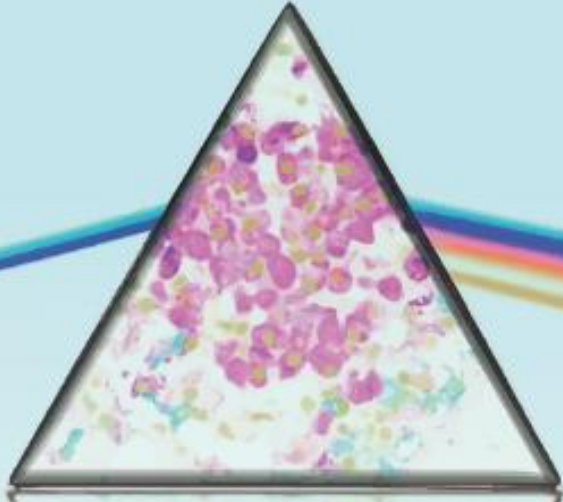


THE BRIGHT SIDE OF DIABETES



LA PREVENZIONE E LA REMISSIONE
NEL DIABETE MELLITO

MILANO
FABBRICA DEL VAPORE



14 MAGGIO 2026

Ottenimento del T1NG con i sistemi AID

Francesco Di Marco



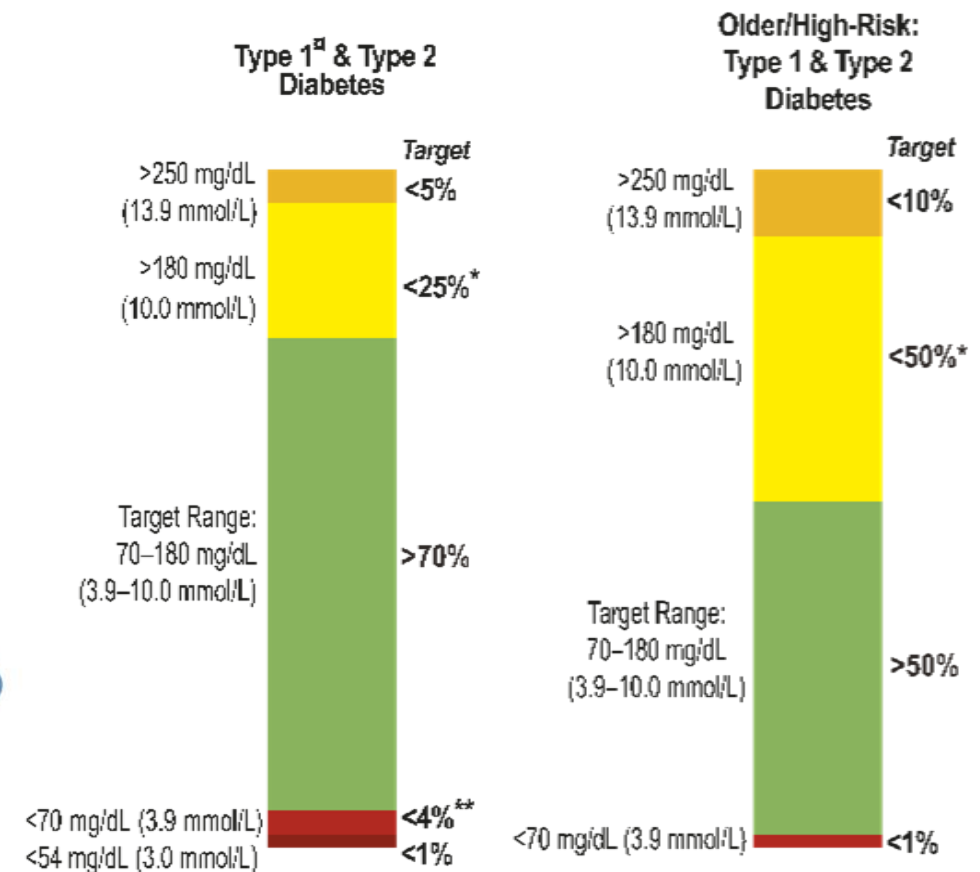
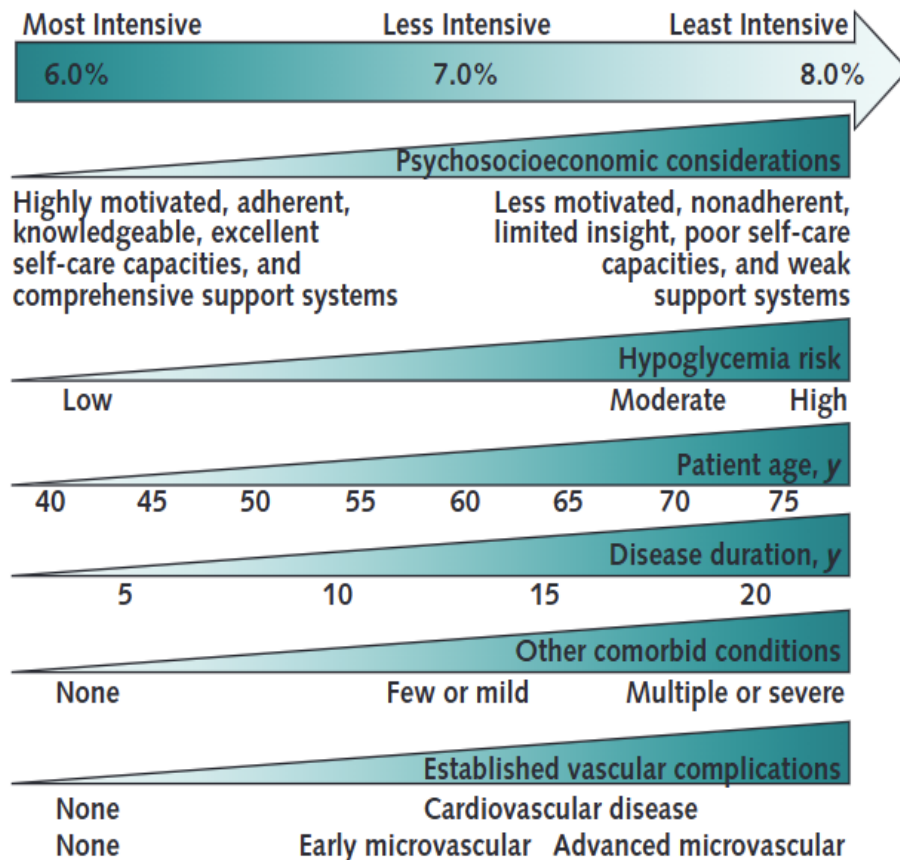
**I.R.C.C.S. Ospedale
Galeazzi - Sant'Ambrogio**

Gruppo San Donato

Il dr. Di Marco Francesco dichiara di NON aver ricevuto negli ultimi due anni compensi o finanziamenti da Aziende Farmaceutiche e/o Diagnostiche

Dichiara altresì il proprio impegno ad astenersi, nell'ambito dell'evento, dal nominare, in qualsivoglia modo o forma, aziende farmaceutiche e/o denominazione commerciale e di non fare pubblicità di qualsiasi tipo relativamente a specifici prodotti di interesse sanitario (farmaci, strumenti, dispositivi medico-chirurgici, ecc.).

Qual è il mio obiettivo?



Dal TIR al TITR

	Overall (N = 455)		Baseline A1C <7.0% (n = 131)		Baseline A1C 7.0-7.9% (n = 182)		Baseline A1C ≥8.0% (n = 142)	
	Estimate	95% CI for the predicted value	Estimate	95% CI for the predicted value	Estimate	95% CI for the predicted value	Estimate	95% CI for the predicted value
A. Estimation of change in A1C for a given level of CGM metric ^a								
	Estimated Change in A1C from Baseline (%)							
Change in TIR ₇₀₋₁₈₀								
-20%	+0.42	(-0.76, +1.60)	+0.64	(-0.35, +1.64)	+0.45	(-0.55, +1.44)	-0.14	(-1.14, +0.85)
-15%	+0.25	(-0.92, +1.43)	+0.50	(-0.49, +1.50)	+0.31	(-0.69, +1.30)	-0.29	(-1.28, +0.71)
-10%	+0.09	(-1.08, +1.26)	+0.36	(-0.63, +1.35)	+0.16	(-0.83, +1.16)	-0.43	(-1.42, +0.57)
-5%	-0.08	(-1.25, +1.10)	+0.22	(-0.77, +1.21)	+0.02	(-0.97, +1.01)	-0.57	(-1.56, +0.42)
0%	-0.24	(-1.41, +0.93)	+0.08	(-0.91, +1.07)	-0.12	(-1.11, +0.87)	-0.71	(-1.70, +0.28)
+5%	-0.41	(-1.58, +0.76)	-0.06	(-1.06, +0.93)	-0.26	(-1.25, +0.73)	-0.85	(-1.84, +0.14)
+10%	-0.57	(-1.74, +0.60)	-0.21	(-1.20, +0.79)	-0.40	(-1.39, +0.59)	-0.99	(-1.99, -0.00)
+15%	-0.74	(-1.91, +0.43)	-0.35	(-1.34, +0.65)	-0.54	(-1.54, +0.45)	-1.14	(-2.13, -0.14)
+20%	-0.90	(-2.08, +0.27)	-0.49	(-1.49, +0.51)	-0.69	(-1.68, +0.31)	-1.28	(-2.27, -0.28)
Equation:	-0.24 - 0.033 × ΔTIR ⁷⁰⁻¹⁸⁰		0.08 - 0.028 × ΔTIR ⁷⁰⁻¹⁸⁰		-0.12 - 0.028 × ΔTIR ⁷⁰⁻¹⁸⁰		-0.71 - 0.028 × ΔTIR ⁷⁰⁻¹⁸⁰	

The Relationships between Time in Range, Hyperglycemia Metrics, and HbA1c

Roy W. Beck, MD, PhD¹, Richard M. Bergenstal, MD²,
Peiyao Cheng, PhD¹, Craig Kollman, PhD¹,
Anders L. Carlson, MD², Mary L. Johnson², RN, CDE,
and David Rodbard, MD³

Journal of Diabetes Science and Technology
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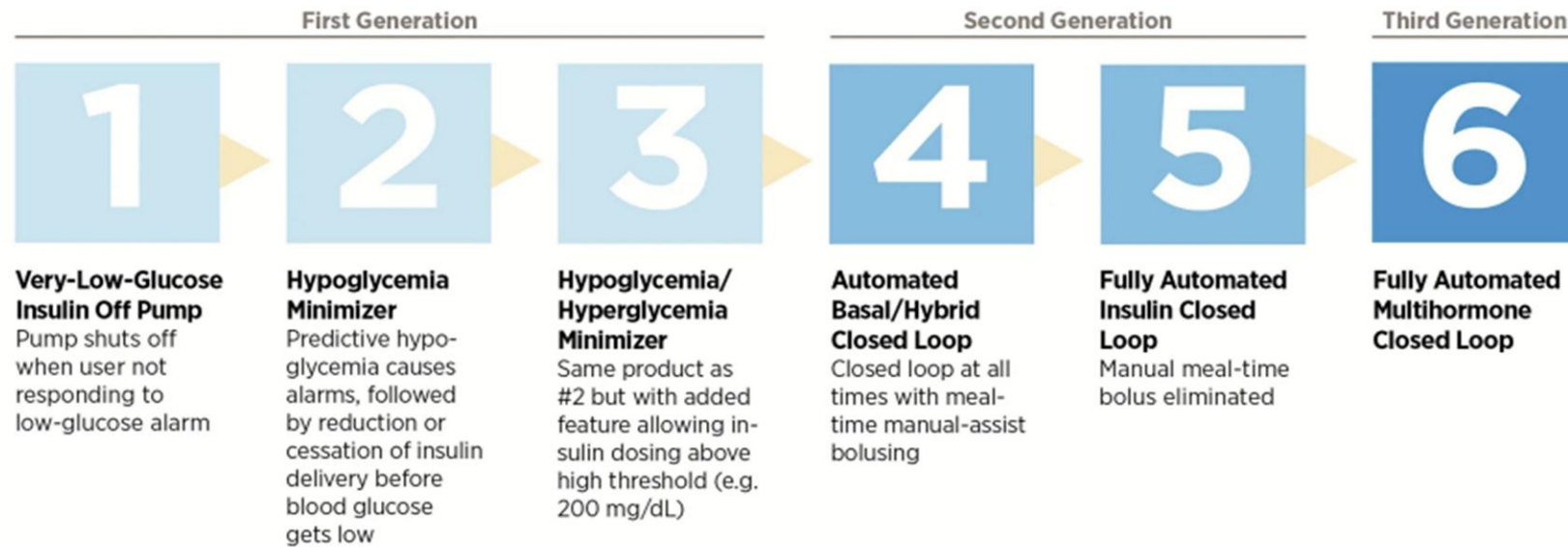
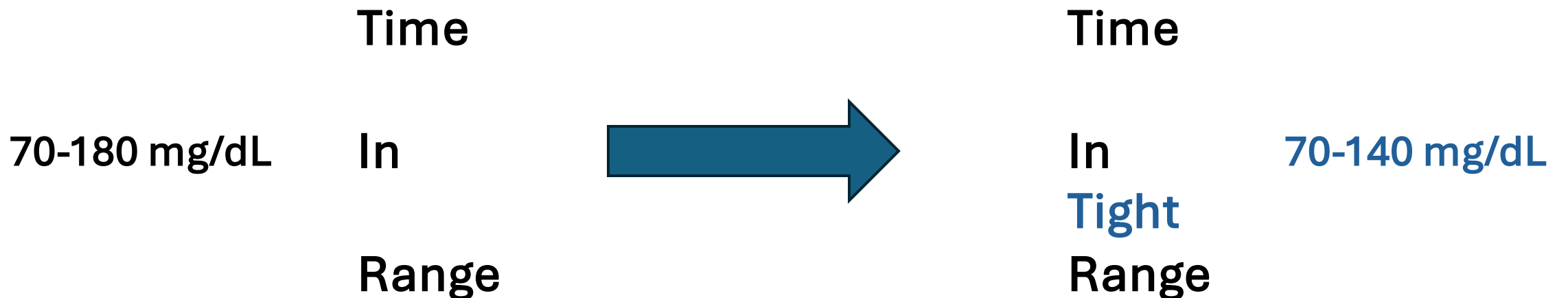


FIGURE 2 | The six categories of closed-loop systems as defined by the JDRF.



Razionale del TITR

153 individui sani non affetti da diabete e con autoimmunità pancreatica negativa

Table 2. Summary of Glucose Metrics Over a 24-h Period (n = 153)

	All Participants	Age Group				
		6 to <12 y	12 to <18 y	18 to <25 y	25 to <60 y	≥60 y
Percentage of glucose sensor values, median (IQR)						
>180 mg/dL	0.0 (0.0–0.2)	0.0 (0.0–0.1)	0.0 (0.0–0.0)	0.0 (0.0–0.4)	0.0 (0.0–0.2)	0.1 (0.0–0.5)
>160 mg/dL	0.3 (0.1–0.9)	0.2 (0.1–0.8)	0.2 (0.0–0.2)	0.4 (0.2–1.1)	0.4 (0.2–0.9)	0.6 (0.1–2.9)
>140 mg/dL	2.1 (0.9–3.9)	1.7 (0.8–2.9)	1.2 (0.3–2.0)	2.4 (1.3–4.4)	2.1 (1.1–3.1)	4.1 (1.3–8.6)
70–140 mg/dL	96 (93–98)	97 (94–97)	97 (95–98)	95 (91–97)	97 (94–98)	93 (89–96)
70–120 mg/dL	89 (82–92)	90 (83–92)	92 (86–93)	87 (82–90)	89 (86–91)	81 (71–86)
<70 mg/dL	1.1 (0.3–2.9)	1.1 (0.3–3.3)	1.7 (0.6–2.6)	1.3 (0.5–3.6)	1.0 (0.3–2.3)	1.4 (0.2–3.4)
<60 mg/dL	0.2 (0.0–0.6)	0.2 (0.0–0.3)	0.2 (0.0–0.8)	0.2 (0.0–0.7)	0.2 (0.0–0.4)	0.3 (0.0–0.7)
<54 mg/dL	0.0 (0.0–0.2)	0.0 (0.0–0.2)	0.0 (0.0–0.4)	0.1 (0.0–0.4)	0.0 (0.0–0.2)	0.1 (0.0–0.2)

**Continuous Glucose Monitoring Profiles in Healthy
Nondiabetic Participants: A Multicenter
Prospective Study**

Viral N. Shah,¹ Stephanie N. DuBose,² Zoey Li,² Roy W. Beck,² Anne L. Peters,³
Ruth S. Weinstock,⁴ Davida Kruger,⁵ Michael Tansey,⁶ David Sparling,⁷
Stephanie Woerner,⁸ Francesco Vendrame,⁹ Richard Bergenstal,¹⁰
William V. Tamborlane,¹¹ Sara E. Watson,¹² and Jennifer Sherr¹¹

TITR



TING

Time In Range $\Leftrightarrow$ Time In Tight Range

912 pazienti T1D

184 pazienti T2D

	<i>TIR (70–180 mg/dL)</i>						
	20%	30%	40%	50%	60%	70%	80%
Ratio of means TITR/TIR	0.42	0.49	0.54	0.58	0.60	0.63	0.66
Predicted TITR (70–140 mg/dL)							
Overall	9%	15%	21%	28%	36%	45%	54%

	<i>TITR (70–140 mg/dL)</i>						
	10%	20%	30%	40%	50%	60%	70%
Ratio of means TIR/TITR	2.6	2.0	1.7	1.6	1.5	1.4	1.3
Predicted TIR (70–180 mg/dL)							
Overall	26%	40%	52%	64%	74%	83%	90%

**A Comparison of Continuous Glucose
Monitoring-Measured Time-in-Range 70–180 mg/dL
Versus Time-in-Tight-Range 70–140 mg/dL**

TITR in T1D - COMPLICANZE

163 pz con DM1

Follow-up mediano 6.5 anni

	DR group (N=71)	Control group (N=92)
Age (years)		
Mean $\pm$ SD, range	27 $\pm$ 13 (14–76)	38 $\pm$ 16 (17–81)
Sex, n (%)		
Female	37 (52)	44 (48)
Male	34 (48)	48 (52)

TABLE 3. ASSOCIATION OF GLYCATED HEMOGLOBIN AND CONTINUOUS GLUCOSE MONITORING METRICS WITH DIAGNOSIS OF INCIDENT DIABETIC RETINOPATHY

Metric	Unit of change for calculation of OR	Unadjusted ^a		Adjusted ^a	
		OR (95% CI)	P	OR (95% CI)	P
HbA1c	0.5% Increase	1.38 (1.18–1.62)	<0.001	1.24 (1.05–1.48)	0.01
	0.4% Increase	1.30 (1.14–1.47)		1.19 (1.04–1.37)	
Time in range 70–180 mg/dL	5% Decrease	1.26 (1.13–1.42)	<0.001	1.18 (1.03–1.35)	0.02
	10% Decrease	1.60 (1.27–2.01)		1.39 (1.06–1.82)	
Time in tight range 70–140 mg/dL	5% Decrease	1.37 (1.19–1.59)	<0.001	1.28 (1.08–1.51)	0.004
Mean glucose	10 mg/dL Increase	1.31 (1.15–1.48)	<0.001	1.22 (1.05–1.41)	0.008
Time >180 mg/dL	5% Increase	1.27 (1.14–1.42)	<0.001	1.20 (1.06–1.36)	0.005
Time >250 mg/dL	5% Increase	1.33 (1.14–1.55)	<0.001	1.19 (0.99–1.43)	0.06
Time >300 mg/dL	1% Increase	1.08 (1.03–1.14)	0.002	1.04 (0.98–1.10)	0.21

Time in Range Is Associated with Incident Diabetic Retinopathy in Adults with Type 1 Diabetes: A Longitudinal Study

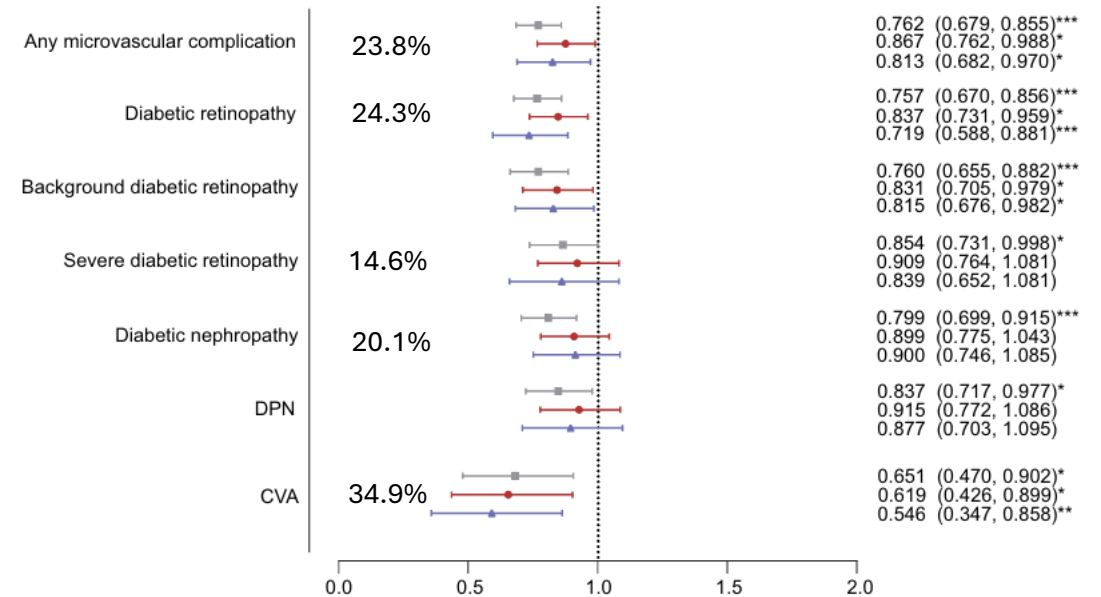
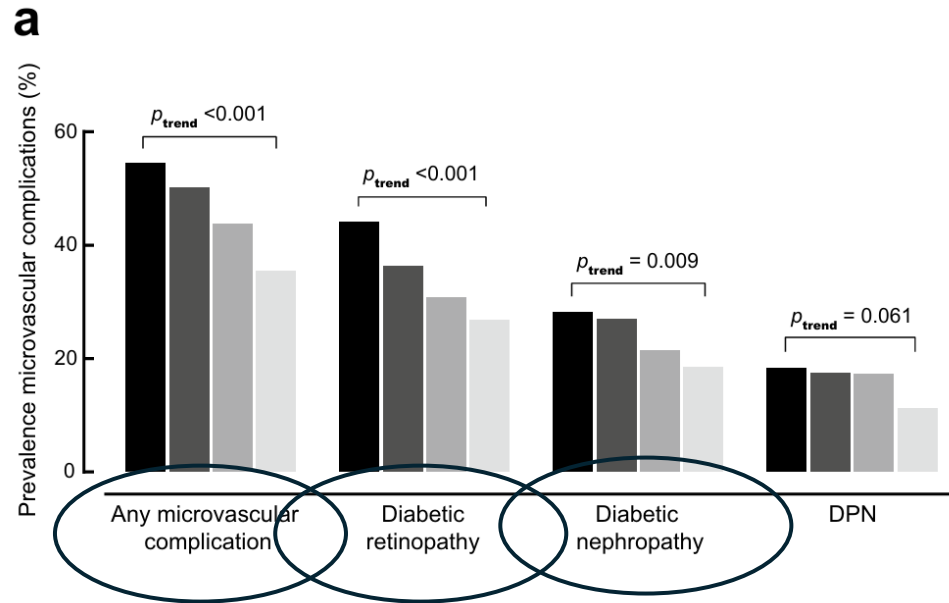
Viral N. Shah, MD,¹ Lauren G. Kanapka, MSc,² Halis K. Akturk, MD,¹
 Sarit Polsky, MD, MPH,¹ Gregory P. Forlenza, MD,¹ Craig Kollman, PhD,²
 Roy W. Beck, MD, PhD,² and Janet K. Snell-Bergeon, PhD¹

TITR in T1D - COMPLICANZE

808 pazienti con DM1

34.5% in AID

65.5% in MDI

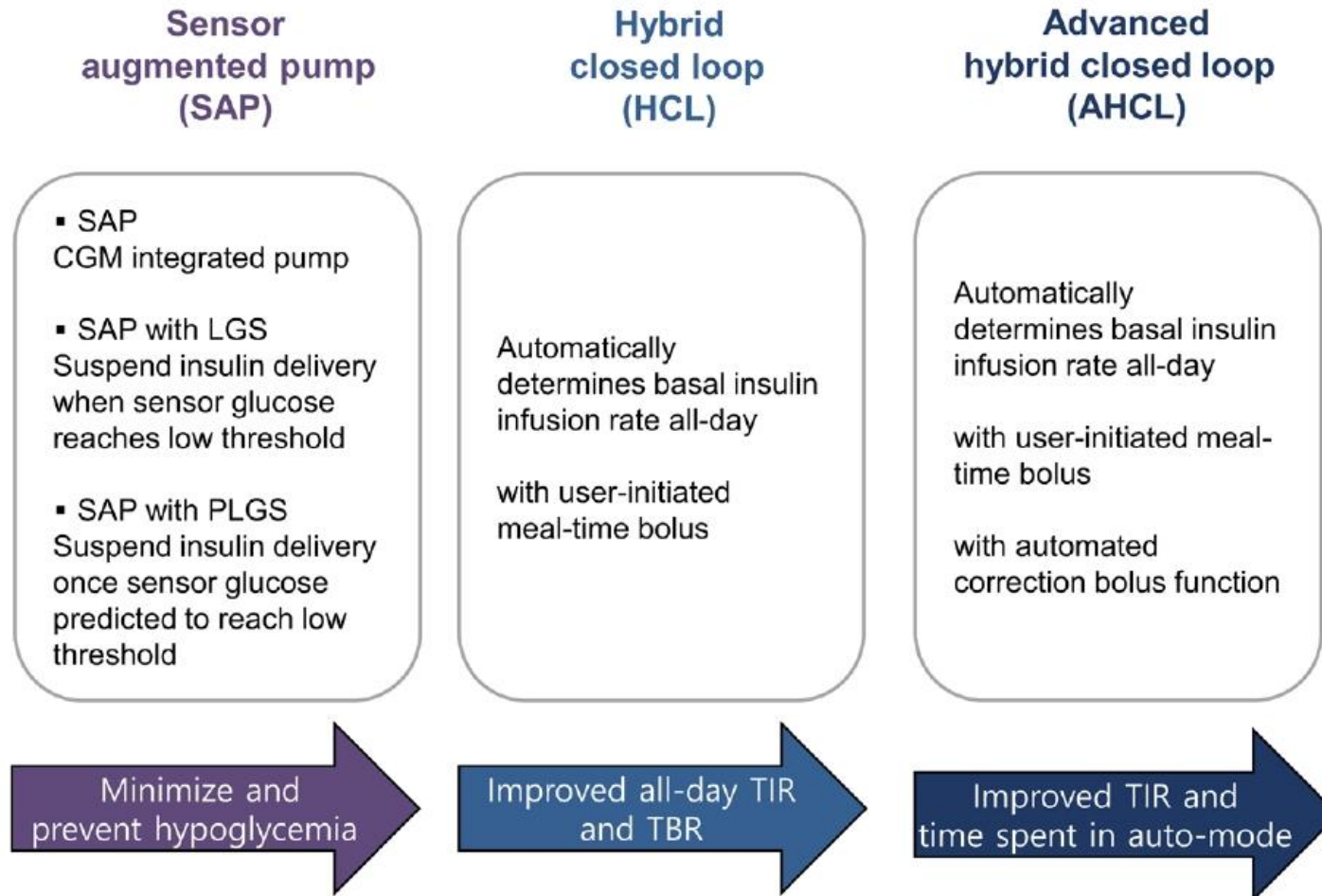


10% del TITR

The association of chronic complications with time in tight range and time in range in people with type 1 diabetes: a retrospective cross-sectional real-world study

Jolien De Meulemeester¹ · Sara Charleer¹ · Margaretha M. Visser¹ · Christophe De Block² · Chantal Mathieu¹ · Pieter Gillard^{1,3}

TING con i sistemi AID: fattibile e sicuro?



Artificial pancreas treatment for outpatients with type 1 diabetes: systematic review and meta-analysis

Eleni Bekiari,¹ Konstantinos Kitsios,² Hood Thabit,³ Martin Tauschmann,³ Eleni Athanasiadou,¹ Thomas Karagiannis,¹ Anna-Bettina Haidich,⁴ Roman Hovorka,³ Apostolos Tsapas^{1,5}

Efficacy of automated insulin delivery systems in people with type 1 diabetes: a systematic review and network meta-analysis of outpatient randomised controlled trials

Anna Stahl-Pehe,^{a,b,*} Nafiseh Shokri-Mashhadi,^{a,b} Marielle Wirth,^{a,b,c} Sabrina Schlesinger,^{a,b} Oliver Kuss,^{a,b,d} Reinhard W. Holl,^{b,e} Christina Bächle,^{a,b} Klaus-D. Warz,^f Jutta Bürger-Busing,^g Olaf Spörkel,^{b,h} and Joachim Rosenbauer^{a,b}

Effect of automated insulin delivery systems on person-reported outcomes in people with diabetes: a systematic review and meta-analysis

Timm Roos,^{a,*} Norbert Hermanns,^{a,b} Christopher Groß,^b Bernhard Kulzer,^{a,b} Thomas Haak,^{a,c} and Dominic Ehrmann^{a,b}

Outcome glicemici

Qualità di vita – riduzione burden

Sicurezza

TITR: che obiettivo?

Table 1—Optimal TITR targets associated with GMI targets of <7%, <6.8%, and <6.5%

Metric	Age ≤15 years		Age >15 years	
	Value	95% CI	Value	95% CI
GMI <7%				
Optimal TITR target, %*	>46.3	46.2–46.8	>45.4	45.2–45.8
Sensitivity	0.93	0.9–0.94	0.93	0.92–0.94
Specificity	0.92	0.89–0.94	0.92	0.91–0.94
Accuracy	0.92	0.91–0.94	0.93	0.92–0.94
AUC	0.98		0.98	
GMI <6.8%				
Optimal TITR target, %*	>50.7	50.1–51.2	>50.7	50.2–50.7
Sensitivity	0.9	0.87–0.93	0.94	0.92–0.95
Specificity	0.9	0.88–0.92	0.93	0.92–0.94
Accuracy	0.9	0.88–0.92	0.93	0.93–0.94
AUC	0.98		0.99	
GMI <6.5%				
Optimal TITR target, %*	>56.4	56.1–58	>58.0	57.3–59
Sensitivity	0.94	0.88–0.97	0.94	0.91–0.96
Specificity	0.9	0.88–0.92	0.93	0.92–0.94
Accuracy	0.91	0.89–0.92	0.93	0.92–0.94
AUC	0.98		0.99	

Optimal TITR target and area under the curve (AUC) calculated from the training set. Sensitivity, specificity, and accuracy calculated from the test set. *70–140 mg/dL.

Obiettivo TITR > 50%

Impostazioni ottimizzate

93% dei pazienti > 45% TITR

81% dei pazienti > 50% TITR

Popolazione Overall

65% dei pazienti > 45% TITR

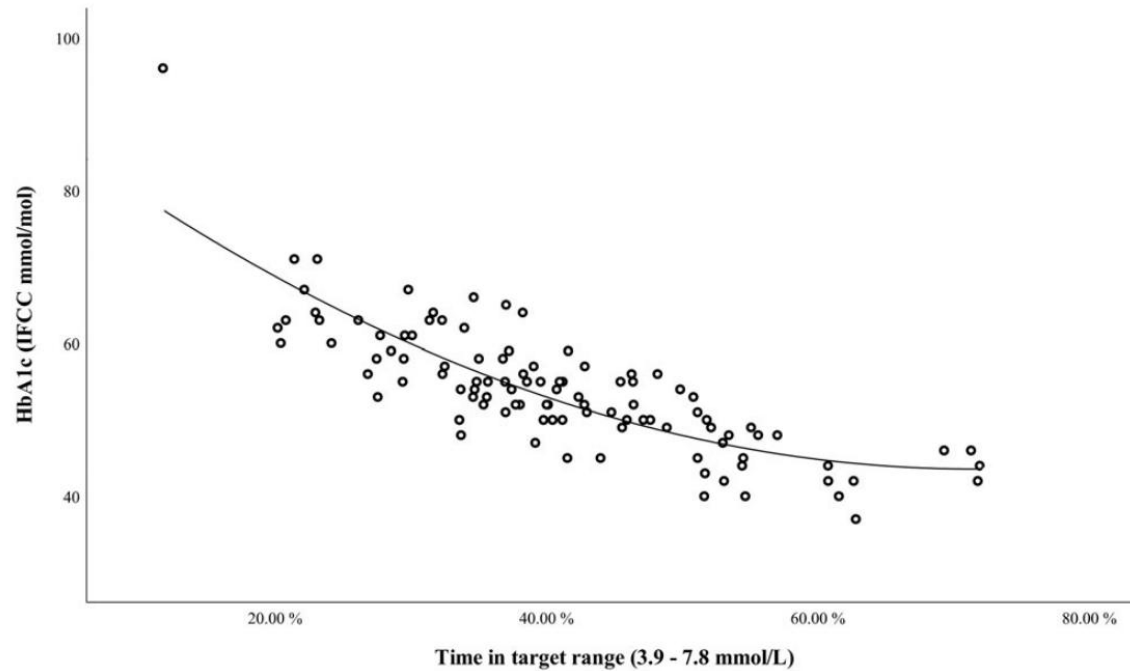
46% dei pazienti > 50% TITR

Time in Tight Glucose Range in Type 1 Diabetes: Predictive Factors and Achievable Targets in Real-World Users of the MiniMed 780G System

Javier Castañeda, Arcelia Arrieta, Tim van den Heuvel, Tadej Battelino, and Ohad Cohen

Diabetes Care 2024;47(5):790–797 | <https://doi.org/10.2337/dc23-1581>

TITR: che obiettivo?



133 bambini e adolescenti con T1D

Associazione curvilinea TITR e HbA1c

HbA1c 6.5%

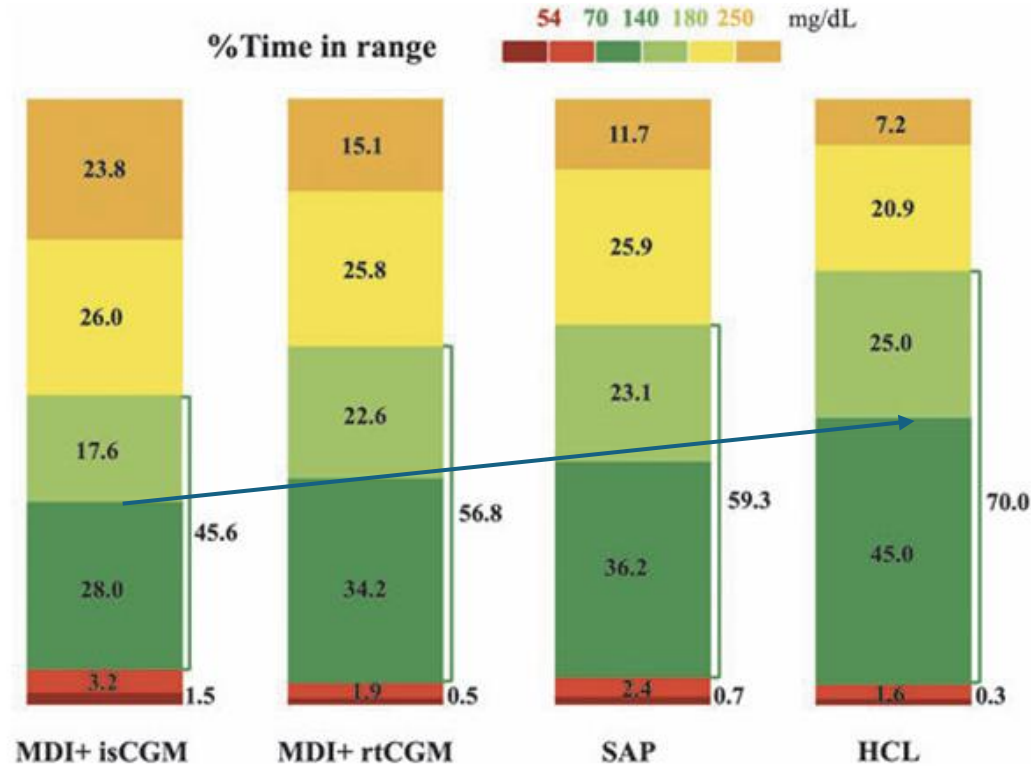


TITR 50%

Translating glycated hemoglobin A1c into time spent in glucose target range: A multicenter study

Jonathan Petersson¹ | Karin Åkesson^{2,3} | Frida Sundberg^{4,5} | Stefan Särnblad^{1,6} 

TING con AID: obiettivo realistico e sicuro?



854 bambini e adolescenti T1D

TIR > 71.9%

TITR > 50%

3.3% MDI+isCGM

vs

34.4% HCL

Aiming for the Best Glycemic Control Beyond Time in Range:
Time in Tight Range as a New Continuous Glucose Monitoring Metric in Children and Adolescents with Type 1 Diabetes Using Different Treatment Modalities

Stefano Passanisi, MD^{1,*} Claudia Piona, MD^{2,*} Giuseppina Salzano, PhD, MD¹
 Marco Marigliano, PhD, MD² Bruno Bombaci, MD¹ Anita Morandi, MD² Angela Alibrandi, PhD³
 Claudio Maffei, PhD, MD^{2,†} and Fortunato Lombardo, MD^{1,†}

TITR

TITR > 50%

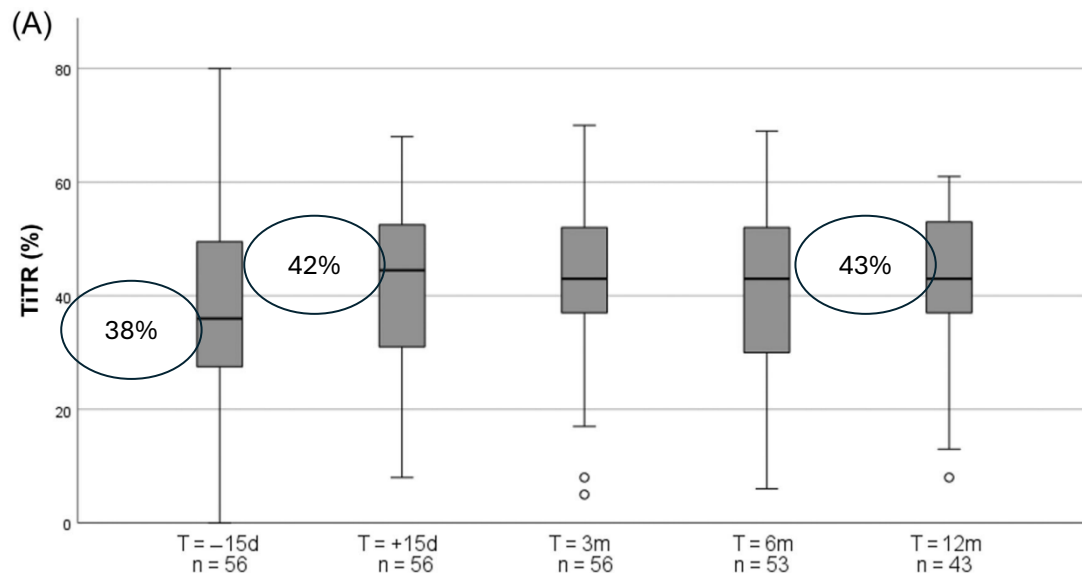
TAR

~~TBR~~

CV

Glicemia media

TING con AID: obiettivo realistico?



Evaluation of time in tight range and the glycaemia risk index in adults with type 1 diabetes using an advanced hybrid closed loop system: A 1-year real-world assessment

Alessandro Rizzi PhD¹ | Linda Tartaglione PhD¹ | Lorenzo Lucaccini Paoli MD¹ |
Maria Laura Leo MD¹ | Valentina Popolla MD¹ | Luca Viti PhD¹ |
Annarita Barberio MD¹ | Mauro Di Leo MD¹ | Alfredo Pontecorvi PhD² |
Dario Pitocco MD¹

56 pazienti T1D

Miglioramento significativo primi 15 giorni

Maggior fiducia



Meno segnalazione
dei boli prandiali



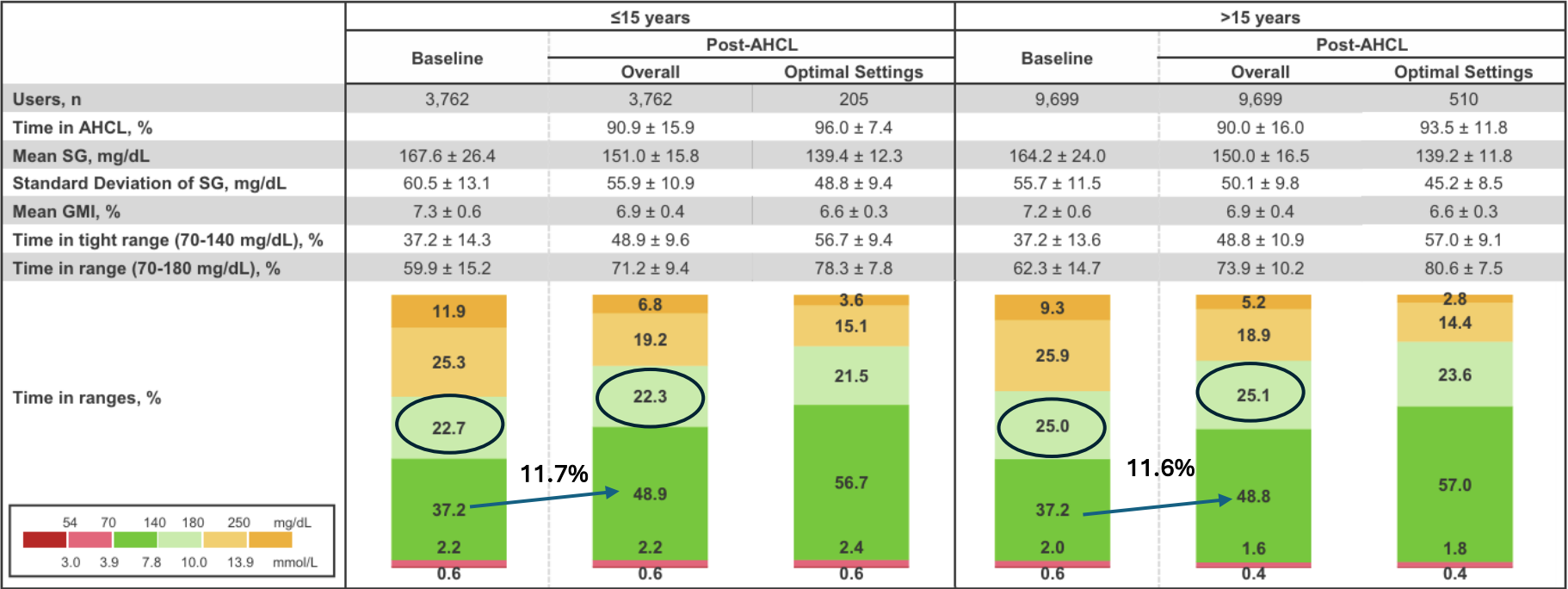
TtTR 43% a 12 mesi



Adulto
≠
Pediatico

TING con i sistemi AID

13461 pazienti



Time in Tight Glucose Range in Type 1 Diabetes: Predictive Factors and Achievable Targets in Real-World Users of the MiniMed 780G System

Javier Castañeda, Arcelia Arrieta, Tim van den Heuvel, Tadej Battelino, and Ohad Cohen

Diabetes Care 2024;47(5):790–797 | <https://doi.org/10.2337/dc23-1581>



TING con i sistemi AID: come?

TITR

% di tempo in AHCL

% basale giornaliera /TDD

Utilizzo GT 100 mg/dL

60%

TITR

86%

Utilizzo AIT 2 h

Numero di autocorrezioni giornaliere

Numero di uscite da AHCL attivate da sistema e/o da utente

Utilizzo di due o tre diversi rapporti I/CHO

Numero di allarmi giornalieri

Numero di boli giornalieri user-initiated

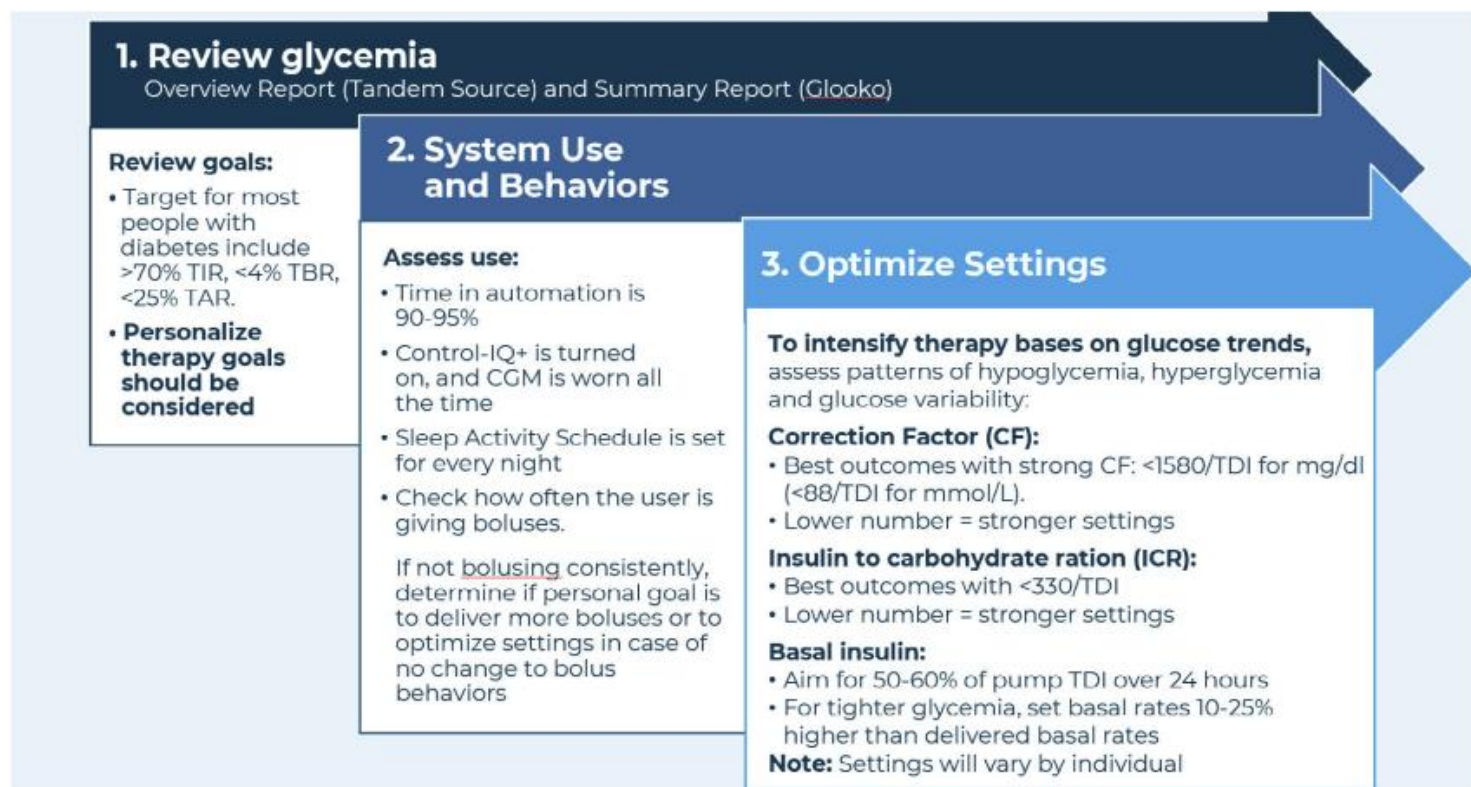
TITR

Time in Tight Glucose Range in Type 1 Diabetes: Predictive Factors and Achievable Targets in Real-World Users of the MiniMed 780G System

Javier Castañeda, Arcelia Arrieta, Tim van den Heuvel, Tadej Battelino, and Ohad Cohen

Diabetes Care 2024;47(5):790–797 | <https://doi.org/10.2337/dc23-1581>

TING con sistemi AID: come?



Rethinking control-IQ+ technology: Simple strategies for easy optimization

Viral N. Shah MD^{1,2} | Pratik Choudhary MD³ | Ilana Halperin MD⁴ |
Ivana Rabbone MD⁵ | Dessi P. Zaharieva PhD^{6,7} | Laurel Messer PhD^{8,9}

FSI < 1580/TDI

ICR < 330/TDI

50-60% TDI/24h



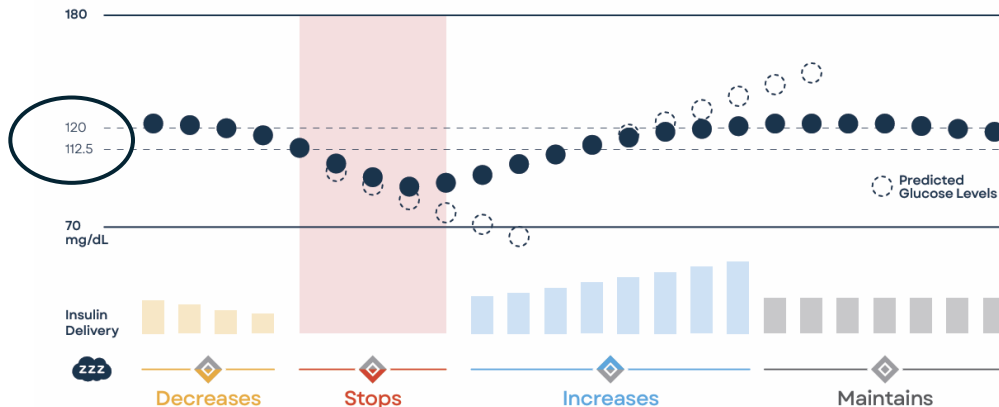
TIR

TITR

TING con sistemi AID: come?

7266 pazienti

Modalità SLEEP (112.5-120) > 80% del tempo



Short Oral Presentation Topic: AS03. Closed-loop System, Algorithm and Artificial Pancreas

**HIGH TIME IN TIGHT RANGE WITH SLEEP
ACTIVITY TARGETS IN CONTROL-IQ
TECHNOLOGY**

Laurel Messer, Sneha Thanasekaran, Jamel Thomas, Jordan Pinski

Glycemic outcomes and insulin delivery associated with SLEEP targets >80% Control-IQ technology, n=7266

	Median (IQR)
Glycemic outcomes	
Time in Range (70-180 mg/dl)	75.6 (63.1, 84.9)
Time in Tight Range (70-140 mg/dl)	49.4 (36.5, 62.0)
Time Below Range (>70 mg/dl)	1.4 (0.6, 2.8)
Time Above Range (>180 mg/dl)	22.2 (12.3, 35.4)
Time Above Range (>250 mg/dl)	4.1 (1.3, 10.7)
Time Below Range (<54 mg/dl)	0.2 (0.1, 0.6)
Glucose Management Indicator	6.9 (6.5, 7.4)
Mean Glucose	148.7 (133.3, 168.9)
Coefficient of Variation	33.2 (29.1, 37.5)

No boli automatici



Target migliore se boli effettuati regolarmente

TITR in Open Source AID

41 pazienti AAPS

Età 35 ± 11 anni

HbA1c $6,4 \pm 2,8\%$



25 pz

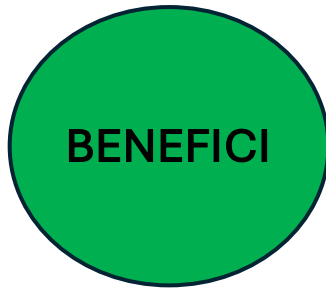
16 pz

V2–V5	AAPS	CIQ + 780G	P value	Δ mean (95% CI)
HbA1c, mmol/mol (%DCCT)	45.98 ± 8.81 (6.4 ± 3)	45.73 ± 6.16 (6.3 ± 2.7)	0.67823	0.24 (–3.15, 0.24)
TIR (3.9–10.0 mmol/L [70–180 mg/dL]), %	84.15 ± 7.61	84.98 ± 6.86	0.3100298	–0.83 (–4.05, 2.39)
TBR (<3.9 mmol/L [<70 mg/dL]), %	3.82 ± 1.92	2.17 ± 1.17	0.000038	1.65 (0.94, 2.35)
TBR (<3.0 mmol/L [<54 mg/dL]), %	0.69 ± 0.65	0.27 ± 0.44	0.000248	0.42 (0.17, 0.66)
TAR (>10.0 mmol/L [>180 mg/dL]), %	11.96 ± 8.38	12.66 ± 7.27	0.240121	–0.7 (–4.19, 2.78)
TAR (>13.9 mmol/L [>250 mg/dL]), %	1.83 ± 2.58	1.55 ± 2.09	0.50114	0.28 (–0.77, 1.33)
TITR (3.9–7.8 mmol/L [70–140 mg/dL]), %	66.38 ± 11.84	63.4 ± 11.77	0.035035	2.98 (–2.73, 8.69)
Mean sensor glucose, mmol/L	7.16 ± 0.84 (129 ± 15.14)	7.35 ± 0.68 (132.43 ± 12.25)	0.04245	–0.19 (–0.53, 0.14)
SD	2.29 ± 0.52	2.2 ± 0.41	0.11008	0.08 (–0.13, 0.29)
%CV	31.62 ± 4.35	29.81 ± 3.49	0.001659	1.81 (0.05, 3.56)
Total daily dose of insulin, units	50.85 ± 16.44	50.78 ± 16.86	0.844515	0.7 (–7.34, 7.48)

Switch of Open-Source Automated Insulin Delivery (AID)
System—AndroidAPS to Commercially Available AID
Systems in Type 1 Diabetes: The Extension
of the CODIAC Study

Quoc Dat Do, MD,^{1,2} Lucie Radovnická, MD,^{2,3} Aneta Hásková, MSc,^{1,2} Judita Konečná, MSc,^{2,4}
Eva Horová, MD, PhD,^{1,2} George Grunberger, MD, FACP, MACE,² Martin Prázný, MD, PhD,^{1,2}
Christopher G. Parkin, MSc,⁵ Milan Flekac, MD, PhD,^{1,2} and Jan Soupal, MD, PhD^{1,2}

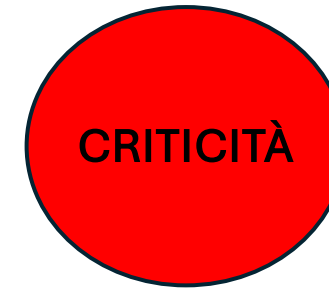
TING e AID... e il paziente?



Pazienti con AID: «**prosecuzione naturale** della gestione quotidiana della malattia»

Stimolo per migliorare il controllo glicemico

Maggior precisione del dato (95 $\neq$ 175 mg/dL)



Aumento del **carico psicologico**: ansia, senso di fallimento, autocritica

Aumento del **conflitto familiare**: metrica più stretta → maggior controllo, discussioni su attività fisica, snack, boli etc..

Verde/Giallo/Rosso? **Impatto visivo** del dato

Soglia unica - Pazienti molto diversi

'We're Taught Green is Good': Perspectives on Time in Range and Time in Tight Range from Youth with Type 1 Diabetes, and Parents of Youth with Type 1 Diabetes

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CONCLUSIONI

Il TITR rappresenta una metrica più vicina alla normoglicemia, per cui definita anche TING

Un TITR più alto sembra associarsi a migliori outcome clinici: minor prevalenza ed incidenza di complicanze soprattutto microvascolari (retinopatia e nefropatia)

Il target di TITR > 50% appare ragionevole e raggiungibile, soprattutto con le impostazioni ottimizzate dei sistemi AID

Il raggiungimento del target di TITR non deve avvenire a costo di più ipoglicemie, maggior burden psicologico o senso di fallimento per il paziente

GRAZIE PER L'ATTENZIONE



“If anybody wants to keep
creating, they have to be about
change.”

Miles Davis