

Eriřkinlerde Tip 1 ve Tip 2 Diabetes Mellitus Tedavisinde Srekli Glukoz İzleminin(CGM) Kullanımı

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Endokrinoloji ve Metab. Hast. Kliniđi



KOÇ NİVERSİTESİ
HASTANESİ

Çerçeve

- DM kontrolü T1 ve T2 DM
- Hedeflere ulaşmada seçenekler
- Glukoz izleminin erişkin DM 'da önemi
- SGI:
 - DM kontrolündeki yeri
 - Değerlendirme parametreleri
- Klavuz önerileri



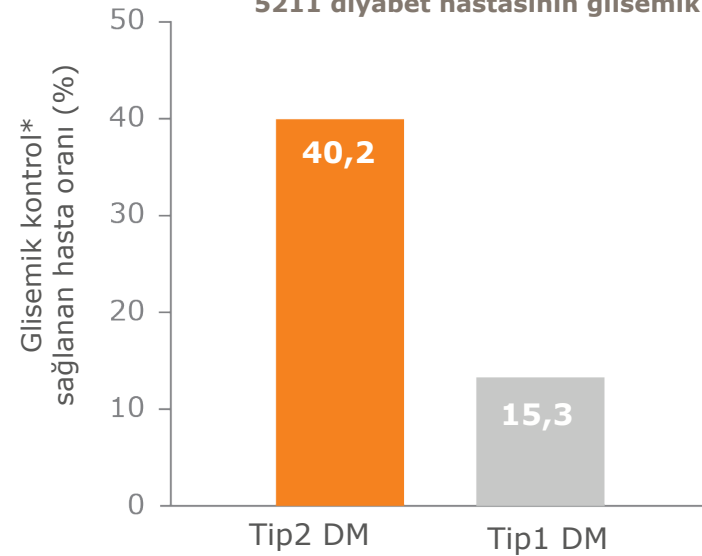
Turkish nationwide survEy of glycemik and other
Metabolic parameters of patients with Diabetes
mellitus (TEMd study)



Türkiye'de glisemik kontrol yetersizdir¹

Turkish Nationwide SurvEy of
Glycemic and Other Metabolic
Parameters of Patients with
Diabetes Mellitus (TEMd Study)

Devlet / üniversite hastanelerinde (%90) veya özel
hastanelerde (%10) en az bir yıl süre ile takip edilen
5211 diyabet hastasının glisemik kontrol düzeyleri



* HbA1c < %7



ELSEVIER

Contents available at ScienceDirect

Diabetes Research and Clinical Practice

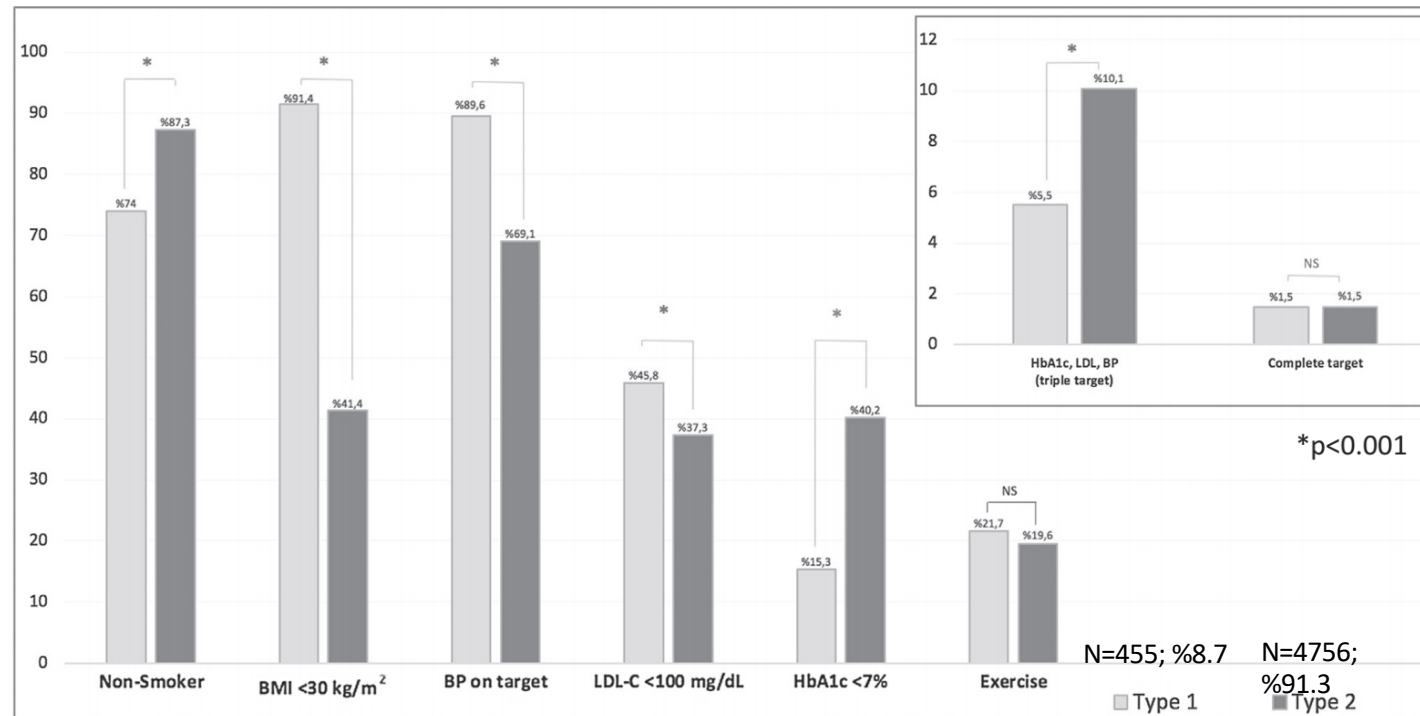
journal homepage: www.elsevier.com/locate/diabres

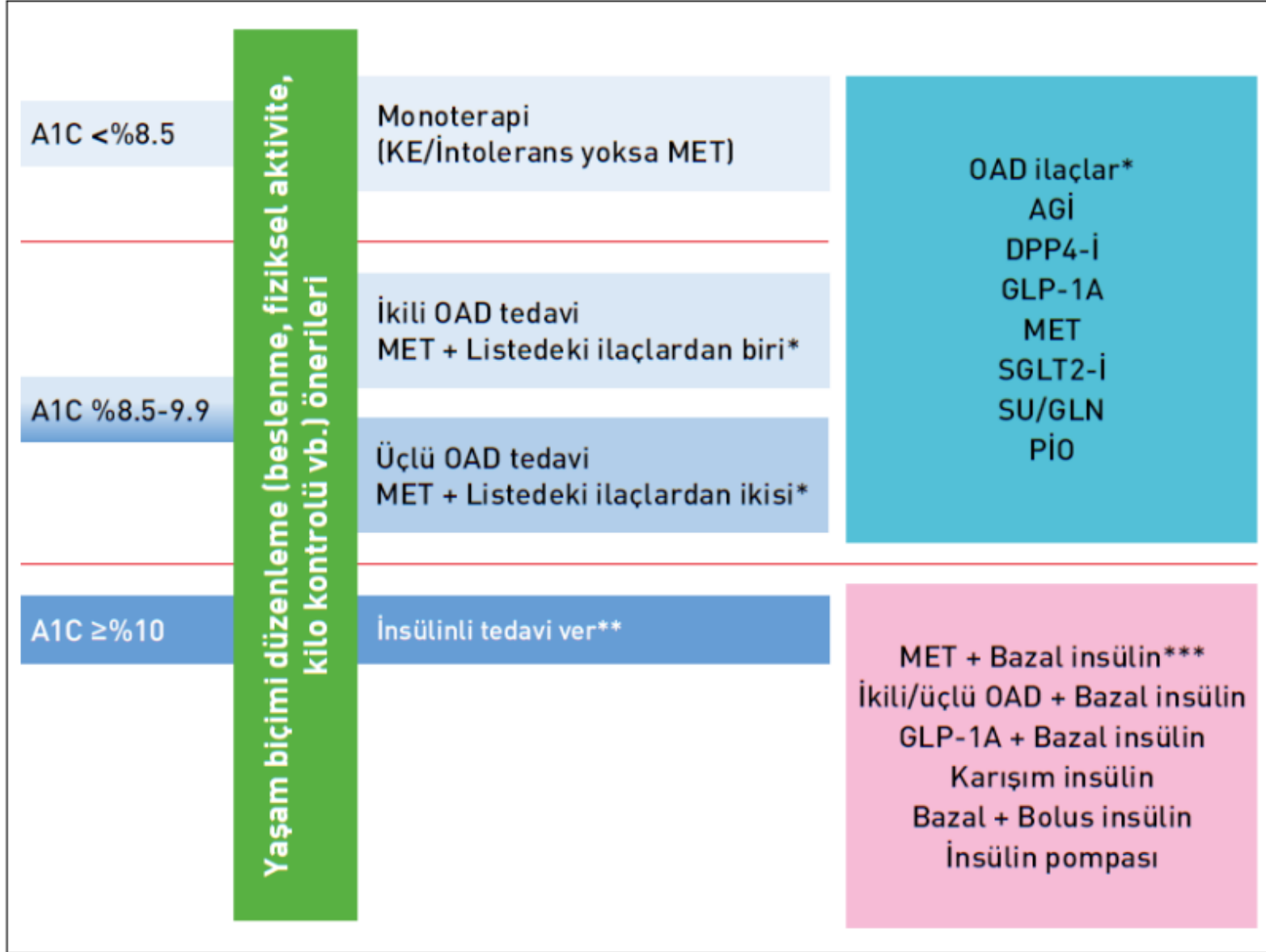


International Diabetes Federation



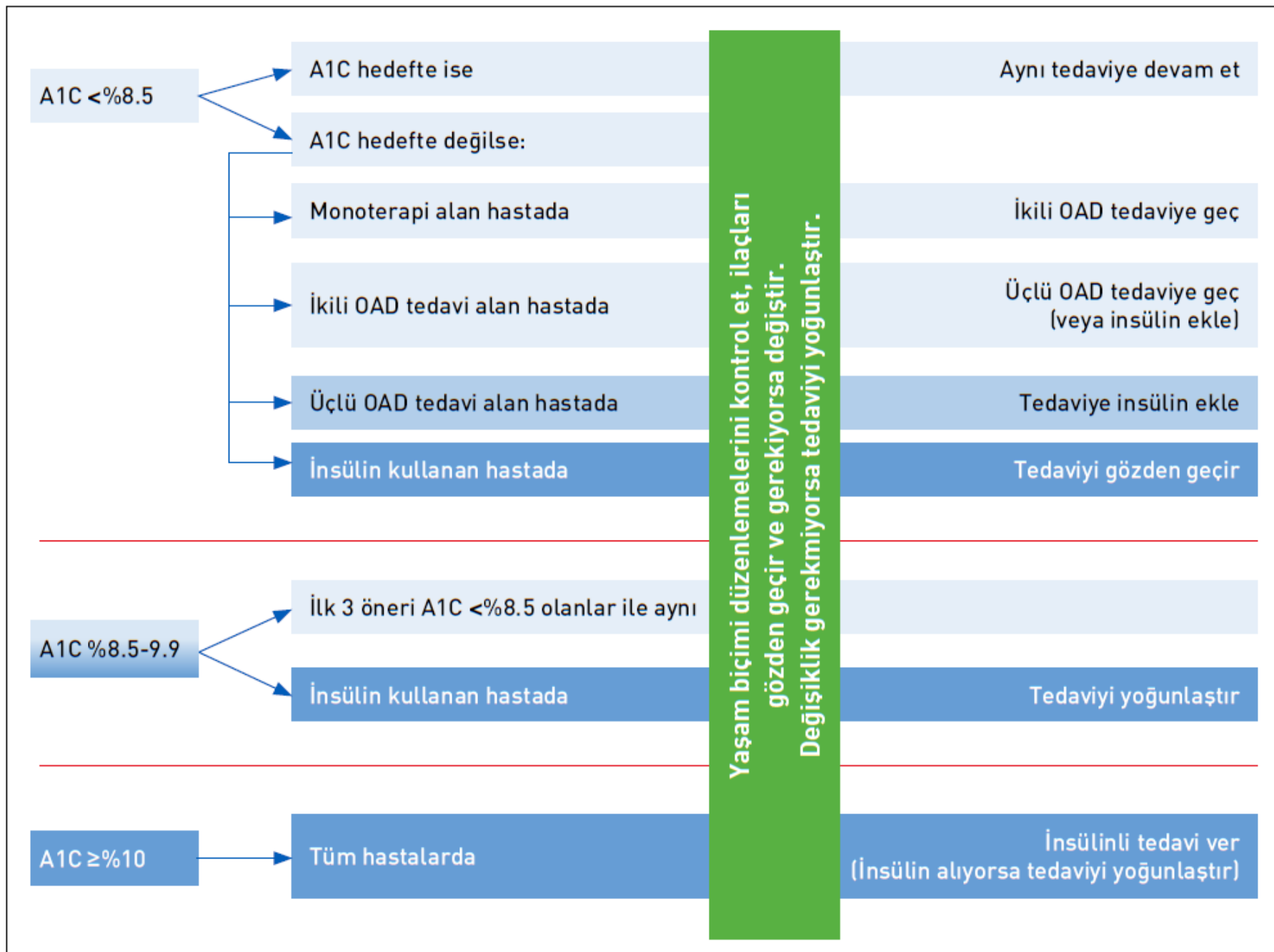
Turkish nationwide survey of glycemic and other Metabolic parameters of patients with Diabetes mellitus (TEMMD study)





Takip:
3 ay sonra A1C kontrol
(Bknz Şekil 9. 2)

	AVANTAJ	DEZAVANTAJ
Etkinlik	İnsülin, SU, MET, GLP-1A, PİO	AGİ, GLN, DPP-4İ, SGLT2-İ
Hipoglisemi riski	AGİ, DPP4-İ, GLP-1A, SGLT2-İ, PİO, MET	İnsülin, SU, GLN
Kilo değişimi	GLP-1A, SGLT2-İ	İnsülin, SU, GLN, PİO
Maliyet	MET, SU, AGİ	GLP-1A
Yağlı KC hast	PİO	
KKY	SGLT2-İ	PİO, Saksagliptin
Kardiyore-nal koruma	GLP-1A, SGLT2-İ	



Glukoz İzlemi

Tarihsel Yöntem



Glukoz İzlemi



Dextrometer - 1969

Günümüzde kan şekeri ölçüm cihazları

küçük,

kullanımı basit,

güvenilir,

daha ucuz, 0.6 μL kan ile

kısa sürede ölçüm yapabiliyorlar.

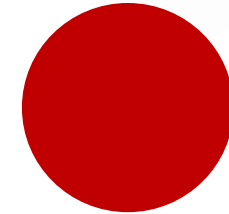
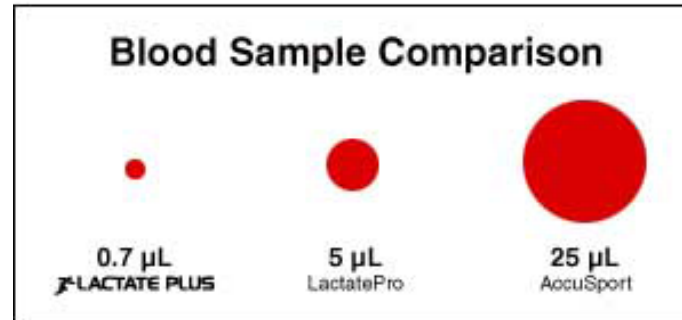
50 microliter kan gerekli

Metal ucu jilete benzer lanset ile kan alınıyor.

Ölçüm süresi çabuk ?? (5 dakika)

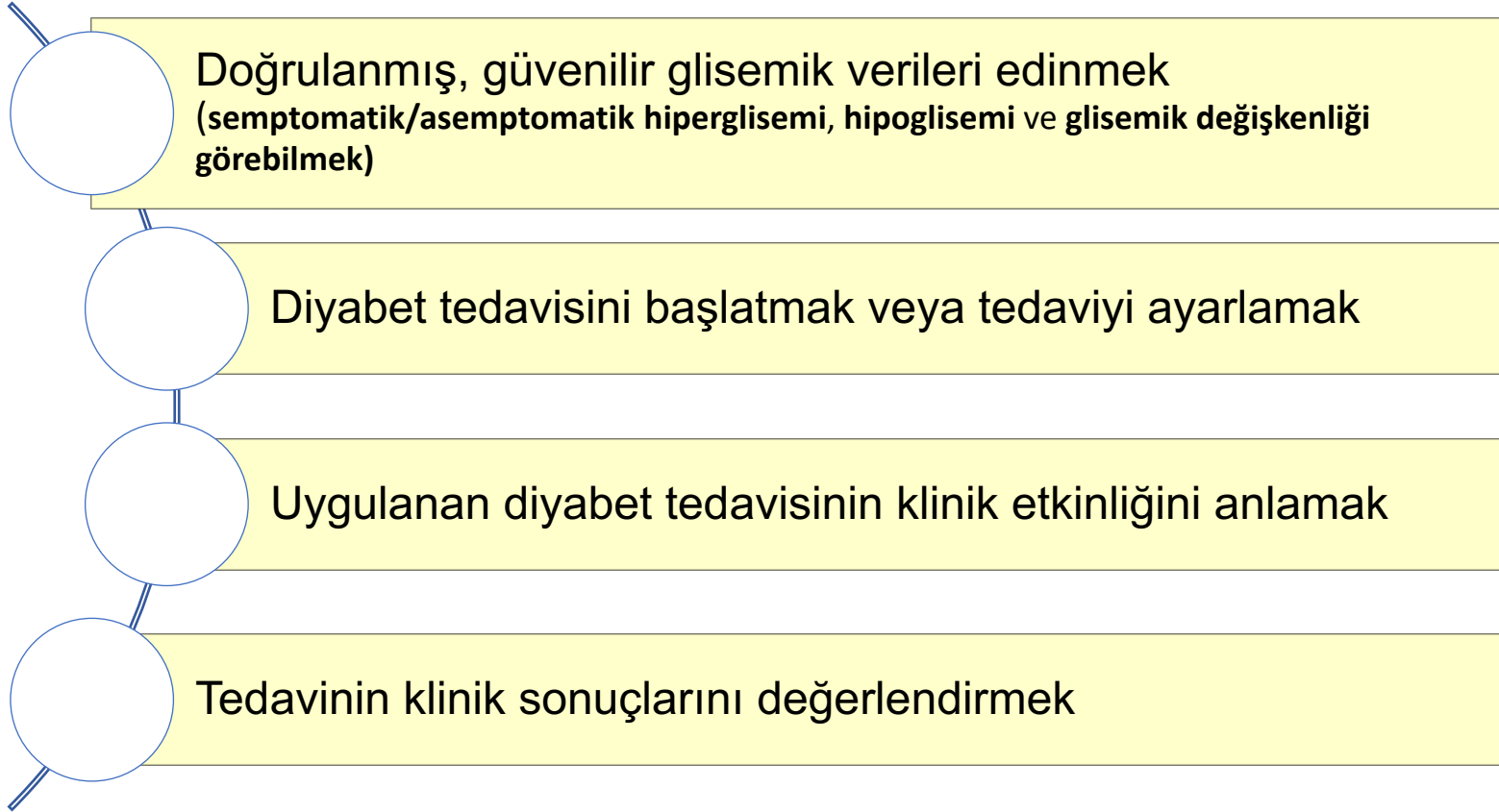
Strip'in yıkanması gerekiyor.

Fiyatı 499 \$





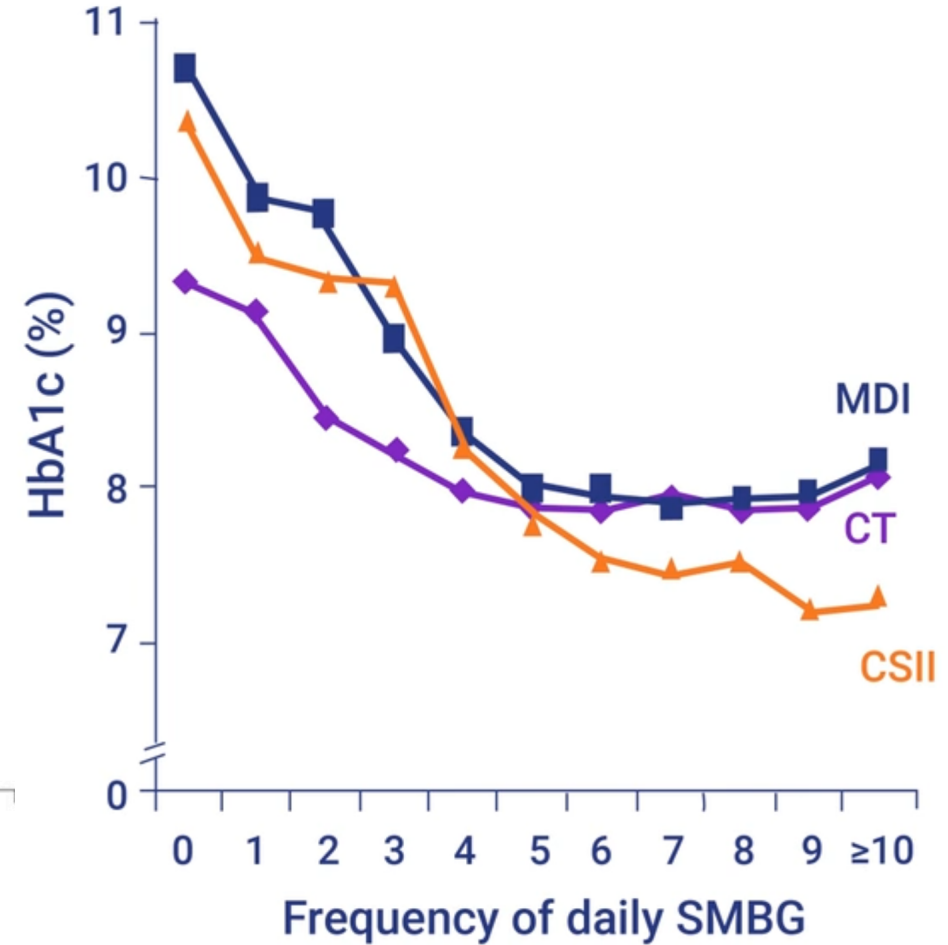
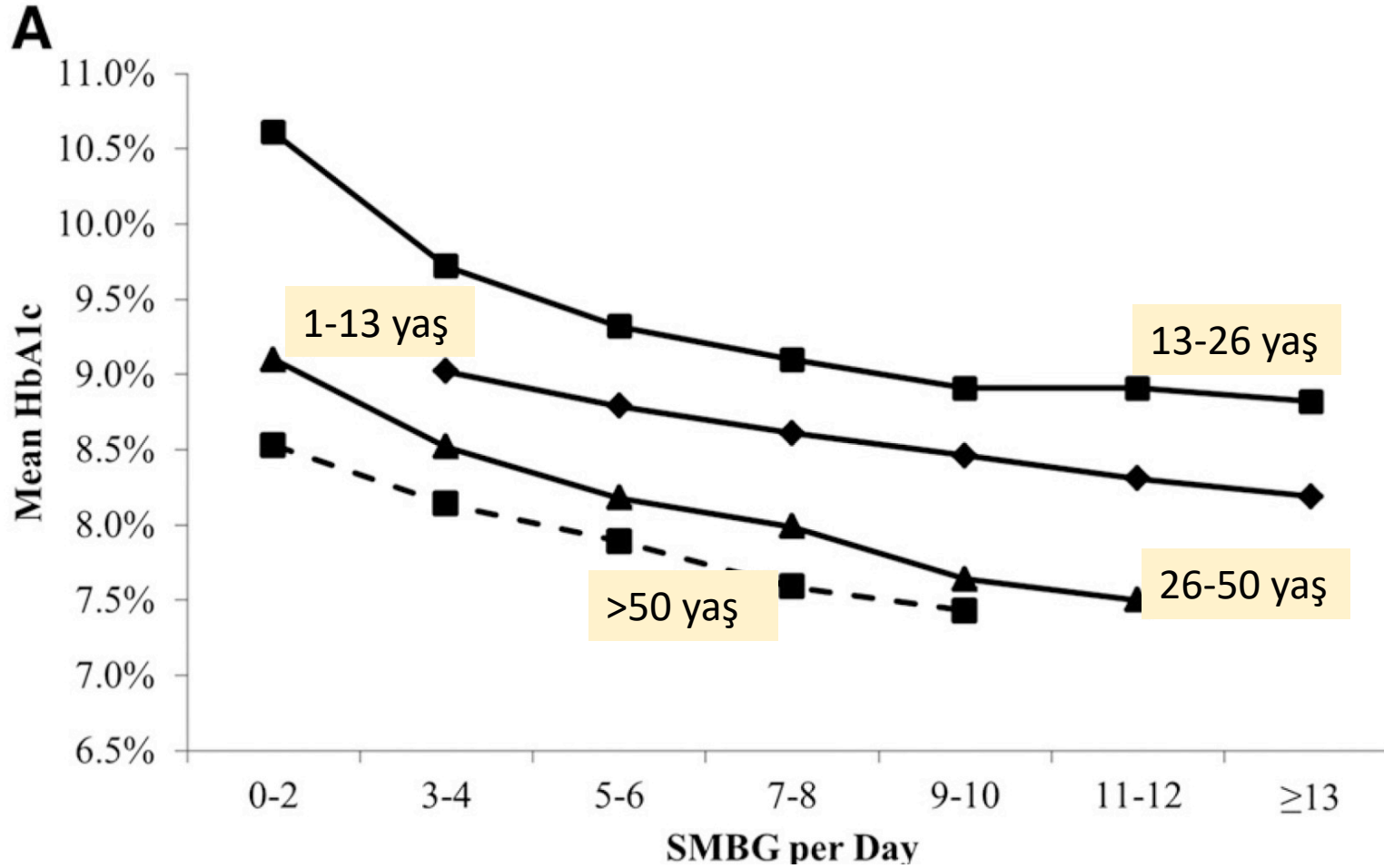
GLUKOZ TAKİBİNE NEDEN İHTİYAÇ DUYUYORUZ?







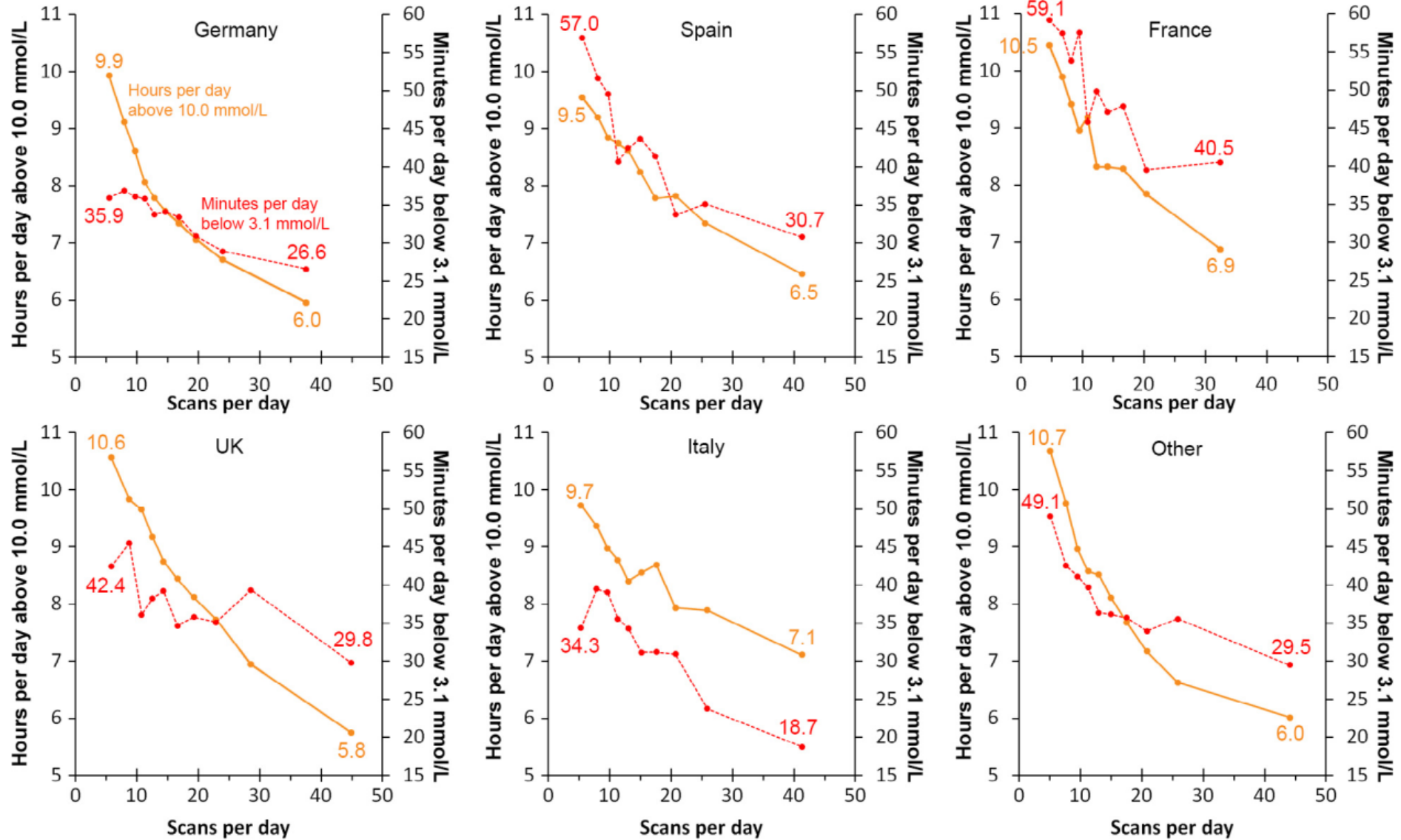
HbA1c ve Günlük Kan Şekeri İzlem Sıklığının İlişkisi



Miller KM, Beck RW, Bergenstal RM, et al. T1D Exchange Clinic Network. Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1c levels in T1D exchange clinic registry participants. *Diabetes Care*. 2013; 36:2009-14.

Ziegler R, Heidtmann B, Hilgard D, Hofer S, Rosenbauer J, Holl R; DPV-Wiss-Initiative. Frequency of SMBG correlates with HbA1c and acute complications in children and adolescents with type 1 diabetes. *Pediatr Diabetes*. 2011 Feb;12(1):11-7.

Glucose control measures for hyperglycaemia and hypoglycaemia by glucose check frequency for different geographic regions.



DAHA İYİ BİR DİYABET YÖNETİMİNDE 3 ANAHTAR KRİTER ?

- Diyabet yönetiminde hedef, kısa ve uzun dönem ciddi komplikasyon riskini azaltmak için **glukoz seviyelerini düşürmektir***.
- Bu hedefe ulaşmak için hastalar ve hekimleri glukoz seviyelerini **düzenli olarak takip** etmelidir.
- SMBG ve HbA1c hastaların glukoz seviyelerindeki değişikliklerin eksiksiz bir resmini sağlamakta yetersiz kalabilir. Bunun sebebi glisemik değişkenliğin tamamını gösteremiyor olmalarıdır*.
- Diyabet tedavisinde daha doğru, kişiye özel kararlar almaya yardımcı olacak, **etkili, pratik ve kapsamlı** bir şeker ölçüm yöntemine ihtiyaç vardır



FreeStyle Libre

8800

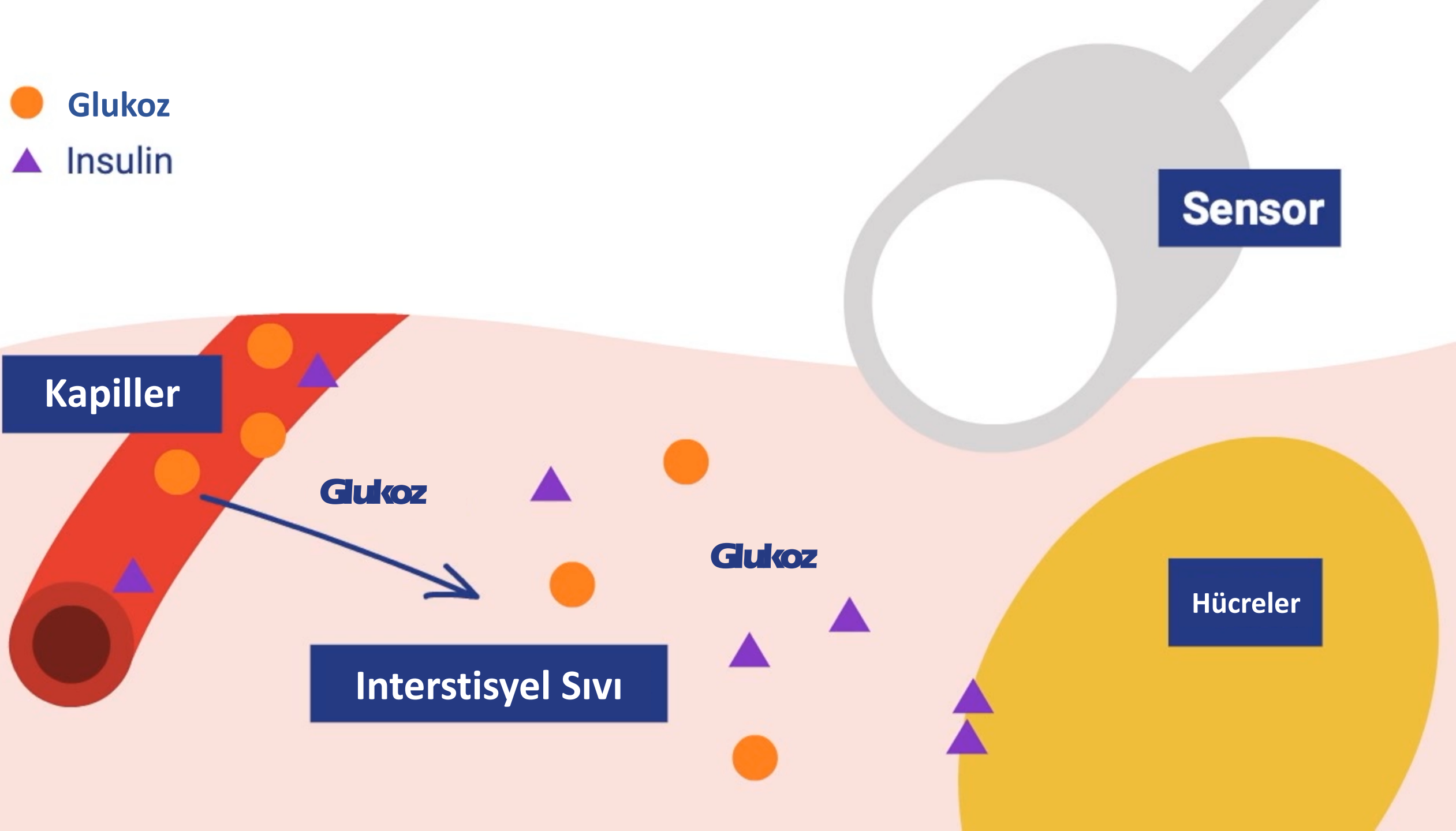
57
mg/dL

60[→]

FreeStyle Libre

- SGI sonucunu deęerlendirirken hatırlanması gereken önemli bir nokta sensörler plazma glukozunu deęil interstisyel sıvıdaki şekeri ölçerler.

- Glukoz
- ▲ Insulin



Kapiller

Glukoz

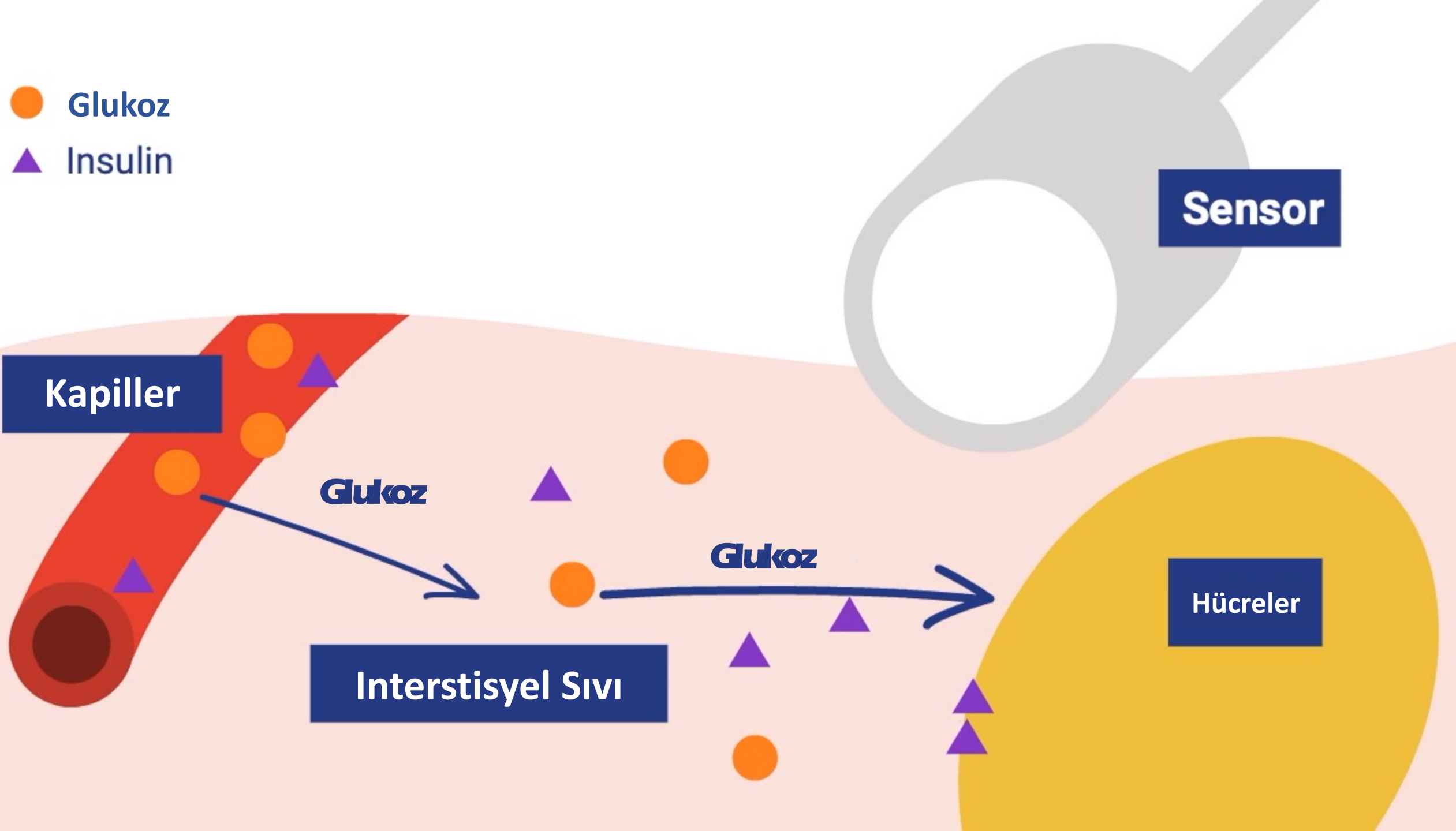
Interstisyel Sıvı

Glukoz

Sensor

Hücreler

- Glukoz
- ▲ Insulin



Kapiller

Sensor

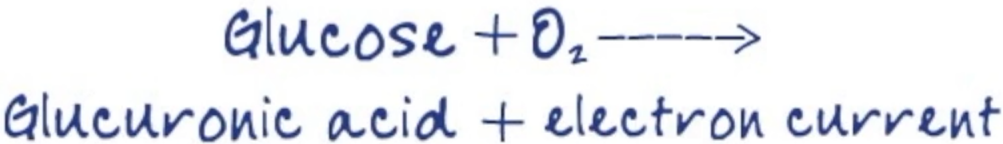
Glukoz

Glukoz

Interstisyel Sıvı

Hücreler

- Glukoz
- ▲ Insulin



Kapiller

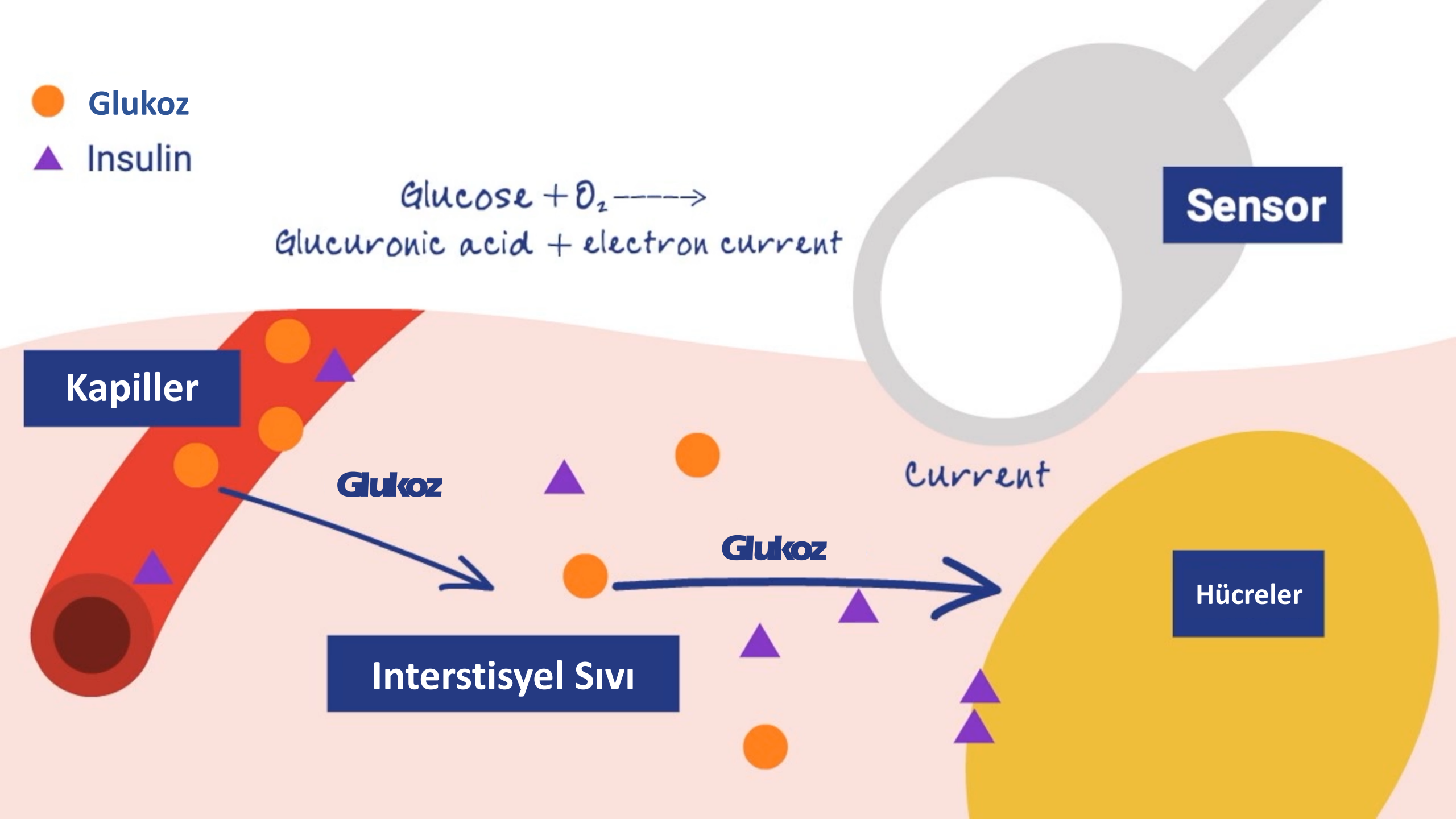
Glukoz

Current

Glukoz

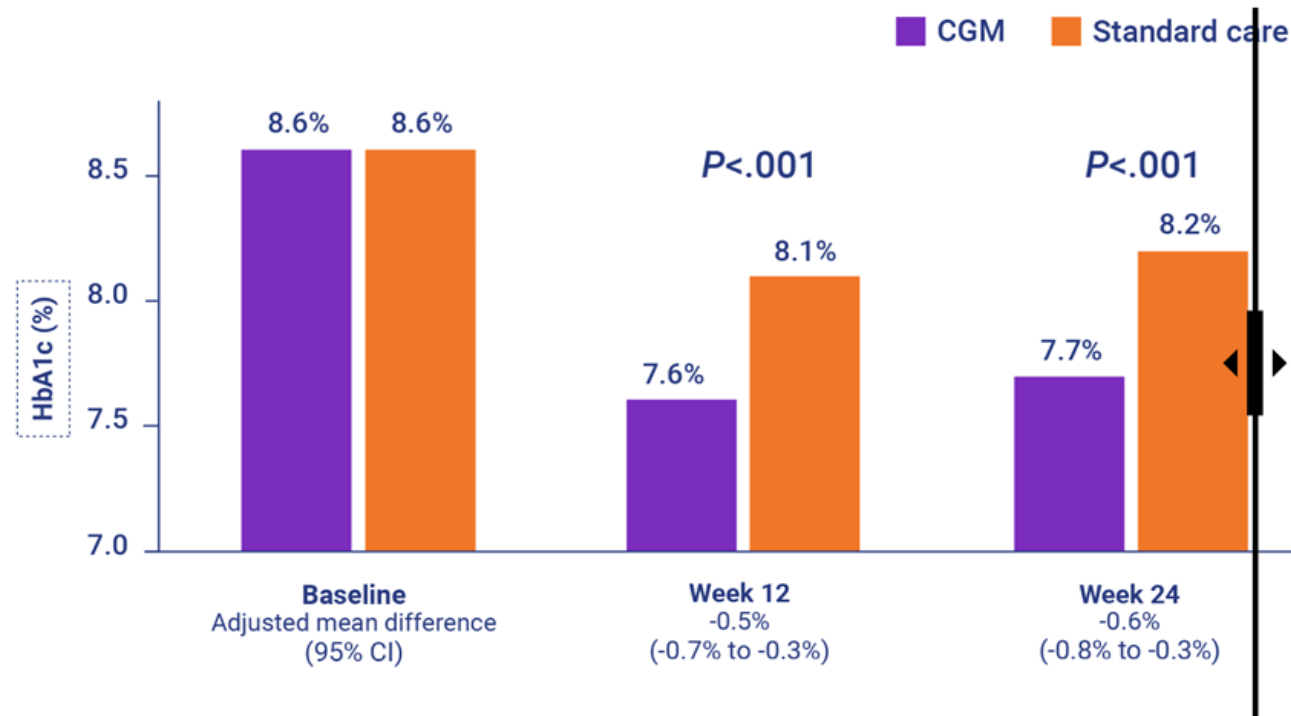
Interstisyel Sıvı

Hücreler



Effect of Continuous Glucose Monitoring on Glycemic Control in Adults With Type 1 Diabetes Using Insulin Injections: The DIAMOND Randomized Clinical Trial

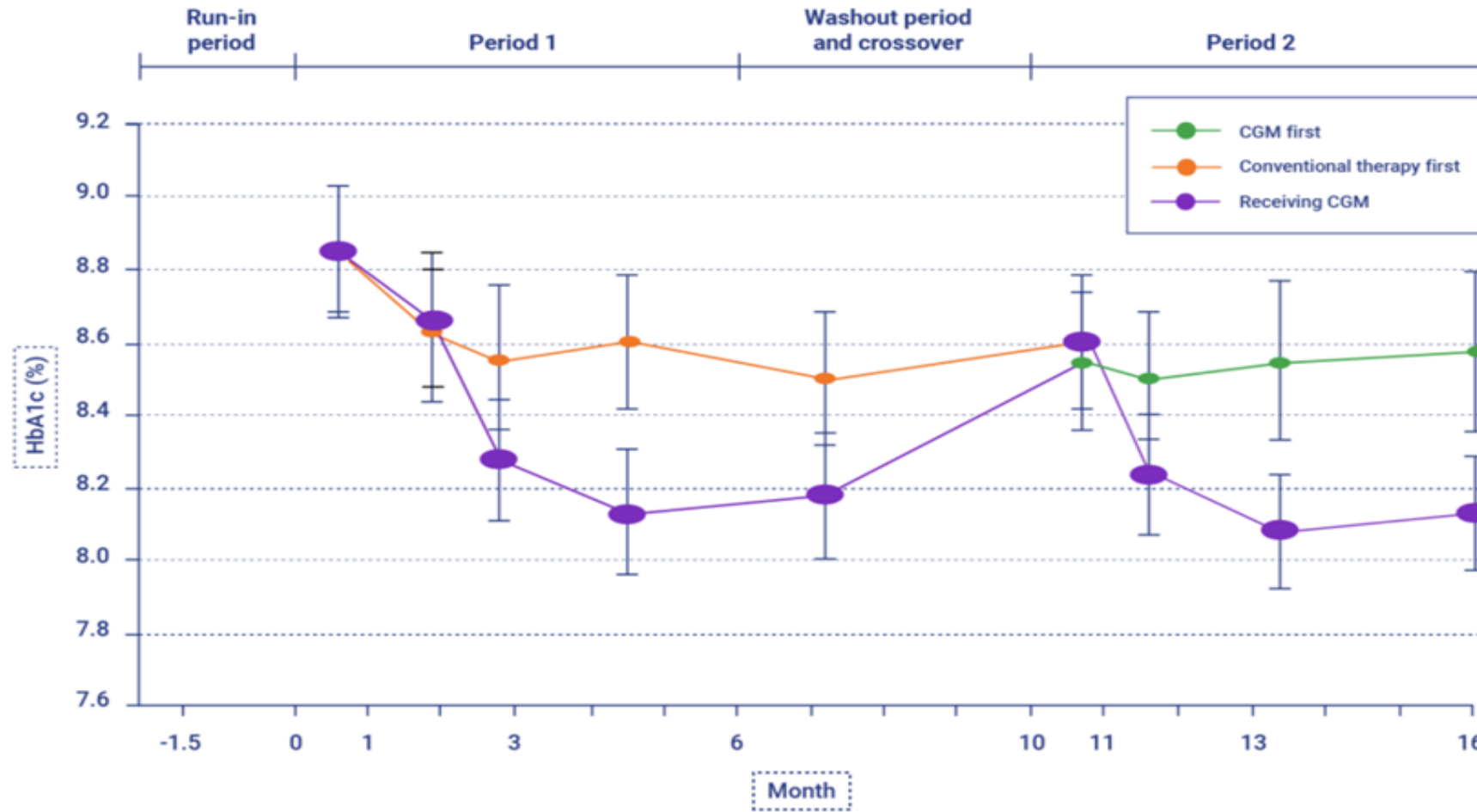
Impact of CGM added to multiple daily insulin injections (MDI) [DIAMOND study]



Continuous Glucose Monitoring vs Conventional Therapy for Glycemic Control in Adults With Type 1 Diabetes Treated With Multiple Daily Insulin Injections

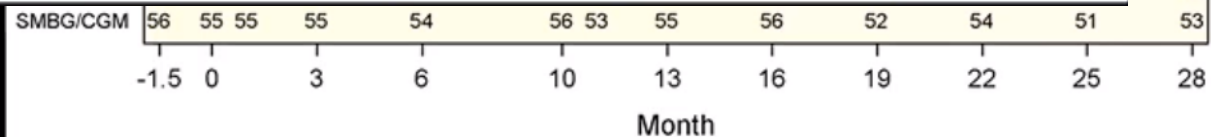
The GOLD Randomized Clinical Trial

Marcus Lind, MD, PhD; William Polonsky, PhD; Irl B. Hirsch, MD; Tim Heise, MD; Jan Bolinder, MD, PhD; Sofia Dahlqvist; Erik Schwarz, MD, PhD; Arndís Finna Ólafsdóttir, RN; Anders Frid, MD, PhD; Hans Wedel, PhD; Elsa Ahlén, MD; Thomas Nyström, MD, PhD; Jarl Hellman, MD



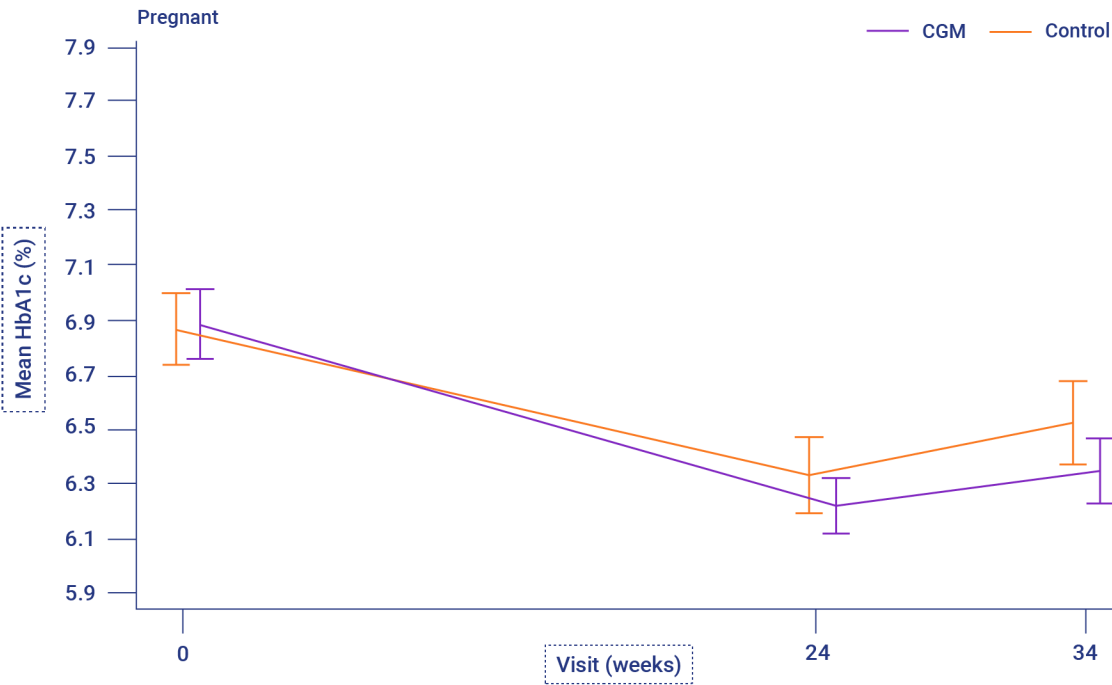
Sustained Intensive Treatment and Long-term Effects on HbA1c Reduction SILVER Study By CGM in Persons with Type 1 Diabetes Treated with MDI

Effect Over 2.5 Years	SMBG GOLD	CGM SILVER	DIFFERENCE	P-VALUE
HbA1c (%)	8.5	8.0	-0.45	<0.001
HbA1c (mmol/mol)	68.8	63.5	-5	<0.001
Percent of time with glucose levels <3.0 mmol/l (54 mg/dl)	2.1	0.6	-1.5	<0.001
Percent of time with glucose levels <4.0 mmol/l (72 mg/dl)	5.5	2.9	-2.5	<0.001
Time in range	40	51	11.3	<0.001



Marcus Lind Professor of diabetology, University of Gothenburg, Sweden
 Authors: Marcus Lind, Arndís F. Ólafsdóttir, Jan Bolinder, Sofia Dahlqvist, Aldina Pivodic, Jarl Hellman, Magnus Wijkman, Erik Schwarcz, Henrik Albrektsson, Tim Heise, William Polonsky
ADA 2020

CONCEPTT Collaborative Group. Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT

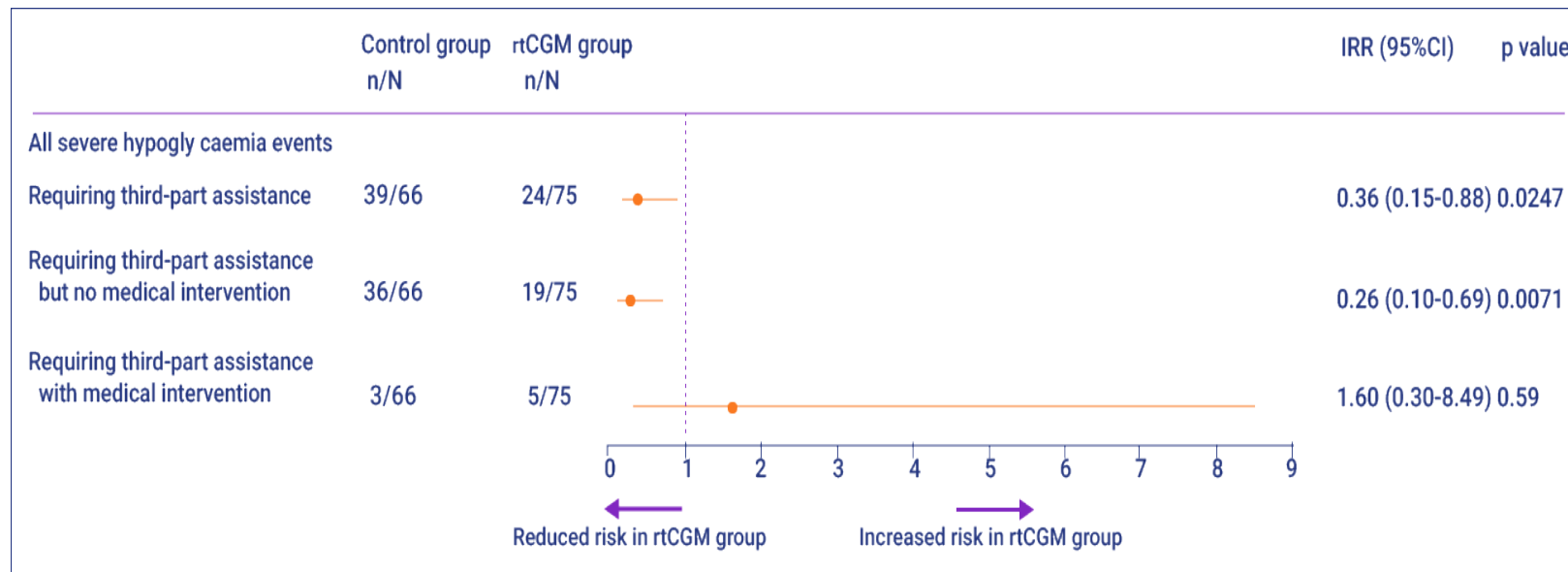


	CGM	Control
Stillbirth	0	1
Congenital anomaly	2	3
Early preterm < 34 weeks	5%	7%
LGA > 90 %	53%*	69%
Mascrosomia > 4000g	23%*	27%
NICU > 24 hrs	27%*	43%

6 Anne adayının CGM kullanımı 1 Neonatal YBÜ ihtiyacını engelliyor

Real-time continuous glucose monitoring in adults with type 1 diabetes and impaired hypoglycaemia awareness or severe hypoglycaemia treated with multiple daily insulin injections (HypoDE): a multicentre, randomised controlled trial.

- In patients with impaired awareness of hypoglycaemia OR recent severe hypoglycaemia:
 64% reduction in severe hypoglycaemia events with CGM with alarms
 No restoration of awareness

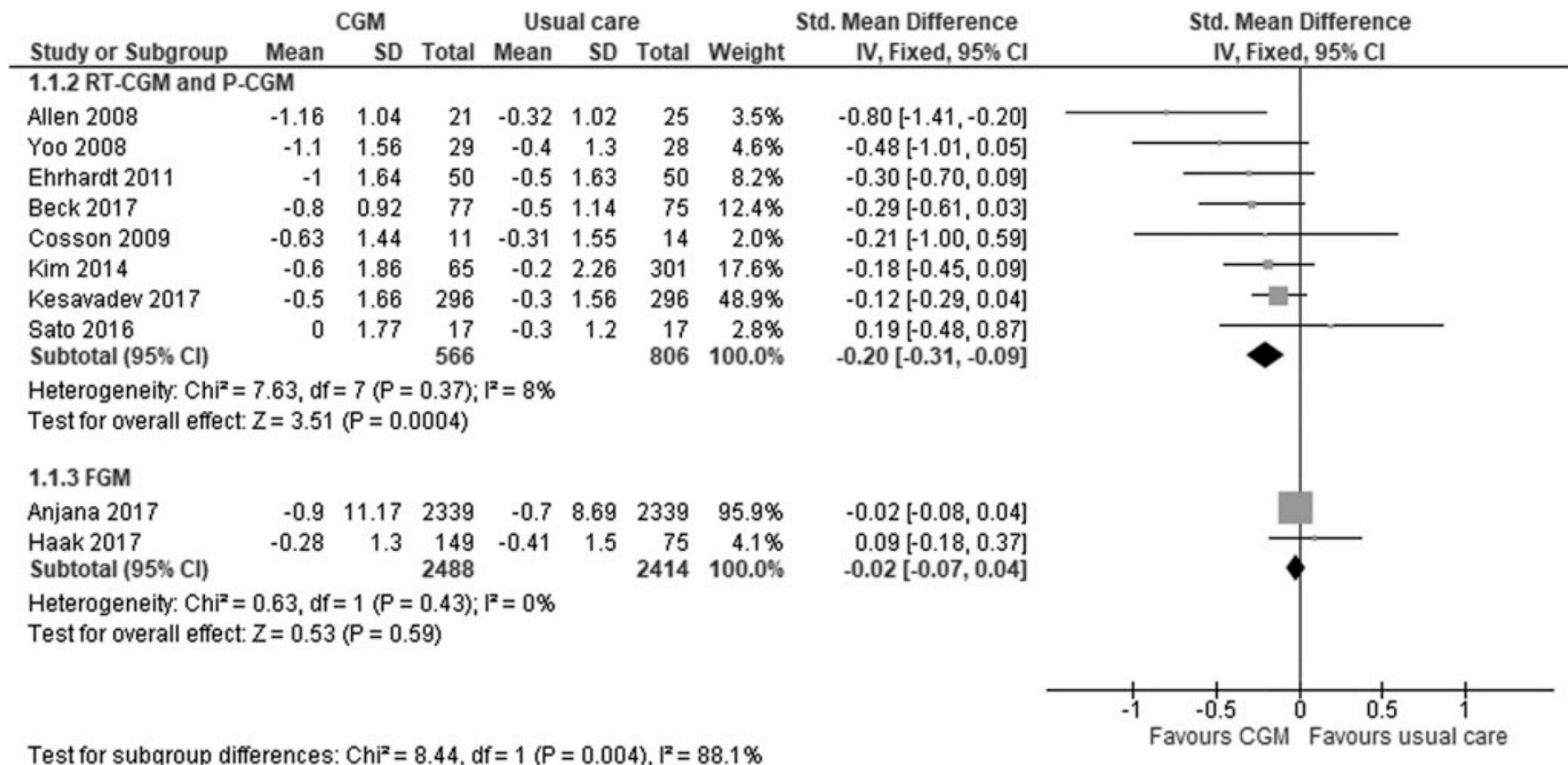


META-ANALYSIS

The Effectiveness of Continuous Glucose Monitoring in Patients with Type 2 Diabetes: A Systematic Review of Literature and Meta-analysis

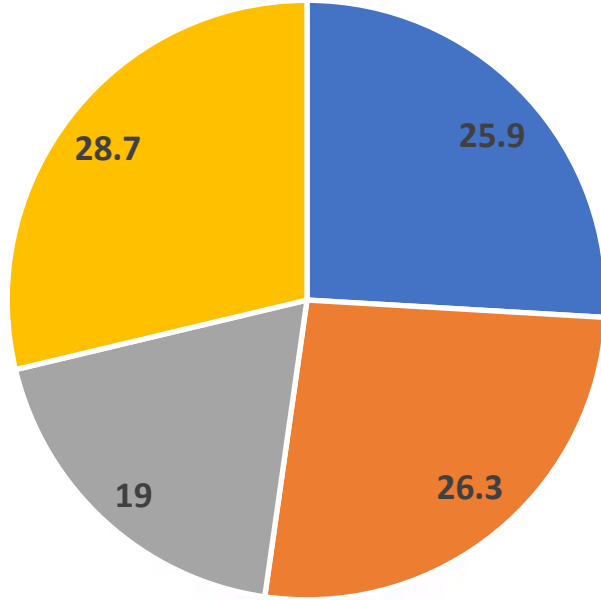
Cin	Study (publication year)	Total sample size	Study duration (weeks)	Country	Device	Mean age (SD) (years)	Gender, males (%)	Insulin use	Inclusion criteria	Exclusion criteria	Change in HbA1c from baseline (SD) (%)	Other outcomes	Details
Randomized controlled trials													
	Beck et al. ¹⁴ (2017)	158	24	United States, Canada	Dexcom™ G4 Platinum	CGM 60 (11); control 60 (9)	44	156	Age ≥25 years; type 2 diabetes treated with multiple daily injections of insulin for ≥1 year; HbA1c levels of 7.5% to 10%; stable diabetes medication regimen ≥3 months	Use of RT-CGM past ≤3 months; plan to use CGM during study; pregnancy; renal disease	CGM 8.5 (0.6) to 7.7 (0.7); control 8.5 (0.7) to 8 (0.9); adjusted difference -0.3 (95% CI -0.5% to 0%); <i>p</i> =0.022	No meaningful differences in severe hypoglycemia, diabetic ketoacidosis, or quality-of-life outcomes	CGM used daily; control group asked to monitor BG at least 4 times a day; therapy managed by the usual providers
	Cosson et al. ¹⁵ (2009)	25	24	France	GlucoDay®	CGM 57.2 (4.4); control 57.3 (5.9)	68	9	Age 40–70 years; type 2 diabetes treated with oral antidiabetic agents with or without insulin at stable dosage ≥3 months; HbA1c levels of 8%–10.5%; SMBG ≥4 times a week; no previous experience with CGM; routine follow-up at the study center for ≥1 year	Pregnancy; acute disease with subsequent poor glycemic control; proliferative retinopathy; and renal failure	CGM 9.22 (0.99) to 8.59 (1.04), adjusted difference -0.63 (0.34), <i>p</i> =0.05; control 9.07 (0.6) to 8.76 (1.43), adjusted difference -0.31 (0.29), <i>p</i> =0.18	5.8% CGM group reported uncomplicated implantation site skin reactions; no significant differences in hypoglycemia	CGM implanted and removed after 48 h for both groups (repeated after 3 months); only intervention group had CGM results disclosed; therapy managed by their usual providers
	Ehrhardt et al. ²¹ (2011)	100	12	United States	Dexcom™ SEVEN®	CGM 60 (11.9); control 55.5 (9.6)	55	33	Age ≥18 years; type 2 diabetes for ≥3 months; HbA1c levels of 7% to 12%; willing to perform SMBG 4 times daily	Use of prandial insulin; pregnant, lactating, or attempting pregnancy; use of glucocorticoids, amphetamines, anabolic or weight reducing medications	CGM 8.4 (1.3) to 7.4 (1); control 8.2 (1.1) to 7.7 (1.2); adjusted difference -0.6; <i>p</i> =0.002	No differences in net change in number or dosage of hypoglycemic agents; no improvements in blood pressure and weight	Four 2-week cycles (2 weeks on/1 week off) of RT-CGM for a total of 12 weeks; therapy managed by their usual providers
	Sato et al. ²⁷ (2016)	34	32	Japan	iPro®2	CGM 59.9 (9); control 63.1 (8.5)	59	34	Age ≥20 years; type 2 diabetes on insulin; HbA1c levels of 6.9% to 11% and fluctuations within ±5% prior 3 months; regular visit to clinic	Proliferative retinopathy; serious liver disease; serious kidney disease; acute heart failure; active malignancy; serious pancreatic disease; pregnancy	CGM 8.2 (1.2) to 8.2 (1.3), <i>p</i> ≥0.05; control 8.2 (0.9) to 7.9 (0.8), <i>p</i> ≥0.05	No significant difference in patient satisfaction (DTSQ score) between groups	2 Visits with 4- to 5-day continuous recording of retrospective CGM per visit for both groups; only intervention group had CGM results disclosed; guidance and treatment recommendations provided by study team
	Yoo et al. ¹⁶ (2008)	57	12	South Korea	Guardian® RT	CGM 54.6 (6.8); control 57.5 (9)	42	32	Age 20–80 years; type 2 diabetes treated with insulin or oral hypoglycemic agents for ≥1 year; HbA1c levels of 8% to 10%; stable diabetes medication regimen ≥2 months	Severe diabetic complications; corticosteroid use past ≤3 months; liver disease; renal insufficiency	CGM 9.1 (1) to 8 (1.2); control 8.7 (0.7) to 8.3 (1.1); <i>p</i> =0.004	Significant increase in total exercise time per week in CGM group compared with control group; no significant differences in dropout rates, reports of skin reactions, or hypoglycemic events weight, and BMI, waist circumference, FBG, PBG, lipid profiles, and total calorie intake	3-Day RT-CGM once a month for 3 months; control group instructed to check SMBG at least 4 times a week

Study (publication year)	Total sample size	Study duration (weeks)	Country	Device	Mean age (SD) (years)	Gender, males (%)	Insulin use	Inclusion criteria	Exclusion criteria	Change in HbA1c from baseline (SD) (%)	Other outcomes	Details
Allen et al. ²² (2008)	52	8	United States	Medtronic™ MiniMed	CGM 57 (14.56); control 57 (12.47)	48	0	Age ≥18 years; type 2 diabetes not receiving insulin; HbA1c levels >7.5%; not engaged in physical activity more than 2 days/week	Inability to walk 0.25 miles in 10 min; taking glucocorticoids; uncontrolled BP; neuropathy	CGM-adjusted difference −1.16 (1.04), $p<0.05$; control-adjusted difference −0.32 (1.02), $p<0.05$	Significant increase in physical activity and significant decrease in BMI and systolic BP in CGM group compared with control	CGM used for 3 days; therapy managed by their usual providers
Haak et al. ¹⁷ (2017)	224	24	France, Germany, United Kingdom	FreeStyle Libre™	CGM 59.0 (9.9); control 59.5 (11)	67	224	Age ≥18 years; type 2 diabetes treated with insulin for ≥6 months; HbA1c levels of 7.5% to 12%; current diabetes medication regimen ≥3 months; SMBG >10 per week for ≥2 months	A total daily insulin dose of ≥1.75 units/kg; severe hypoglycemia, diabetic ketoacidosis or hyperosmolar-hyperglycemic state past ≤6 months; use of CGM past ≤4 months; pregnant or planning pregnancy; receiving steroid therapy	CGM 8.65 (1.01) to 8.37 (0.83); control 8.75 (0.98) to 8.34 (1.14); 0=0.82	Significant reduction of hypoglycemia in CGM group; no difference in hyperglycemia, insulin dose, and weight; significant increase in patient satisfaction (DTSQ and DQOL); no serious adverse events related to CGM; 4% CGM group reported skin reactions	FGM used daily; control group managed by SMBG
Observational studies												
Kesavadev et al. ¹⁸ (2017)	592	24	India	iPro2, Medtronic™	CGM 54 (13); control 54.47 (11.66)	73	545	Age ≥21 years; type 2 diabetes treated with insulin or oral agents; had baseline P-CGM for 6–7 days and 6-month follow-up evaluation at comprehensive diabetes clinic from June 2010 to August 2014	History of bleeding disorder or on warfarin/heparin; recent history of steroid or alcohol abuse; pregnant or lactating; noncompliant with instructions from diabetes care team	CGM 7.5 (1.4) to 7 (0.9), $p<0.0001$; control 7.7 (1.1) to 7.4 (1.1), $p=0.0663$	Significant increase in frequency of performing SMBG from the baseline in CGM group compared with control	7-Day P-CGM data collected from patient charts; therapy managed by diabetes care team
Kim et al. ¹⁹ (2014)	366	24	South Korea	Medtronic MiniMed	CGM 59 (10); control 59.1 (11)	71	98	Type 2 diabetes; CGM use between December 2008 and November 2009 for CGM group; clinic visit over 3 months starting December 2008 for insulin-treated control group or over 2 weeks for noninsulin-treated control group	Lack of HbA1c measurements before CGM and at 3 months post-CGM use; cancer or severe illness; renal insufficiency;	CGM 7.9 (1.5) to 7.3 (1.1); control 7.9 (1.6) to 7.7 (1.6); $p=0.010$	Significantly more changes in the treatment modality of CGM group compared with control group	3-Day retrospective CGM data collected from patient charts; therapy managed by study team; propensity score matched
Anjana et al. ²⁰ (2017)	4678	24	India	FreeStyle Libre	CGM 57.3 (12.1); control 57.1 (12.2)	61.1	3164	Type 1 or 2 diabetes; FGM-based ambulatory glucose profiling use between March 2015 and October 2016	Lack of HbA1c measurements; HbA1c <7%	CGM 9.2–8.3; control 9.2–8.5; $p<0.001$	30.4% patients had no insulin dose adjustment following AGP, while 33.2% patients had insulin dose increase	14-Day FGM data collected from patient charts; therapy managed by their usual providers



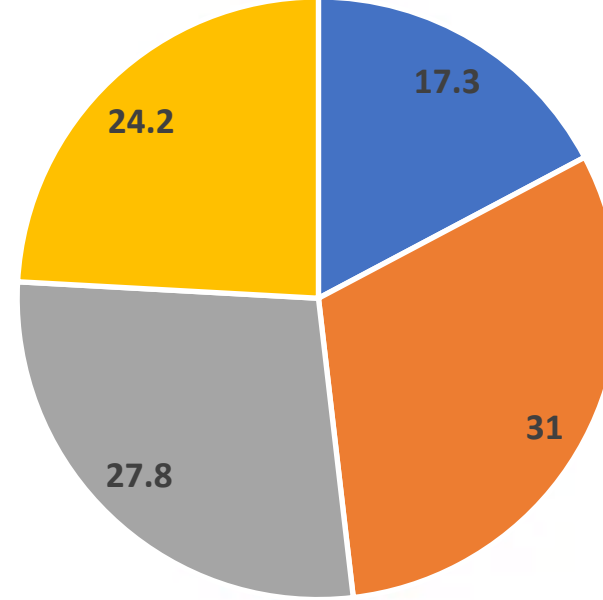
Çalışmaya alınan bireylerin Libre başlangıcından 12 ay önce kan şeker ölçüm çubuğu kullanımları !

• R | >5strip/gün 4-5strip/gün 1-3 strip/gün 0 strip



T1 DM N=33 165

>5strip/gün 4-5strip/gün 1-3 strip/gün 0 strip



T2 DM N=40 846

and

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- Sustainable HbA1c Decrease at 12 Months for Adults with Type 1 and Type 2
- Diabetes Using the FreeStyle Libre System² (Abstract 74-LB): Through a realworld
- analysis of the National Diabetes Register in Sweden, researchers identified 39,554
- people with type 1 or type 2 diabetes using the FreeStyle Libre system. A subgroup of
- people who had used the FreeStyle Libre system for nine to 15 months were able to
- significantly lower their HbA1C levels with a sustained effect at 12 months (0.44% drop in
- people with type 1 diabetes and a 0.66% reduction in those with type 2 diabetes). These
- A1c changes are usually associated with intensification of diabetes treatment regimens
- and highlight the important clinical benefits the FreeStyle Libre system may have in
- people with diabetes.

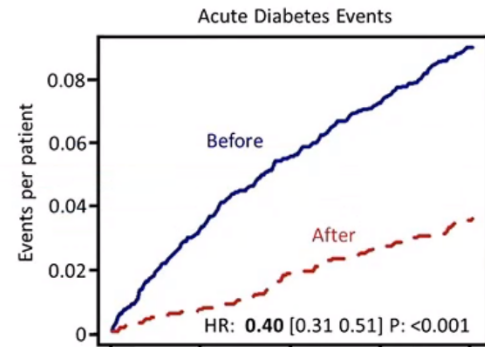
FreeStyle Libre® System Use Is Associated with Reduction in Inpatient and Outpatient Emergency Acute Diabetes Events and All-Cause Hospitalizations in Patients with Type 2 Diabetes

Richard M. Bergenstal¹, MD; Matthew S. D. Kerr², PhD; Gregory J. Roberts², BS; Diana Souto³, BS; Yelena Nabutovsky⁴, MS; Irl B. Hirsch⁵, MD

1. International Diabetes Center, Park Nicollet and HealthPartners, Minneapolis, MN, USA
2. Abbott, Sylmar, CA, USA
3. Abbott Diabetes Care, Alameda, CA, USA
4. Abbott, Santa Clara, USA
5. University of Washington, Seattle, WA, USA

Note: Data presented have been updated to reflect most recent analyses

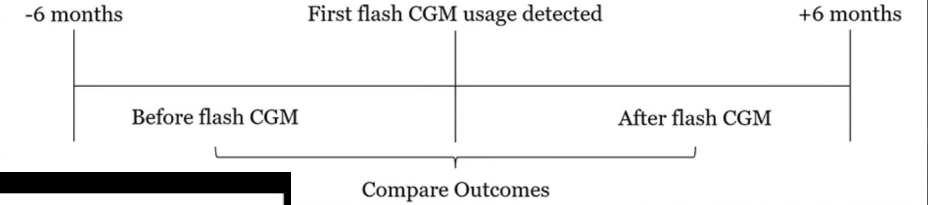
Results: Reduction in Acute Diabetes Events



	0	-45	-90	-135	-180
Before	0	-45	-90	-135	-180
After	0	45	90	135	180
Patients at risk					
Before	2,463	2,463	2,463	2,463	2,463
After	2,463	2,421	2,370	2,276	2,186

	6-months Pre-Purchase	6-months Post-Purchase
Number of Events	221	84
Number of Patients Affected	181	73
Event Rate (per patient-year)	0.180	0.072

Methods: Analysis and Outcomes



	Statistics
Events—combination of inpatient and outpatient events, including hypoglycemia, Ketoacidosis, and hyperosmolarity	<ul style="list-style-type: none"> All hazard ratios computed using Cox regression with Andersen-Gill extension Nelson-Aalen estimator used for visualizations

Methods: Data Source

IBM Watson Health MarketScan®

- Commercial and Medicare Supplemental insurance claims for 30+ million individuals in the US
- Inpatient, outpatient, and prescription-drug information
- Person-level enrollment indicator allows for longitudinal analysis
- Widely published in peer-reviewed journals^{1,2}



1. Edelman SV, Polonsky WH. Type 2 Diabetes in the Real World: The Elusive Nature of Glycemic Control. *Diabetes Care*. 2017;40(11):1425-1432.
 2. Fitch K, Pyenson BS, Inasaki K. Medical claim cost impact of improved diabetes control for Medicare and commercially insured patients with type 2 diabetes. *J Manag Care Pharm*. 2013;19(8):609-20.

Cohort

CGM (Nov 2017-Sep 2018) – identified via pharmacy NDC codes via ICD-9/-10 diagnosis codes

-acting insulin therapy – identified via pharmacy NDC codes purchase database enrollment

Exclusion criteria

- History of any CGM purchase – identified via pharmacy NDC codes or HCPCS codes
- Gestational diabetes – identified via ICD-9/-10 diagnosis codes
- Both Type 1 and Type 2 code on latest encounter

Change in A1c With and Without Intermittent Use of CGM in Adults With Type 2 Diabetes Participating in the Onduo Virtual Diabetes Clinic

Ronald F. Dixon, MD



J. Layne¹, H. Zisser², R. Bergenstal³, R. Gabbay⁴, N. Barleen², D. Miller², R. Dixon¹

¹Onduo LLC, Newton, MA; ²Verily Life Sciences, S San Francisco, CA; ³International Diabetes Center at Park Nicollet, Minneapolis, MN; ⁴Joslin Diabetes Center, Boston MA

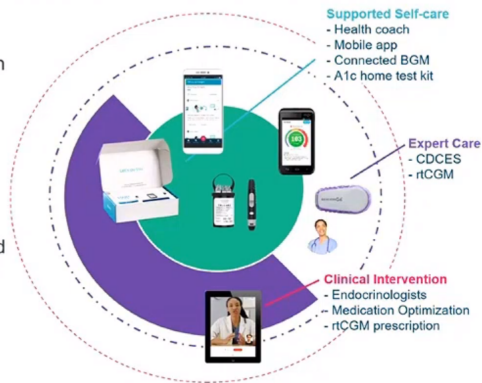
Participant Characteristics

Parameter	Overall n = 612	rtCGM n = 213	No CGM n = 399
Age, yr	53.5 ± 8.7	53.2 ± 8.1	53.7 ± 9.0
Female, n (%)	374 (61.1)	134 (62.9)	240 (60.2)
BMI, kg/m ²	35.5 ± 7.9	35.1 ± 7.2 ^a	35.7 ± 8.3 ^b
Baseline HbA1c, %	7.7 ± 1.7	7.8 ± 1.9	7.7 ± 1.7
Medication use, n (%)			
Sulfonylurea	144 (23.5)	56 (26.3)	88 (22.1)
Insulin	202 (33.0)	70 (32.9)	132 (33.1)
Rural geography, n (%)	161 (26.4)	51 (24.2)	110 (27.7)

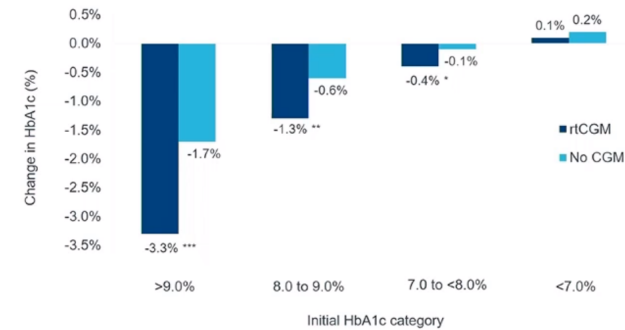
Data are mean ± SD unless otherwise indicated. ^an = 208. ^bn = 390. No significant differences between groups.

Onduo Virtual Diabetes Clinic (VDC)

- > Technology- and relationship-driven care for people with diabetes
- > Live video consultations with endocrinologists for medication management
- > Ability to remotely prescribe medication and rtCGM devices, and to ship rtCGM devices in 50 states

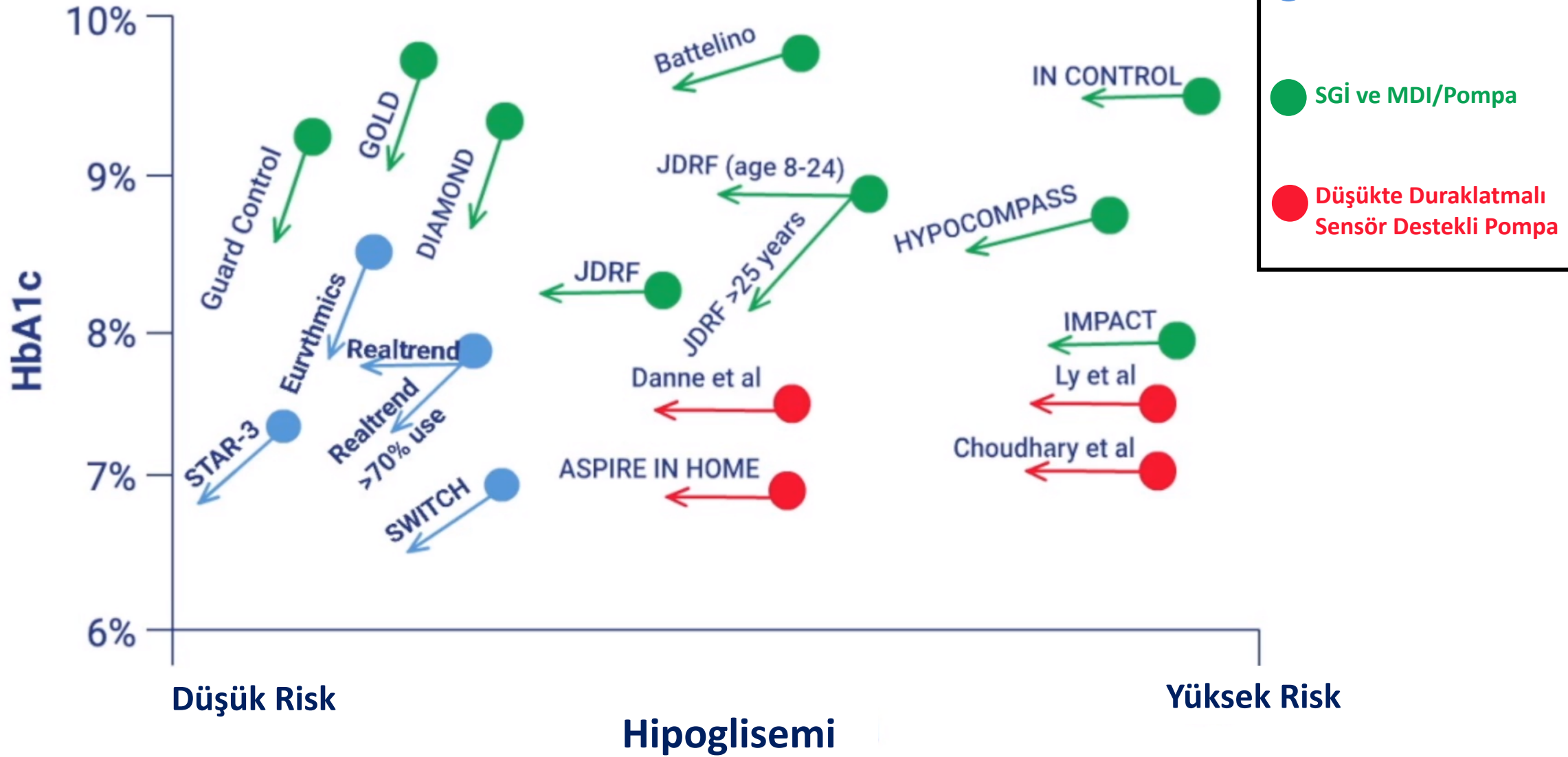


Greater Improvement in HbA1c with rtCGM



Mean follow-up: 6.1 ± 0.9 months

*p=0.023; **p=0.004; ***p<0.001



Monoterapide antihiperglisemik ajanlara yanıt¹

En yüksek HbA_{1c} düşüşü insülinler ile elde edilmektedir.

	APG'de azalma	A1c'de azalma
Yaşam tarzı değişimi	40-60 mg/dL	%1-2
Metformin	50 mg/dL	%1,5
İnsülin	50-80 mg/dL	%1,5-2,5
Sülfonilüreler	40-60 mg/dL	%1-2
Glinidler	30 mg/dL	%1-1,5
Tiazolidindionlar	25-55 mg/dL	%0,5-1,4
Alfa glukozidaz inh.	20-30 mg/dL	%0,5-0,7
GLP-1 agonistleri	20-30 mg/dL	%1-1,5
DPP-4 inh.	20-30 mg/dL	%0,5-1
SGLT-2 inh.	20-30 mg/dL	%0,5-1

APG: Açlık plazma glukozu

POSITION STATEMENT

Improving the clinical value and utility of CGM systems: issues and recommendations

A joint statement of the European Association for the Study of Diabetes and the American
Diabetes Association Diabetes Technology Working Group

John R. Petrie¹ · Anne L. Peters² · Richard M. Bergenstal³ · Reinhard W. Holl⁴ ·
G. Alexander Fleming⁵ · Lutz Heinemann⁶

Diabetes Care Volume 40, December 2017



International Consensus on Use of Continuous Glucose Monitoring

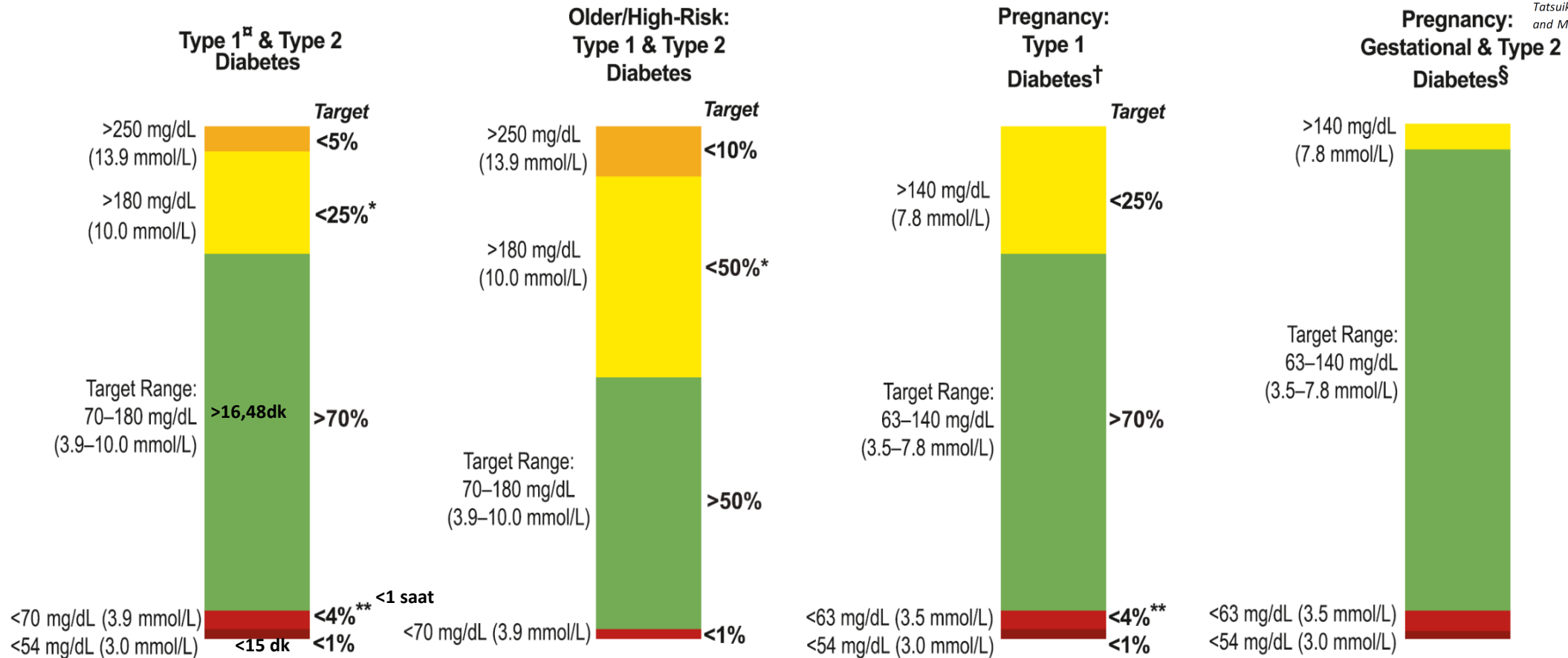
Diabetes Care 2017;40:1631–1640 | <https://doi.org/10.2337/dc17-1600>

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Stuart A. Weinzierl,²⁹ and Moshe Phillip²

Clinical Targets for Continuous Glucose Monitoring Data Interpretation: Recommendations From the International Consensus on Time in Range

Diabetes Care 2019;42:1593–1603 | <https://doi.org/10.2337/dci19-0028>

Tadej Battelino,¹ Thomas Danne,² Richard M. Bergenstal,³ Stephanie A. Amiel,⁴ Roy Beck,⁵ Torben Biester,² Emanuele Bosi,⁶ Bruce A. Buckingham,⁷ William T. Cefalu,⁸ Kelly L. Close,⁹ Claudio Cobelli,¹⁰ Eyal Dassau,¹¹ J. Hans DeVries,^{12,13} Kim C. Donaghue,¹⁴ Klemen Dovc,¹ Francis J. Doyle III,¹¹ Satish Garg,¹⁵ George Grunberger,¹⁶ Simon Heller,¹⁷ Lutz Heinemann,¹⁸ Irl B. Hirsch,¹⁹ Roman Hovorka,²⁰ Weiping Jia,²¹ Olga Kordonouri,² Boris Kovatchev,²² Aaron Kowalski,²³ Lori Laffel,²⁴ Brian Levine,⁹ Alexander Mayorov,²⁵ Chantal Mathieu,²⁶ Helen R. Murphy,²⁷ Revital Nimri,²⁸ Kirsten Nørgaard,²⁹ Christopher G. Parkin,³⁰ Eric Renard,³¹ David Rodbard,³² Banshi Saboo,³³ Desmond Schatz,³⁴ Keaton Stoner,³⁵ Tatsuiko Urakami,³⁶ Stuart A. Weinzimer,³⁷ and Moshe Phillip^{28,38}



AGP Report

Name _____

MRN _____

GLUCOSE STATISTICS AND TARGETS

26 Feb 2019-10 Mar 2019 **13 days**
% Time CGM is Active **99.9%**

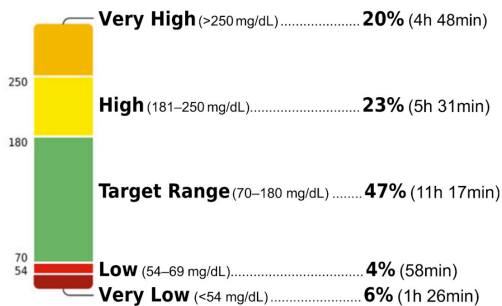
Glucose Ranges	Targets [% of Readings (Time/Day)]
Target Range 70–180 mg/dL	Greater than 70% (16h 48min)
Below 70 mg/dL	Less than 4% (58min)
Below 54 mg/dL	Less than 1% (14min)
Above 180 mg/dL	Less than 25% (6h)
Above 250 mg/dL	Less than 5% (1h 12min)

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

Average Glucose **173 mg/dL**
Glucose Management Indicator (GMI) **7.6%**
Glucose Variability **49.5%**

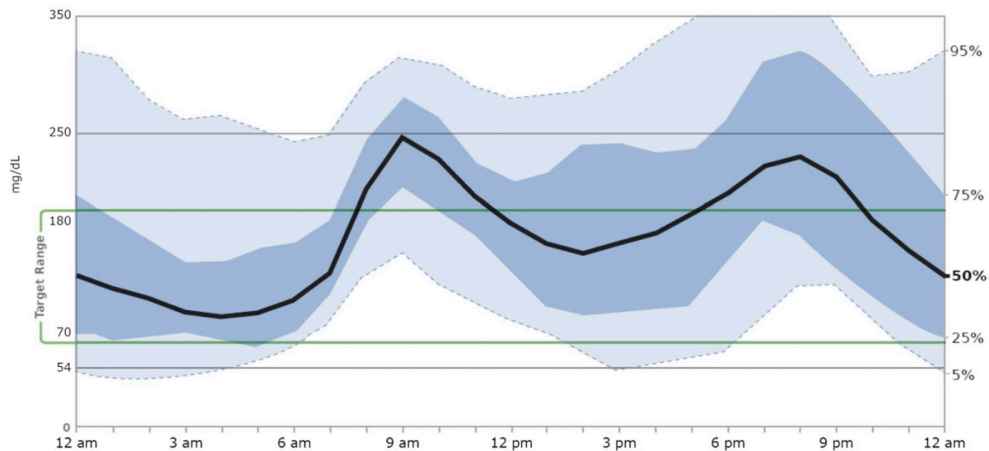
Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES

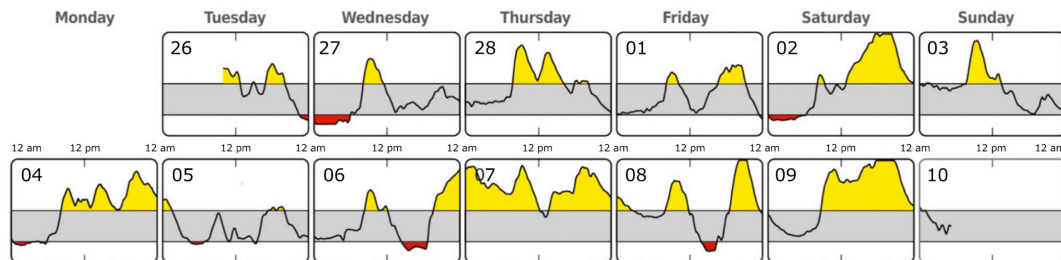


AMBULATORY GLUCOSE PROFILE (AGP)

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



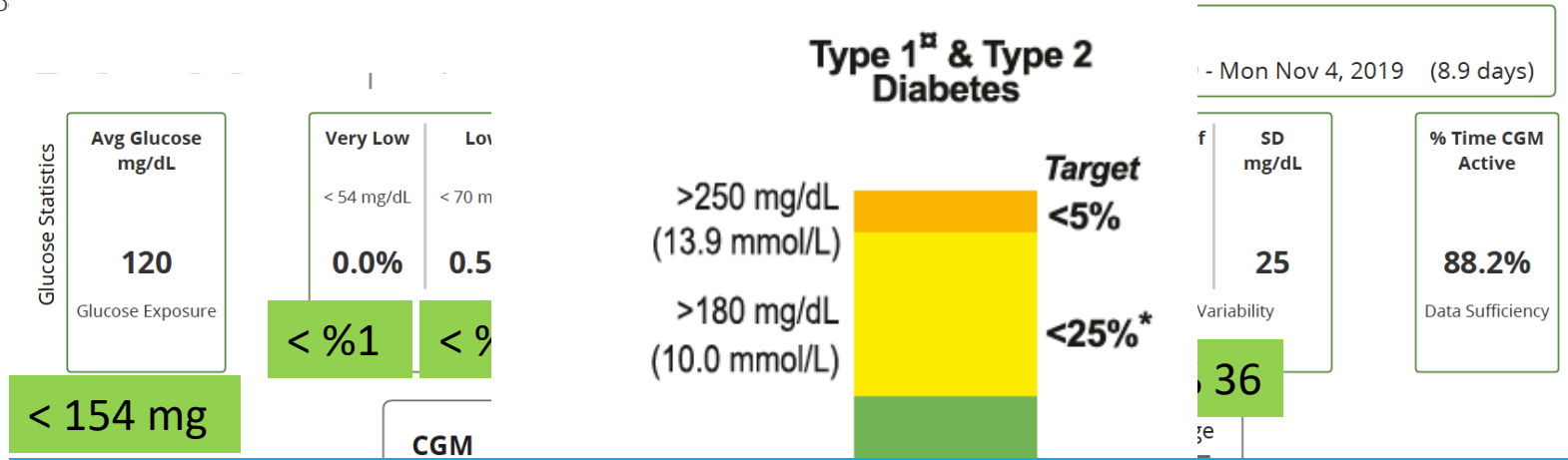
DAILY GLUCOSE PROFILES



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

Tip 1 diyabetlilerde yeni hedeflerimiz

D



- 70-180 mg > % 70 > 16 saat 48 dk.
- <70 mg < % 4 < 1 saat
- <54 mg < % 1 < 15 dk
- >180 mg < % 25 < 6 saat
- >250 mg < % 5 > 1 saat 12 dk.



Çok yeşil, az kırmızı; düz, dar ve normal aralık içinde bir glukoz seyri

Table 5—Estimate of A1C for a given TIR level based on type 1 diabetes and type 2 diabetes studies

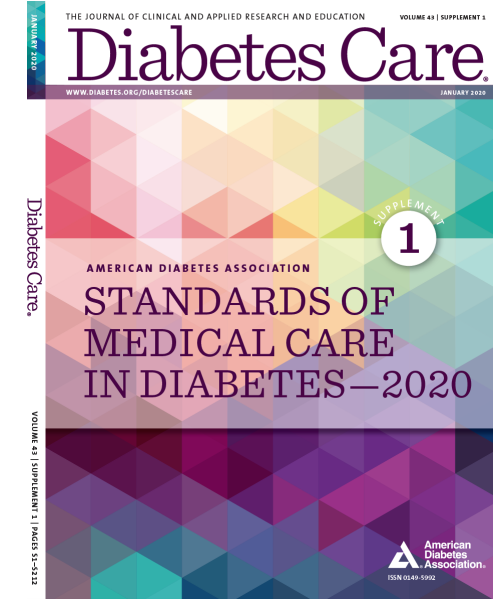
Beck et al. (26) (n = 545 participants with type 1 diabetes)			Vigersky and McMahon (27) (n = 1,137 participants with type 1 or type 2 diabetes)	
TIR 70–180 mg/dL (3.9–10.0 mmol/L)	A1C, % (mmol/mol)	95% CI for predicted A1C values, %	TIR 70–180 mg/dL (3.9–10.0 mmol/L)	A1C, % (mmol/mol)
20%	9.4 (79)	(8.0, 10.7)	20%	10.6 (92)
30%	8.9 (74)	(7.6, 10.2)	30%	9.8 (84)
40%	8.4 (68)	(7.1, 9.7)	40%	9.0 (75)
50%	7.9 (63)	(6.6, 9.2)	50%	8.3 (67)
60%	7.4 (57)	(6.1, 8.8)	60%	7.5 (59)
70%	7.0 (53)	(5.6, 8.3)	70%	6.7 (50)
80%	6.5 (48)	(5.2, 7.8)	80%	5.9 (42)
90%	6.0 (42)	(4.7, 7.3)	90%	5.1 (32)
Every 10% increase in TIR = ~0.5% (5.5 mmol/mol) A1C reduction			Every 10% increase in TIR = ~0.8% (8.7 mmol/mol) A1C reduction	

The difference between findings from the two studies likely stems from differences in number of studies analyzed and subjects included (RCTs with subjects with type 1 diabetes vs. RCTs with subjects with type 1 or type 2 diabetes with CGM and SMBG).

7. Diabetes Technology: *Standards of Medical Care in Diabetes—2020*

American Diabetes Association

Diabetes Care 2020;43(Suppl. 1):S77–S88 | <https://doi.org/10.2337/dc20-S007>



Recommendations

7.8 When prescribing continuous glucose monitoring (CGM) devices, robust diabetes education, training, and support are required for optimal CGM device implementation and ongoing use. People using CGM devices need to have the ability to perform self-monitoring of blood glucose in order to calibrate their monitor and/or verify readings if discordant from their symptoms. **E**

7.10 When used properly, intermittently scanned continuous glucose monitors in conjunction with insulin therapy are useful tools to lower A1C levels and/or reduce hypoglycemia in adults with type 1 diabetes who are not meeting glycemic targets, have hypoglycemia unawareness, and/or have episodes of hypoglycemia. **C**

7.12 Continuous glucose monitoring (CGM) should be considered in all children and adolescents with type 1 diabetes, whether using injections or continuous subcutaneous insulin infusion, as an additional tool to help improve glucose control. Benefits of CGM correlate with adherence to ongoing use of the device. **B**

7.11 When used properly, real-time and intermittently scanned continuous glucose monitors in conjunction with insulin therapy are useful tools to lower A1C and/or reduce hypoglycemia in adults with type 2 diabetes who are not meeting glycemic targets. **B**

7.13 Real-time continuous glucose monitoring (CGM) devices should be used as close to daily as possible for maximal benefit. Intermittently scanned CGM devices should be scanned frequently, at a minimum once every 8 h. **A**

7.14 Real-time continuous glucose monitors may be used effectively to improve A1C levels, time in range, and neonatal outcomes in pregnant women with type 1 diabetes. **B**

7.15 Blinded continuous glucose monitor data, when coupled with diabetes self-management education and medication dose adjustment, can be helpful in identifying and correcting patterns of hyper- and hypoglycemia in people with type 1 diabetes and type 2 diabetes. **E**

7.9 When used properly, real-time continuous glucose monitors in conjunction with insulin therapy are a useful tool to lower A1C levels and/or reduce hypoglycemia in adults with type 1 diabetes who are not meeting glycemic targets, have hypoglycemia unawareness, and/or have episodes of hypoglycemia. **A**

7.16 People who have been using continuous glucose monitors should have continued access across third-party payers. **E**

AGP yorumlama adımları-1

Koç Üniversitesi Hastanesi Diyabet Teknolojileri Eğitim Merkezi

Sürekli Glukoz İzlemi İçin Klinik Rehber



Ayaktan (Ambulatuvar) Glukoz Profili (AGP) Yorumlamak İçin 9 Adım

Sürekli glukoz izlemi (CGM)'nin hem hiperglisemi hem de hipoglisemi riskini azaltarak diyabet yönetimini iyileştirdiği gösterilmiştir. Aşağıdaki örnekteki görüldüğü gibi, CGM verileri görsel olarak Ambulatuvar (Ayaktan) Glukoz Profili'nde (AGP) gösterilir. CGM'i en iyi şekilde kullanmak, verileri etkili bir şekilde yorumlamak ve diyabetlilerin karar verme süreçlerine dahil olması için 9 adımdan oluşan bu rehberi kullanabilirsiniz.

1. Adım: Karar vermek için yeterli veri olduğundan emin olun. Aşağıdaki örnek AGP, 13 günlük veriyi göstermektedir. En az 10 gün, ideal olarak 14 günlük veri olmalıdır.

2. Adım: Mümkünse, AGP'nin çıktısını alarak üzerine aşağıdaki konularda notlar alın:

- Diyabetin tipi ve süresi, yaş, ağırlık (kg) ve insülin kullanıyorsa günlük doz (ünite/kg).
- Rutin uyanma zamanı (UZ), kahvaltı (K), öğle yemeği (Ö), akşam yemeği (A) ve yatma zamanı (YZ).
- İlaç/insülin zamanları, dozu ve düzenli alındığı zamanlarda eğrinin altında geçen zamana etkisi (Bu, bolus insülinin yemeklerden önce alınmasının ne kadar önemli olduğunu vurgulamak için çok iyi bir fırsattır)
- Rutin olarak yapılan bir egzersiz veya ara öğün/atıştırma zamanı var ise not edin.

3. Adım: Rapora notlarınızı "işaretledikten" sonra diyabetli ve/veya ailesine kısaca ne gördüğünü sorun ve bunların nedenleri konusunda açıklama isteyin. Genel olarak HbA1C değerinin %7'den az, glukozun %70 veya daha fazla oranda hedef aralıkta olması gerektiğini açıklayın. Hipoglisemide (70 mg/dL altında) geçirilen zamanın % 5'in altında olması hedeflenmelidir. Genellikle diyabetliler glukoz seyirleri konusunda dürüst ve yardımcı bilgiler sağlarlar.

4. Adım: Düşük glukoz seyirlerine bakın.

- % 5 alt çizgisi günün belirli bir döneminde 70 mg / dL hedef çizgisine geçiyorsa, o dönemde tüm glukoz değerlerinin % 5'inin <70 mg / dL olduğunu düşünün ve tedavide değişiklik yapmayı planlayın. Eğer %25 çizgisi 70 mg/dL hedef çizgisine geçiyor veya altında kalıyorsa veya %5 çizgisi 54 mg/dL'ye ulaşıyorsa hemen harekete geçilmelidir.
- Düşük glukoz olaylarını bir kez daha kontrol etmek için günlük görünümlere de bakın ve hafta sonları veya özel etkinlik günlerinde kümelenme olup olmadığına dikkat edin.

AGP yorumlama adımları-2

5. Adım: Yüksek glukoz seyirlerine bakın.

- İnsülinin/ilacın haftada kaç kez atlanmış olabileceğini veya insülinin gerçekten yemeklerden önce alınıp alınmadığını sormayı unutmayın.
- Rutin yemek zamanlarına bakın ve kan glukozundaki yüksekliklerin yemek öncesinde mi sonrasında mı olduğunu tartışın.
- Hafta içi ve hafta sonu uyanma zamanı, yemek zamanları ve yatma zamanları arasındaki farklılıkları sorun.
- Yüksek glukoz olaylarını bir kez daha kontrol etmek ve hafta sonları veya özel etkinlik günlerinde kümelenip kümelenmediklerini görmek için ayrıca günlük görünümünün çıktılarını bakın.

6. Adım: Koyu mavi (değerlerin %50'si) veya açık mavi (değerlerin %90'ı) alanların çok geniş olduğu yerleri (glukoz değişkenliği fazla olan yerleri) tartışın.

- Diyabetli glisemik değişkenliği azaltmak için; yiyeceklerin miktarını veya zamanını ayarlamak, karbonhidrat sayımını doğru bir şekilde yapmak, insülin zamanlamasını ayarlamak, egzersiz yapmak ve/veya stresi azaltmak gibi değişiklikler yapabilir mi?
- Diyabetli yiyecek ve egzersiz günlüğünü ya da varsa elektronik verilerini AGP ile eşleştirin.

7. Adım: Diyabetli mevcut AGP ve CGM verilerini bir önceki verileri ile karşılaştırın ve gelişmeleri tartışın. Yolunda giden ve iyileşen glukoz değerlerine dikkat edin. Her olumlu gelişmeyi pekiştirin. "Bu olumlu değişiklikleri sağlayabilmek için neleri yapmak yardımcı oldu? Daha fazla iyileşme için neler yapabiliriz konusunda fikirleriniz var mı?" diye sorun.

8. Adım: Diyabetli ile birlikte bir veya iki spesifik öneriden oluşan bir eylem planı oluşturun.

- Her zaman önce hipoglisemiyi tedavi edin.
- Bir hiperglisemi paternini tedavi ederken, tedavi etmeyi planladığınız hipergliseminin en az 12-18 saat sonrasında göz önüne alın. Koyu mavi (değerlerin %25'i) veya gri (değerlerin %5'i) eğrileri 70 mg / dL çizgisine veya daha düşük bir değere iniyorsa çok dikkatli olun veya hipoglisemi düzelene kadar hiperglisemiyi düzeltmeyi erteleyin.

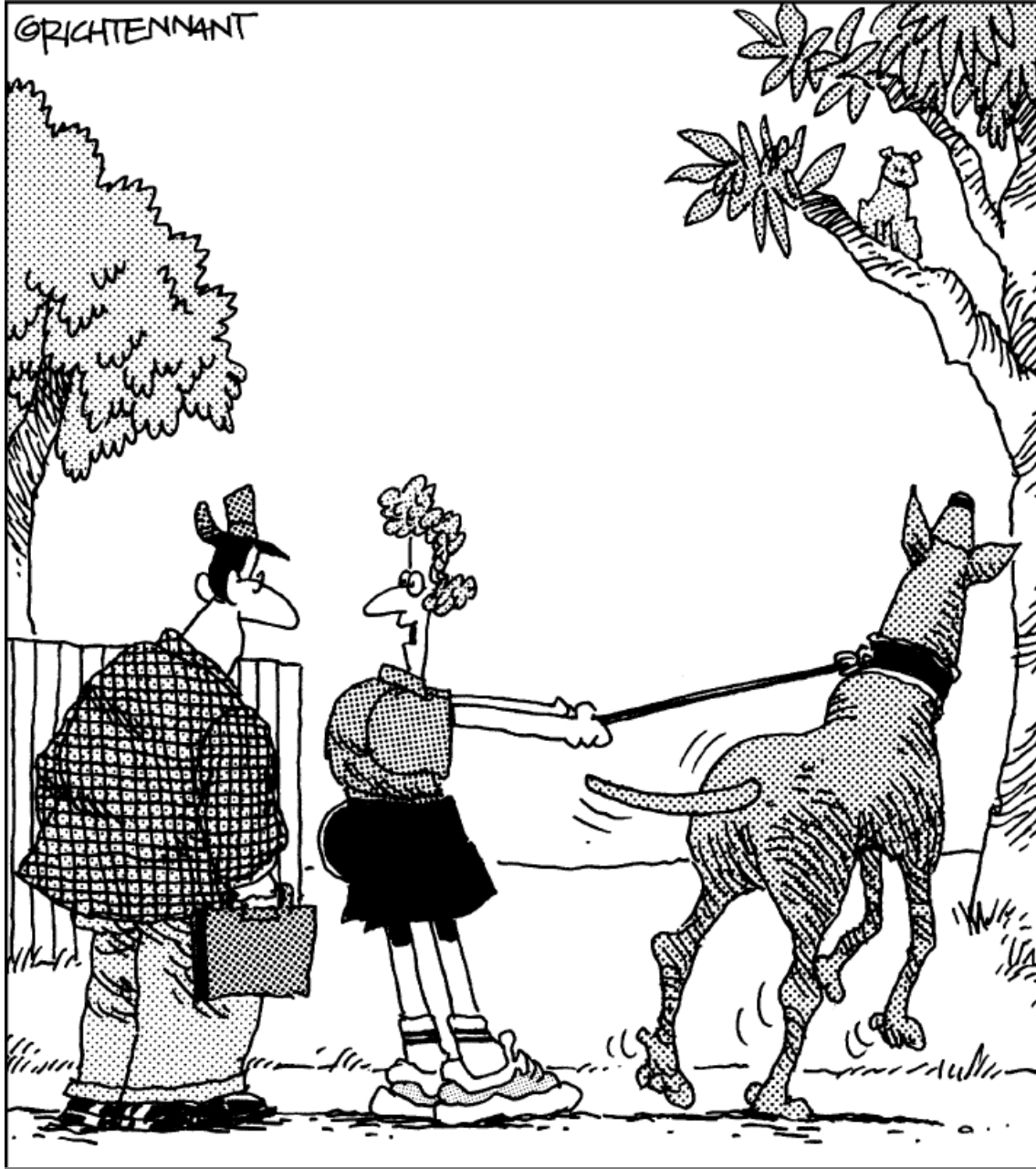
9. Adım: Diyabetli veya ailesine üzerinde notlarınızın da yazılı olduğu AGP verilerinin bir çıktısını verin. Kayıt altına almak için AGP verilerini taratın ve elektronik sağlık kaydına ekleyin. Hastanızın bir sonraki randevuyu ne zaman planlayacağını ve herhangi bir şüphe halinde diyabet ekibini ne zaman arayacağını anladığına emin olun.

Bu rehber aşağıdaki kaynağa dayanılarak hazırlanmıştır.

Kaynak

Johnson ML, Martens TW, Criego AB, Carlson AL, Simonson GD, Bergenstal RM. Utilizing the Ambulatory Glucose Profile to Standardize and Implement Continuous Glucose Monitoring in Clinical Practice. Diabetes Technol Ther. 2019 Jun;21(S2):S217-S225.

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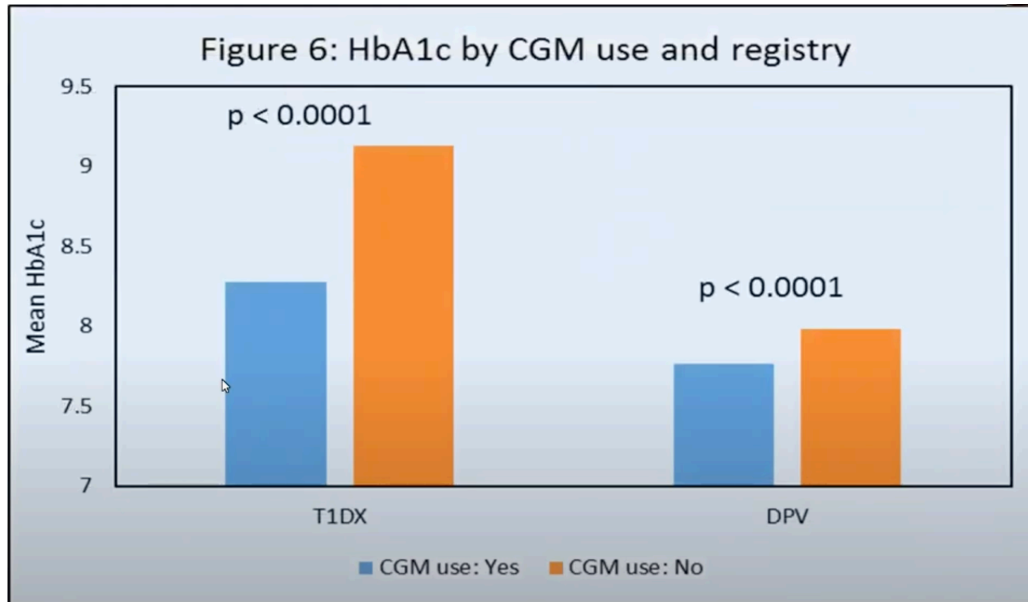


Onu **Şeker** diye çağırıyorum, çünkü onu da sürekli kontrol altında tutmam gerekiyor

TEŞEKKÜRLER



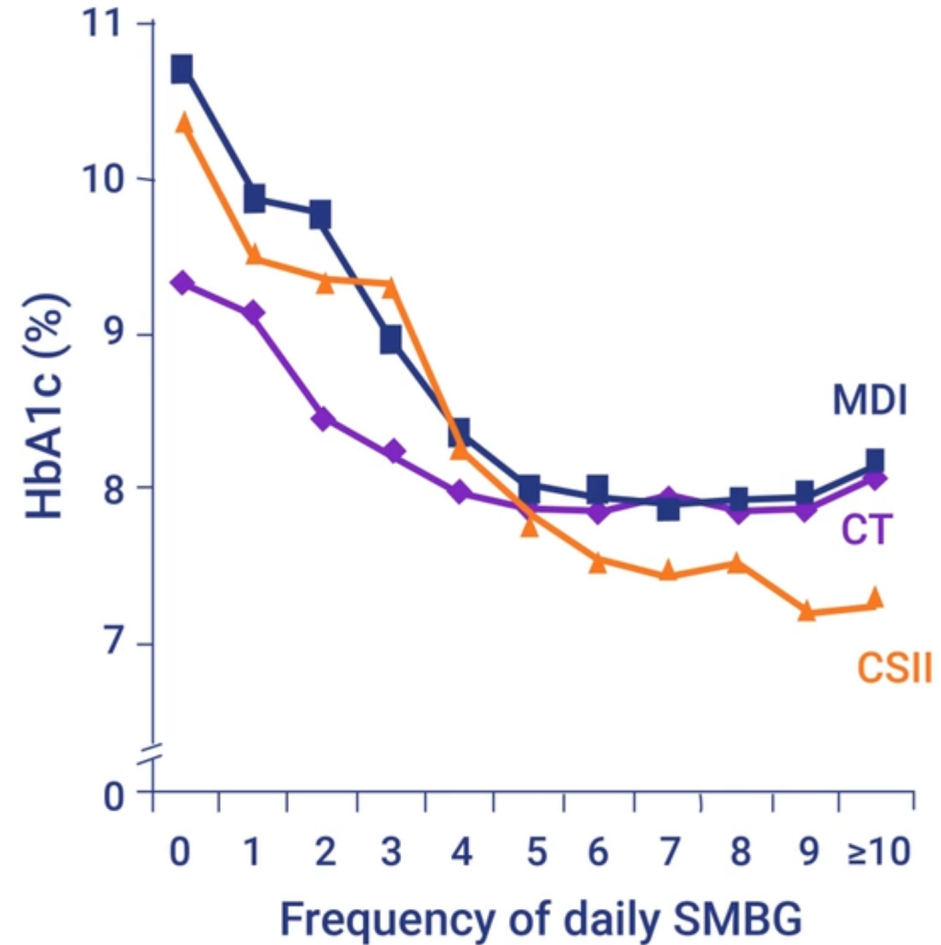
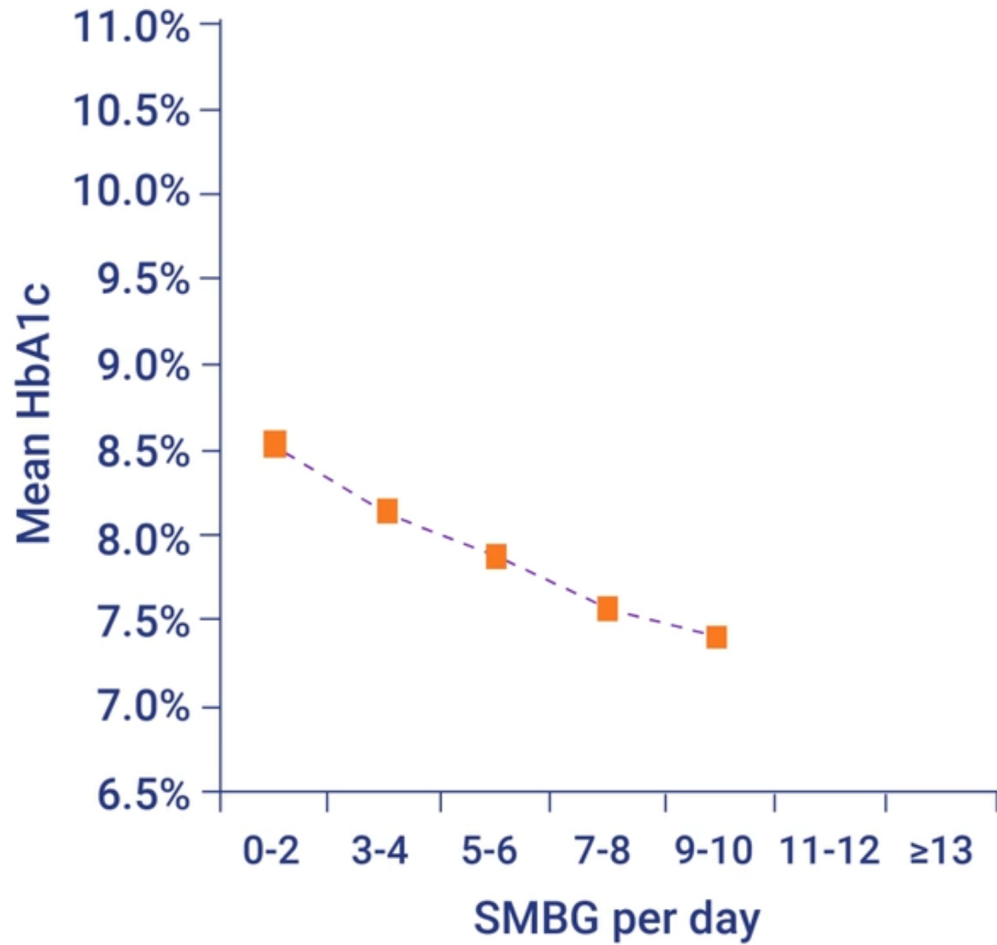
SGI'nin HbA1c üzerine etkisi ve ADA önerileri



HbA1c'nin <%7,5 olma oranı, kullanmayanlara göre ABD'de %56'ya karşın %43, Almanya/Avusturya'da ise %30'a karşın %15.

DeSalvo DJ, Miller KM, Hermann JM, et al. Continuous glucose monitoring and glycemic control among youth with type 1 diabetes: international comparison from the T1D exchange and DPV initiative. *Pediatr Diabetes* 2018;19(7):1271–5.

7.12 Continuous glucose monitoring (CGM) should be considered in all children and adolescents with type 1 diabetes, whether using injections or continuous subcutaneous insulin infusion, as an additional tool to help improve glucose control. Benefits of CGM correlate with adherence to ongoing use of the device. **B**



Miller KM, Beck RW, Bergenstal RM, et al. T1D Exchange Clinic Network. Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1c levels in T1D exchange clinic registry participants. *Diabetes Care*. 2013; 36:2009-14.

Ziegler R, Heidtmann B, Hilgard D, Hofer S, Rosenbauer J, Holl R; DPV-Wiss-Initiative. Frequency of SMBG correlates with HbA1c and acute complications in children and adolescents with type 1 diabetes. *Pediatr Diabetes*. 2011 Feb;12(1):11-7.