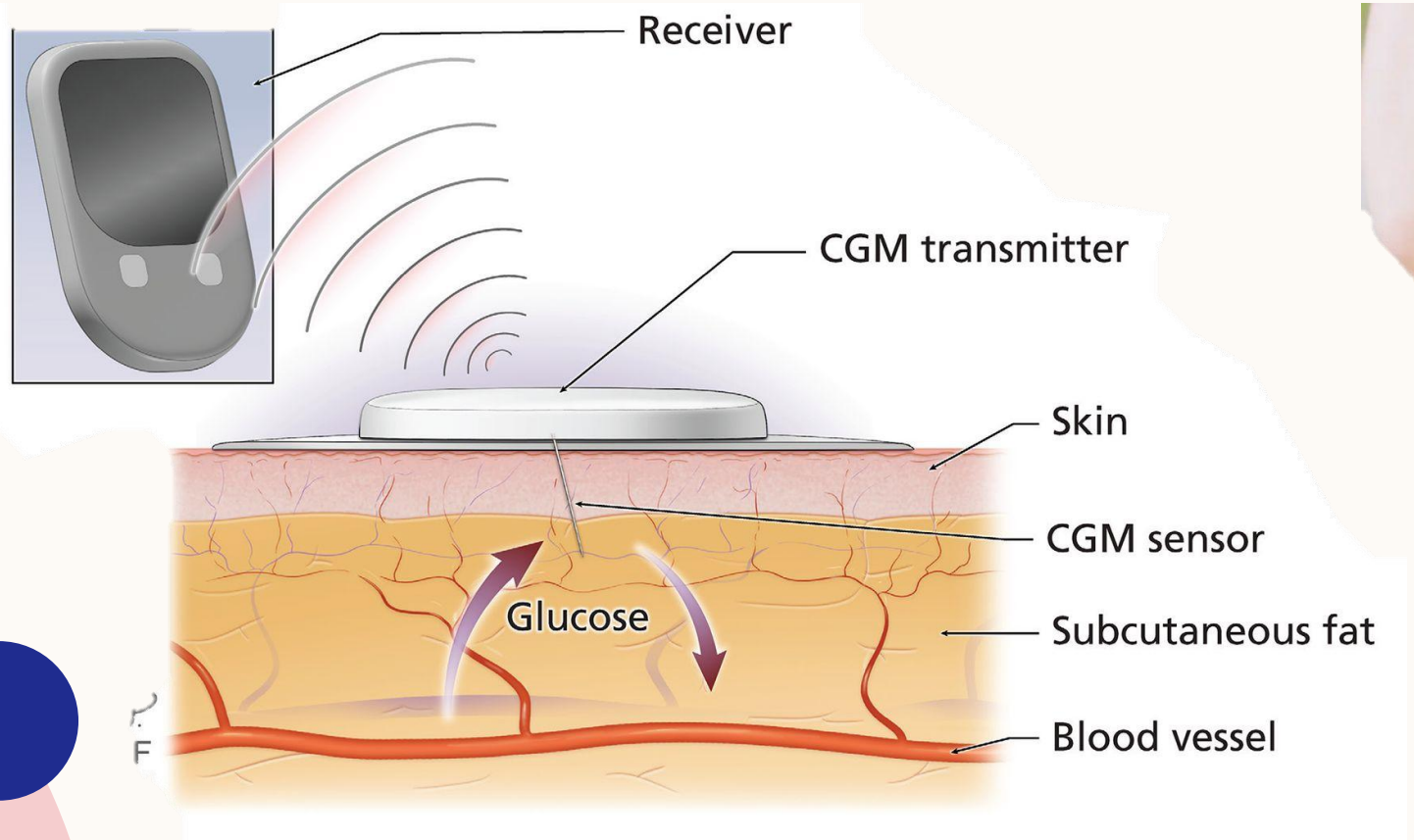
CONTINUE GLUCOSEMONITORING BIJ TYPE 2 DIABETES



DR. ISABEL CLINCK
ZAS CAMPUS MIDDELHEIM

NOOD AAN SENSOR IN T2D?

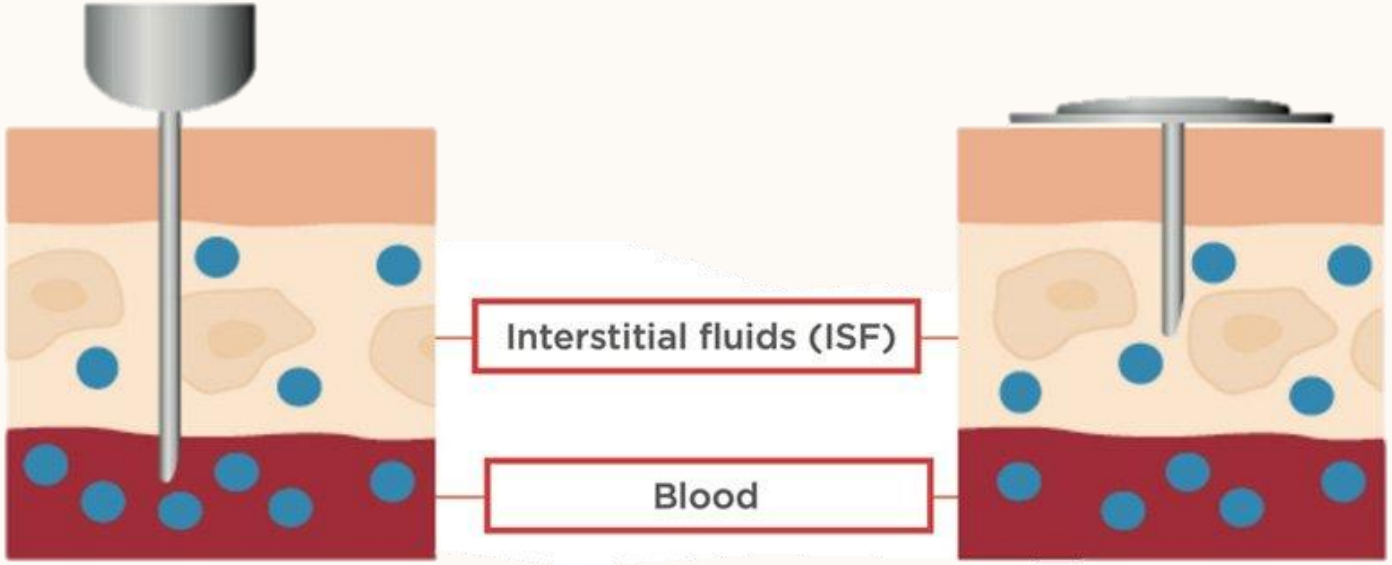
WERKING





CGM = continue glucose monitoring

WERKING

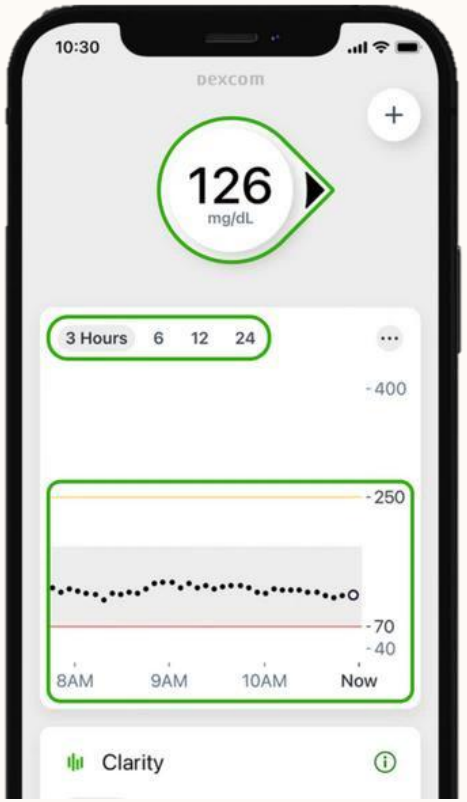


- Eerste uur na plaatsing minder betrouwbaar (30 min- 2u)
- 5minuten vertraging
- Toch nog vingerprikken:
  - Waarde sensor ≠ symptomen
  - Geen getal (HOOG/LAAG)

	Dexcom ONE	FreeStyle Libre 2
Tijdsduur	10 dagen	14 dagen
Connectiviteit	rt-CGM (real-time): waarden worden automatisch doorgestuurd	Is-CGM (intermittent): min. elke 8 uur scannen (reader) ⇔ Rt-CGM: app gsm
Controle glycemie	Elke 5 minuten	Elke minuut
Plaatsing	Buik / bovenarm	Bovenarm
Alarm	hypo- en hyperglycemie	hypo- en hyperglycemie

TRENDS

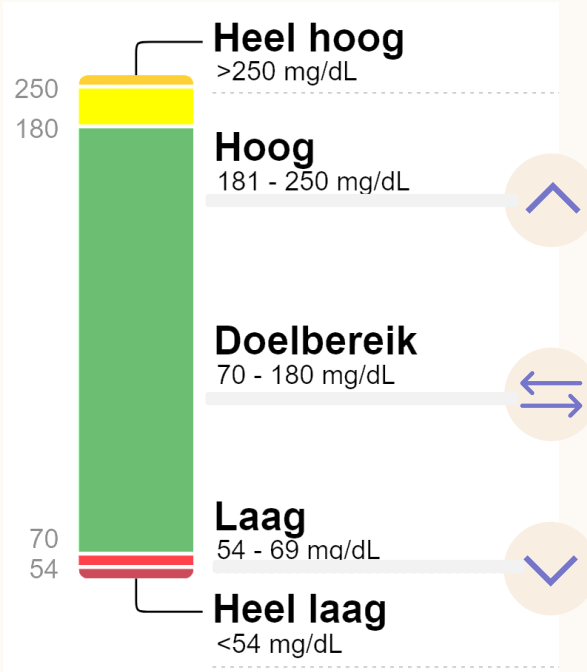
↑	**Glucose stijgt snel** 18 mg/dl over 10 min.
↗	**Glucose stijgt** 11 tot 18 mg/dl over 10 min.
→	**Glucose verandert langzaam** 11 mg/dl over 10 min.
↘	**Glucose daalt** 11 tot 18 mg/dl over 10 min.
↓	**Glucose daalt snel** 18 mg/dl over 10 min.





Bv. glycemie van 90 mg/dL en stijle pijl → hypo-opvang

NIEUWE PARAMETERS



	Doel
Time-above-range (TAR) > 180 mg/dl	*< 25 %*
Time-in-range (TIR) 70-180 mg/dl	*> 70 %*
Time-below-range (TBR) < 70 mg/dl	*< 4 %*

Glucose variabiliteit **≤ 36%**

Glucose Management Indicator (GMI) – geschatte HbA1c

NIEUWE PARAMETERS

Recommended Glycemic Targets for Type 2 Diabetes Patients on Continuous Glucose Monitors

Parameter	T2D (%)	T2D with advanced age or significant comorbidities
HbA1c	<7.0	<8.0%
TIR (70–180 mg/dL)	>70	>50%
% Under 70 mg/dL	<4	<1%
% Under 54 mg/dL	<1	To be avoided
Glucose variability (CV)	≤36	≤33%

Open in a new tab

Adapted from Battelino et al.[4]

CV, coefficient of variation; T2D, type 2 diabetes; TIR, time in range.

VOORDELEN?

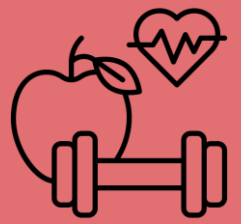


VOORDELEN VAN CGM

- Geen vingerprikken
- Accuraat beeld glycemie doorheen de dag/nacht + voorspelling (trends)
- Inzicht in eigen glycemieprofiel, effect van behandeling en levensstijl
- Alarmen (*ernstige hypoglycemie - unawareness*)
- Data – beschikbaar voor jezelf, familie en je zorgverlener

Behandeling type 2 diabetes

01 Levensstijlaanpassingen



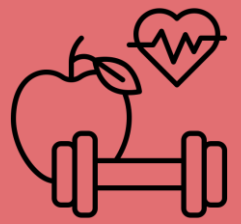
02 Medicatie



03 Glucose monitoring



01 **Levensstijlaanpassingen**



02 **Medicatie**



03 **Glucose monitoring**





Daling HBA1c met 0,30-0,90% * zonder stijging/daling hypoglycemie

Seidu S, Kunutsor SK, Ajjan RA, Choudhary P. Efficacy and Safety of Continuous Glucose Monitoring and Intermittently Scanned Continuous Glucose Monitoring in Patients With Type 2 Diabetes: A Systematic Review and Meta-analysis of Interventional Evidence. Diabetes Care. 2024
Jancev M, Vissers TACM, Visseren FLJ, van Bon AC, Serné EH, DeVries JH, de Valk HW, van Sloten TT. Continuous glucose monitoring in adults with type 2 diabetes: a systematic review and meta-analysis. Diabetologia. 2024 May;67(5):798-810. doi: 10.1007/s00125-024-06107-6. Epub 2024 Feb 16. PMID: 38363342; PMCID: PMC10954850.

Jancev M, Vissers TACM, Visseren FLJ, van Bon AC, Serné EH, DeVries JH, de Valk HW, van Sloten TT. Continuous glucose monitoring in adults with type 2 diabetes: a systematic review and meta-analysis. Diabetologia. 2024 May;67(5):798-810. doi: 10.1007/s00125-024-06107-6. Epub 2024 Feb 16. PMID: 38363342; PMCID: PMC10954850.

VOORDELEN VAN CGM

Inzicht in eigen glycemieprofiel, effect van behandeling en levensstijl

Continuous Glucose Monitoring in Adults with Type 2 Diabetes: A Systematic Review and Meta-Analysis

Aim



Effects of real time or intermittently scanned CGM versus SMBG on glycaemic control

Participants



Adults with type 2 diabetes

Results



Randomised controlled trials n=12



Participants n=1248



Follow-up median 24 weeks



HbA_{1c} -3.43 mmol/mol (95%CI: -4.75 to -2.11)



Similar reduction in participants using insulin or oral agents only

TIR +6.36% (95%CI: 2.48 to 10.24)
TBR -0.66% (95%CI: -1.21 to -0.12)
TAR -5.86% (95%CI: -10.88 to -0.84)



Conclusion

CGM use compared to SMBG is associated with improvements in glycaemic control in type 2 diabetes.

Abbreviations: CGM, continuous glucose monitoring; SMBG, self-monitoring of blood glucose; TAR, time above range; TBR, time below range; TIR, time in range

Oser TK, Martens T, Ruedy KJ, Bergford S, Calhoun P, Chang KL, Kramer ES, Klug BA, Anderson RL, Cook BR, Pickering D, Ortega M, Peterson B, Davidson L, Schmid R, Desai ND, Burkett E, Haynes JL, Herman A, Topiwala SM, Bailey R, Oser SM, Cadet NN, Johnson ML, Elkind-Hirsch KE, Beck SE, Castle JR, Beck RW; CONNECT Study Group. Continuous Glucose Monitoring in Non-Insulin-Treated Type 2 Diabetes. N Engl J Med. 2026 Oct 29;395(17):1717-1727. doi: 10.1056/NEJMoa2608571. Epub 2026 Oct 14. PMID: 42878622.

VOORDELEN VAN CGM

Inzicht in eigen glycemieprofiel, effect van behandeling en levensstijl

- 26 weken, 22 huisartsenpraktijken in de VS
- Type 2 diabetes ZONDER insuline

Table 2. Primary and Secondary Hierarchical Efficacy Outcomes.*

Outcome	At Baseline		At Follow-up†		Adjusted Difference (95% CI)‡	P Value
	CGM (N=145)	Routine Care (N=138)	CGM (N=145)	Routine Care (N=138)		
Primary outcome						
Glycated hemoglobin — %	8.8±1.3	8.7±1.2	7.2±1.1	8.0±1.4	−0.9 (−1.1 to −0.6)	<0.001
Time with glucose level in range 70–180 mg/dl — %	29±26	31±23	62±25	42±26	21 (16 to 26)	<0.001
Mean glucose level — mg/dl§	229±58	225±49	175±40	207±47	−35 (−44 to −26)	<0.001
Time with glucose level >180 mg/dl — %	70±27	69±24	38±25	58±26	−21 (−26 to −15)	<0.001
Time with glucose level <54 mg/dl — %¶	0.21±0.31	0.26±0.44	0.02±0.04	0.19±0.25	−0.17 (−0.27 to −0.11)	<0.001
Time with glucose level <70 mg/dl — %¶	0.30±0.44	0.28±0.45	0.12±0.17	0.31±0.41	−0.20 (−0.43 to −0.09)	<0.001

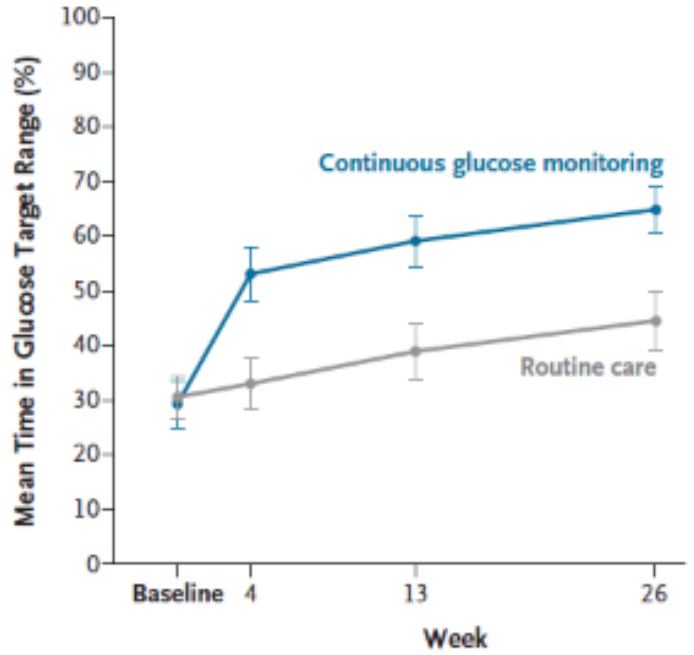
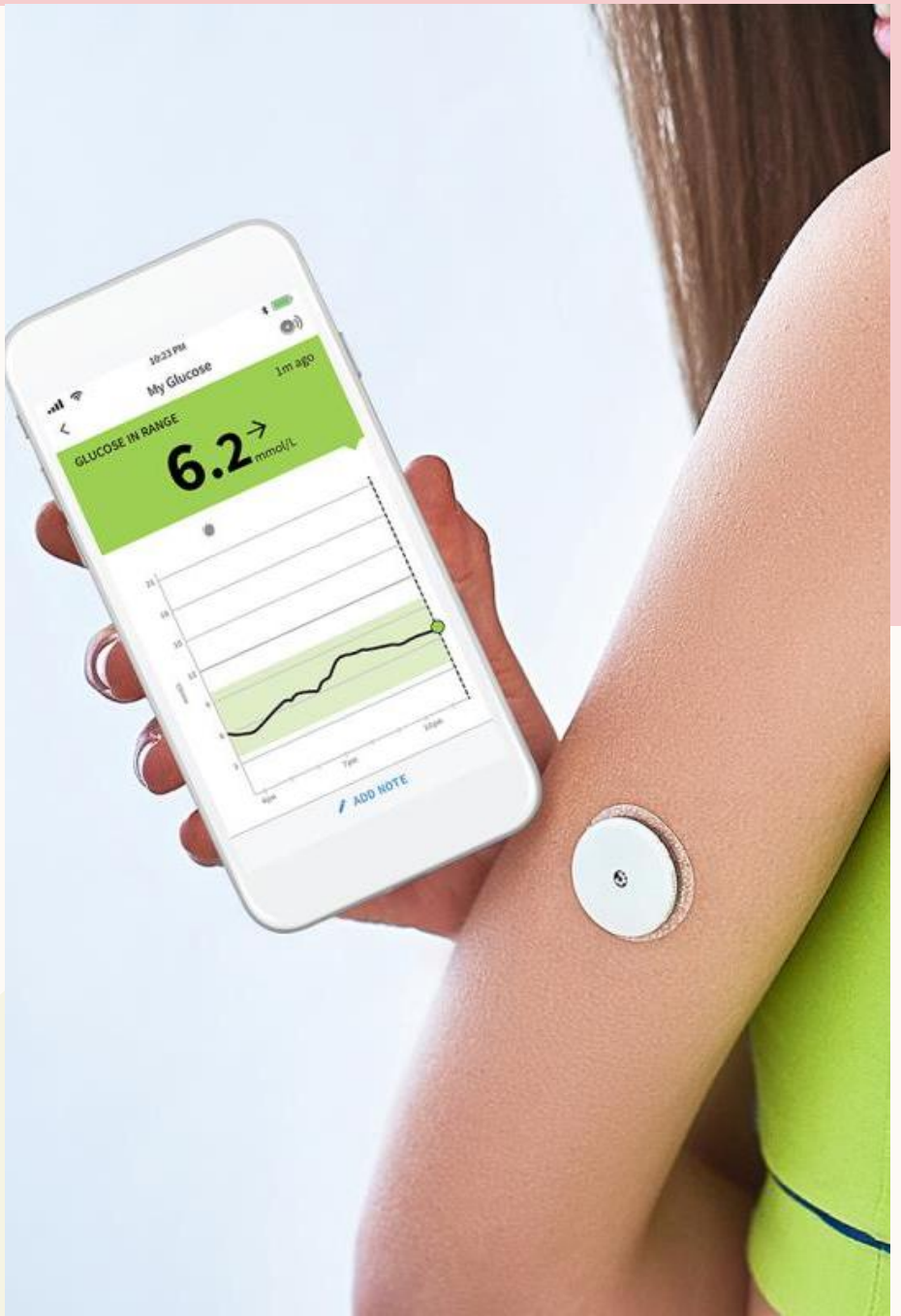


Figure 2. Mean Time in Glucose-Level Target Range at Baseline and at 4, 13, and 26 Weeks.

The glucose-level target range was defined as 70 to 180 mg per deciliter. I bars indicate the 95% confidence intervals.

NADELEN?



NADELEN VAN CGM

- Technologie - leercurve
- Informatie overload
- Alarmen (optioneel) - moeheid
- Sensor op het lichaam: zichtbaarheid, huidirritatie (minder met nieuwere sensoren)
- Kost

  Juli '23: terugbetaling T2D met min. 3 insuline inspuitingen

TIR I.P.V. HBA1C?

- Lagere TIR geassocieerd met diabetes retinopathie, perifere neuropathie, albuminurie, mortaliteit, … bij patiënten met type 2 diabetes
- HbA1c beïnvloed door andere factoren dan glycemie bv anemie, lever- of nierfalen, zwangerschap, ….
- HbA1c zegt niet over glucose variabiliteit
- Veranderingen in behandeling worden meteen opgemerkt in de TIR

- *Jingyi Lu, Xiaojing Ma, Jian Zhou, Lei Zhang, Yifei Mo, Lingwen Ying, Wei Lu, Wei Zhu, Yuqian Bao, Robert A. Vigersky, Weiping Jia; Association of Time in Range, as Assessed by Continuous Glucose Monitoring, With Diabetic Retinopathy in Type 2 Diabetes. Diabetes Care 1 November 2018;*
- *Mayeda L, Katz R, Ahmad I, Bansal N, Batacchi Z, Hirsch IB, Robinson N, Trence DL, Zelnick L, de Boer IH. Glucose time in range and peripheral neuropathy in type 2 diabetes mellitus and chronic kidney disease. BMJ Open Diabetes Res Care. 2020 Jan;8(1):e000991. doi: 10.1136/bmjdrc-2019-000991. PMID: 31958307; PMCID: PMC7039577.*
- *Yoo JH, Choi MS, Ahn J, Park SW, Kim Y, Hur KY, Jin SM, Kim G, Kim JH. Association Between Continuous Glucose Monitoring-Derived Time in Range, Other Core Metrics, and Albuminuria in Type 2 Diabetes. Diabetes Technol Ther. 2020 Oct;22(10):768-776. doi: 10.1089/dia.2019.0499. Epub 2020 Apr 13. PMID: 32167394. Lu J, Wang C, Shen Y, Chen L, Zhang L, Cai J, Lu W, Zhu W, Hu G, Xia T, Zhou J. Time in Range in Relation to All-Cause and Cardiovascular Mortality in Patients With Type 2 Diabetes: A Prospective Cohort Study. Diabetes Care. 2021 Feb;44(2):549-555. doi: 10.2337/dc20-1862. Epub 2020 Oct 23. PMID: 33097560; PMCID: PMC9162101.*

IEDEREEN CGM?

- In eerste plaats bij patiënten met hoog hypoglycemie risico
  - Insulinetherapie

- Geen bewijs om te gebruiken voor screening/diagnose

- Ook al effect op eerste stap v.d. behandeling: levensstijl
  - Leidt tot gedragsaanpassingen, meer inzicht in diabetes regeling
  - Kanttekening: kostprijs, duur effect?

- Als alternatief voor HbA1c indien deze niet betrouwbaar is

Continuous glucose monitors (CGMs) are wearable devices that track blood glucose throughout the day. CGMs are routinely used by people with type 1 diabetes, but their use by people with type 2 diabetes and without diabetes is increasing.

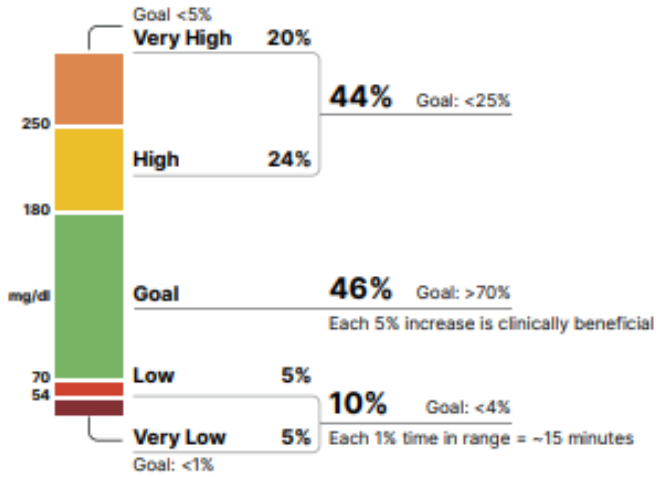
Does CGM use help to	People with type 2 diabetes	People without any type of diabetes
prevent disease?	There is no evidence that using CGM prevents disease (like cardiovascular disease or kidney or eye disease)	
prevent complications from low blood glucose?	CGM helps detect low blood glucose, but there is no evidence that CGM reduces severe low blood glucose reactions (like seizures or coma)	Not relevant for most people without diabetes
guide decisions about lifestyle habits (like diet, physical activity)?	Seeing blood glucose levels in real time may encourage healthier choices, but reacting to isolated readings may also lead to unnecessary diet restrictions or diet changes that are less healthy	The meaning of fluctuations in blood glucose is uncertain for people without diabetes. Using CGM to avoid spikes may lead to misguided decisions such as replacing healthy foods with less healthy options (eg, fresh fruits replaced by low-carbohydrate, high-fat foods)
guide decisions about blood glucose-lowering medications?	May help with treatment changes	Not relevant for most people without diabetes
reduce blood glucose levels?	There is a modest reduction in hemoglobin A_{1c} of 0.3% (3 mmol/mol) when used for at least 8-10 weeks. This is an average effect, and some patients experience larger (or smaller) effects. The effect is similar in people treated with and without insulin	There is no evidence that CGM leads to lower blood glucose levels

VOORBEELDEN



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

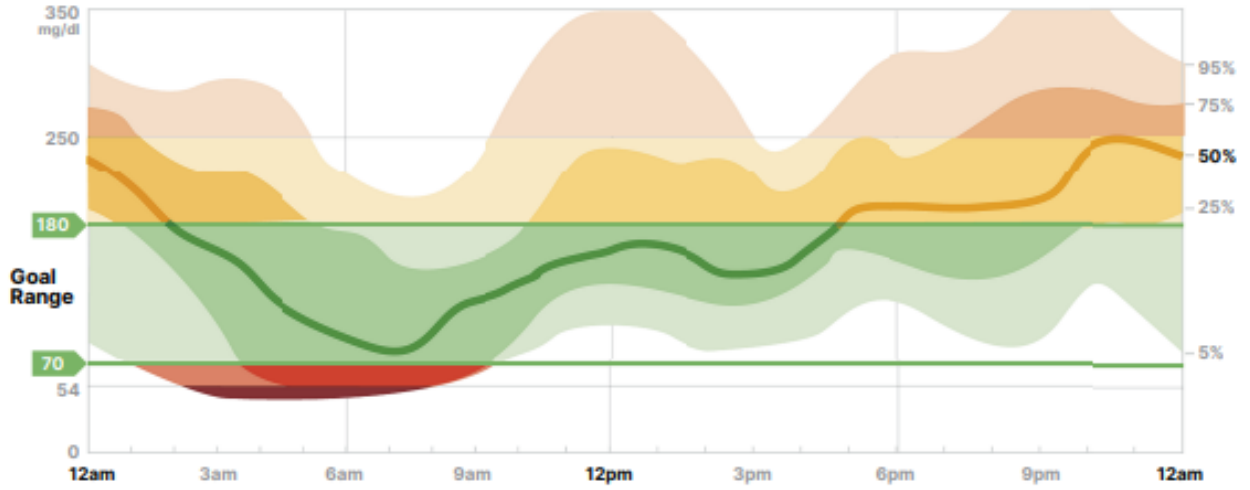
Time CGM Active: 100%

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)

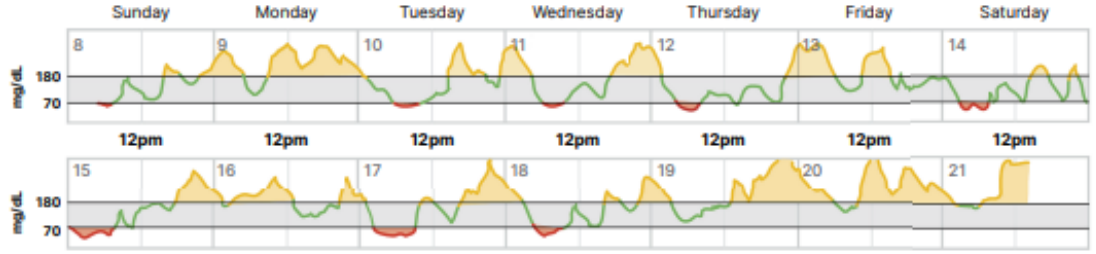
AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if they occurred in a single day.



Man, 75 jaar
Diabetes type 2
Medicatie: metformine 850 mg 2dd,
Ozempic 1 mg 1x week en
Novorapid (6-6-6) en Lantus 50 E

Daily Glucose Profiles

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



PATIENT

THOMAS
TYPE 2 DIABETES



PERSONAL HISTORY

AGE:	84 years
GENDER:	Male
DURATION:	T2D since 1994
THERAPY:	BOT
PROFESSION:	Retired
BMI:	27.1 kg/m²*
LAST HbA_{1C}:	7.1%*
TIR:	62%



COMPLICATIONS

- Retinopathy R1M0 both eyes

COMORBIDITIES & CO-MEDICATION

- Moderately frail
- Angina 2022
- Myocardial infarction 2021
- Essential hypertension 1995
- Medications: Acetylsalicylic Acid 75 mg daily; Atorvastatin 80 mg; Bisoprolol 1.25 mg; Ramipril 5 mg; Lansoprazole 15 mg

CURRENT TREATMENT OF DIABETES

- FreeStyle Libre 2 sensor to monitor interstitial fluid levels. Prior to this the district nurse was monitoring capillary blood glucose at their visit for insulin administration
- Insulin Degludec 100 units/mL, 58 IU daily
- Metformin 500 mg twice daily
- Sitagliptin 100 mg daily

* This has been falling over the last 3 years
BOT Basal-supported Oral Therapy
IU International Unit

THOMAS
TYPE 2 DIABETES

DATA – PHYSICIAN PERSPECTIVE

AGP Report

8 February 2023 - 21 February 2023 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

8 February 2023 - 21 February 2023	**14 Days**
Time sensor active:	**91%**

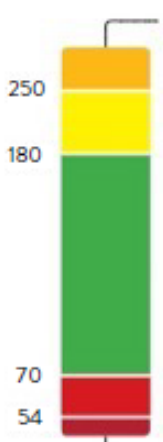
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	**Targets** % of Readings (Time/Day)
Target Range 70-180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

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

Average Glucose	**144.1 mg/dL**
Glucose Management Indicator (GMI)	**6.7% or 50 mmol/mol**
Glucose Variability	**50.2%**

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

TIME IN RANGES



Very High >250 mg/dL	**10%**	(2h 24min)
High 181 - 250 mg/dL	**16%**	(3h 50min)
Target Range 70 - 180 mg/dL	**62%**	(14h 53min)
Low 54 - 69 mg/dL	**9%**	(2h 10min)
Very Low <54 mg/dL	**3%**	(43min)

DATA

THOMAS
TYPE 2 DIABETES

DATA – PHYSICIAN PERSPECTIVE

AGP Report

8 February 2023 - 21 February 2023 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

8 February 2023 - 21 February 2023	14 Days
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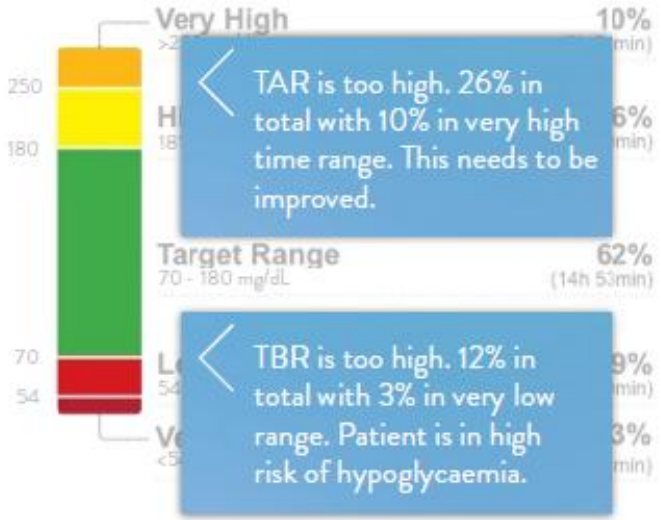
Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.

Average Glucose	144.1 mg/dL
Glucose Management Indicator (GMI)	6.7% or 50 mmol/mol
Glucose V…	50.2%

Defined as pe…

Variability too high at 50.2%.

TIME IN RANGES



TAR is too high. 26% in total with 10% in very high time range. This needs to be improved.

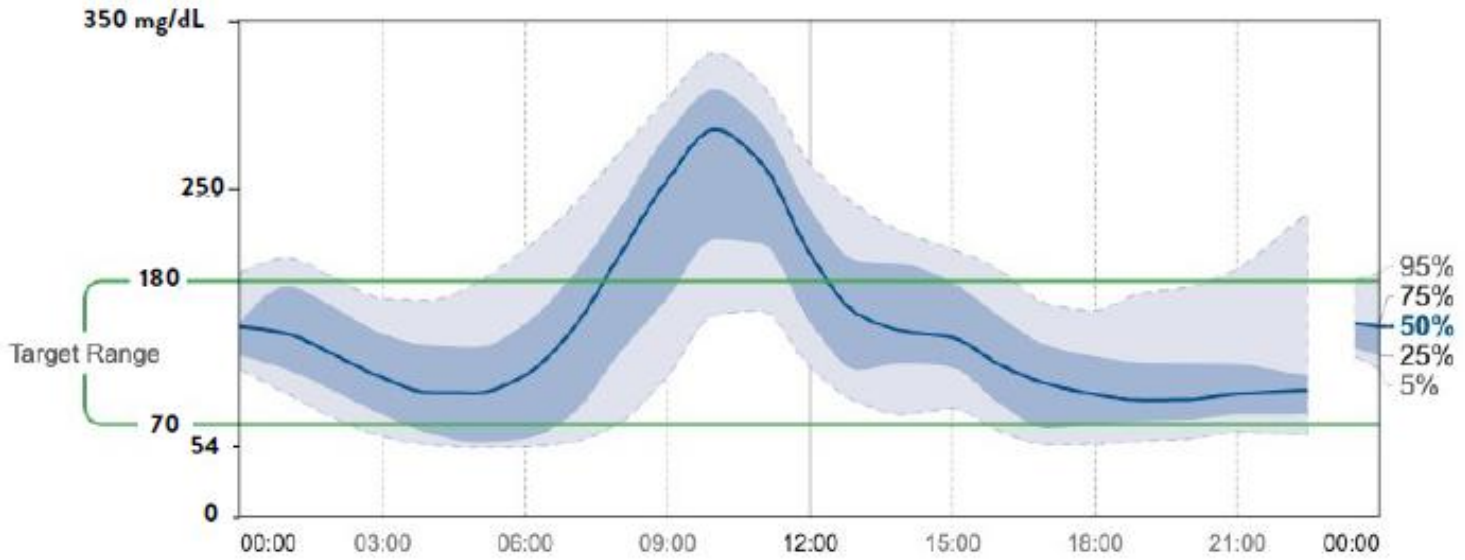
TBR is too high. 12% in total with 3% in very low range. Patient is in high risk of hypoglycaemia.

THOMAS
TYPE 2 DIABETES

DATA – PHYSICIAN PERSPECTIVE

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.



ANAMNESIS

THOMAS
TYPE 2 DIABETES

ANAMNESIS

- This elderly and frail patient has **nocturnal hypoglycaemia.**
- This was not **recognised by the patient prior to using FreeStyle Libre 2 system**.
- When district nurses were attending to administer the insulin **mid morning**, all capillary **glucose readings were high**. As a result the dose of insulin was increased.
- However, it was further discovered that when the carers attended to help the patient dress and prepare his breakfast, he was taking a large glass of orange juice with his breakfast. He was requesting the orange juice as he said he felt '**weak and wobbly**'.

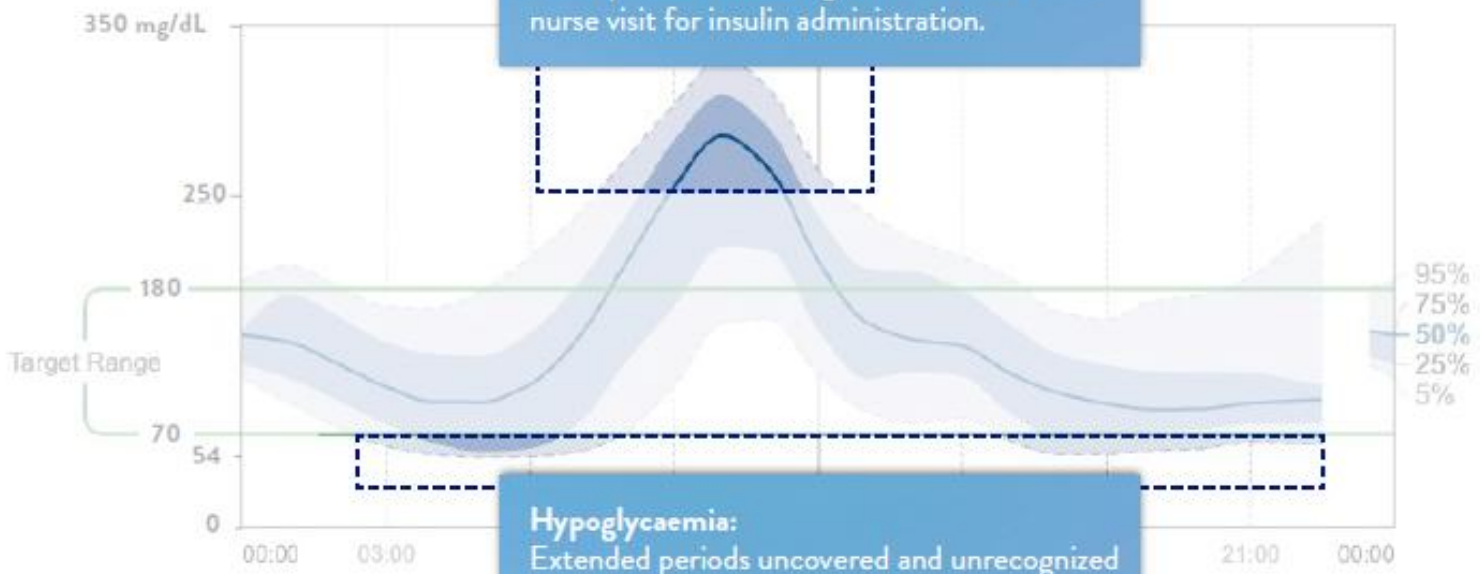
DATA

THOMAS
TYPE 2 DIABETES

DATA – PHYSICIAN PERSPECTIVE

AMBULATORY GLUCOSE PROFILE (AGP)

AGP is a summary of glucose values from the report period, ... single day



Hyperglycaemia:
Short periods coinciding with time of district nurse visit for insulin administration.

Hypoglycaemia:
Extended periods uncovered and unrecognized by the patient.

ADJUSTMENT

THOMAS
TYPE 2 DIABETES

THERAPY ADJUSTMENT

FreeStyle Libre 2 revealed nocturnal hypoglycaemia as the main issue.

Over the previous year he had become increasingly frail and as a result was eating less in the evenings as he was now **reliant on carers support** to help him with his meals. Due to their visit times, he was now having **extended overnight fasts of greater than 12 hours**, which led to the main issue. The carers were therefore adviced to leave a **bedtime snack** for him.

The insulin dose was reduced until the nocturnal hypoglyceamia was eliminated and the TIR improved for the level of frailty seen in this gentleman, aiming for >50% TIR and <1% TBR.*

Insulin Degludec was reduced by 20% of dose:

- Initial dose was 58 IU, this was reduced by 12 IU to 46 IU.
- **After a further week, another 10% reduction in dose was advised to 42 IU.**

OUTCOME

THOMAS
TYPE 2 DIABETES

OUTCOME - AFTER ADJUSTMENT

Since using FreeStyle Libre 2:

- **No further hypoglycaemia**, so no time spent <70 mg/dL - No further spikes in glucose in the morning.
- **Improved glucose variability** from 50.2% to 27.9%.
- **Reduction in insulin dose.**

Patient showed **overall improvement in quality of life.** As he no longer felt 'weak and wobbly' in the mornings there was no need for the large glass of orange juice and so the resulting mid-morning spike in glycaemia was improved. The patient reported feeling less tired.

THOMAS
TYPE 2 DIABETES

OUTCOME - AFTER ADJUSTMENT

GLUCOSE STATISTICS AND TARGETS

21 June 2023 - 4 July 2023	**14 Days**
Time sensor active:	**100%**

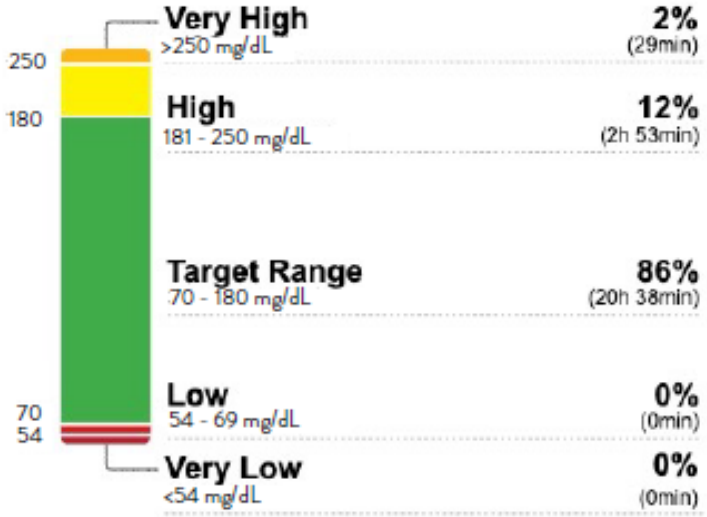
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Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

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

Average Glucose	**142.3 mg/dL**
Glucose Management Indicator (GMI)	**6.7% or 50 mmol/mol**
Glucose Variability	**27.9%**

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

TIME IN RANGES



THOMAS
TYPE 2 DIABETES

OUTCOME - AFTER ADJUSTMENT

GLUCOSE STATISTICS AND TARGETS

21 June 2023 - 4 July 2023 — 14 Days

Time sensor active: — 100%

Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges Target Range 70-180 mg/dL	Targets % of Readings (Time/Day) Greater than 70% (16h 48min)
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Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.

Average Glucose — 142.3 mg/dL

Glucose Management Indicator (GMI) — 6.7% or 50 mmol/mol

Glucose Variability — **27.9%**

Defined as percentage coefficient of variation

Improved glucose variability at 27.9%.

TIME IN RANGES

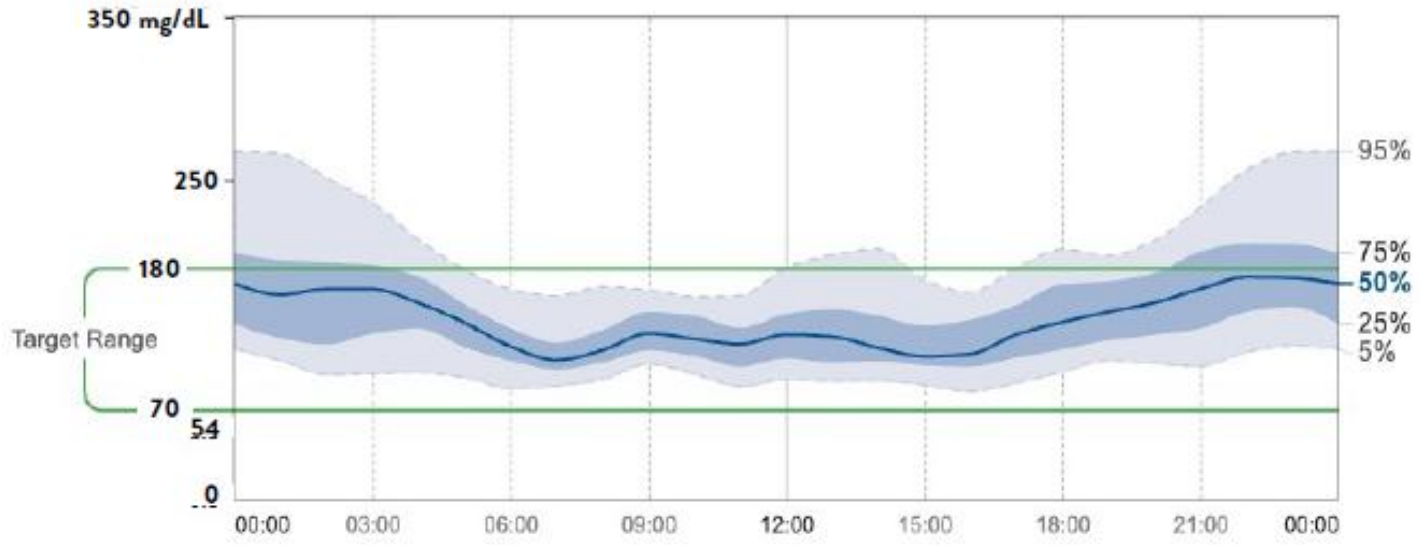


THOMAS
TYPE 2 DIABETES

OUTCOME - AFTER ADJUSTMENT

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.

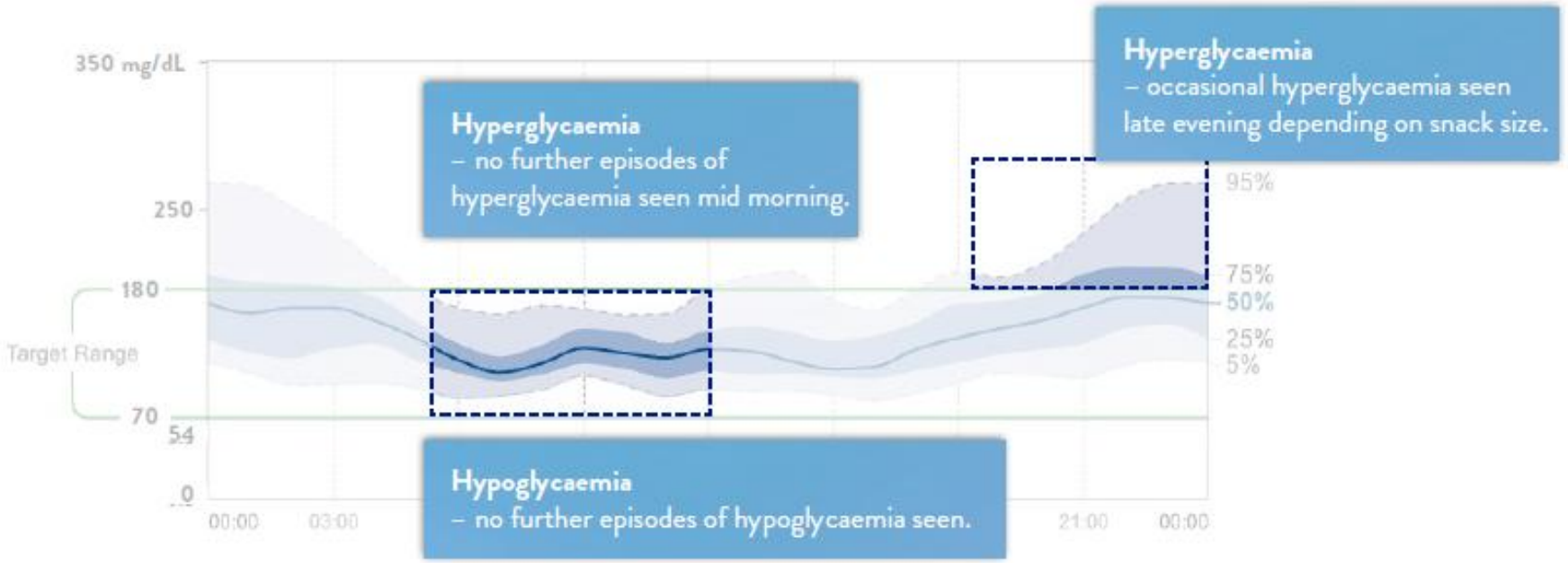


THOMAS
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AMBULATORY GLUCOSE PROFILE (AGP)

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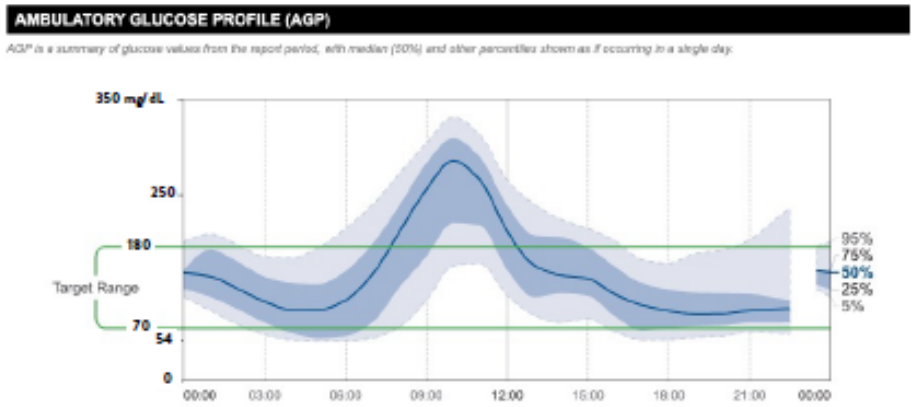


OUTCOME

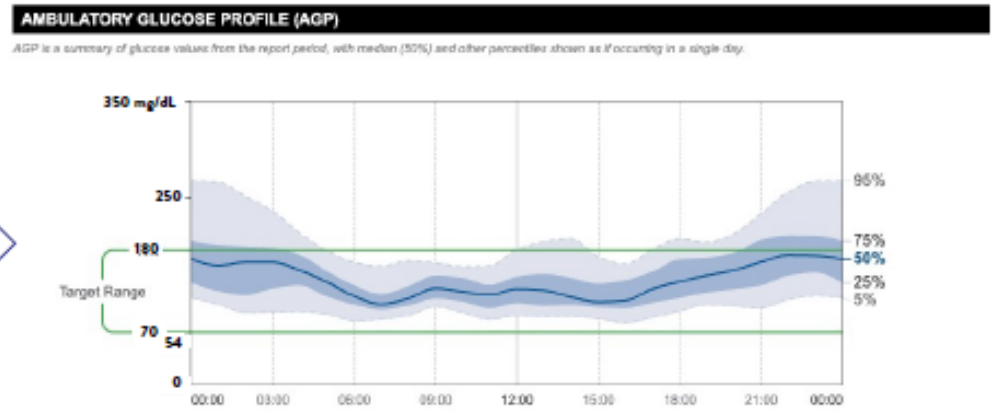
THOMAS
TYPE 2 DIABETES

CONCLUSION

Before adjustment



After adjustment



Main challenges:

- Prior to the recognition of nocturnal hypoglycaemia, this gentleman became increasingly frail.

Important adjustments:

- Once the hypoglycaemia was identified and eliminated by reduction in insulin dose, his mood changed considerably.
- He was far less irritable in the mornings; this was reported by all the care teams.
- The reduction in insulin dose had to be significant to evoke this change in AGP.

KEY TAKEAWAYS:

FreeStyle Libre 2 system

- **helps to detect and eliminate hypoglycaemia.**
- **helps to better adjust the insulin dosage to the needs of the patient.**
- **helps to improve the quality of life based on a better adaptation of the therapy.**

MAN 69 JAAR

Diabetes type 2 2011, insulinedependent 2018

Novorapid wisselend: 6-7e als hij pasta eet, 3e als het koolhydraten arme maaltijd is

Toujeo 28-30 E

Vingerprik profielen:
· gebruiksduur: 3.3 metingen/dag
· glycemie (gemiddeld +/- standaarddeviatie): 113 +/- mg/dl
· Derived time in range: 78 % (70 - 180 mg/dl)
· % metingen < 70 mg/dl: 2 %

- ‘spuit soms Toujeo niet bij hypoglycemie of maar 20E’
- ‘ik slaag Novorapid soms over als ik goed sta’
- Beweging: fietsen en wandelen, regelmatig lagere afstand bv 8-13 km.
- Hba1c 5,5%

Tijd binnen Bereiken

Doelen voor diabetes type 1 en type 2

Elke 5% verhoging in het streefbereik is gunstig op klinisch gebied.
Elke 1%-tijd binnen bereik = ongeveer 15 minuten per dag



0% Erg Hoog
Doel: <5%

6% Hoog

6%
Doel: <25%

92% Binnen Bereik
Doel: >70%

2% Laag

<1% Erg Laag
Doel: <1%

2%
Doel: <4%

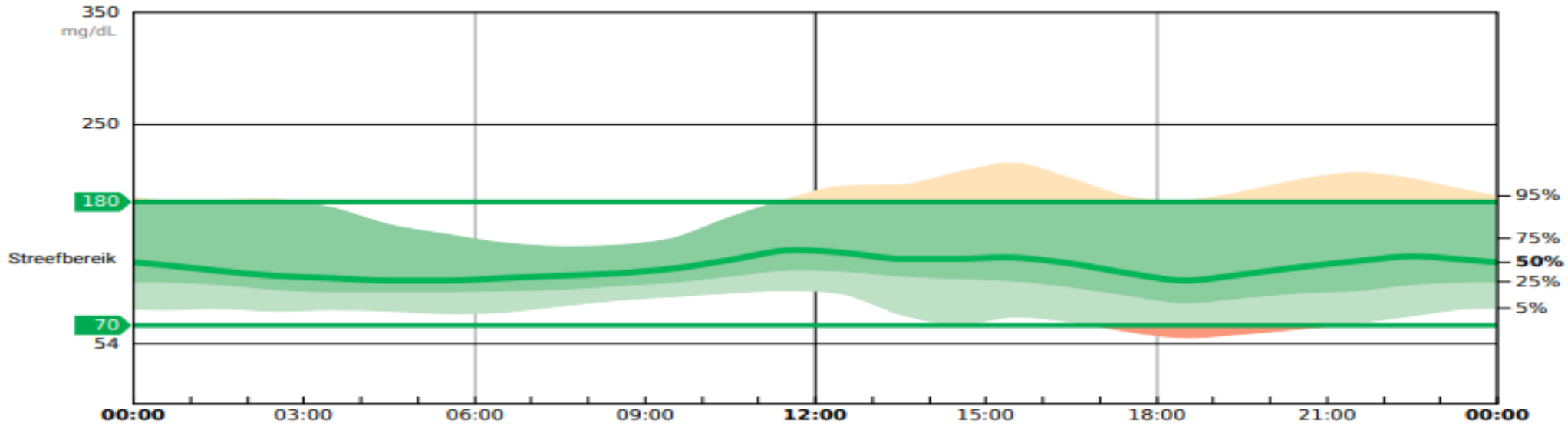
Streefbereik: 70-180 mg/dL
Erg hoog: Boven 250 mg/dL
Erg laag: Onder 54 mg/dL

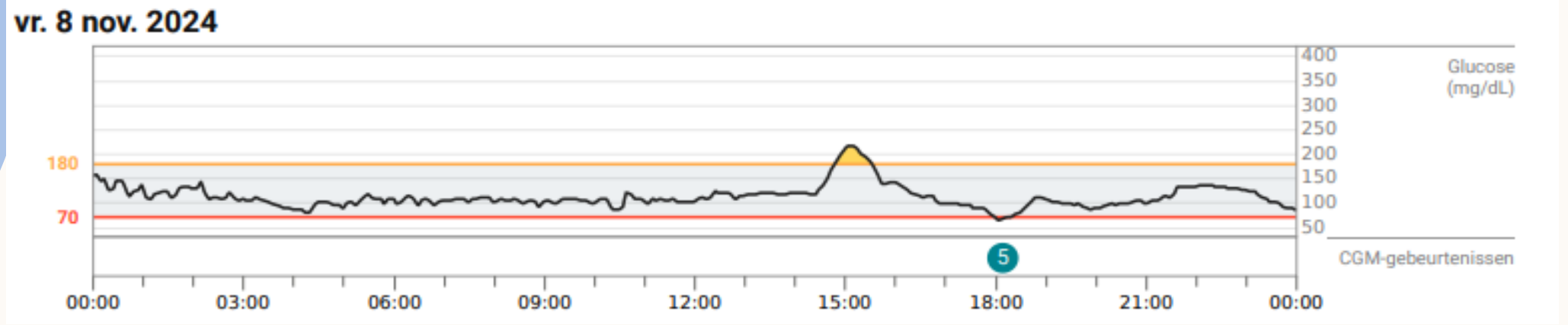
Glucosestatistieken

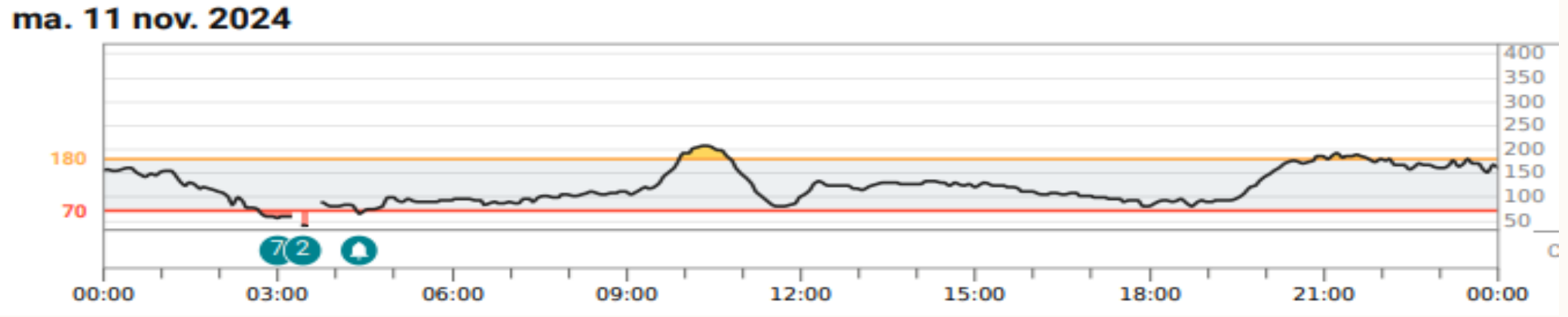
Gemiddelde glucose Doel: <154 mg/dL	125 mg/dL
GMI Doel: <7%	6,3%
Variatie coëfficiënt Doel: <36%	25,6%
Tijd CGM actief	98,6%

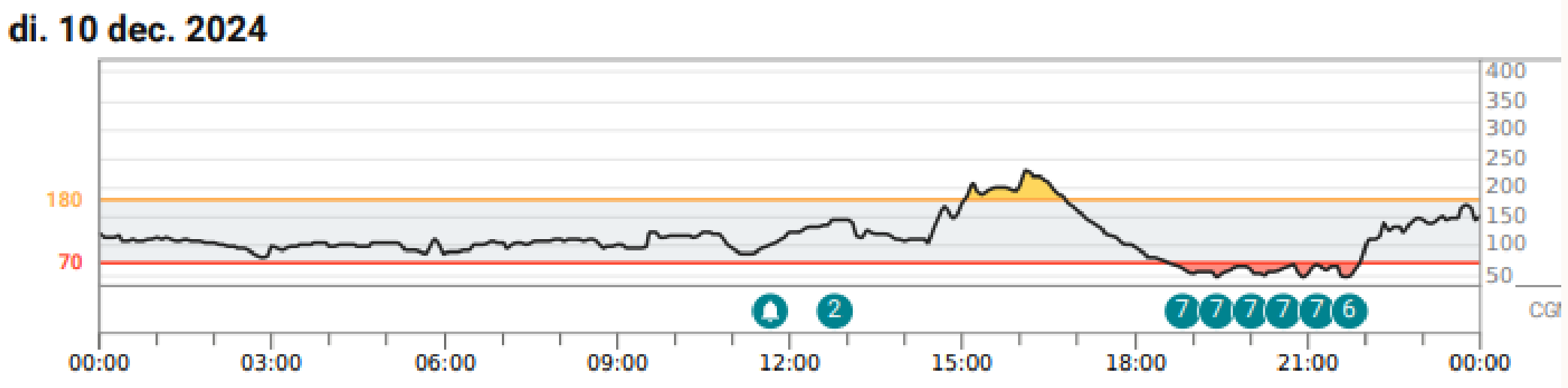
Ambulatory Glucose Profile (AGP)

AGP is een samenvatting van glucosewaarden uit de rapportperiode, waarbij de mediaan (50%) en andere percentielen worden weergegeven alsof ze op één dag zijn opgetreden.




vr. 8 nov. 2024
Glucose (mg/dL)
400
350
300
250
200
150
100
50
180
70
5
CGM-gebeurtenissen
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00

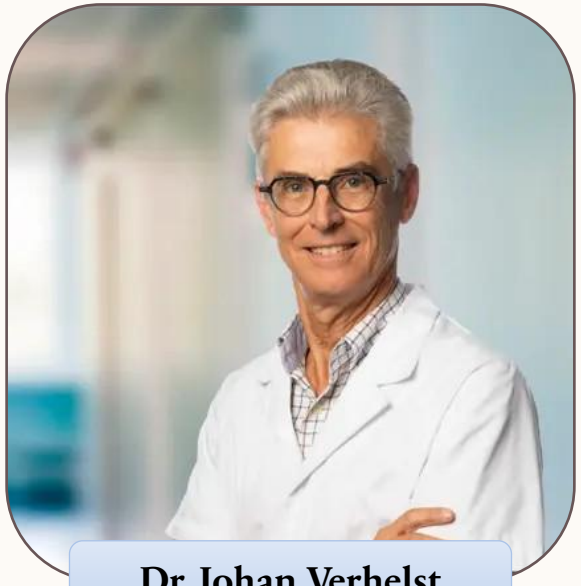

ma. 11 nov. 2024
400
350
300
250
200
150
100
50
180
70
7
2
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00


di. 10 dec. 2024
400
350
300
250
200
150
100
50
180
70
2
7
7
7
7
7
6
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00

BEDANKT

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Dr. Kim Bernaerts



Dr. Ben Broos



Dr. Yentl De Roeck