

# A review of the analytical performance of continuous glucose monitoring devices and their potential role in managing hypoglycaemia in patients with metabolic disorders

Osman A G E, Schulenburg-Brand D. University Hospital of Wales, Cardiff

## Introduction

Continuous glucose monitoring (CGM) is a method to measure real time glucose concentration in the interstitial fluid. It is useful in the management of patients with recurrent episodes of hypoglycaemia such as patients with glycogen storage disorders by continuously monitoring their blood glucose concentrations to identify the times and magnitudes of the hypoglycaemia. We reviewed the analytical performance of the available continuous glucose monitoring devices to make an informed decision on their clinical utility.

## Method

We reviewed the published evidence on the clinical utility of CGM in the management of GSD patients and the published data on the analytical performance of the available CGM devices.

## Results

- The accuracy metrics used to assess the analytical performance of CGM devices are:

**Mean absolute relative difference (MARD):** this is the percentage average difference between the laboratory value and the CGM value.

$$\frac{\text{Lab value} - \text{CGM value}}{\text{Lab value}} \times 100\%$$

**The %15/15, %20/20 and %30/30 metrics:** these metrics refer to the following:

- the percentage of CGM glucose values that fall within 15, 20 or 30 mg/dl (corresponds to 0.8, 1.1 or 1.7 mmol/L, respectively) from the laboratory glucose values, when the laboratory glucose value is  $\leq 5.6$  mmol/L
  - the percentage of CGM glucose values that fall within 15%, 20%, or 30% of laboratory glucose values when the laboratory glucose value is  $> 5.6$  mmol/L.
- DEXCOM G6 CGM system has the best analytical performance compared to other systems such as Free style Libre.
  - FDA classifies DEXCOM G6 as "moderate risk" class II medical devices with special controls.

## Discussion

CGM continuously measures blood glucose in the interstitial fluid. This is very useful in the management of patient with recurrent hypoglycaemia, however the results must be interpreted as 'trend' rather than a single figure and should be coupled with the clinical picture.

The accuracy metrics used to evaluate CGM analytical performance are MARD and the %15/15mg/dl, %20/20mg/dl and %30/30mg/dl metrics. The lower the MARD the better the performance. The %20/20 rule (%20/1.1mmol/l) is the most commonly used metric to evaluate the analytical performance of CGM.

This rule means that at venous blood glucose values below 5.6mmol/L, CGM glucose results will be within +/- 1.1mmol/L from the corresponding venous glucose value. For example, a CGM result of 5.0mmol/L could be anything between 3.9mmol/L and 6.1mmol/L.

**It is important to note that the lower the venous blood glucose value the less accurate is the reading obtained by CGM. For example:**

When venous blood glucose value (laboratory value) is between 3-3.8mmol/L, only 94.4% of DEXCOM G6 glucose results are within +/- 1.1mmol/L margin of the venous blood glucose value. **The remaining 5.6% of the results are outside this +/- 1.1mmol/L range.**

When venous blood glucose value is less than 3mmol/L, only 85% of DEXCOM G6 results are within +/- 1.1mmol/L margin of the true result. **The remaining 15% of the results are outside this +/- 1.1mmol/L range.**

The published papers on clinical utility of CGM in GSD patients have not assessed these metrics, however, they showed correlation between the CGM glucose values when measured against capillary blood glucose values.

## Conclusion

CGM is a useful tool in the management of patients with recurrent episodes of **hypoglycaemia** such as patients with GSD. The glucose results obtained by CGM should be interpreted within the limitations of the instrument and should be used to identify 'trends' of timings and magnitudes of the hypoglycaemia to guide dietary adjustments. It would be very useful to reassess the occurrence of hypoglycaemia following the implementation of these dietary adjustments.

### References :

- Performance of a Factory-Calibrated Real-Time Continuous Glucose Monitoring System Utilizing an Automated Sensor Applicator. Shah et al. DIABETES TECHNOLOGY & THERAPEUTICS. Volume 20, Number 6, 2018
- Accuracy of a Factory-Calibrated Real-Time Continuous Glucose Monitoring System during 10 days of use in youth and adults with diabetes. Wadwa et al. DIABETES TECHNOLOGY & THERAPEUTICS. Volume 20, Number 6, 2018
- The Performance and Usability of Factory-Calibrated Flash Continuous Glucose Monitoring System. Baily et al. DIABETES TECHNOLOGY & THERAPEUTICS. Volume 17, Number 11, 2015
- FDA (den170088summary) EVALUATION OF AUTOMATIC CLASS III DESIGNATION FOR Dexcom G6 Continuous Glucose Monitoring System, DECISION SUMMARY
- DEXCOM G6 continuous glucose monitoring abbreviated instructions on: getting started using the Dexcom receiver.

DEXCOM G6 glucose	Percentage of results within %15/0.8 mmol/L	Percentage of results within %20/1.1 mmol/L	Percentage of results within %30/1.7 mmol/L	MAD mmol/L
<3.0mmol/L	78.7%	85.0%	93.5%	0.61
3.0-3.8mmol/L	89.5%	94.4%	97.7%	0.43