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a. Full title of manuscript

Accuracy and time delay of glucose measurements of continuous glucose monitoring and bedside artificial pancreas during hyperglycemic and euglycemic hyperinsulinemic glucose clamp study.

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Abbreviations: (BMI) body mass index, (HbA1c) glycated hemoglobin, (CGM) continuous glucose monitoring, (PG) plasma glucose, (AP) artificial pancreas,

d. Keywords: artificial pancreas, continuous glucose monitoring, euglycemic hyperinsulinemic clamp study, hyperglycemic clamp study, Parkes consensus error grid

e. Figures and table count: 3 figures, 4 tables, 1 supplementary table

Abstract

Background:

Glucose values of continuous glucose monitoring (CGM) have time delays compared with plasma glucose (PG) values. Artificial pancreas (STG-55, Nikkiso, Japan) (AP), which measures venous blood glucose directly, also has a time delay

because of the long tubing lines from sampling vessel to the glucose sensor. We investigate accuracy and time delay of CGM and AP in comparison with PG values during 2-step glucose clamp study.

Methods:

Seven patients with type 2 diabetes and 2 healthy volunteers were included in this study. CGM (Enlite sensor, Medtronic, CA) was attached on the day before the experiment. Hyperglycemic (200 mg/dL) clamp was performed for 90 minutes, followed by euglycemic (100 mg/dL) hyperinsulinemic (100 μU/mL) clamp for 90-120 minutes using AP. CGM sensor glucose was calibrated just before and after the clamp study. AP and CGM values were compared with PG values.

Results:

AP values were significantly lower than PG values at 5, 30 minute during hyperglycemic clamp. In comparison, CGM value at 0 minute was significantly higher, and its following values were almost significantly lower than PG values. The time delay of AP and CGM values to reach maximum glucose levels were 5.0 ± 22.3 (NS) and 28.6 ± 32.5 ($p<0.05$) min, respectively. Mean absolute rate difference of CGM was significantly higher than AP (24.0 ± 7.6 vs. 15.3 ± 4.6, $p < 0.05$) during glucose rising period (0-45 min), however, there are no significant difference during other periods.

Conclusions:

Both CGM and AP failed to follow plasma glucose values during non-physiologically rapid glucose rising, however, indicated accurate values during physiological glucose change.

a. Introduction

The accuracy of glucose monitoring is important to control blood glucose in patients with diabetes. Continuous glucose monitoring (CGM) measures subcutaneous interstitial fluid glucose concentrations, and it has been available in many countries. The overall accuracy of CGM depends on the sensor, the reference blood glucose concentrations used for calibration, and the calibration algorithm (1). Because blood glucose is diffused to interstitial tissues, interstitial glucose value is reported to be delayed approximately 10 minutes than plasma glucose (PG) (2). However, it was also reported that Enlite sensor (Medtronic, CA) provided accurate data at different glucose concentrations and rates of change (3). Enlite sensor in combination with iPro2 (Medtronic, CA) is not a real-time (unblinded) CGM, but a retrospective (i.e. blinded when wearing) CGM. iPro2 CGM was designed to show data after the maximum of 7 days of wearing and the data was adjusted mathematically using reference finger-prick glucose values.

Artificial pancreas STG-55 (Nikkiso CO.,LTD, Tokyo, Japan) (AP) was a device for the evaluation of glucose metabolism and the management of critically ill patients (4, 5). AP measures venous blood glucose directly, but it has also time delay because of a long tubing line (1.0 m) from sampling vessel to the glucose sensor. There are no reports, which compared subcutaneous continuous device with an

intravenous continuous device at various glucose values so far.

The aim of the study is to investigate accuracy and time delays of CGM and AP in comparison with PG during acute rising (20mg/dl/min) to hyperglycemic and euglycemic glucose clamp conditions.

b. Methods

Seven patients with type 2 diabetes and 2 healthy volunteers were included in this study. We studied 10 times of experiment, 8 subjects were studied once and 1 subject was done twice. This study protocol was approved by Tokushima University Institutional Review Board (#1598) and in compliance with the World Medical Association's Declaration of Helsinki. All subjects gave written informed consents. The characteristics of subjects were shown in Table 1.

CGM (Enlite sensor, Medtronic, CA) was attached on the day before the experiment. CGM sensor glucose values were calibrated with venous blood glucose measurement by a point-of-care glucose analyzer IVD, GLUTEST MINT (Sanwa Kagaku Kenkyusho, Kyoto, Japan) just before and after the clamp study. AP system was also calibrated just before the experiment according to the manufacturer's instruction.

After an overnight fasting, antecubital vein was cannulated with three

catheters in each subject. First catheter was inserted for venous sampling and the second one was for the infusion of glucose, and the third one was for the insulin infusion. Two catheters were connected to the intravenous continuous glucose monitor of AP and infusion. The total volume of the tubing is 0.9 mL, and the rate of flow is approximately 0.2 mL/min depending on the body weight and blood glucose concentration. STG-55 monitors blood glucose levels using a dual-lumen catheter and a glucose sensor electrode with a glucose oxidase method. Before starting the procedure, two-point internal calibration of AP was performed using two standard solutions (glucose concentration, 0 and 200 mg/dL).

We designed our study basically the same protocol as previous our report Gorogawa, et al. (6), which was modified from original report from DeFronzo et al. (7). Hyperglycemic clamp was performed for 90 minutes, followed by euglycemic hyperinsulinemic clamp for 90-120 (90- 180 or 210 from the beginning) minutes using AP (Figure 1). In detail, infusion of 20% glucose solution was started to raise blood glucose from fasting state to 200mg/dL within 5 minutes and was followed by hyperglycemic clamp. Soon after hyperglycemic clamp procedure, primed-constant infusion of insulin (starting from 4.62 to 1.45 mU/kg/min) and computer-controlled exogenous infusion of 20% glucose solution were started to achieve the desired steady-state plasma insulin concentrations (100 μU/mL) and to maintain blood

glucose levels (100 mg/dL) during euglycemic hyperinsulinemic clamp (8). PG values were recorded every 5 minutes for the first 15 minutes, and thereafter every 15 minutes during the study period. AP and CGM values were retrospectively analyzed. The time to reach maximum glucose value was recorded during hyperglycemic clamp period. Hyperglycemic clamp was divided into CGM glucose rising period as ‘Rising period’ and 60-90 minutes as ‘Hyperglycemic Plateau period’. Euglycemic hyperinsulinemic clamp was divided into 90-150 minutes as ‘Falling period’ and 150-180 or 180-210 minutes as ‘Euglycemic period’. AP and CGM values were compared with PG values using Parkes consensus error grid for type 1 diabetes (9) during the study period. Because of the quality of the approximation of reference BG from readings taken at isolated static points in time, regardless of the temporal structure of the data as reported by Kovatchev et al. (10), Error matrix combining rate– error grid analysis and point– error grid analysis zones in each period of AP and CGM were calculated according to the reference 10.

The comparison of mean absolute rate difference (MARD (%)) of glucose values with plasma glucose (PG) between AP and CGM in each period were calculated as previously reported (11).

Plasma insulin levels were measured in the laboratory of Tokushima University Hospital using the Fluorescence-Enzyme Immunoassay (FEIA)

procedure (Tosoh Corp, Tokyo, Japan).

Statistical analysis

Glucose values were not normally distributed; they were analyzed using non-parametric tests. The comparison of glucose values of CGM or AP were compared with PG values using non-parametric Mann-Whitney's U test. The difference of glucose values of each clamp period of CGM, AP and PG values were evaluated using one-way repeated-measures ANOVA, with Bonferroni-Holm adjusted post hoc tests for multiple comparisons. *p*-values of less than 0.05 were considered statistically significant. Statistical analyses were performed using SPSS software version 21 (SPSS, Chicago, Illinois, USA).

c. Results

Seven patients with type 2 diabetes and 2 healthy volunteers were enrolled in this study. Plasma glucose between these patients and volunteers were similar at fasting state and during hyperglycemic clamp in our study

AP values were significantly lower than PG values at 5 minute (AP: 141.1 (median 134.1) vs. PG: 233.9 (235.5) mg/dL, $p < 0.0001$) and 30 minute (AP: 141.1 (median 134.1) vs. PG: 233.9 (235.5) mg/dL, $p < 0.05$) during hyperglycemic clamp (Figure

1). In comparison, CGM value at 0 minute was significantly higher, and its following values except 45 minutes were significantly lower than PG values (CGM: 135.2 (125.5) vs. PG: 108.4 (101.0) mg/dL,, $p < 0.05$) (Figure 1). The CGM glucose values rose until 45 minutes during hyperglycemic clamp period, therefore, we defined 0-45 minute period as ‘Rising period’. As evaluated with one-way ANOVA, AP and CGM values during ‘Rising period’ and ‘Hyperglycemic period’ were significantly lower than PG values (Table 2). CGM values during ‘Hyperglycemic Plateau period’ were significantly lower than PG values (Table 2).

AP, CGM and PG values were not different between these groups during the ‘Falling period’ and ‘Euglycemic Plateau period’ (Table 2). The time delay of AP values to reach maximum glucose levels were comparable with PG values and the time delay of CGM values to reach maximum glucose levels were significantly higher than PG values (Table 3).

The differences between AP, CGM and PG values in the whole experiment were shown in Figure 2. Ninety-nine percent of CGM and AP values were within the zone A and B in the Parkes consensus error grid (Figure 2). The distributions of Parkes consensus error grid of AP and CGM in each period were investigated. The distribution of zone A in AP values were significantly higher than in CGM values during Rising period (Figure 3). Zone A in CGM was higher than AP values during

the falling period according to the error matrix combining rate– error grid analysis and point– error grid analysis zones in each period of AP and CGM (Supplementary table).

MARD of rising period was significantly lower in AP than CGM (15.3 ± 4.6 vs. 24.0 ± 7.6, $p < 0.05$), however, there were no difference between the MARD of AP and CGM in the other time periods (Table 4).

d. Discussion

We investigated herein the accuracy and time delays of CGM and AP in comparison with PG during acute rising (20mg/dL/min) to hyperglycemic and euglycemic glucose clamp conditions. Hyperglycemic clamp was designed to raise plasma glucose from approximately 100 to 200 mg/dL within 5 minutes, which equates to an average rate of 20 mg/dL/min, so this trial does not represent blood glucose fluctuation in the real life. AP and CGM values were supposed to show the same glucose values as PG values, however, both of these values were behind PG values during the acute rising period.

To our knowledge, this is the first study to compare AP, CGM values and PG values during non-physiological glucose rising of hyperglycemic clamp followed by euglycemic hyperinsulinemic clamp. CGM values did not catch up PG values

during ‘Rising period’ and ‘Hyperglycemic period’. There are several reasons for this phenomenon. Because CGM values were calibrated with two reference points which were just before and after the experiment in this study. This indicates that retrospective mathematical smoothing, i.e. adjustment to values to show an even curve, delayed CGM values during the ‘Rising period’, which might lead to the higher CGM values at the beginning of hyperglycemic clamp and the lower CGM values during this period. It is reported that the mean (standard deviation) time delay of the CGM values to blood glucose meter was 9.5 (3.7) minutes (12). The time to catch up maximum glucose of CGM values in this study was more delayed than the previous report. This may also account for the delay during the acute rising of glucose.

AP values were significantly lower during ‘Rising period’ in several points (Figure 1). It might be because of the time lag of the AP system due to the length of the tubing set during clamp procedure is approximately 4-5 minutes. However, AP values were not statistically delayed compared with PG values using multiple comparison method (Table 2). This rising speed is far faster than the previous report, which describes the comparison of PG and CGM values during hyperglycemic clamp by Monsod et al (13). It might not be necessary for CGM to catch up for these conditions.

The previous reports by Morrow et al (14) compared AP and CGM during steady state in variable glucose clamp, and they found CGM was accurate from 50-250 mg/dl. They used Biostator CGIIs as the artificial pancreas system, while we used STG55 which is only an available bedside AP in Japan. The study design was quite different from the previous study by Morrow in the view of changing speed of glucose concentration. The blood glucose was raised up by 20mg/dl/min in our study, however, it was raised up by 2mg/dl/min in the previous study. So, the raising speed of blood glucose was 10 times faster than previous report. Although MARD values were not so different from Morrow's report, there might be another index to be evaluated. Medtronic's sensor response is limited by filtering algorithms to be no more than 3mg/dL/min (15). Our protocol is to raise up blood glucose levels 100mg/dL within 5 minutes, so the delay of the CGM sensor glucose value compared to PG value was expected to be more than their report. There also might have streaming/mixing effect and also the sensor in the AP device is in the center of the AP system. There must have time delay because of tubing. Although, there are no other smaller tubing available for the current STG55 system. We could not test smaller tubing.

On the other hand, AP and CGM values were not different as PG values during rest of the periods (Table 2). These rest of the periods were almost usual

physiological blood glucose change. Both CGM and AP may be able to catch up with glucose change in the most of daily life.

Zone A and zone B in the Parkes consensus error grid has been regarded as clinically acceptable (9). Although AP and CGM values were significantly different from PG values, more than 99% of AP and CGM values were within zone A and zone B (Figure 2). These indicate that AP and CGM values were at least clinically safe to use. However, the distribution of zone A in AP was significantly higher than CGM during Rising period according to precise investigation (Figure 3). These results indicate that AP reflects the glucose change better than CGM during rapid glucose change. On the other hands, zone A of the error matrix combining rate– error grid analysis and point– error grid analysis zones during falling period, AP seems worse than CGM, this maybe because of automatic smoothing of the CGM computer algorithm (Supplementary table).

We studied 10 times of experiment, 8 subjects were studied once and 1 subject were done twice, however, the number of the subjects were small. There are several questions left for this experiment. If we change the calibration time to very distant time from experimental period, do the results be the same? Also, if we use real time CGM sensors, do they perform the same way? These questions were still left so far.

e. Conclusions

Both CGM and AP did not follow non-physiological acute glucose-rising, however, matched well during physiological glucose-lowering change.

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Conflict-of-Interest Disclosure: Munehide Matsuhisa has received research support from Nikkiso CO. LTD.

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Figures and figure legends

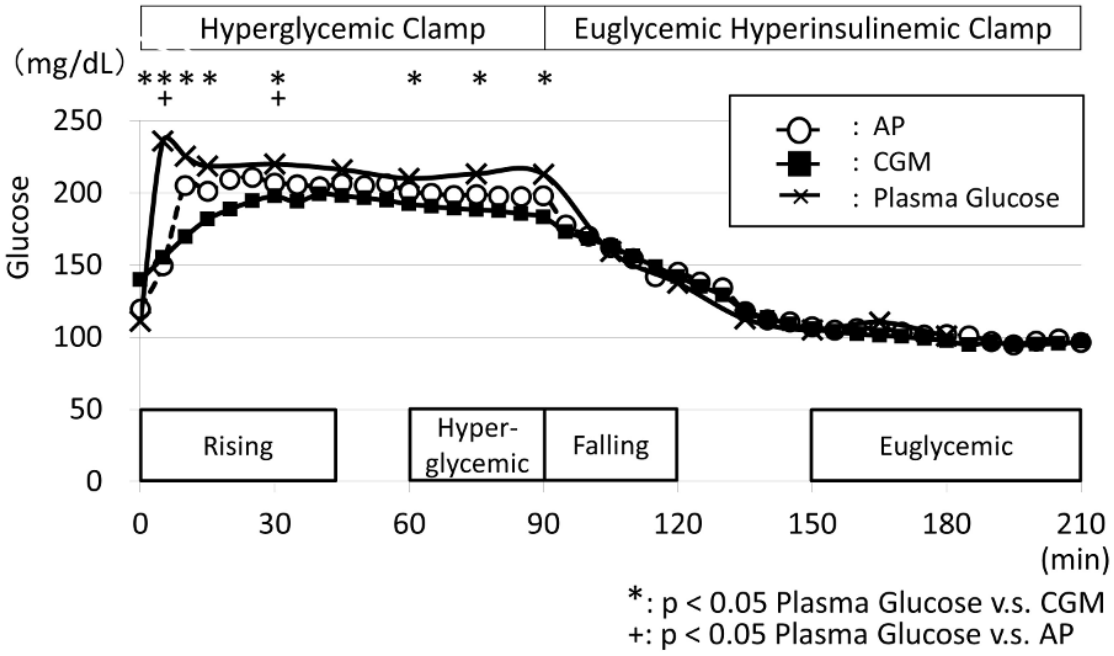

Figure 1. Two step clamp

Hyperglycemic clamp (200mg/dL), followed by hyperinsulinemic (100 μU/mL) euglycemic (100 mg/dL) clamp was performed and the average glucose values of 10 experiment were shown. The reference blood glucose values for CGM were done just before and after the clamp study.

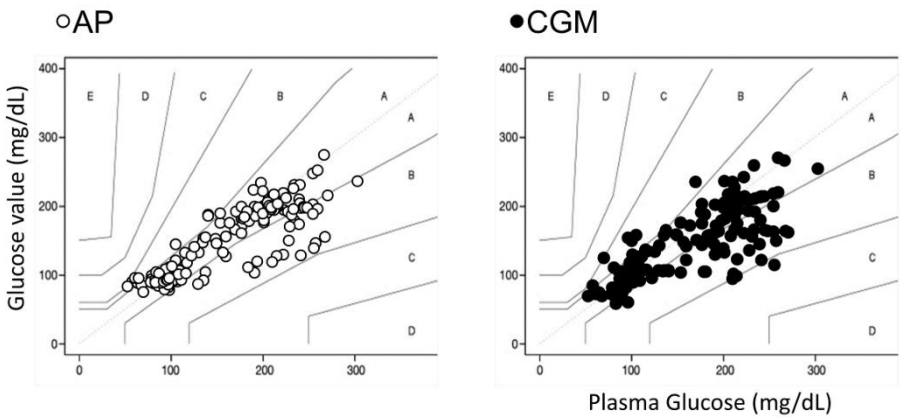

Figure 2. Parkes consensus error grid of AP, CGM and PG during the experiment

Vertical values indicate PG values. More than 99% of glucose values of AP and CGM were within zone A and B.

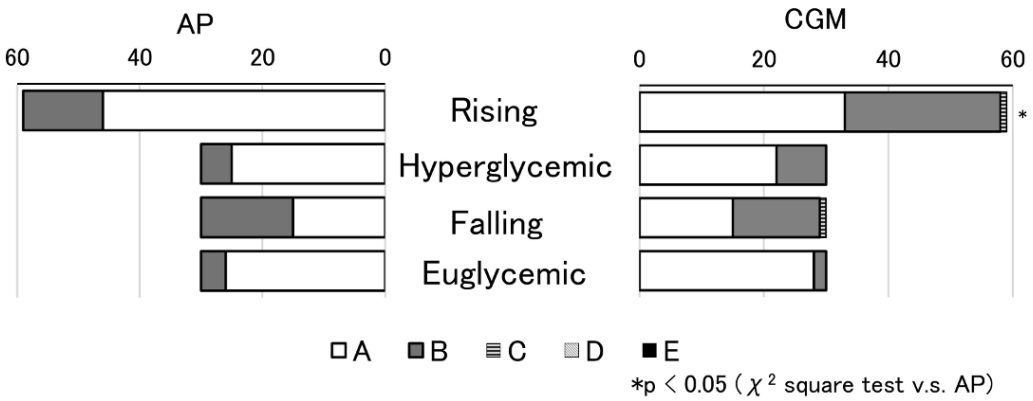

Figure 3. The distribution of Parkes consensus error grid of AP and CGM in each period. X-axis is the percentage of the values in each zone. The distribution of zone A in AP values were significantly higher than in CGM values during Rising period ($p < 0.05$).

Tables and table legends

Table 1. Characteristics of subjects

Characteristics of participants	median (range)
Age (years old)	45.8 ± 13.1
Gender (M/F)	7/1
BMI (kg/m^2)	29.8 ± 8.8
Duration of diabetes (years)	9.4 ± 5.4
Fasting Plasma Glucose (mg/dL)	115.7 ± 24.1
HbA1c (%)	7.8 ± 1.4

Data are mean ± SD values.

BMI: body mass index, HbA1c: glycated hemoglobin

Table 2. One-way ANOVA analysis of CGM, AP and PG during each period.

		Average (median) Glucose (mg/dL)			p value of Bonferroni-Holm adjusted post hoc test	
Period	time(min)	PG	AP	CGM	vs AP	vs CGM
Rising	0-45	202.2(211.0)	176.1(189.6)	168.7(161.5)	<0.001	<0.001
Hyperglycemic	60-90	211.6(212.5)	198.8(198.6)	186.1(194.0)	0.04	<0.001
Falling	90-120	166.2(178.0)	163.0(184.4)	159.1(161.0)	1.00	1.00
Euglycemic	180-210	99.6(100.0)	95.7(94.8)	94.8(93.0)	0.65	0.39

AP: artificial pancreas, CGM: continuous glucose monitoring

Table 3. The comparison between the time to reach maximal glucose during hyperglycemic clamp among plasma glucose, AP and CGM.

	Time to reach maximal glucose (min)	**Difference between plasma glucose and AP or CGM (min)**	**Statistical difference**
Plasma Glucose	15.9 ± 20.0		
AP	20.9 ± 13.5	-5.0 ± 22.3	*NS*
CGM	44.5 ± 21.0	-28.6 ± 32.5	$p < 0.05$

Data are mean ± SD values.

AP: artificial pancreas, CGM: continuous glucose monitoring

Table 4. The comparison of mean absolute rate difference (MARD (%)) of glucose values with plasma glucose (PG) between AP and CGM in each period.

Data are mean ± SD values.

Period	Rising (0-45 min)	Hyperglycemic (60-90 min)	Falling (90-120 min)	Euglycemic hyperinsulinemic (150-210 min)
AP	15.3 ± 4.6	10.3 ± 8.5	13.1 ± 9.5	12.6 ± 9.3
CGM	24.0 ± 7.6	13.2 ± 9.7	13.7 ± 8.7	13.8 ± 6.5
p value	< 0.05	n.s.	n.s.	n.s.

AP: artificial pancreas, CGM: continuous glucose monitoring

The result of the MARD of AP and CGM. The reference value of MARD was PG.

The p value is the MARD difference between AP and CGM.

Supplementary Table. Error matrix combining rate– error grid analysis and point–error grid analysis zones in each period of AP and CGM according to the reference 10.

a. Rising period of AP

		point error-grid zones (Rising period of AP)										
		Hypgycemia			euglycemia			hyperglycemia				
		BG <= 70			70 < BG <= 180			180 < BG				
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	0%	0%	0%	20%	0%	0%	31%	2%	0%	0%	0%
	B	0%	0%	0%	0%	0%	0%	9%	9%	0%	6%	0%
	uC	0%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	2%
	uE	0%	0%	0%	0%	0%	0%	13%	0%	0%	0%	0%
	IE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

b. Rising period of CGM

		point error-grid zones (Rising period of CGM)										
		Hypgycemia			euglycemia			hyperglycemia				
		BG <= 70			70 < BG <= 180			180 < BG				
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	0%	0%	0%	7%	0%	0%	20%	9%	0%	0%	0%
	B	0%	0%	0%	4%	2%	0%	9%	4%	0%	2%	0%
	uC	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uD	0%	0%	0%	0%	2%	0%	4%	5%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	4%	0%	4%	4%
	uE	0%	0%	0%	4%	2%	0%	5%	5%	0%	0%	0%
	IE	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%

c. Hyperglycemic period of AP

		point error-grid zones (Hyperglycemic period of AP)									
		Hypgycemia			euglycemia			hyperglycemia			
		BG <= 70			70 < BG <= 180			180 < BG			
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	0%	0%	0%	0%	0%	0%	38%	0%	0%	0%	0%
	B	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%
	uC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uD	0%	0%	0%	12%	0%	0%	12%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	12%	0%	0%	0%	0%
	uE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IE	0%	0%	0%	0%	0%	0%	12%	0%	0%	0%	0%

d. Hyperglycemic period of CGM

		point error-grid zones (Hyperglycemic period of CGM)									
		hypgycemia			euglycemia			hyperglycemia			
		BG <= 70			70 < BG <= 180			180 < BG			
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	0%	0%	0%	0%	12%	0%	19%	0%	0%	0%	0%
	B	0%	0%	0%	0%	0%	0%	38%	0%	0%	0%	0%
	uC	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
	uD	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IE	0%	0%	0%	0%	0%	0%	0%	12%	0%	0%	0%

e. Falling period of AP

		point error-grid zones (Falling period of AP)									
		Hypgycemia			euglycemia			hyperglycemia			
		BG <= 70			70 < BG <= 180			180 < BG			
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	0%	8%	0%	8%	0%	0%	8%	0%	0%	0%	0%
	B	0%	0%	0%	0%	8%	4%	8%	8%	0%	0%	0%
	uC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IC	0%	0%	0%	4%	0%	0%	0%	4%	0%	0%	0%
	uD	0%	0%	0%	8%	4%	0%	4%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	4%	4%	0%	0%	0%
	uE	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%
	IE	0%	0%	0%	0%	4%	0%	4%	4%	0%	0%	0%

f. Falling period of CGM

		point error-grid zones (Falling period of CGM)									
		Hypgycemia			euglycemia			hyperglycemia			
		BG <= 70			70 < BG <= 180			180 < BG			
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	8%	0%	0%	27%	4%	0%	23%	0%	0%	0%	0%
	B	0%	0%	0%	12%	4%	0%	8%	0%	0%	0%	0%
	uC	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
	uD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uE	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%
	IE	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%

g. Euglycemic period of AP

	point error-grid zones (Euglycemic period of AP)										
	Hypgycemia			euglycemia			hyperglycemia				
	BG <= 70			70 < BG <= 180			180 < BG				
	A	D	E	A	B	C	A	B	C	D	E

Rate Error-Grid Zones	A	0%	0%	0%	50%	4%	0%	0%	0%	0%	0%	0%
	B	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	0%
	uC	0%	0%	0%	4%	4%	0%	0%	0%	0%	0%	0%
	IC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uD	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IE	0%	0%	0%	4%	8%	0%	0%	0%	0%	0%	0%

h. Euglycemic period of CGM

		point error-grid zones (Euglycemic period of CGM)										
		Hypgycemia			euglycemia			hyperglycemia				
		BG <= 70			70 < BG <= 180			180 < BG				
		A	D	E	A	B	C	A	B	C	D	E
Rate Error-Grid Zones	A	4%	0%	0%	23%	4%	0%	0%	0%	0%	0%	0%
	B	4%	0%	0%	38%	4%	0%	0%	0%	0%	0%	0%
	uC	0%	0%	0%	12%	0%	0%	0%	0%	0%	0%	0%
	IC	0%	0%	0%	4%	4%	0%	0%	0%	0%	0%	0%
	uD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	ID	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	uE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	IE	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%

Accurate Readings

Benign Errors

Erroneous Readings