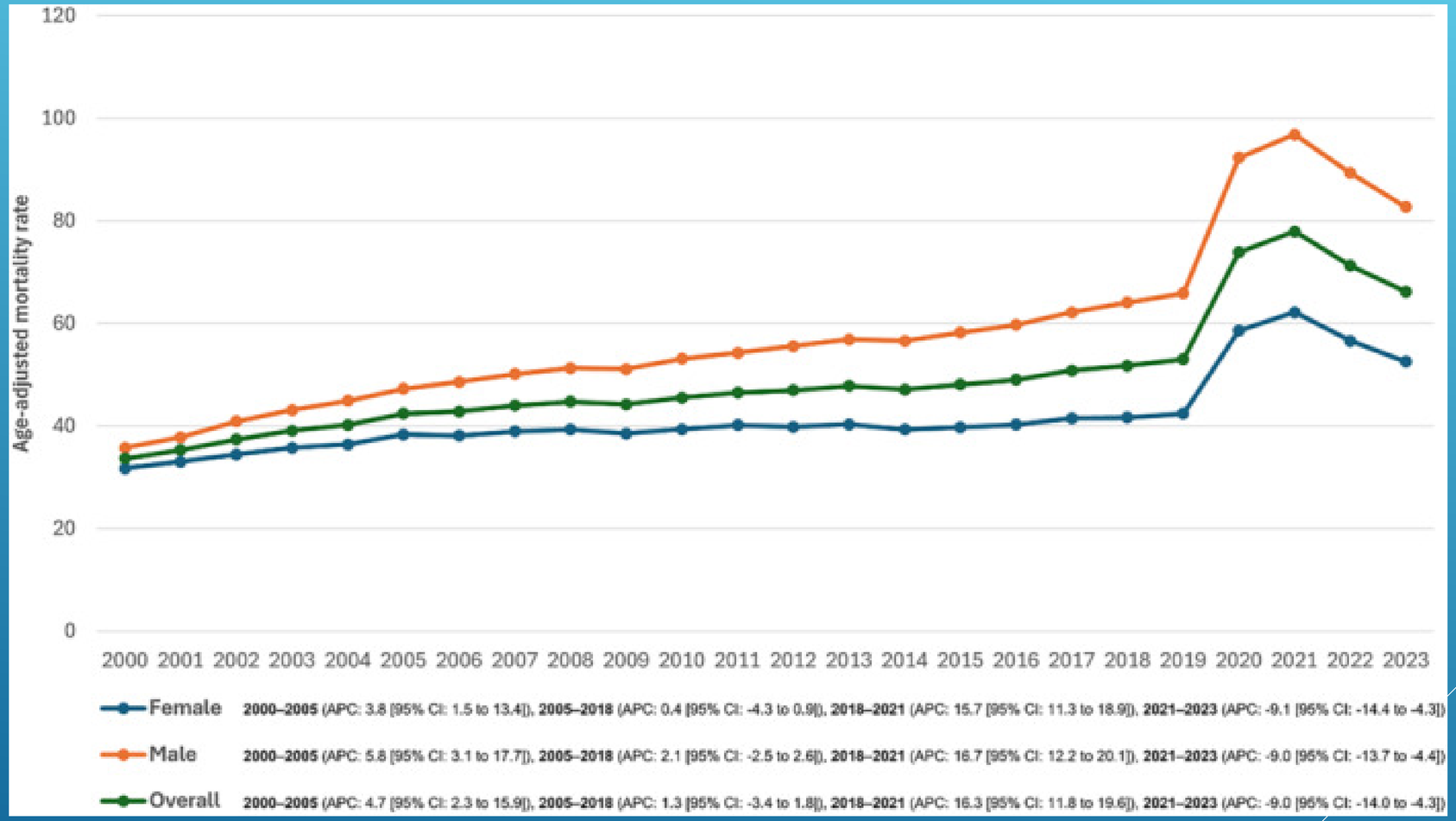
New technologies

- Pumps, sensors, closed loops

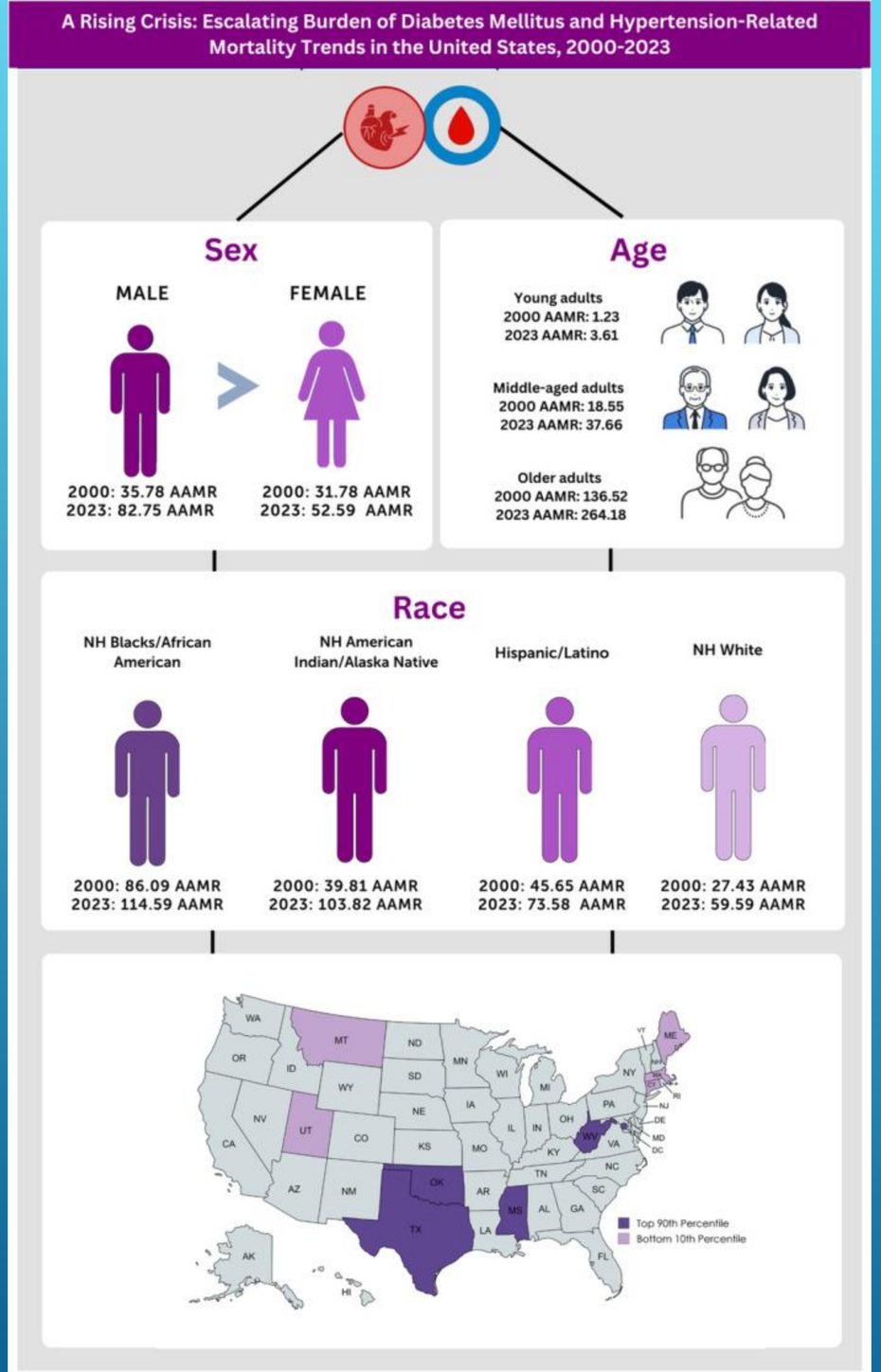
Effects on Mortality?

"Diabetes Paradox": Improved treatments but uneven mortality benefits across demographics

STATE OF DIABETES MORTALITY: 2025 UPDATE



Siddiqui H, Imran Z, Ali D, Sajid M, Khan TM, Salim H, Uddin MS, Qureshi S, Farhan M, Waqas SA. A Rising Crisis: Escalating Burden of Diabetes Mellitus and Hypertension-Related Mortality Trends in the United States, 2000-2023. Clin Cardiol. 2025 Jul;48(7):e70167. doi: 10.1002/clc.70167. PMID: 40600774; PMCID: PMC12217654.



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DIABETES TECHNOLOGY

Continuous Glucose Monitors (CGMs):

- Real-world benefits: Reductions in hypoglycemia, ER visits, hospitalizations
- Time-in-Range (TIR) as a new risk marker: Stronger predictor than A1c?

Insulin Pumps:

- Traditional vs. hybrid closed-loop (e.g., Tandem Control-IQ, Medtronic 780G)
- Impact on severe hypoglycemia, A1c, and time-in-range

CURRENTLY AVAILABLE GLUCOSE MONITORS

CGM system	Suitable ages	Fingerstick calibration	Warm-up time	Wear time	Alarms	Data display	On-body form and transmitter design	AID integration
Dexcom G6	Ages 2+	Not required	2 hours	10 days	Yes	Receiver, Android and iPhone apps, smartwatches	Eraser-sized sensor, separate 3-month use transmitter	Tandem t:slim X2, Tandem Mobi, Insulet Omnipod 5, Beta Bionics iLet
Dexcom G7	Ages 2+ and in pregnancy	Not required	30 minutes	10 days	Yes	Receiver, Android and iPhone apps, smartwatches	~3 stacked quarters, fully disposable transmitter integrated with sensor patch	Tandem t:slim X2, Tandem Mobi, Insulet Omnipod 5, Beta Bionics iLet
Stelo by Dexcom	Ages 18+ and not on insulin	Not required	Unknown	15 days	None	Android and iPhone apps	~3 stacked quarters, fully disposable transmitter integrated with sensor patch	None
Freestyle Libre 2+	Ages 4+ and in pregnancy	Not required	1 hour	15 days	Yes	Reader, Android and iPhone apps	~2 stacked quarters; no separate transmitter	Tandem t:slim X2, Insulet Omnipod 5
Freestyle Libre 3+	Ages 4+ and in pregnancy	Not required	1 hour	15 days	Yes	Reader, Android, and iPhone apps	Sensor is smaller than 2 stacked pennies; no separate transmitter	Coming soon
Guardian 3	Ages 3+	2/day minimum	2 hours	7 days	Yes	Guardian Connect Android and iPhone apps, compatible smartwatches	~2 stacked quarters (clamshell), separate rechargeable transmitter	MiniMed 630G, 770G
Guardian 4	Ages 7+	Not required	2 hours	7 days	Yes	Guardian Connect Android and iPhone apps, compatible smartwatches	~2 stacked quarters (clamshell), separate rechargeable transmitter	MiniMed 780G
Simplera	Ages 2+	Not required	2 hours	7 days	Yes	Android and iPhone apps	Smallest Medtronic sensor with flat, square shape; sensor and transmitter combined in 1 disposable device	None yet, though it integrates InPen Smart Multiple Daily Injections System
Eversense 365	Ages 18+	2/day minimum for first 13 days, then 1/week	24 hours	365 days	Yes	Android and iPhone apps	Sensor inserted by a healthcare professional, separate rechargeable, watchface-sized transmitter	None

Diabetes Technology Trends: A Review of the Latest Innovations

Erika L Lundgrin , Clare A Kelly , Natalie Bellini , Claudia Lewis , Ebne Rafi , Betul Hatipoglu

The Journal of Clinical Endocrinology & Metabolism, Volume 110, Issue Supplement_2, April 2025, Pages S165–S174, https://doi.org/10.1210/clinem/dgaf034

CURRENTLY AVAILABLE GLUCOSE MONITORS

Dexcom G7

Disposable, small, fast-acting

Abbott FreeStyle Libre 3

90-day wear, factory-calibrated

Medtronic Guardian 4

Lifecycle of 7 days

Senseonics Eversense

3-month implant

Guardian Connect

Compatible with iOS and Android

CURRENTLY AVAILABLE INSULIN PUMPS

Tandem Control-IQ+

Predictive algorithm, hybrid closed loop

Dexcom G7 integration

Insulet Omnipod 5

Tubeless patch pump

Smartphone-controlled

Medtronic MiniMed 780G

Auto-correction boluses

Works with Guardian 4 sensor

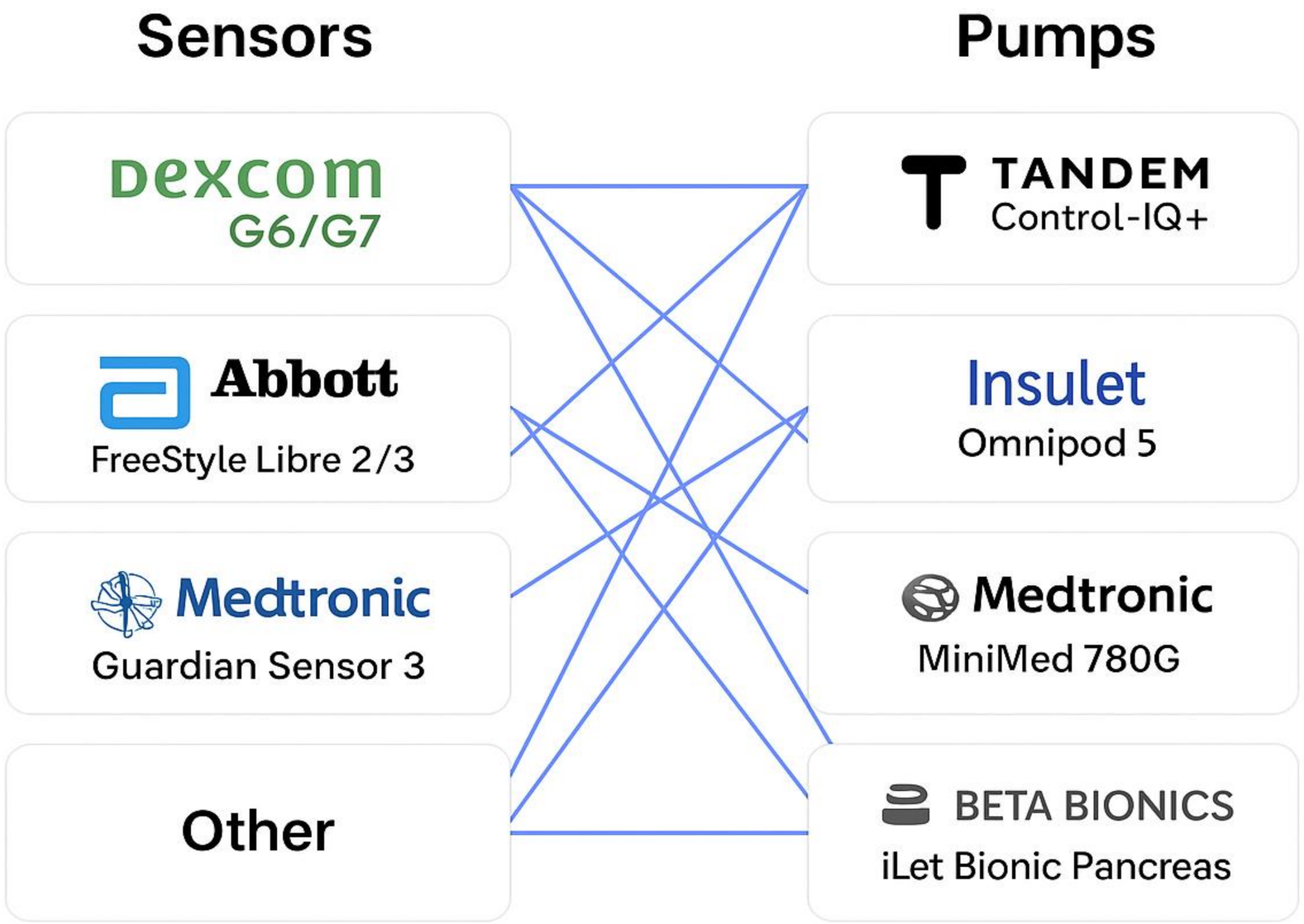
Beta Bionics iLet Bionic Pancreas

Fully automated insulin dosing

Minimal user input

Sequel twiist AID System

Modular and smaller footprint


Sensors
Pumps
Dexcom
G6/G7
Abbott
FreeStyle Libre 2/3
Medtronic
Guardian Sensor 3
Other
TANDEM
Control-IQ+
Insulet
Omnipod 5
Medtronic
MiniMed 780G
BETA BIONICS
iLet Bionic Pancreas

IMPACT ON PATIENT OUTCOMES

Improved Glycemic Control

Reduced Hypoglycemia

Reduced Hospitalizations

Better Pregnancy Outcomes

Enhanced Quality of Life

MORTALITY ????

IMPACT ON MORTALITY- CGMS

For Type 1 diabetes: CGM users had a 57% lower risk of all-cause mortality compared to non-users.

For Type 2 diabetes: CGM users had a 14% lower risk of all-cause mortality compared to non-users.

Independent predictor of mortality: Some CGM metrics, such as time in range, were found to be more closely linked to mortality risk than HbA1c values.

Peter D. Reaven, Michelle Newell, Salvador Rivas, Xinkai Zhou, Gregory J. Norman, Jin J. Zhou; Initiation of Continuous Glucose Monitoring Is Linked to Improved Glycemic Control and Fewer Clinical Events in Type 1 and Type 2 Diabetes in the Veterans Health Administration. Diabetes Care 1 April 2023; 46 (4): 854–863. https://doi.org/10.2337/dc22-2189

IMPACT ON MORTALITY- INSULIN PUMPS

Improved cardiovascular outcomes: A 2015 study based on the Swedish National Diabetes Register found that pump users had a 42% lower risk of fatal cardiovascular disease and a 27% lower risk of all-cause mortality than those on MDI.

2025-

PUMPS, MORTALITY IN TYPE 1 DIABETES

Outcome	Pump n/N	MDI n/N	Relative Risk (95% CI)	Relative Risk (95% CI, p-value)
Mortality	191/16,763	355/16,763		0.538 (0.452, 0.641, p <0.001)
Diabetic Ketoacidosis	906/16,763	1,107/16,763		0.818 (0.752, 0.891, p <0.001)
Diabetic Retinopathy	1,526/16,763	1,098/16,763		1.390 (1.290, 1.497, p <0.001)
Diabetic Foot Ulcer	111/15,439	109/15,515		1.023 (0.786, 1.332, p = 0.864)
Ischaemic Heart Disease	1,233/16,763	1,158/16,763		1.065 (0.986, 1.150, p = 0.111)
Acute Myocardial Infarction	214/16,763	228/16,763		0.939 (0.780, 1.130, p = 0.503)
Cerebral infarction and Transient Ischaemic Attack	350/16,763	384/16,763		0.911 (0.790, 1.052, p = 0.204)

Outcome	Pump n/N	MDI n/N	Relative Risk (95% CI)	Relative Risk (95% CI, p-value)
Mortality	485/17,067	677/17,067		0.716 (0.639, 0.803, p <0.001)
Diabetic Ketoacidosis	1,140/17,067	1,345/17,067		0.848 (0.786, 0.915, p <0.001)
Diabetic Retinopathy	1,912/17,067	1,437/17,067		1.331 (1.247, 1.420, p <0.001)
Diabetic Foot Ulcer	196/15,606	245/15,620		0.801 (0.664, 0.965, p = 0.019)
Ischaemic Heart Disease	1,575/17,067	1,413/17,067		1.115 (1.041, 1.194, p = 0.002)
Acute Myocardial Infarction	354/17,067	414/17,067		0.855 (0.743, 0.984, p = 0.029)
Cerebral Infarction and Transient Ischaemic Attack	516/17,067	473/17,067		1.091 (0.965, 1.234, p = 0.165)

Haughton S, Riley D, Berry S, Arshad MF, Eleftheriadou A, Anson M, Yap YW, Cuthbertson DJ, Malik RA, Azmi S, Alam U, Iqbal A. The impact of insulin pump therapy compared to multiple daily injections on complications and mortality in type 1 diabetes: A real-world retrospective cohort study. Diabetes Obes Metab. 2025

LIMITATIONS

- Observational studies
- Patient selection
- Increased eye disease risk

CHALLENGES

- Access
- Education
- Individualize
- Long Term Data

FUTURE

Remote Monitoring

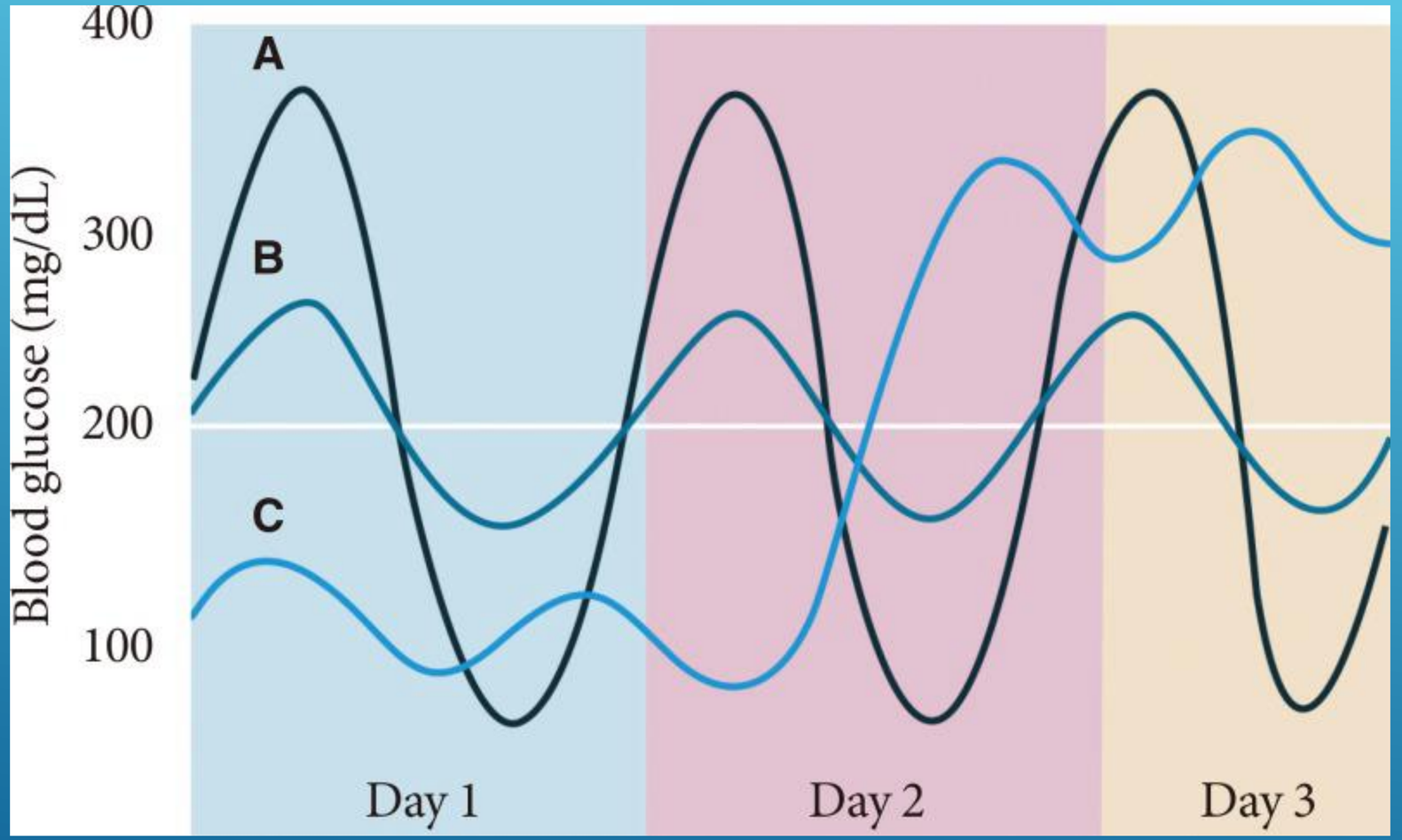
AI integration

KEY CLINICAL INDICATORS THAT PREDICT RISK BEYOND A1C

Glycemic Variability (GV):

- High GV can be an independent risk factor for diabetes complications, even with a well-controlled A1C.
- Metrics like standard deviation (SD) and coefficient of variation (CV) (SD divided by mean glucose) are used to quantify GV.
- A higher CV (e.g., >36%) indicates increased glycemic variability, potentially increasing the risk of hypoglycemia.

GLYCEMIC VARIABILITY



Suh S, Kim JH. Glycemic Variability: How Do We Measure It and Why Is It Important?. Diabetes Metab J. 2015;39(4):273-282.

KEY CLINICAL INDICATORS THAT PREDICT RISK BEYOND A1C

Time-in-Range (TIR): 70-180

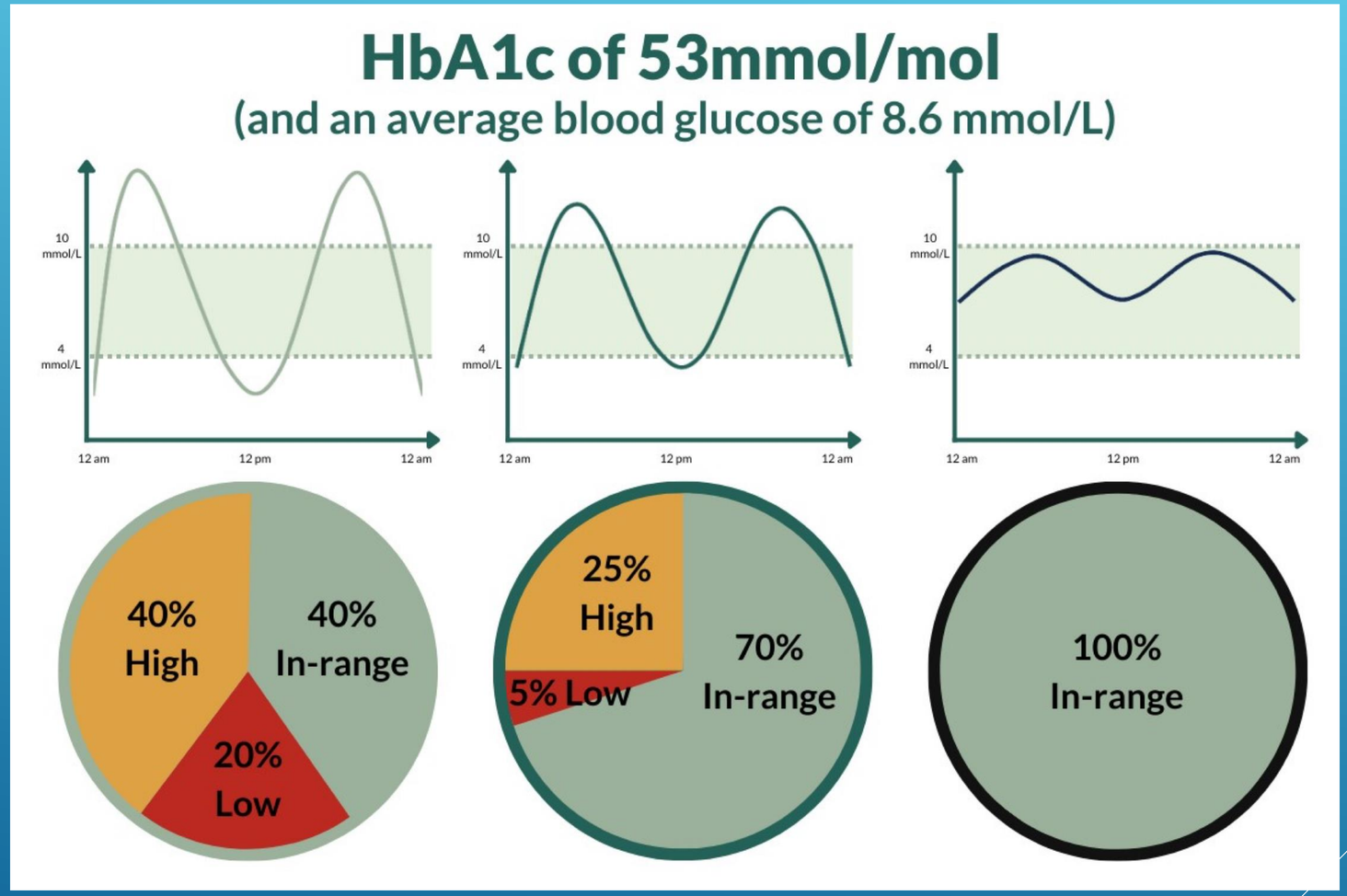
Time below range (TBR): and time above range (TAR) are also important TIR components.

Increasing TIR and reducing TBR and TAR are primary goals of diabetes management.

General TIR Goals for Adults

- At least 70% of the time in range
- Less than 4% of the time below
- Less than 25% of the time above

TIME IN RANGE



https://www.mydiabetes.com/resources/internal/hba1c-and-time-in-range-explained/

KEY CLINICAL INDICATORS THAT PREDICT RISK BEYOND A1C

Why are TIR and GV important beyond A1C?
TIR and GV provide more actionable information.

TIR is linked to complications:
Studies show that higher TIR and lower GV are associated with reduced risk of diabetes complications according to the National Institutes of Health (NIH).

CGM provides more detailed data.
CGM-derived metrics are used in clinical practice.

In essence, while A1C remains a valuable tool, incorporating TIR and GV metrics from CGM provides a more complete picture of glycemic control, enabling more effective and personalized diabetes management strategies.

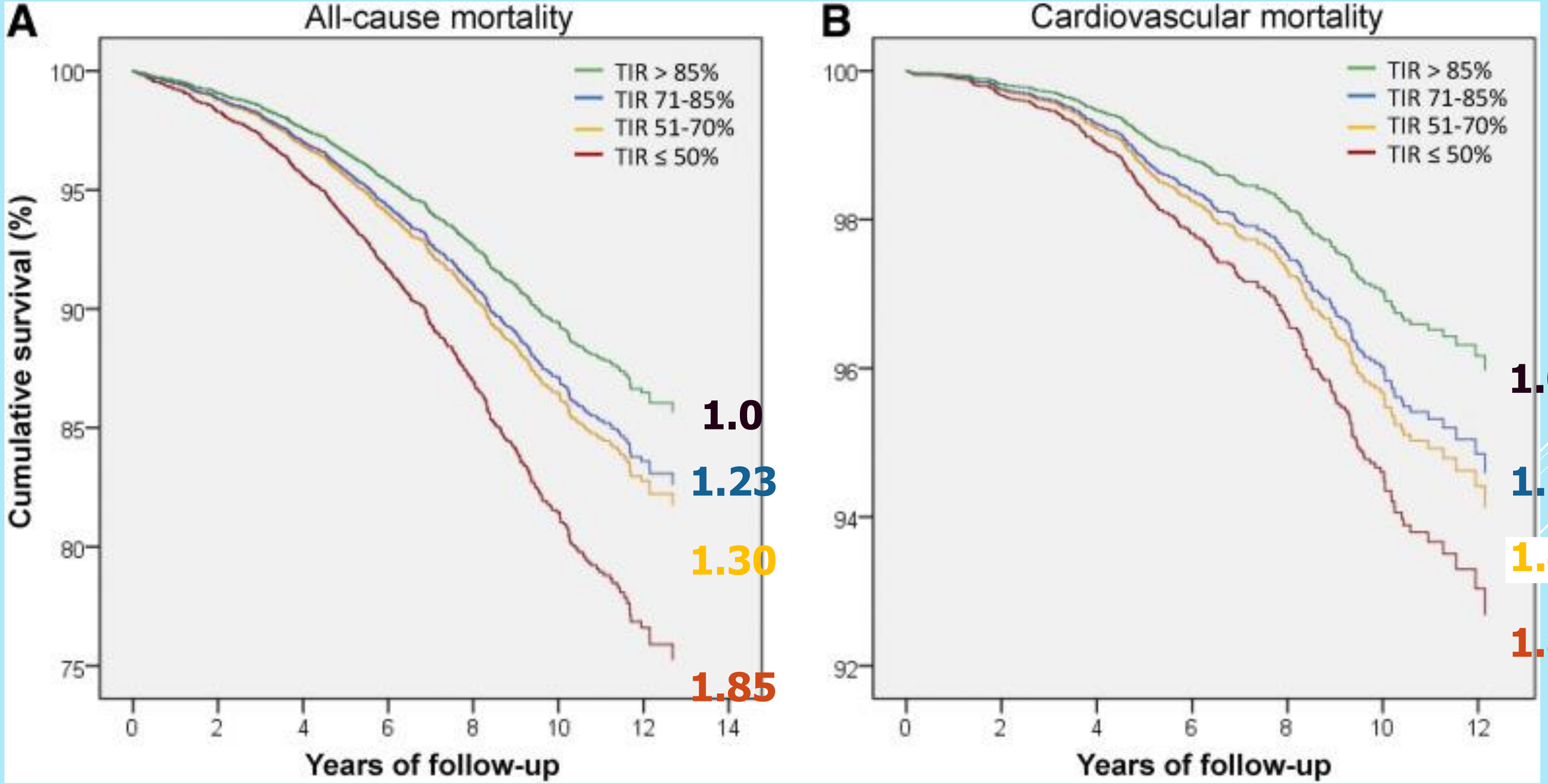
TIR AND MORTALITY

After adjusting for age and mortality, higher time in range lowered the risk for all-cause mortality (HR = 0.83; 95% CI, 0.72-0.92), while higher estimated blood glucose (HR = 1.18; 95% CI, 1.06-1.32), higher time above range (HR = 1.2; 95% CI, 1.07-1.34), higher glycemia risk index (HR = 1.23; 95% CI, 1.1-1.38) and higher coefficient of variation (HR = 1.18; 95% CI, 1.05-1.33) were tied to increased mortality risk.

Peter D. Reaven, Michelle Newell, Salvador Rivas, Xinkai Zhou, Gregory J. Norman, Jin J. Zhou; Initiation of Continuous Glucose Monitoring Is Linked to Improved Glycemic Control and Fewer Clinical Events in Type 1 and Type 2 Diabetes in the Veterans Health Administration. Diabetes Care 1 April 2023; 46 (4): 854–863. https://doi.org/10.2337/dc22-2189

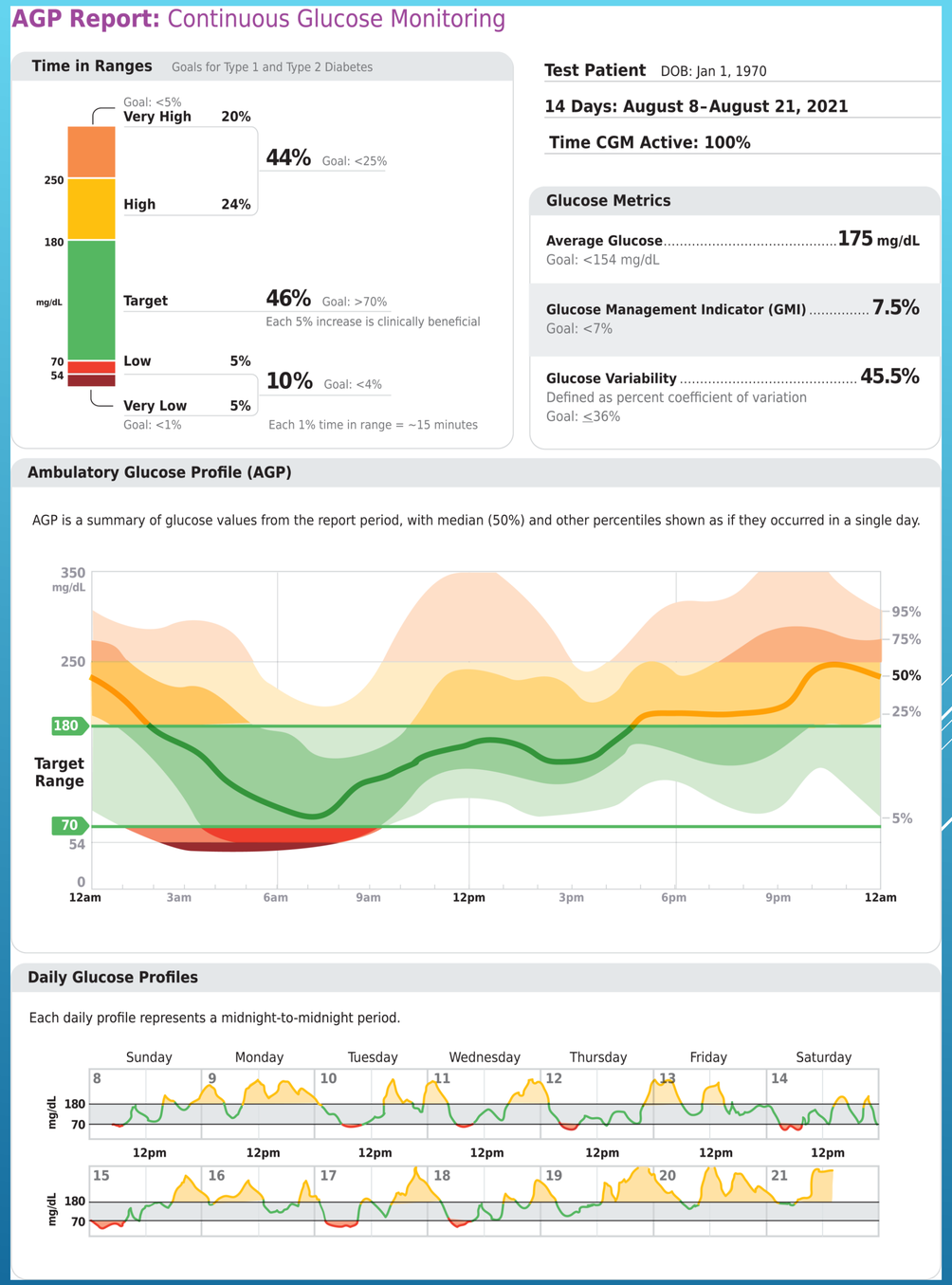
TIR AND MORTALITY

Diabetes Care. 2020 Oct 23;44(2):549–555. doi: 10.2337/dc20-1862



TIR- EXAMPLE

Nuha A. ElSayed, Grazia Aleppo, Vanita R. Aroda, Raveendhara R. Bannuru, Florence M. Brown, Dennis Bruemmer, Billy S. Collins, Marisa E. Hilliard, Diana Isaacs, Eric L. Johnson, Scott Kahan, Kamlesh Khunti, Jose Leon, Sarah K. Lyons, Mary Lou Perry, Priya Prahalad, Richard E. Pratley, Jane Jeffrie Seley, Robert C. Stanton, Robert A. Gabbay; on behalf of the American Diabetes Association, 6. Glycemic Targets: *Standards of Care in Diabetes—2023*. *Diabetes Care* 1 January 2023; 46 (Supplement_1): S97–S110. https://doi.org/10.2337/dc23-S006



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

6% Very High Goal: <5% 42% High	48% Goal: <25%
52% In Range Goal: >70%	
0% Low 0% Very Low Goal: <1%	0% Goal: <4%

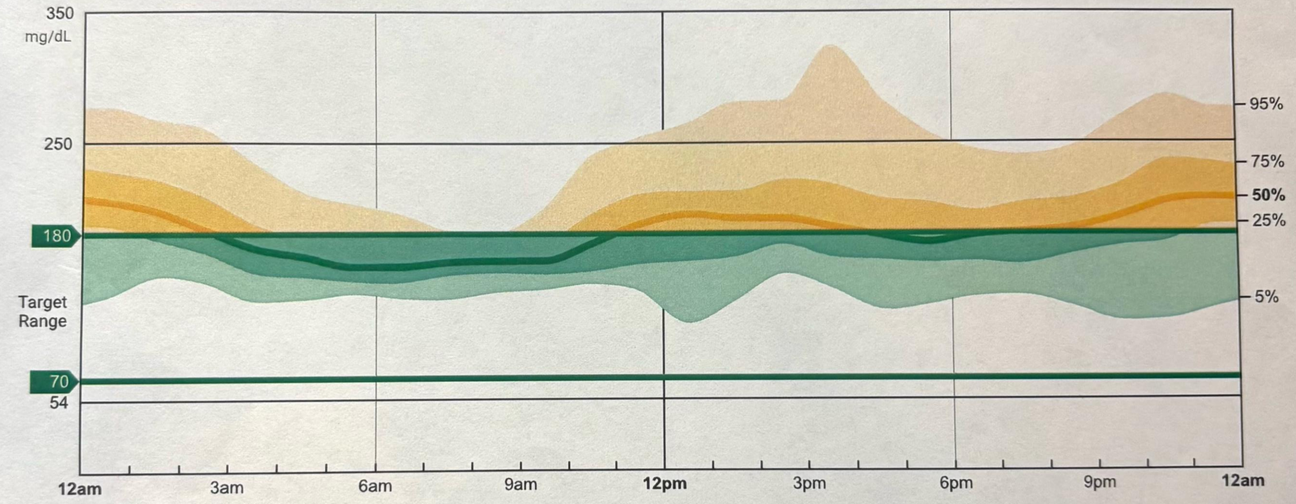
Target Range: 70-180 mg/dL
Very High: Above 250 mg/dL
Very Low: Below 54 mg/dL

Glucose Metrics

Average Glucose Goal: <154 mg/dL	184 mg/dL
GMI Goal: <7%	7.7%
Coefficient of Variation Goal: <36%	21.3%
Time CGM Active	95.2%

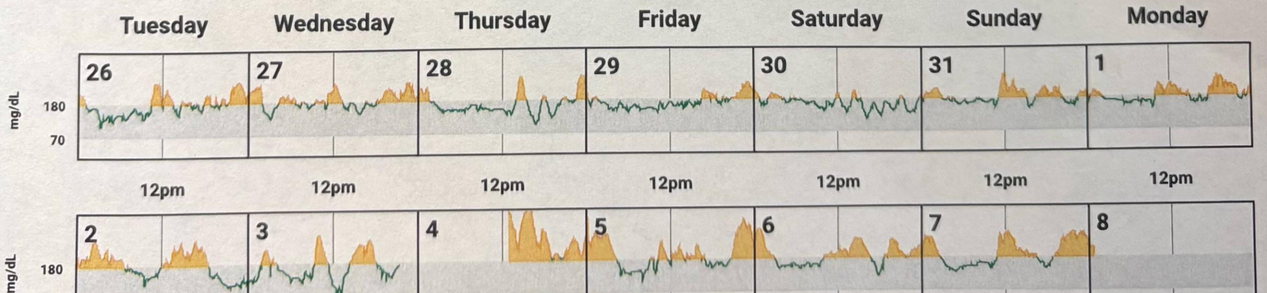
Ambulatory Glucose Profile (AGP)

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.



Time in Ranges

Very High	>250 mg/dL	9%	50%
High	181 - 250	41%	Goal: <25%
Target	70 - 180	50%	50%
			>70%
Low	54 - 69	0%	0%
Very Low	<54	0%	<4%

Glucose Statistics

Average Glucose

185 mg/dL Goal: ≤154 mg/dL

Glucose Management Indicator (GMI)

Approximate A1C level based on average CGM glucose level.

7.7% Goal: ≤7.0%

Considerations for the Clinician[1]

Most Important Pattern: Highs Overnight, All Day

Medication

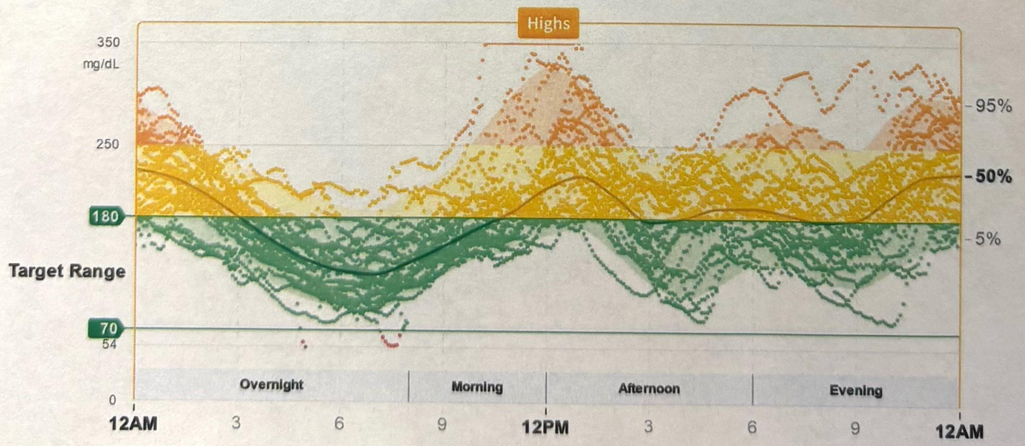
- For T1 patients, consider adjusting insulin
- For T2 patients currently taking insulin or sulfonylurea, consider adjusting medication
- For other T2 patients, consider starting a new medication such as insulin

Lifestyle

- Meals or snacks often high in carbohydrates?

Occasional hypoglycemia occurrences below 54 mg/dL. See Weekly Summary report.

Glucose Patterns (28 Days)



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

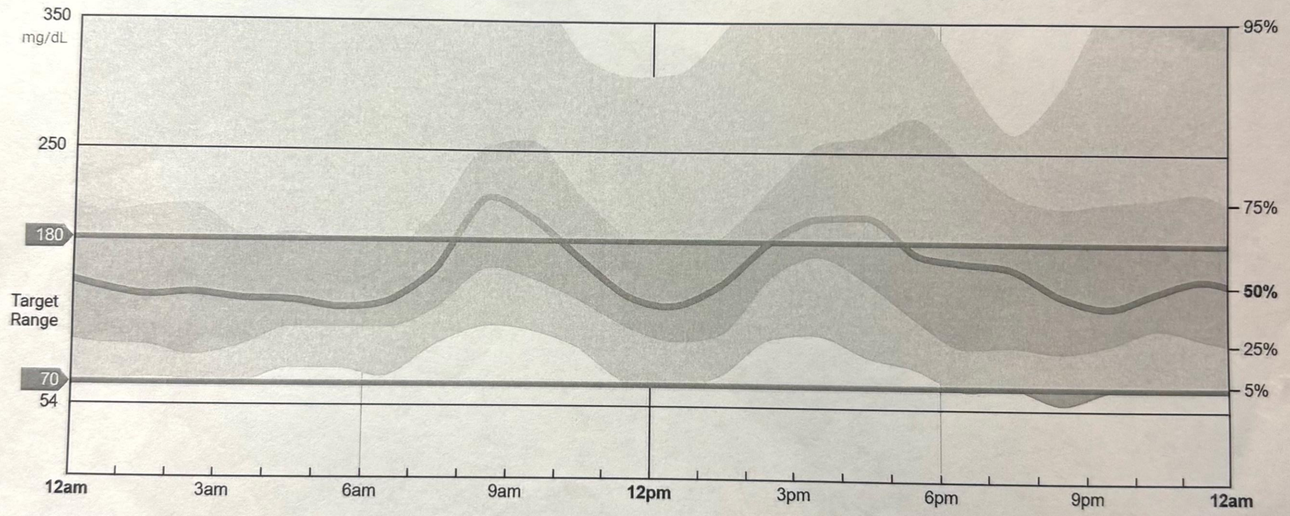
17% Very High Goal: <5%	39% Goal: <25%	
22% High		
59% In Range Goal: >70%		
2% Low	2% Goal: <4%	
<1% Very Low Goal: <1%		

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

Average Glucose Goal: <154 mg/dL	177 mg/dL
GMI Goal: <7%	7.5%
Coefficient of Variation Goal: <36%	48.3%
Time CGM Active	97.9%

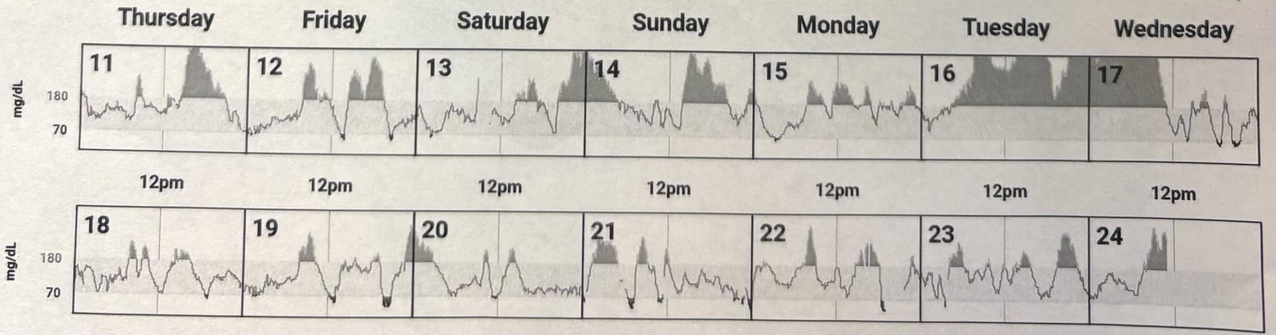
Ambulatory Glucose Profile (AGP)

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.



August 21, 2025 - September 17, 2025	28 Days
Time CGM Active:	95%

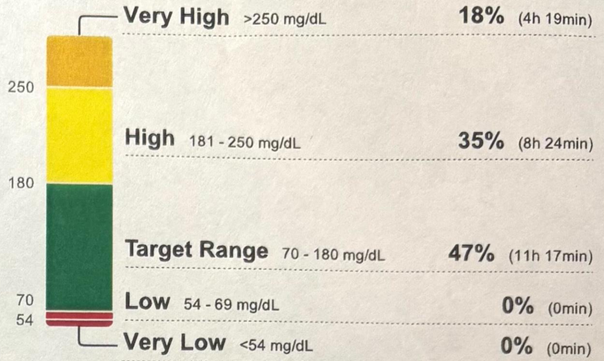
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	**Targets** % of Readings (Time/Day)
Target Range 70-180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

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

Average Glucose	**194** mg/dL
Glucose Management Indicator (GMI)	**8.0%**
Glucose Variability	**33.5%**

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

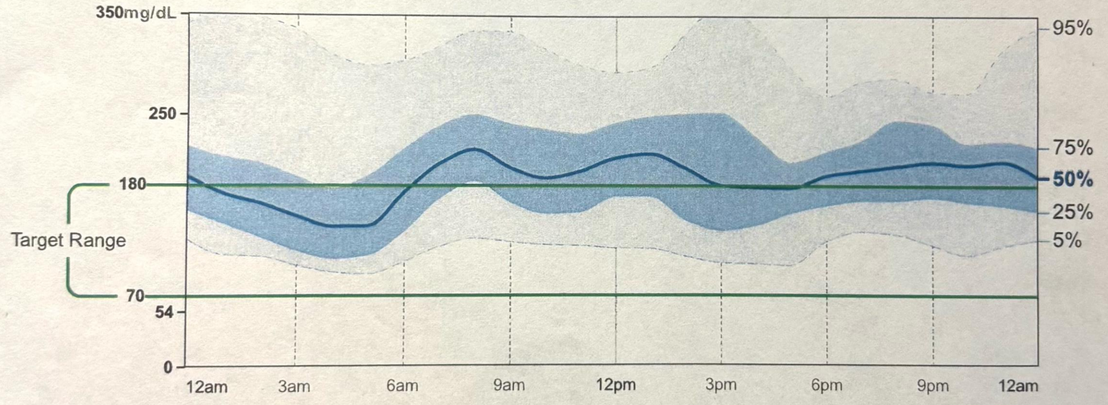
TIME IN RANGES



Very High	>250 mg/dL	**18%** (4h 19min)
High	181 - 250 mg/dL	**35%** (8h 24min)
Target Range	70 - 180 mg/dL	**47%** (11h 17min)
Low	54 - 69 mg/dL	**0%** (0min)
Very Low	<54 mg/dL	**0%** (0min)

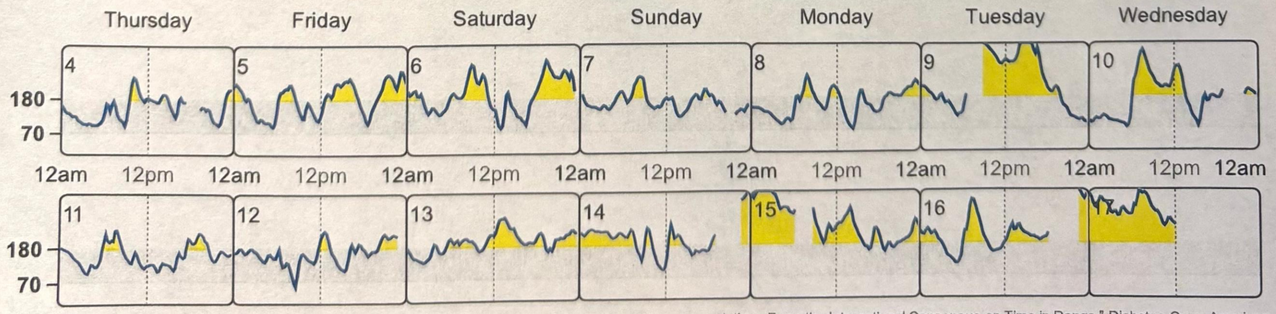
AMBULATORY GLUCOSE PROFILE (AGP)

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.



DAILY GLUCOSE PROFILES Most recent 14 days. See Weekly Summary report for more days.

Each daily profile represents a midnight to midnight period with the date displayed in the upper left corner.



Selected Dates: Aug 21, 2025 - Sep 17, 2025 (28 Days)

Time CGM Active: 88%

Time in Ranges

Very High	>250 mg/dL	4%	38%
High	181 - 250	34%	Goal: <25%
Target	70 - 180	62%	>70%
Low	54 - 69	0%	0%
Very Low	<54	0%	<4%

Glucose Statistics

Average Glucose

168 mg/dL Goal: ≤154 mg/dL

Glucose Management Indicator (GMI)

Approximate A1C level based on average CGM glucose level.

7.3% Goal: ≤7.0%

Considerations for the Clinician[1]

Most Important Pattern: Highs All Day

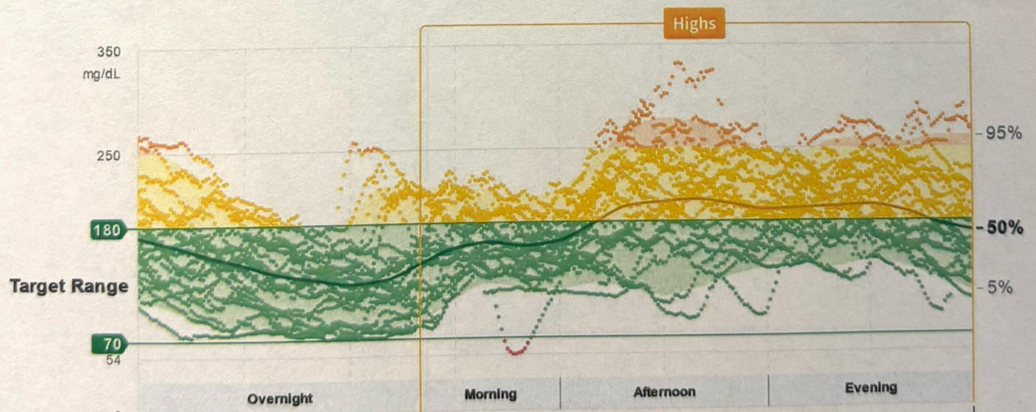
Medication

- If starting or adjusting medication to address highs, consider how the medication could induce lows

Lifestyle

- Meals or snacks often high in carbohydrates?

Glucose Patterns (28 Days)

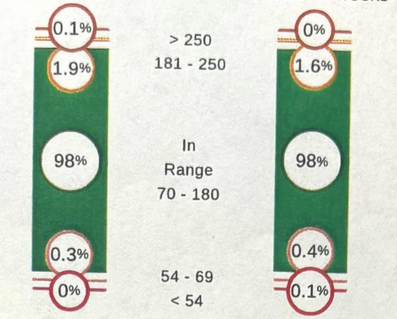


CGM Data by Dexcom

CGM summary

Average reading	128 mg/dL
Time in range	98 %
Time CGM in use	100 %
Standard deviation	24 mg/dL
Coefficient of variation	19 %
GMI	6.4 %

Time in range comparison

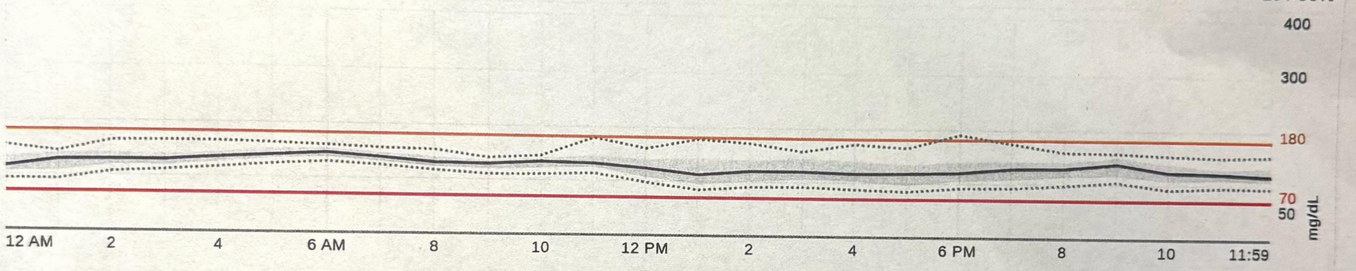


Control-IQ summary

Time active	92 %	12 d 6 hr
Control-IQ off	0 %	0 hr 0 min
CGM inactive	7 %	22 hr 41 min
Pump inactive	1 %	2 hr 50 min

Average sleep		Average exercise	
Duration	12 hr	Duration	0 hr
Weekly	7 times	Weekly	0 times

Glucose trends



Insulin summary

Average daily dose		31.37 units
Basal	47 %	14.64 units
Bolus	53 %	16.73 units
Average daily boluses		7 boluses
Manual	92 %	6 boluses
Control-IQ	8 %	1 boluses
Average daily carbs		38 g

Bolus review (daily average)

Type		
Food	33 %	5.46 units
Correction	0 %	0.00 units
Override	65 %	10.85 units
Control-IQ	3 %	0.42 units
Delivery Method		
Standard	97 %	16.31 units
Extended	0 %	0.00 units
Quick	0 %	0.00 units
Control-IQ	3 %	0.42 units

Load activity

Cartridge change	every	2.7 d
Tubing fill	every	2.7 d
Cannula fill	every	0.30 d

APPLY TO UNDERWRITING

Personalized Risk Assessment:

Identifying High-Risk Individuals:

Improved Efficiency:

Digital Divide:

Training and Education:

IMPLICATIONS FOR MORTALITY RISK AND UNDERWRITING

Going beyond A1c, Which applicants are "lower-risk diabetics" today?

Use of Closed Loop Systems (80%)
Time-in-Range (70–180 mg/dL) >70%
Glycemic variability (%CV) <36%
Absence of hypoglycemia unawareness
No microvascular/macrovascular complications

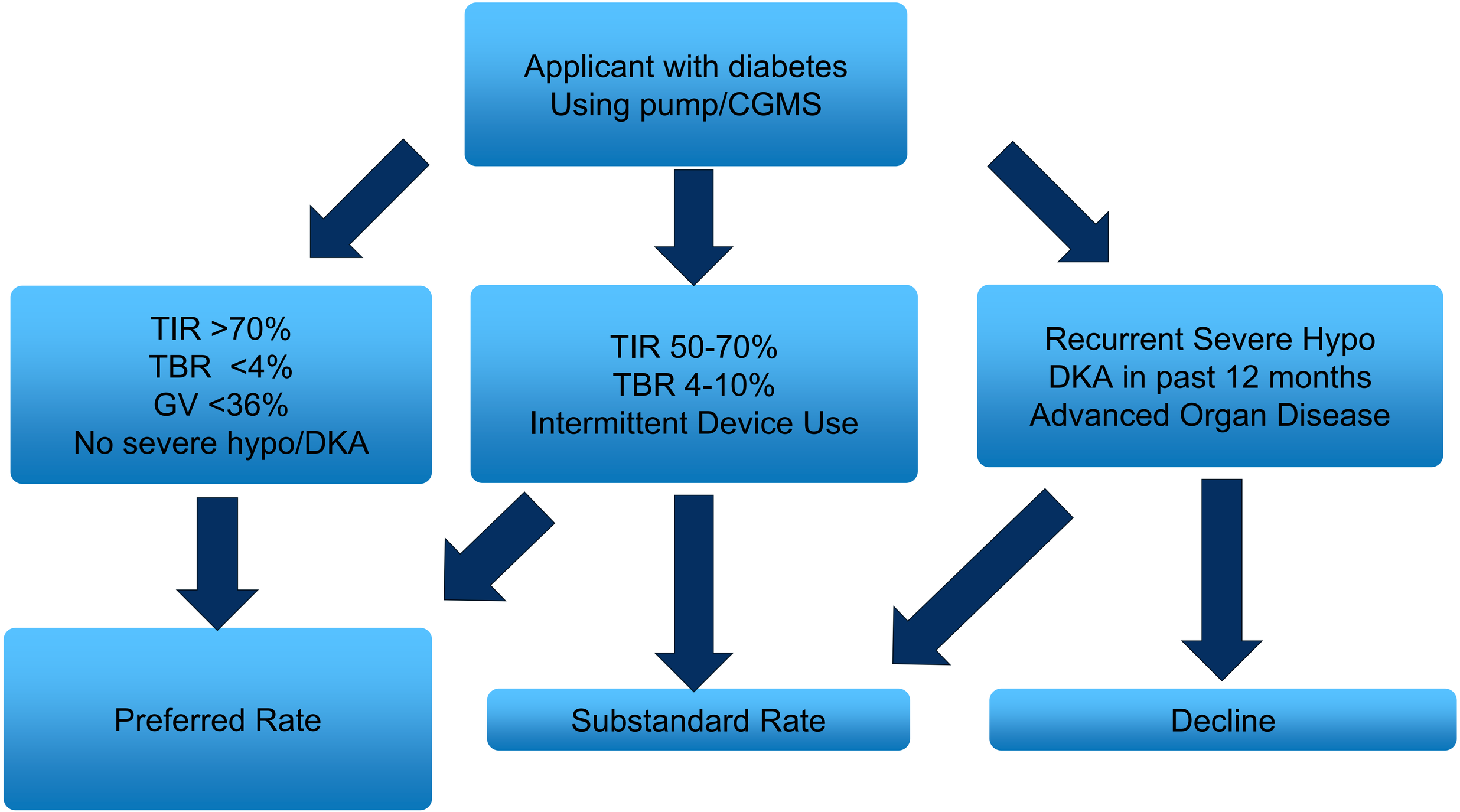
Low A1c can be misleading!

DIABETES TECHNOLOGY CHEAT SHEET

Metric	Favorable	High-Risk/Concern
Time-in-Range (70–180 mg/dL)	>70%	<50%
Time <70 mg/dL	<4%	>10% or frequent <54 mg/dL
%CV (glycemic variability)	<36%	>36%
CGM Wear Time	>80–90%	<60%
Pump/AID Closed-Loop Usage	High % closed-loop	Frequent manual overrides, off >20%
Severe Hypo/DKA in past year	None	Any events in last 12 mo

QUICK CHECKLIST

Question	Y/N
CGM TIR >70%?	
Time <70 <4%?	
%GV <36%?	
Device wear > 80%?	
No severe hypo / DKA last 12 mo?	


Applicant with diabetes
Using pump/CGMS
TIR >70%
TBR <4%
GV <36%
No severe hypo/DKA
TIR 50-70%
TBR 4-10%
Intermittent Device Use
Recurrent Severe Hypo
DKA in past 12 months
Advanced Organ Disease
Preferred Rate
Substandard Rate
Decline

CONCLUSION

Integrating technology into underwriting approaches for diabetes offers the potential to create a more personalized, efficient, and accurate assessment of risk, ultimately leading to better outcomes for both individuals with diabetes and the insurance industry.