Introduction to Continuous Glucose Monitoring and the Dexcom and Freestyle Devices

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In support of improving patient care, Idaho State University Kasiska Division of Health Sciences is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.
Disclosures

• The planners and presenters of this CE event have disclosed no conflict of interest, including no relevant financial relationships with any commercial interests pertaining to these CE activities, except:
  • Cara Liday receives speaker's bureau honoraria from Dexcom
Objectives

• Compare and contrast currently available continuous glucose monitoring (CGM) devices for use in patients with diabetes

• Interpret an ambulatory glucose profile

• Discuss the benefits and limitations of CGM

• Describe the role of the health care provider in identifying patients for CGM

• Determine an appropriate device and provide education for an individual patient

• Identify components, demonstrate set-up and review downloaded data of Dexcom and Freestyle CGM devices
Case: 28 year old male

- Type 1 diabetes (T1DM)
- MDI: detemir 20 units BID, aspart 1:13 CHO & 1:30 correction
- A1c 15%
- Non-compliant with insulin and SMBG
- 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
- 6-9 times/day
  - 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
- CGM 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 or medical supply
- Reader or smart phone
- Replace sensor every 14 days
- $\geq$ 18 years of age
- Data sharing with LinkUp app
- Provider/patient can download
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
FDA website, Libre website
Dexcom G6®

- Real time CGM: rtCGM
  - Real time alerts and alarms
  - Continuous data stream to device or phone
  - Urgent low soon alert
- Replace sensor every 10 days; 2 hour warm-up
- Dispensed from pharmacy
- ≥ 2 years of age
- Receiver or smartphone app; data sharing
- No calibration required; replaces fingersticks
- Links to Tandem insulin pumps
Sensor insertion device

Display devices

Sensor/transmitter

Control-IQ

Tandem & Dexcom websites
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; if 670G pump system then 7 years
- Share data with 5 people
- Acetaminophen falsely elevates glucose readings
- 2 hour warm-up
- Calibration required: 2 hrs, 6 hrs, then every 12 hrs
• Guardian 3 sensors link with 630G and 670G insulin pumps
• Closed loop/hybrid system
• AutoMode

Medtronicdiabetes website
Sensor placement

- Freestyle Libre: back of arms
- Dexcom G6: abdomen and upper buttocks
- Medtronic: back of arm and abdomen
- Flat and ”pinchable” area
- Rotate insertion sites
- Avoid:
  - Areas of pressure: clothing, sleeping, bony
  - Tattoos or 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

The graph compares SMBG (Self-Monitoring Blood Glucose) and CGM (Continuous Glucose Monitoring) using glucose levels over time.
Glucose Variability

24-Hour CGM Data From Nine “Well-Controlled” Patients
(Mean HbA1c=6.7%)

mg/dL

Glucose Levels

“High Glucose” Excursions
Target Range
Hypoglycemia
Ambulatory Glucose Profile

• Consensus on what is included in summary page

• Profile summaries for CGM and SMBG
  1. Statistics and targets
  2. Time in ranges
  3. Ambulatory glucose profile
  4. Daily glucose profiles
**GLUCOSE STATISTICS AND TARGETS**

26 Feb 2019 - 10 Mar 2019

% Time CGM is Active: 99.9%

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<tr>
<th>Glucose Ranges</th>
<th>Targets [% of Readings (Time/Day)]</th>
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<td>Target Range 70-180 mg/dL</td>
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<tr>
<td>Below 70 mg/dL</td>
<td>Less than 4% (58min)</td>
</tr>
<tr>
<td>Below 54 mg/dL</td>
<td>Less than 1% (14min)</td>
</tr>
<tr>
<td>Above 250 mg/dL</td>
<td>Less than 5% (1hr 12min)</td>
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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%

**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)

**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.

**DAILY GLUCOSE PROFILES**

Each daily profile represents a midnight to midnight period.
AGP Report

GLUCOSE STATISTICS AND TARGETS

26 Feb 2019-10 Mar 2019  13 days
% Time CGM is Active  99.9%

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Average Glucose  173 mg/dL
Glucose Management Indicator (GMI)  7.6%
Glucose Variability  49.5%

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

**T1D & T2D**
- Target Range: 70-180 mg/dL (3.9-10.0 mmol/L)
- >70% Target time
- <70 mg/dL (3.9 mmol/L), <54 mg/dL (3.0 mmol/L)
- <4% Target time
- <1% Target time

**Older/High-Risk: T1D & T2D**
- Target Range: 70-180 mg/dL (3.9-10.0 mmol/L)
- >50% Target time
- <70 mg/dL (3.9 mmol/L)
- <1% Target time

1% of the day is ~15 minutes

Battelino T et al. Diabetes Care 2019;42(8):1593-1603
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
- Use of CGM is more beneficial to glucose control than insulin delivery
COMISAIR Study Demonstrated Most Improved A1C ONLY with the Addition of CGM Regardless of Insulin Delivery Method

65 T1D patients were followed up for a year (3 groups): 27 patients with Sensor-Augmented Insulin Regimens (15 on CSII + RT-CGM & 12 on MDI + RT-CGM); 20 patients on CSII therapy alone; 18 subjects on MDI alone

HbA$_{1c}$ RESULTS

*Animas & Medtronic pumps    *Medtronic & Dexcom CGM

cgmeducation.net
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 2020 recommendations

- T1DM and/or MDI
- Struggle with glucose variability
- Hypoglycemia unawareness or frequent lows
- Non-compliant with glucose meter
- rtCGM considered in all children with T1DM
- rtCGM may be used in pregnancy
- isCGM considered as SMBG substitute when frequent monitoring is required
- Recommend the AGP for all CGM devices

https://care.diabetesjournals.org/content/43/Supplement_1/S77
When prescribing continuous glucose monitoring (CGM) devices, robust diabetes education, training, and support are required for optimal CGM device implementation and ongoing use.

ADA Standards of Medical Care 2020
Pharmacist role

- At a minimum..... providing education
- Recommend CGM to appropriate patients
- Prescribe CGM
- 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
Idaho Medicaid

- Freestyle or Dexcom G5/G6
- T1 or T2 diabetes
- Submit SMBG documenting 4+ checks/day
- Insulin treatment with 3+ injections/day or pump
- Insulin requires frequent adjustment
- Within 6 months prior in-person visit with provider
- Every 6 months in-person visit
Medicare

- T1 or T2 diabetes
- SMBG 4+ checks/day
- Insulin treatment with 3+ injections/day or pump
- Insulin requires frequent adjustments
- Freestyle libre
- Dexcom G5 or G6
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 Share2 or Follow
Resources

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: 28 year old male

• T1DM
• MDI: detemir 20 units BID, aspart 1:13 CHO & 1:30 correction
• A1c 15%
• Non-compliant with insulin and glucose testing
• Hospitalized 4 times in the past 6 mo for DKA
• In clinic complains of hypoglycemia signs & symptoms periodically
• Good candidate for CGM? If so which do you recommend? THINK/PAIR/SHARE
Case: 47 year old female

• T1DM
• A1c 7.4%
• Taking MDI: glargine 44 units HS and aspart for meals and correction (1:9 CHO & 1:30 correction)
• Checks glucose 2-3 times/day before meals or bedtime with infrequent daytime hypoglycemia
• Fasting typically < 130 & bedtime @200
• Some headaches in the middle of the night

https://core.anlearn.com/contentdetails.aspx?id=1393CCAFBCF3432CA4546AF09EAF6686
Case: 47 year old female

HbA1c = 7.4%

Blood glucose level (mg/dL)

Too Low

Too High

Too Variable

12AM  2AM  4AM  6AM  8AM  10AM  12PM  2PM  4PM  6PM  8PM  10PM  12AM

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

- T2DM x 30 years
- A1c 5.9%
- MDI regimen with degludec 70 units daily and aspart 15 units with meals; metformin
- Checks glucose fasting and before dinner
  - Patient states these are “at goal”
- Complains of only rare hypoglycemia symptoms
Case: 77 year old male

Summary

<table>
<thead>
<tr>
<th>Average Glucose</th>
<th>Estimated A1c</th>
<th>Time In Range</th>
<th>Coefficient of Variation (CV)</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mg/dL</td>
<td>4.2%</td>
<td>In Target Range (70-180 mg/dL) 29%</td>
<td>43.4%</td>
<td>32.6 mg/dL</td>
</tr>
<tr>
<td>88-116*</td>
<td>&lt;6*</td>
<td>Above 180 mg/dL (above 250 mg/dL: 0%) 6%</td>
<td>19-25*</td>
<td>10-26*</td>
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<td>Below 70 mg/dL (below 54 mg/dL: 10.3%) 65%</td>
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*Reference ranges calculated from population without diabetes.
Questions?

Hands on practice with Dexcom G6® and Freestyle Libre®