Q-Score: A composite metric for monitoring glycemic control after therapeutic intervention

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Background and aims

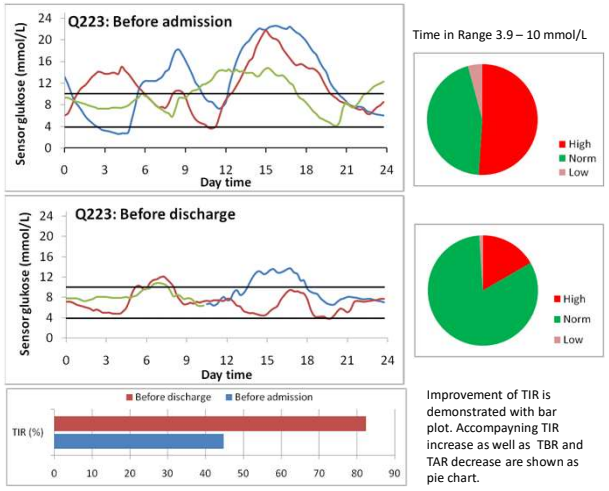
Q-Score is a single-number composite metric for analysis of short-term glycemic control. Q-Score rises with worsening of glycemic quality recorded by continuous glucose monitoring (CGM). Here, we evaluated the suitability of Q-Score for screening of therapeutic effects.

Methods

Q-Score components are central glycemic tendency [mean sensor glucose, MSG (mmol/L)], hyperglycemia [time above range, TAR (h)], hypoglycemia [time below range, TBR (h)], intra- (Range, mmol/L) and inter-daily (MODD, mmol/L) variability.

CGM-profiles were from a non-interventional, retrospective cross-sectional study. 212 people with diabetes mellitus using intermitted CGM were enrolled to investigate Q-Score at admission vs. discharge of inpatient diabetes care. Q-Score was correlated with time in range (TIR (%)). t-Test was used one-tailed for comparison inpatient admission vs. discharge and two-sided for comparison between diabetes types.

Figure 1: Sensor glucose profiles of a participant with type 1 diabetes demonstrating glycemic control before admission vs. discharge



Improvement of TIR is demonstrated with bar plot. Accompayning TIR increase as well as TBR and TAR decrease are shown as pie chart.

Design

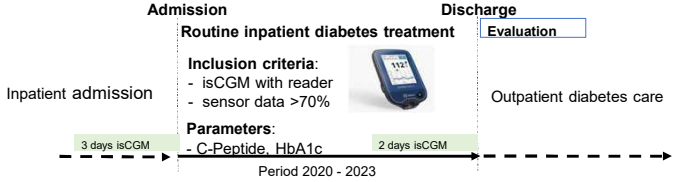
Cross-sectional observational study

Outpatient care

- People with diabetes (PwD) using intermitted glucose scanning (isCGM)
- Analysis of isCGM data recorded under daily life conditions

Inpatient diabetes care

- Participants: 212 Patient (115 type 1, 97 type 2) admitted for inpatient diabetes care
- Duration of stay 4 – 14 days



Results

Inpatient diabetes care resulted in significantly (p<0.001) Q-Score decrease in people with type 1 and with type 2 diabetes, respectively (Table 2). Q-Score decrease was dependent from baseline level (Fig.2, Fig. 3). Equally, TIR and GMI improved during inpatient diabetes treatment (Table 2). Accompanying Q-Score, the components MSG, Range, TAR and MODD declined significantly (p<0.001). TBR maintained stable in both diabetes types (Table 2). Q-Score was highly correlated with TIR and GMI in both diabetes types (Table 3).

Table 2: Short-term glycemic control of participants at admission vs. discharge

Parameter	Type 1 Before admission	Type 1 Before discharge	Type 1 Change	Type 2 Before admission	Type 2 Before discharge	Type 2 Change
Q-Score	15.5±4.8	11.8±3.5	-3.6±4.8**	11.9±4.7	8.4±3.2	-3.5±4.1**
TIR (%)	51.8±21.7	65.4±18.2	13.6±25.2**	56.6±28.1	77.1±21.7	20.4±26.9**
GMI (%)	8.5±1.9	7.3±0.9	-1.2±1.9**	8.2±2.0	6.9±1.0	-1.3±1.7**
MSG (mmol/L)	10.9±3.0	9.0±1.5	-1.9±3.5**	10.4±3.1	8.3±1.6	-2.1±2.6**
Range (mmol/L)	13.0±3.3	11.0±2.9	-1.9±4.8**	9.4±2.6	8.0±2.4	-1.4±2.6**
TAR (h)	11.0±5.5	7.8±4.4	-3.2±6.4**	10.2±6.9	5.3±5.3	-4.9±6.5**
TBR (h)	0.6±1.0	0.5±0.8	-0.05±0.9	0.2±0.5	0.2±0.6	0.03±0.8
MODD (mmol/L)	3.9±1.4	2.8±1.1	-1.0±1.6**	2.5±1.1	1.7±0.8	-0.7±1.2**

Data are Mean±SD, ** p<0.001 between inpatient admission vs. discharge, GMI = Glucose Management Indicator

Conclusion

Q-Score is suitable for assessment of therapeutic effects on short-term glycemic control of people with type 1 and 2 diabetes.

Table 1: Baseline characteristics of study participants

Parameter	Diabetes type Type 1	Type 2	All
N	115	97	212
Sex (female/male)	59/56	50/47	109/103
Age (years)	54.1 ± 15.8	64.9 ± 9.1 **	59.1 ± 14.2
Diabetes duration (years)	25.8 ± 18.2	20.7 ± 11.7 *	23.5 ± 15.7
BMI (kg/m^2)	28.0 ± 5.7	35.1 ± 11.3 **	31.3 ± 9.4
Therapy (OAD/OAD+Insulin/Insulin)	0/2/113	9/66/22 **	9/68/135
HbA1c (%) p<0.001	8.26 ± 1.37	8.16 ± 1.12	8.22 ± 1.26
HbA1c (mmol/mol)	66.8 ± 15.0	65.7 ± 12.3	66.3 ± 13.8
TIR (%)	52 ± 22	57 ± 28	54 ± 25
Q-Score	15.5 ± 4.8	11.9 ± 4.7 **	13.8 ± 5.1
Participants with TIR>70% (%)	26.1	37.1	31.1

Data are Mean±SD, * p<0.05, ** p<0.001 between diabetes types

Table 3: Correlation of Q-Score with other parameters for short-term glycemic control

Parameter	Type 1	Type 2
TIR (%)	-0.865**	-0.899**
GMI (%)	0.879**	0.929**
HbA1c (%)	0.784**	0.775**

** p<0.001

Figure 2: Scatter plot for Q-Score at admission vs. discharge of hospital stay

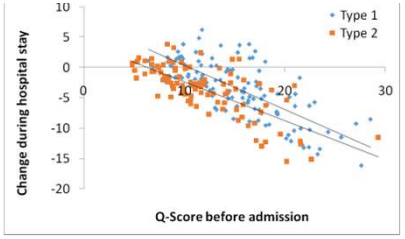
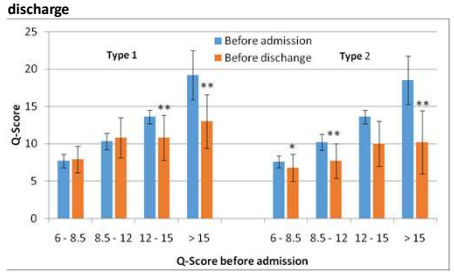


Figure 3: Q-Score in participants with type1 and type 2 at admission vs. discharge



Data are Mean±SD; * p<0.05, ** p<0.001 between inpatient admission vs. discharge

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Augstein P. et al: Q-Score: development of a new metric for continuous glucose monitoring that enables stratification of antihyperglycaemic therapies. BMC Endocrine Disorders, 2015;15:22

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