Optimizing Use of Continuous Glucose Monitoring in Clinical Practice

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Disclosures
• Diana Isaacs, PharmD is a consultant or speaker for the following companies:
  - Dexcom, Abbott, Companion Medical, Insulet, Novo Nordisk, Lilly, Xeris Pharmaceuticals

Learning Objectives
At the end of this presentation, participants will be able to:
• Summarize the clinical data supporting CGM use in people with diabetes
• Compare and contrast CGM devices available for personal and professional use
• Utilize the ambulatory glucose profile and key metrics to systematically review a CGM report
• Describe how to use retrospective and real time CGM data to engage the PWD in self-management

Introduction to CGM
• Measures glucose from interstitial fluid (ISF) every 1-5 minutes
• Records glucose every 5-15 minutes (up to 288 readings/day)
• 3 components (Sensor, Transmitter, Receiver)

SMBG vs CGM

Poor Technique Can Negatively Affect Accuracy
Skin contaminants reduce meter accuracy 1 hour after peeling fruit

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Washed Hands</th>
<th>Exposed Finger (No Washing)</th>
<th>1 Alcohol Wipe</th>
<th>5 Alcohol Wipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peeling an orange</td>
<td>98 mg/dL</td>
<td>171 mg/dL</td>
<td>118 mg/dL</td>
<td>119 mg/dL</td>
</tr>
<tr>
<td>(n=10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peeling a grape</td>
<td>93 mg/dL</td>
<td>360 mg/dL</td>
<td>274 mg/dL</td>
<td>131 mg/dL</td>
</tr>
<tr>
<td>(n=10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peeling a kiwi</td>
<td>90 mg/dL</td>
<td>183 mg/dL</td>
<td>144 mg/dL</td>
<td>106 mg/dL</td>
</tr>
<tr>
<td>(n=10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Limitations to Hemoglobin A1C

- It is a surrogate marker
- Based on an average
- Factors that affect red blood cell turnover can make this inaccurate
- Anemia, hemoglobinopathies and other conditions may falsely elevate or decrease

How does exercise affect glucose levels?

- A. Increase
- B. Decrease
- C. No effect
- D. It depends

Types of CGM

<table>
<thead>
<tr>
<th>Professional</th>
<th>Personal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned by the clinic</td>
<td>Owned by the patient</td>
</tr>
<tr>
<td>Blinded and unblinded (real-time feedback) options</td>
<td>Real-time feedback or scan for feedback (flash device)</td>
</tr>
<tr>
<td>Short term use (3-14 days)</td>
<td>Long term use</td>
</tr>
<tr>
<td>Alarms for hypo/hyperglycemia in select devices</td>
<td>Alarms for hypo/hyperglycemia in select devices</td>
</tr>
<tr>
<td>Insurance coverage for most people with type 1 or type 2 diabetes</td>
<td>Insurance coverage more limited to type 1 diabetes or those on MDI insulin</td>
</tr>
<tr>
<td>Not compatible with insulin pumps</td>
<td>Compatible with smartphones and insulin pumps with select devices</td>
</tr>
</tbody>
</table>

At least 42 factors affect glucose!

Professional CGM Options

- Libre Pro
- iPro2
- G6 Pro

Professional CGM Comparison

<table>
<thead>
<tr>
<th></th>
<th>Libre Pro</th>
<th>G6 Pro</th>
<th>Freestyle LibrePro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blinded vs unblinded</td>
<td>Blinded</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Maximum wear time</td>
<td>6 days</td>
<td>10 days</td>
<td>14 days</td>
</tr>
<tr>
<td>Calibration</td>
<td>3x per day</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Downloading reports</td>
<td>Carelink</td>
<td>Clarity</td>
<td>LibreView</td>
</tr>
<tr>
<td>Care between uses</td>
<td>Clean and disinfect transmitter</td>
<td>Disposable 1 time use</td>
<td>Disposable 1 time use</td>
</tr>
<tr>
<td>MARD (accuracy-the lower the better)</td>
<td>11.05%</td>
<td>9%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Alarms for high/low alerts</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Interfering substances</td>
<td>Acetaminophen, Hydroxyurea</td>
<td>Salicylic acid and vitamin C</td>
<td></td>
</tr>
</tbody>
</table>

**CGM Shared Medical Appointments**
- Class time: 60-90 minutes
- 4-6 patients, 2 clinicians, 1 student
- Download devices
- Show report on the screen and interpret with the PWD’s food/activity/medication logs
- PWD learn from each other—Discuss “bright spots” and “landmines”
- Lifestyle/meal planning recommendations
- Medication adjustments
- Each PWD gets a printed copy of their report and sent to ordering provider

**Meet Derek**
- 48yoM, type 2 DM x 10 years, maxed out on metformin, GLP-1 agonist, SGLT2 inhibitor, sulfonylurea
- A1C 9-9.5% for 12 months, FBG and pre-dinner SMBG ~150mg/dL
- He agreed to wear a professional CGM for 7 days

Derek was shocked by what happened between breakfast and dinner; he agreed to start insulin.

**Types of Personal CGM**

- **Real-Time CGM (rtCGM)**
  - Sensor data transmitted continuously to a receiver or display device, which allows for alerts and alarms to be provided to the wearer without any action

- **Intermittently Scanned CGM (isCGM)**
  - Results are available only when the sensor is scanned with a reading device; optional real time alerts
  - Full 24-h data can be captured and downloaded if the sensor is scanned at least every 8 hours

**Personal CGM Options**

- Freestyle Libre Flash
- Libre 2
- Medtronic Guardian Connect or Guardian 3
- Dexcom G6
- Senseonics Eversense

**CGM: Real Time Data**

**Personal CGM Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Dexcom G6</th>
<th>Freestyle Libre 14 Day</th>
<th>Freestyle Libre 2</th>
<th>Guardian Connect or Eversense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin pump</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Integration</td>
<td>T:Slim X2</td>
<td>No</td>
<td>No</td>
<td>Medtronic 710G, 770G, 630G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Guardian 3)</td>
</tr>
<tr>
<td>Receiver</td>
<td>iPhone, Android</td>
<td>No</td>
<td>No</td>
<td>Medtronic 710G, 770G, 630G</td>
</tr>
<tr>
<td></td>
<td>reader</td>
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<td>(Guardian Connect)</td>
</tr>
<tr>
<td>Maximum wear</td>
<td>10 days</td>
<td>14 days</td>
<td>14 days</td>
<td>7 days</td>
</tr>
<tr>
<td>Time</td>
<td></td>
<td></td>
<td></td>
<td>30 days</td>
</tr>
<tr>
<td>Warm-up time</td>
<td>2 hours</td>
<td>1 hour</td>
<td>1 hour</td>
<td>Up to 2 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 hours</td>
</tr>
<tr>
<td>Calibrations</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
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<td>Clarity, Glooko, Tidepool</td>
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<tr>
<td>Drug Interactions</td>
<td>No</td>
<td>Hydroxyurea, Salicylic acid, vitamin C</td>
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<td>Yes</td>
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</tr>
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</table>
All people with diabetes should wear CGM

True or False?

Give PWD a Choice!

There is no “one-size-fits-all” approach to technology use in people with diabetes

Patient Factors and Preferences Are Key in Individualizing CGM Device Selection

Technology Access

- Meet Abby who is feeling great on her hybrid-close loop insulin pump
- She wears the sensor that is designed for her pump
- She became 65 and went on Medicare
- Medicare doesn’t pay for her sensor

Abby Is Forced to Switch her Technology
What is the Evidence for CGM?

Guideline Updates

- Technology section added in 2019
- Ambulatory glucose profile (AGP) and time in range discussed as glycemic targets (in addition to A1C)
- Real-time CGM (rtCGM) and intermittently scanned CGM (isCGM) are useful to lower A1C and/or reduce hypoglycemia in adults who are not meeting glycemic targets, have hypoglycemia episodes, and/or unawareness
- There is no “one-size-fits-all” approach to technology use in people with diabetes
- CGM use requires robust and ongoing diabetes education, training, and support

Increased BG Monitoring Leads to Lower A1C in T1DM

**DIAMOND Trial: T1DM MDI**

<table>
<thead>
<tr>
<th>HbA1c baseline</th>
<th>CGM Group</th>
<th>Usual Care Group</th>
<th>Difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 7.5%</td>
<td>-0.9% (n=79)</td>
<td>-0.5% (n=79)</td>
<td>0.4%</td>
<td>0.02</td>
</tr>
<tr>
<td>≥ 8.0%</td>
<td>-0.9% (n=63)</td>
<td>-0.6% (n=57)</td>
<td>0.3%</td>
<td>0.05</td>
</tr>
<tr>
<td>≥ 8.5%</td>
<td>-1.1% (n=39)</td>
<td>-0.7% (n=39)</td>
<td>0.4%</td>
<td>0.02</td>
</tr>
<tr>
<td>≥ 9.0%</td>
<td>-1.4% (n=17)</td>
<td>-0.7% (n=21)</td>
<td>0.7%</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Flash CGM in T1DM

- Prospective, randomized controlled trial
- 241 participants with type 1 diabetes and A1C<7.5%, mean A1C=6.7%


Days

38% reduction in hypoglycemia
19% reduction in hyperglycemia

FLARE-NL 4 Study

- The FLAsh monitor Registry in the Netherlands (FLARE-NL)
- Prospective, observational nationwide registry
  - 95 internal medicine and diabetes center N=1365, 16% T2DM
- Overall average A1c reduction of 0.4% (p<0.001)
  - Baseline A1c >8.5%, reduction of 0.8% (p<0.001)
- At 12 months decrease in diabetes related hospitalizations from 13.7% to 4.7% (p<0.05), 66% reduction
- 37% of subjects reported they increased their exercise/physical activity
- 95% reported a better understanding of their glucose fluctuations
- 59% reduction in work absenteeism


The Role of the DCES in Technology

- Diabetes technology is associated with improved outcomes, that is enhanced when the person using is knowledgeable and actively engaged
- Simply wearing the device may not automatically translate into health benefits
- The DCES has the central role in defining and establishing a technology-enabled practice setting that is efficient and sustainable
- The DCES can serve as the technology champion in their respective practices and work to reduce therapeutic inertia while improving health outcomes


CGM Data Interpretation
**Data Management Tools**

<table>
<thead>
<tr>
<th>System</th>
<th>Website</th>
<th>Associated Mobile Apps</th>
<th>What it Downloads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glooko</td>
<td>glooko.com</td>
<td>Glooko</td>
<td>Insulin pumps (Omnipod, Tandem), Dexcom, Eversense, many glucose meters, kPen</td>
</tr>
<tr>
<td>Clarity</td>
<td>clarity.dexcom.com</td>
<td>Dexcom</td>
<td>Dexcom, InPen</td>
</tr>
<tr>
<td>LibreView</td>
<td>libreview.com</td>
<td>LibreLink, LibreLinkUp</td>
<td>FreeStyle Libre</td>
</tr>
<tr>
<td>Clarity</td>
<td>clarity.medtronic.com</td>
<td>Guardian Connect, Carelink, Sugar IQ Diabetes Assistant</td>
<td>Medtronic insulin pump and Medtronic CGM</td>
</tr>
<tr>
<td>Tidepool</td>
<td>tidepool.org</td>
<td>Tidepool Mobile</td>
<td>Insulin pumps (Medtronic, Tandem, Omnipod), Freestyle Libre, Dexcom, Guardian Connect, many glucose meters, kPen</td>
</tr>
<tr>
<td>Eversense Data Management System</td>
<td>eversensedms.com</td>
<td>Eversense</td>
<td>Eversense</td>
</tr>
<tr>
<td>InPen Insights Report</td>
<td>NA</td>
<td>InPen</td>
<td>InPen, Dexcom</td>
</tr>
</tbody>
</table>

**Standardized CGM Metrics for Clinical Care**

<table>
<thead>
<tr>
<th>Key Metrics</th>
<th>Number of Days CGM is worn</th>
<th>Percentage of Time CGM Is Active</th>
<th>Time above range (TAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>141 days recommended</td>
<td>&gt;70% of data recommended</td>
<td>&gt;250 mg/dL</td>
</tr>
</tbody>
</table>

**Mean Glucose**

Coefficient of Variation (CV) - Measure of glycemic variability (st. dev/mean)

- CV <36% is considered acceptable

- CV >36% is considered unacceptable

**Level 2 Hypoglycemia**

- <70 mg/dL

**Level 1 Hypoglycemia**

- <54 mg/dL

**Level 2 Hyperglycemia**

- >250 mg/dL

**Level 1 Hyperglycemia**

- >180 mg/dL

**Time in range (TIR)**

- 70-180 mg/dL

**Time above range (TAR)**

- >250 mg/dL

**Time below range (TBR)**

- <54 mg/dL

**CGM-Based Targets for Different Populations**

<table>
<thead>
<tr>
<th>AGP Report</th>
<th>Customizing Reports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Time in Range Settings**

- Target range refers to 70 – 180 mg/dL, except for patients who are pregnant
- Otherwise, interpreting time-in-range and other key metrics is difficult

**Case Study: Meet Janet**

- 70-years old female
- Diagnosed with type 2 diabetes 18 years ago
- Retired
- Married, 3 children, 2 grandchildren
- A1C 10.5%
- Has arthritis, hoping to get a knee replacement, but needs to bring down A1C

**BMI=34kg/m²**
- Metformin 1000 mg BID
- Insulin glargine 60 units daily
- Insulin lispro 10-20 units TID at each meal

**Numbers are not Good or Bad**

- Thank the person for wearing CGM
- Express that this is information, not good or bad
- Ask permission to explore the highs
- If the person wants to stop at any point, develop an action plan until next visit

**CGM Data Review- DATAA**

- Key metrics, AGP, day by day or spaghetti graph
- Start with global overview what AGP key metrics mean, ask what the person learned/what is going well with self-management
- Hypoglycemia - Identify times below range, % time in hypoglycemia, If events
- Interactive discussion: possible causes and solutions
- Focus on the positive - identify days or times when time in range is highest
- Interactive discussion: how to replace what is working well

***At each stop, express that this is information, not good or bad***

**Action Plan in collaboration with the PWD**
What is Janet's time in range goal?

A. >50%
B. >70%
C. >80%
D. >100%

DATAA Discussion

No hypoglycemia, however, glucose falls overnight, Janet feels symptoms
Rarely taking lispro, never misses glargine

- Ate eggs for breakfast, Sandwich for lunch and she injected lispro

Janet Wears Professional CGM

Janet liked seeing the data
- She learned the direct effects of food on her blood sugars
- She realized that she would benefit from taking lispro with her food during the day

Janet gets a prescription for personal rCGM
- Follow-up with the diabetes care and education specialist

1 Month Later

- Time in range improved!
- Janet is more consistent with lispro (2 injections/day) but asks if there are any other medications that can help with weight and blood sugars
- GLP-1 agonist is added

3 Months Later

- Time in range improved, >70%!
- A1C is now 7.1%
- Janet is eating smaller meals, allows herself 1 treat/day, taking lispro consistently at 2 main meals, continues on glargine and GLP-1 agonist (rarely misses doses)
- She lost 12 lbs, feels great!
- She is scheduled for her surgery
CGM Revenue Opportunities

<table>
<thead>
<tr>
<th>CGM Services</th>
<th>Medicare Fee Schedule</th>
<th>Private Payer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory CGM of interstitial tissue fluid via a subcutaneous sensor for a minimum of 72 hours; patient-provided equipment, sensor placement, hook-up, calibration of monitor, patient training, and printout of recording.</td>
<td>$55.58</td>
<td>$127</td>
</tr>
<tr>
<td>Bill only once during the time period that the patient owns the device.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulatory CGM of interstitial tissue fluid via a subcutaneous sensor for a minimum of 72 hours; physician or other qualified health care professional (office) provided equipment, sensor placement, hook-up, calibration of monitor, patient training, removal of sensor, and printout of recording.</td>
<td>$152.66</td>
<td>$305.94</td>
</tr>
<tr>
<td>Do not bill more than 1x/month.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambulatory CGM of interstitial tissue fluid via a subcutaneous sensor for a minimum of 72 hours; analysis, interpretation and report.</td>
<td>$36.01</td>
<td>$86</td>
</tr>
<tr>
<td>Do not bill more than 1x/month.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Summary

- Clinical data and guidelines support use of CGM in many different types of people with diabetes (PWD)
- There are multiple CGM options and connected devices; one size does not fit all
- Retrospective and real time CGM data can engage the PWD in self-management
- Review CGM in 5 steps:
  - Download, assess safety, time in range, areas to improve, action plan

Resources

- Diabetes Advanced Network Access (DANAtech)
  - https://www.danatech.org/
- Association of Diabetes Care & Education Specialists (ADCES) Glucose monitoring resources
- DiaTribe: https://diatribe.org/
- Eversense: https://eversensediabetes.com
- Dexcom G6: https://www.dexcom.com/g6-cgm-system
- Freestyle Libre: https://www.freestylelibre.us/

THANK YOU