

## Introduction

Continuous glucose monitoring (CGM) systems are designed to report glucose results over a claimed use life and typically require finger-stick calibrations to achieve claimed accuracy. However, some systems allow extending the sensor use life and continue to report glucose results without required calibrations. This study evaluated the impact of performing the calibration only at the start-up and extending the use life beyond the product label-indicated 7-days on the accuracy of Dexcom G4® Platinum CGM (G4) system with 505 software (which uses the same sensor and software as the Dexcom G5® Mobile CGM System). Performance of FreeStyle Libre™ system, which is designed to be used for up to 14 days without fingerstick calibration is also provided.

## Methods

A total of 46 subjects 18 years or older with Type 1 or Type 2 diabetes requiring insulin therapy were recruited at two clinical sites. Each subject wore two G4 sensors on the abdomen and one FreeStyle Libre sensor on the back of the arm. One of the G4 sensors was calibrated per instructions for use while the other was only calibrated at start-up using FreeStyle Libre built-in blood glucose meter. At the end of the indicated use life of 7 days, both G4 sensors were reinitiated and continued to be worn for additional 7 days with the same calibration scheme as that of the previous 7-days of wear. Subjects performed up to 8 (average 7.8) SMBG measurements per day which served as reference for accuracy evaluation.

The subjects characteristics were

- Gender: 61 % Female / 39% Male
- Age : 20- 72 years
- HbA1c: 5.9% – 10.7%
- Duration of insulin use 2-55 years
- Type 1 patients : 82.6%
- Diabetes management: 50% pump/ 50% MDI

Calibration Compliance:

- For sensors used per instructions
  - 4% received fewer than 2 calibrations on some days
  - 4% received more than 2 calibrations on some days
- For the sensors requiring calibration only at startup,
  - 13% (6/46) received additional calibrations on some days.

Sensor glucose readings were paired with the closest SMBG reference readings using a 5-minute time window. Sensor readings outside of dynamic range were excluded before pairing and not included in the analyses.

## Results

Table 1 & 2 show the performance parameters of G4 systems and FreeStyle Libre under different use conditions when compared to SMBG reference.

Table 1: Performance parameters of CGM systems under different use conditions

Sensor	Calibration	Wear Days	Mean Bias (SD) (%)	MARD (SD)%	%Within 20mg/dL/ 20%, %	N
FreeStyle Libre	N/A	1-14	-1.0 (16.4)	11.9 (11.3)	84.9	3392
G4	Per Label	1-7	-1.8 (16.0)	11.0 (11.8)	88.1	2169
		8-14	-6.8 (15.8)	13.2 (11.0)	81.2	2192
	At start-up	1-7	12.4 (23.2)	18.9 (18.3)	67.6	2082
		8-14	-14.8 (19.4)	20.2 (13.7)	57.0	2121

Table 2: t- test comparison of performance parameters to 1-7 day use per label

Calibration	Wear days	Difference in MARD(%)	p-Value	Difference In % Within 20/20	p-Value
Per label	8-14	-2.6	0.0006	7.7	0.0004
At start up	1-7	-8.4	<0.0001	21.8	<0.0001
	8-14	-9.8	<0.0001	32.6	<0.0001

## Results (Continued)

Mean Percent Bias and Mean Absolute Relative Difference (MARD) compared to SMBG reference for three systems on individual wear days are presented in Figures 1 and 2. G4 sensors were reinitialized on day 8 and both systems were calibrated at that time.

Figure 1: Mean Percent bias across sensor wear days

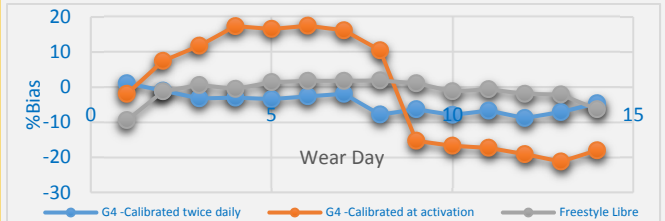


Figure 2: Mean Absolute Relative Difference (MARD) across sensor wear days

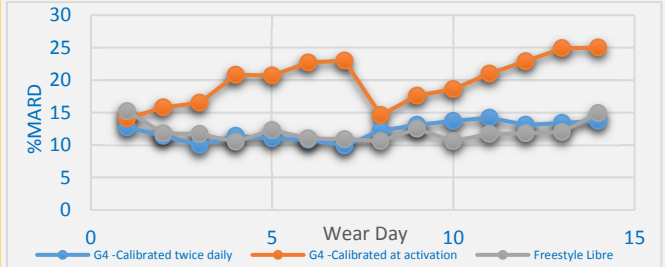
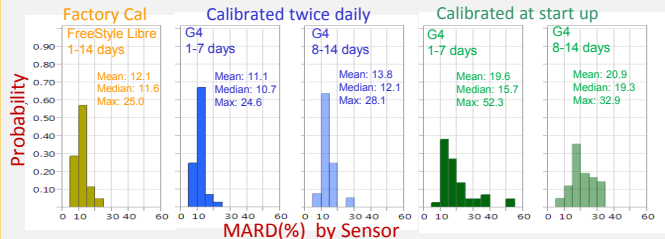


Figure 3 summarizes the MARD distribution by sensor for FreeStyle Libre, G4 sensors with different calibration and wear durations.

Figure 3: MARD distribution by sensor for different systems



The study demonstrates that not calibrating the sensor with SMBG as required adversely affects sensor accuracy. Accuracy deteriorates when the sensor is reinitialized for extending the use. Extending beyond 14 days may continue to further deteriorate the accuracy.

## Conclusions

Decision for the approval of CGM systems for safe and effective use to manage diabetes is based on using the sensor as instructed by the manufacturer. Some CGM systems can be (repeatedly) reinitialized to extend the use life. Some CGM systems do not disable the sensor when required calibrations are not provided or if calibrated, do not check if CGM result is provided for calibration. This study demonstrates -

- Extending the sensor life by reinitialization could affect the sensor performance.
- Not calibrating the sensors with SMBG as required affects the sensor performance

CGM systems are being used for therapy decisions. In the absence of controls for disabling the device when not used as indicated, following manufacture's use instructions is very important for safe and effective use of the device.

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