

## Using CGM for Non-Diabetic Endocrine Issues– A Useful Weapon?

Veronica J. Brady, PhD, FNP-BC, BC-ADM, CDE  
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- I have no conflicts of interest to disclose

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### Diabetes Warrior



William "Lee" Dubois

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## Objectives

- Define hypoglycemia & glycemic variability
- Identify non-diabetes endocrine disorders causing glycemic variability
- Review components of CGM
- Review the role/use of CGM for non-diabetes related glycemic variability management
- Identify benefits and challenges of CGM in non-diabetes settings

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## Pediatric Hypoglycemia

- Hypoglycemia— <70mg/dL
- Whipple's triad
  - Symptoms
  - Low blood glucose
  - Relief after treatment

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## Glycemic Variability

- Glycemic variability (GV), which refers to swings in blood glucose levels, has a broader meaning because it alludes to blood glucose oscillations that occur throughout the day, including hypoglycemic periods and postprandial increases, as well as blood glucose fluctuations that occur at the same time on different days. Suh & Kim, JH (2015)

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**NON-DIABETES ENDOCRINE  
DISORDERS CAUSING  
GLYCEMIC VARIABILITY**

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**Glycogen Storage Disease**

- Glycogen Storage Disease (GSD)
  - Impaired production of glucose from gluconeogenesis and glycogenolysis
  - Defects in glucose 6-phosphate enzyme system [liver, kidney, intestines] (1a)
  - Defect of the G6P transporter, G6P translocase [leukocytes](1b)
  - Kasapkara, Demir, Hasanoglu, & Turner (2014)

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**GSD**

- Clinical Manifestations
  - Failure to thrive
  - Hepatomegaly
  - Severe fasting hypoglycemia
  - Hyperlipidemia
  - Hyperuricemia

Kasapkara, Demir, Hasanoglu, & Turner (2013)

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## Gastric Surgery

- Dumping syndrome as a complication of fundoplication surgery is characterized by severe post prandial hypoglycemia (PPH).
- PPH
  - occurs 1-3 hours after meal
  - Occurred in 24%

Calabria, Charles, Givier & DeLeon (2016)

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## ACTH & GH Deficiency

- “Impaired synthesis and release of ACTH from the pituitary gland, or impaired release or action of hypothalamic corticotropin-releasing factor, eventually leading to blunted cortisol secretion”.

Cambiaso, Schiaffini, Pontrelli, Carducci, Ubertini, Crea & Cappa (2013)

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## Kidney Transplant

- New -onset diabetes after transplantation (NODAT) and impaired glucose tolerance (IGT) are common complications following solid organ transplant.
- Incidence/prevalence
  - Occurs in 2-53% of all solid organ transplants
  - Incidence 3 yrs post transplant 7.1%
  - Prevalence of 13% in children

Pasti,Szabo, Prokai,Meszaros,Peko, Solyom, Sallay, Reusz, (2013)

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## Kidney Transplant

- Causes for glucose issues:
  - Increased insulin resistance
  - Increased insulin clearance
  - Deficient insulin production
- Risk factors:
  - Age > 10 years
  - Steroid use
  - Obesity
  - Diseased donor graft
  - Use of tacrolimus
  - Cytomegalovirus

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## USE OF CGM IN ASSESSING GLYCEMIC VARIABILITY

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## What is CGM?

- Sensor composed of microelectrode coated with glucose oxidase beneath biocompatible membrane, which converts glucose in the interstitial fluid into an electronic signal proportional to amount of glucose present.
- Provides BG readings every 5 minutes (288 readings/day)
- Lag time= 5 minutes
- Requires finger stick BG at least q12 hours for calibration
- **Accurate for BG 40-400mg/dL**

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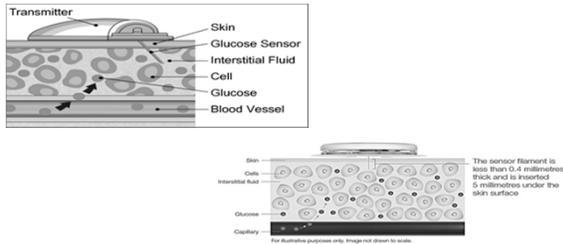
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## CGM at a Glance




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## CGM Categories and Devices

- GlucoWatch – 1999
- Current devices
  - DexCom G4 Platinum
  - DexCom G5
  - Medtronic Guardian REAL-Time
  - MiniMed Paradigm REAL-Time
  - MiniMed 530G with Enlite
  - FreeStyle Libre Pro
- Two categories:
  - Professional- Medtronic iPro2, FreeStyle Libre or DexComG4 Platinum Professional
  - Personal

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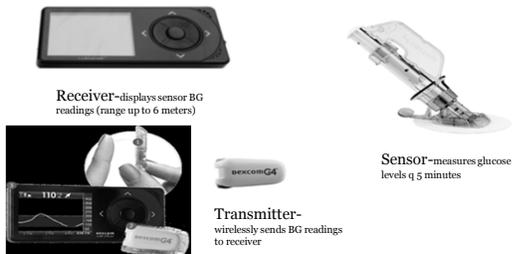
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## DexCom G4




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## Medtronic ipro2



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## Libre Pro Sensor



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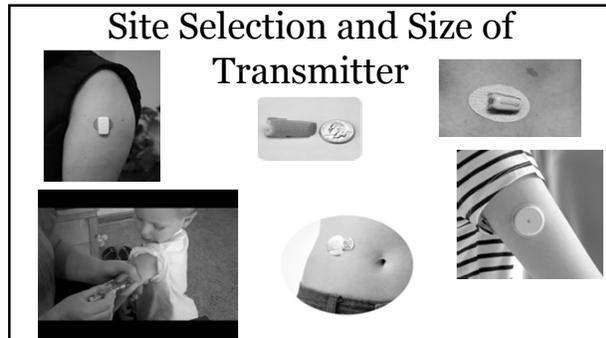
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## Site Selection and Size of Transmitter



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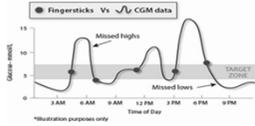
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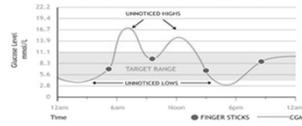
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## Detection of hyper/hypoglycemia



CGM provides a “movie” of BG readings as opposed to a “snapshot”. Grunberger, 2015




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## Benefits of CGM (DiaMonD Study, ADA 2016)

### Results

	CGM	Fingersticks
<b>A1c Reduction</b>	0.9% improvement	0.4% improvement
<b>Time spent &lt; 70 mg/dl</b>	30% improvement (-23 minutes per day)	17% improvement (-15 minutes per day)
<b>Time spent &lt; 50 mg/dl</b>	50% improvement (-11 minutes per day)	21% improvement (-6 minutes per day)
<b>Time spent &gt; 180 mg/dl</b>	12% improvement (-83 minutes per day)	1% worse (+9 minutes per day)
<b>Time in range (70-180 mg/dl)</b>	11% improvement (+72 minutes per day)	2% worse (-15 minutes per day)
<b>Glycemic variability</b>	4% reduction	No change

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RESULTS FROM RECENT STUDIES

## USE OF CGM FOR NON-DIABETES GLYCEMIC VARIABILITY MANAGEMENT

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### Hypoglycemia in Glycogen Storage Disease

- Aim: determine magnitude & significance of hypoglycemia and evaluate efficacy of revised dietary treatment
- Subjects: 16 children with GSD, mean age 7.59+/- 4.12 years
- Results: significant hypoglycemia detected & duration of events as well as liver size were reduced
- Conclusions: CGM is a useful tool for assessment and long term management of hypoglycemia in GSD

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### Post prandial Hypoglycemia after Gastric Surgery

- Aim: to evaluate pathogenesis of PPH by examining post meal BG & insulin responses
- Subjects: 6 children with known PPH age 6- 18 years
- Results: No significant hypoglycemia detected
- Conclusion:

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### Nocturnal Hypoglycemia in ACTH & GH Deficiency

- Aim: to evaluate use of CGM to identify nocturnal hypoglycemia and optimize hydrocortisone therapy.
- Subjects: 11 patients with ACTH & GH deficiency, mean age 5.3 years
- Results: hypoglycemia lasting 30-155 minutes was detected
- Conclusions: CGM is useful in detecting nocturnal asymptomatic hypoglycemia and assisting in dosing of hydrocortisone.

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## Glucose Variability Following Kidney Transplant

- Aim: to monitor BG levels following renal transplant using CGM
- Subjects: 20 patients, mean age 16 years
- Results: 5% w/NODAT and 30% w/IGT
- Conclusions: IGT has prevalence of approximately 30% in renal transplant patients. CGM may be useful in detecting post-transplant hyperglycemia.

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## BENEFITS AND CHALLENGES OF CGM USE

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## Parent/Caregiver Perspective (Young Children)

### Benefits

- Ability to detect impending hypoglycemia
- More BG information with fewer finger sticks
- Ability to remotely monitor (overnight, daycare, pre-school, etc.)

### Challenges

- Limited body surface for sensor placement
- Difficulty with adherence
- Pain with insertion

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## Patient Perspective (Adolescents)

### Benefits

- Increased/constant availability of readings
- Increased self-care

### Challenges

- Overwhelming amount of data
- Unwilling to have parents follow remotely

Forlenza, Argento & Laffel, 2017

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## Take Home Message

- CGM can be useful in assessing glycemic variability beyond diabetes management
- CGM use in the pediatric population is safe and efficacious

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vbrady@med.unr.edu

**THANK YOU!!**

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