Supplementary Data

SUPPLEMENTARY TABLE S1. DEFINITION OF THE GLYCEMIC VARIABILITY METRICS AND GLUCOSE CONTROL INDICES

Glucose variability metrics	
SD[S1]	$SD = \sqrt{\sum_{i=1}^{N}\left(G_i - \overline{G}\right)^2/(N-1)}$, where G is glucose reading, N is the number of observations, and I is the sample index
%CV[S1]	$\%CV = SD/\overline{G}\cdot 100$
MAGE[S2]	$MAGE = \sum_{i=1}^{x}\lambda_i/x \quad if\ \lambda > \nu$, where λ is the blood glucose changes from peak to nadir (or nadir to peak), x is the total number of valid observations, and ν is 1 SD of mean glucose for a 24-h period
CONGAn[S3]	$CONGA_n = \sqrt{\sum_{t=1}^{k}\left(D_t - \overline{D}\right)^2/(k-1)}$, $D_t = G_t - G_{t-m}$, where k is the number of observations where there is an observation nx60 min ago, m is nx60, G_t is the glucose reading at time t min after start of observations
MODD[S4]	$MODD = \sum_{t=t_1}^{t_k}\lvert G_t - G_{t-24h}\rvert/k$, where k is the number of observations with an observation 24 h ago
M-value[S1]	$M = \sum_{i=1}^{N}\lvert 10\cdot \log_{10}(G_i/IGV)\rvert^3/N$, where G is glucose measured, IGV is the ideal glucose value (default: 100 mg/dL), and N is the total number of readings
J-index[S5]	$J = 0.001\cdot\left(\overline{G} + SD\right)^2$
MAG[S5]	$MAG = \sum_{i=1}^{N-1}(G_i - G_{i+1})/T$, where G_i is the glucose measured, N is the number of measurements, and T is the total time (in hours)
AARC[S6]	$ROC_i = (G(t_i) - G(t_{i+1}))/(t_{i+1} - t_i)$, $I = 1, 2, 3, \ldots,$ N-1, where $G(t_1)$ and $G(t_2)$ are consecutive glucose readings taken at times t_1 and t_2. $AARC = \sum_{i=1}^{N-1}ROC_i/(N-1)$
GVP[S7]	$GVP = 100\cdot(L/L_0 - 1)$, $L = \sum_{i=1}^{n}\sqrt{dx_i^2 + dy_i^2}$, where L_0 is the ideal length for a given temporal duration, dx is the decomposition of the temporal line into horizontal component, dy is the decomposition of the temporal line into vertical component, and n is the total number of glucose recordings
LI[S8]	$LI = \sum_{i=1}^{N-1}(G_{i+1} - G_i)^2/(t_{i+1} - t_i)$, where G is the glucose measured, N is the total number of glucose readings in a week, and t is the time
Glucose control indexes	
GRADE[S9] %$GRADE_{hypo}$	$GRADE = \sum_{i=1}^{N}\min(50;\ 425\cdot\log_{10}(\log_{10}(G_i))\ )/N$, $GRADE_{hypo} = \sum_{i=1}^{N_{hypo}}\min\left(50;\ 425\cdot\log_{10}(\log_{10}(G_{hypo\,i}))\ \right)/N_{hypo}$, $\%GRADE_{hypo} = GRADE_{hypo}/GRADE\cdot 100$, where G is the glucose measured, N is the total number of glucose readings, G_{hypo} is the glucose value lower than hypoglycemic threshold, N_{hypo} is the number lower than hypoglycemic threshold glucose readings
IGC[S10,S11]	$IGC = Hypo\ Index + Hyper\ Index$, $Hypo\ Index = \left(\sum_{i=1}^{k_{hypo}}\left(LLTR - G_{hypo_i}\right)^b\right)/(N\cdot d)$, $Hyper\ Index = \left(\sum_{i=1}^{k_{hyper}}(G_{hyper_i} - ULTR)^a\right)/(N\cdot c)$, where LLTR is the lower limit of target range (default 80 mg/dL), b is an exponent in the range [1.0–2.0] (default = 2.0), d is a scaling factor to weight hypoglycemic and hyperglycemic values (default = 30), ULTR is the upper limit of target range (default = 140 mg/dL), a is an exponent in the range [1.0–2.0] (default = 1.1), and c is a scaling factor (default = 30)

(*continued*)

SUPPLEMENTARY TABLE S1. (CONTINUED)

Glucose control indexes	
LBGI HBGI[S12]	$LBGI = \left(\sum_{i=1}^{N} rl(x_i)\right)/N,$ $HBGI = \left(\sum_{i=1}^{N} rh(x_i)\right)/N,$ $rl(x_i) = 22.77 \cdot f(x_i)^{2} \quad if\ f(x_i) \leq 0,\ and\ 0\ otherwise.,$ $rh(x_i) = 22.77 \cdot f(x_i)^{2} \quad if\ f(x_i) > 0, and\ 0\ otherwise.,$ $f(x_i) = \ln(x_i)^{1.084} - 5.381\ ,$ where x_i is the glucose recording and N is the total number of recordings
ADRR[S13]	$ADRR = \left(\sum_{j=1}^{M} LR^j + HR^j\right)/M,$ $LR^j = \max(rl(x_1), ..rl(x_n)),$ $HR^j = \max(rh(x_1), ..rh(n)),$ where j is the day index, M is the total number of days, x_i is the glucose recording, and n is the total number of recordings per day
PGS[S14]	$PGS = F(GVP) + F(MG) + F(PTIR) + F(H),$ $F(GVP) = 1 + 9/\left(1 + e^{-0.049 \cdot (GVP - 65.47)}\right),$ $F(MG) = 1 + 9/\left(1 + e^{0.1139 \cdot (MG - 72.08)}\right) + 9/\left(1 + e^{-0.1139 \cdot (MG - 157.57)}\right),$ $F(PTIR) = 1 + 9/\left(1 + e^{0.0833 \cdot (PTIR - 55.04)}\right),$ $F(H) = F_{54}(H) + F_{70}(H),$ $F_{54}(H) = 0.5 + 4.5 \cdot (1 - e^{-0.81093 \cdot N_{54}}),$ $F_{70}(H) = \begin{cases} 0.5714 \cdot N_{70} + 0.625 & N_{70} \leq 7.65 \\ 5 & N_{70} > 7.65 \end{cases},$ where MG is the mean glucose, PTIR is the percentage time in range (70–180 mg/dL), N_{54} is the number of hypoglycemia events per week below the low threshold (≤54 mg/dL), and N_{70} is the number of hypoglycemia events per week below the high threshold (≤70 mg/dL)

%CV, coefficient of variation; AARC, average absolute rate of change; ADRR, average daily risk range; CONGAn, continuous overlapping net glycemic action over an n-hour period; GRADE, glycemic risk assessment diabetes equation; GVP, glycemic variability percentage; HBGI, high blood glucose index; IGC, index of glycemic control; LBGI, low blood glucose index; LI, lability index; MAG, mean absolute glucose; MAGE, mean amplitude of glucose excursion; MODD, mean of daily differences; PGS, personal glycemic state; SD, standard deviation.

Supplementary References

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