Introduction to Continuous Glucose Monitoring

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Objectives

- Compare and contrast currently available continuous glucose monitoring (CGM) devices for use in patients with diabetes
- Discuss the benefits and limitations of CGM in patients with diabetes
- Describe the role of pharmacy in identifying patients for CGM and selecting a device
- Identify the components and demonstrate the set-up of the most common CGM devices
Disclosure

I do not have (nor does any immediate family member have) a vested interest in or affiliation with any corporate organization offering financial support or grant monies for this continuing education activity, or any affiliation with an organization whose philosophy could potentially bias my presentation.
Case 3: 28 year old male

- T1DM
- MDI: detemir 20 units BID, aspart 1:13 CHO & 1:30 correction
- A1c 15%
- Non-compliant with insulin and BG testing
- Hospitalized 4 times in the past 6 mo for DKA
- In clinic complains of hypoglycemia signs & symptoms periodically
Fingerstick glucose monitors

• Standard for guiding treatment decisions
• Blood glucose reading “right now”
• No information regarding past or future glucose direction
• T1DM must check frequently for insulin dosing and corrections
• T2DM - data doesn’t show benefit unless multiple daily insulin (MDI) doses or use FPG to adjust basal insulin doses
Monitoring

- Recommended monitoring for T1DM
  - Before meals and snacks
  - 2-3 hours post-prandial
  - Bedtime
  - Before exercise or activity
  - Hypoglycemia signs & symptoms
  - After treating low or high
  - Before critical tasks such as driving
CGM Basics

- Tiny wire sensor placed into subcutaneous fat
- Attached to a transmitter that sends glucose data to a reader/receiver, phone, or other device
- Measures interstitial fluid not serum glucose
- Measures glucose @ every 5 mins; 288/day
- Gives glucose with direction and rate of change
- Disposable sensors
- Reusable transmitter (except Libre)
- Professional versions available
The sensor measures glucose in the interstitial fluid.

Your meter measures glucose in your blood.

*10-15 minute lag time between BG and SG

*Normal for BG ≠ SG

Medtronic Diabetes website
Freestyle Libre®

- Intermittently scanned CGM: isCGM
  - *Only receive SG readings when you scan*
  - *NO alarms or alerts*
- Dispensed from pharmacy
- Reader or Smart phone
- Replace sensor every 14 days
- ≥ 18 years
- No data sharing
- Provider/patient can download
Freestyle Libre®

- Ascorbic acid and salicylic acid can interfere with sensor readings
- Warm up of 1 hour without readings; should use fingerstick glucose for first 12 hours
- Scan minimum of every 8 hours
- No calibration
- Need fingerstick for decisions
A number representing your current glucose reading
A trend arrow showing the direction your glucose is heading
A trend graph depicting the latest 8 hours

FDA website, Libre website
Dexcom G6®

- Real time CGM: rtCGM
  - Real time alerts and alarms
  - Continuous data stream to device or phone
  - Predictive low alert
- Replace sensor every 10 days
- ≥ 2 years of age
- Receiver or smartphone app; data sharing
- 2 hour warm-up
- No calibration required; replaces fingersticks
- Links to Tandem insulin pumps
• Freestyle Libre 14 day sensor insertion

• Dexcom G6 sensor insertion
Guardian Connect®

- Real time CGM: rtCGM
  - Real time alerts and alarms
  - Predictive alerts for high and low
- No reader; smartphone app only; links to Sugar.IQ
- Replace sensor every 7 days
- ≥ 14 years of age
- Share data with 5 people
- Acetaminophen falsely elevates glucose readings
- 2 hour warm-up
- Calibration required: 2 hrs, 6 hrs, every 12 hrs
• Medtronic sensors link with 630G and 670G insulin pumps
• Closed loop/hybrid system
Sensor placement

- Freestyle Libre: back of arms
- Dexcom G6: belly and upper buttocks
- Guardian: arm, belly and upper buttocks
- Rotate insertion sites
- Avoid:
  - Areas of pressure: clothing, sleeping, bony
  - Tattoos
  - Scar tissue
  - Hair
  - Irritation
Eversense®

- rtCGM
  - On body vibration and device alerts
- Insert sensor in arm q90 days (180 days Europe)
- In office procedure
- ≥ 18 years of age
- Daily removable and rechargeable transmitter
- Smart phone app; data sharing with 5 people
- Warm up 24 hours
- 2 calibrations per day
SMBG vs CGM vs A1c
Ambulatory Glucose Profile

- Consensus on what is included in summary page
- Profile summaries for CGM and SMBG
  - Statistics and targets
  - Time in ranges
    *General goals: > 70% time in target range
    < 3% time < 70 mg/dL
- Ambulatory glucose profile
- Daily glucose profiles
**CGM AGP**

**GLUCOSE STATISTICS AND TARGETS**

- **26 Feb 2019 - 10 Mar 2019**
- **13 days**
- **99.9%**

**Glucose Ranges**

- **Target Range 70-180 mg/dL**
- **Greater than 70%** (16hr 48min)
- **Below 70 mg/dL**
  - Less than 4% (56min)
  - Less than 1% (14min)
- **Above 250 mg/dL**
  - Less than 5% (1hr 12min)

Each 5% increase in time in range (70-180 mg/dL) is clinically beneficial.

**Average Glucose**

- **173 mg/dL**

**Glucose Management Indicator (GMI)**

- **7.6%**

**Glucose Variability**

- **49.5%**

Defined as percent coefficient of variation (%CV); target ≤36%

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**TIME IN RANGES**

- **Very High** (>250 mg/dL) **20%** (4hr 48min)
- **High** **23%** (5hr 31min)
- **Target Range** (70-180 mg/dL) **47%** (11hr 17min)
- **Low** **4%** (58min)
- **Very Low** (<54 mg/dL) **6%** (1hr 26min)

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**AMBULATORY GLUCOSE PROFILE (AGP)**

AGP is a summary of glucose values from the report period, with median (50%) and other percentiles shown as if occurring in a single day.

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**DAILY GLUCOSE PROFILES**

- **Monday**
- **Tuesday**
- **Wednesday**
- **Thursday**
- **Friday**
- **Saturday**
- **Sunday**

Each line represents a midnight to midnight period.
Benefits of CGM

• Patient engagement
• More accurate insulin dosing
• Less glucose variability
  • Fewer hypo and hyperglycemic excursions
• Improvements in A1c
• Move from A1c to AGP
CGM selection

- **rtCGM** (Dexcom G6®, Guardian®, Eversense®)
  - Intensive insulin therapy
  - Increased hypoglycemic risk/ unawareness
  - Nocturnal hypoglycemia
  - Significant glycemic variability
  - Continuous data, alerts and alarms
  - Children ≥ 2 years (G6®)
  - Pump integration (G6®, Guardian®)
  - Allergy to tape adhesives (Eversense®)
CGM selection

- **isCGM** (Freestyle®)
- Non-insulin or only LA insulin regimen
  *Medicare requires ≥ 3 insulin injections/day*
- Doesn’t need alerts & will scan device
- Low risk of hypoglycemia
- Non-compliant with fingerstick
- Less expensive and very easy set-up
ADA recommendations

• When to use CGM / Who is best candidate
  • T1DM and/or MDI
  • Struggle with glucose variability
  • Hypoglycemia unawareness or frequent lows
  • Non-compliant with glucose meter
• isCGM considered as SMBG substitute when frequent monitoring is required

https://care.diabetesjournals.org/content/42/8/1593
Pharmacist role

- At a minimum...... providing education
- Recommend CGM to appropriate patients
- Prescribe CGM if allowed
- All providers struggle to keep up with new advances! Be the one who does.
Pharmacists role
Patient selection

- Frequent glucagon fills
- Excessive or little to no refills on test strips
- Reducing doses of insulin to avoid lows resulting in high A1c
- Frequent hospitalizations: severe hypoglycemic events or DKA
- Motivated to achieve better control
- Caregiver concern
Resources

• **Dexcom**
  
  https://www.dexcom.com/get-started-cgm/40?sfc=701f30000018vibAAA#form
  
  https://www.dexcom.com/dexcom-care
  
  Demo app: Dexcom G6 Simulator
  
  Patient app: Dexcom G6
  
  Patient share app: Dexcom Follow

• **Freestyle Libre**
  
  https://www.freestylelibre.us/support/buying-guide.html
  
  https://www.freestylelibre.us/support/overview.html
  
  Freestyle Libre app: Freestyle LibreLink
  
  Patient share app: LibreLinkUp
Case 3: 28 year old male

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THINK/PAIR/SHARE  Good candidate for CGM? If so which do you recommend?
Case: 77 year old male

- T2DM
- A1c 7.4%
- MDI regimen with degludec 70 units daily and aspart 15 units with meals
- Checks glucose fasting and at bedtime
- Wakes up fasting with headaches frequently

https://core.anlearn.com/contentdetails.aspx?id=1393CCAFBCF3432CA4546AF09EAF6686
Case: 77 year old male

HbA1c = 7.4%

HbA1c levels:
- Too Low
- Too High
- Too Variable

Blood glucose levels throughout the day:
- 12AM, 2AM, 4AM, 6AM, 8AM, 10AM, 12PM, 2PM, 4PM, 6PM, 8PM, 10PM, 12AM

https://core.anlearn.com/contentdetails.aspx?id=1393CCAFBCF3432CA4546AF09EAF6686
Which patient is most likely to benefit from CGM technology?

A. Patients at goal A1c without glucose variability
B. Patients at low risk of hypoglycemia
C. Patients taking oral glucose lowering medications
D. Patients using multiple daily injections of insulin
Of the personal CGM devices listed below, which can be self-inserted and worn for the longest period of time?

A. Freestyle Libre®
B. Eversense®
C. Dexcom G6®
D. Guardian Connect®
When would patients most likely expect a down-ward trend arrow?

A. Throughout the nighttime hours on a daily basis
B. After giving a bolus to correct a high glucose reading
C. After correcting a hypoglycemic event with carbohydrate
D. After eating a high carbohydrate meal or snack
CGM is associated with which of the following?

A. Increased hyperglycemia
B. Reduced glucose time in range
C. Reduced glucose variability
D. Increases in A1c
E. Less patient engagement in glucose control
Questions?