Case Based Continuous Glucose Monitoring Reports and Interpretation

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Sunday, December 13, 2020
Disclosure:

No Conflicts of Interest to Disclose

This presentation is intended for educational purposes only and does not replace independent professional judgment.

I am expressing my own views of evidence medicine based on my reading, analysis and interpretation of the scientific information.

I am a member of SPED and a Federal Government employee, but I am not speaking in representation of or presenting the views of the Veterans Administration, Puerto Rican Society of Endocrinology and Diabetes, State or Federal Government Agency or Department, other Professional Societies, Public or Private Corporation, or Pharmaceutical Company.
Learning Objectives

At the end of this lecture, participants will be able to:

- Understand the Continuous Glucose Monitoring (CGM) technology and the difference with the capillary blood glucose monitoring
- Discuss the Continuous Glucose Monitoring systems in the market
- Outline the Continuous Glucose Monitoring use recommendations.
- Interpret the Ambulatory Glucose Profile (AGP)
- Apply the concepts of CGM to real life cases
Continuous Glucose Monitoring (CGM)

- System
  - Sensor
  - Transmitter
  - Reader
    - Smart phones
    - CSII
    - CGM’s Reader

- Continuous Glucose Monitoring is measuring interstitial glucose, not blood glucose, which lags behind ~ 15 minutes.
Self-Monitoring of Blood Glucose (SMBG) vs Continuous Glucose Monitoring (CGM)

- Self-monitoring of blood glucose (SMBG) systems have achieved improved accuracy; however, they offer only static information about glucose levels without taking into consideration the dynamic nature of glucose changes.

- Continuous Glucose Monitoring (CGM) technology has enabled patients and clinicians to gain a more comprehensive view of glycemic dynamic trends and patterns.
Currently, two different types of CGM systems are available on the market:

- **Real-time continuous glucose monitoring** (rt-CGM) systems
  - System measures the glucose values and automatically display

- **Intermittently scanned continuous glucose monitoring** (isc-CGM, flash glucose monitoring [FGM]) systems
  - Measures glucose levels every minute and stores one value every 15 min
  - System needs to be actively scanned to obtain glucose information and to show it on the device display.
  - The scans must be performed at least every 8 h

Freckmann G. *J of Lab Med* 2020;44:71
### Personal Continuous Glucose Monitoring

<table>
<thead>
<tr>
<th></th>
<th>Dexcom G6®</th>
<th>Eversense® Eversense XL®</th>
<th>FreeStyle Libre® FreeStyle Libre 2®</th>
<th>Medtronic Guardian 3® or Enlite 2®</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>&gt; 2 yrs</td>
<td>&gt; 18 yrs</td>
<td>&gt; 18/4 yrs</td>
<td>&gt; 2 Guardian 3®</td>
</tr>
<tr>
<td><strong>Sensor Life</strong></td>
<td>10 days</td>
<td>90/180 days</td>
<td>14 days</td>
<td>6d Enlite/7d Guardian3</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Abdomen</td>
<td>Implanted Upper arm</td>
<td>Back Upper Arm</td>
<td></td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td>N/A</td>
<td>4 after warm-up then every 10-14 h</td>
<td>N/A</td>
<td>2-4 per day</td>
</tr>
<tr>
<td><strong>Freq of Readings</strong></td>
<td>5 mins</td>
<td>5 mins</td>
<td>Per scanning: every 1m but stored Q 15 m</td>
<td></td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Enzyme Electrode</td>
<td>Optical Fluorescence</td>
<td>Enzyme Electrode</td>
<td></td>
</tr>
<tr>
<td><strong>Alert/Alarms</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No/Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Interoperable</td>
<td></td>
<td>No/Interoperable</td>
<td></td>
</tr>
<tr>
<td><strong>MARD</strong></td>
<td>9</td>
<td>8.8</td>
<td>9.4/9.3</td>
<td>8.7-9.1/13.6</td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Dexcom</td>
<td>Senseonics</td>
<td>Abbott</td>
<td>Medtronic</td>
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Freckmann G. *J of Lab Med* 2020;44:71
# Personal Continuous Glucose Monitoring

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<tr>
<td><strong>Calibration</strong></td>
<td>N/A Optional Manual</td>
<td>N/A</td>
<td></td>
<td>2-4 per day</td>
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<td>Yes</td>
<td>No/Yes</td>
<td>Yes</td>
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<td><strong>Interopera</strong>ble**</td>
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*None approved for pregnant women or ESRD patients.*

Freckmann G. *J of Lab Med* 2020;44:71  
Pregnancy: CONCEPTT Trial

CGM therapy is not yet approved for use during pregnancy.

- 215 women with T1DM preconception or less than 14 weeks of gestation in MDI or CSII.
- Randomized to CGM vs SBGM
- CGM patients:
  - ↓ in A1c 0.19\% (p=0.02)
  - Were 100 min/d in target (70-140) and 72 fewer mins in HyperG

Offspring:
- ↓ rate of large-for-gestational-age
  - HR = 0.51 (CI: 0.28 -0.90)
- ↓ admission to neonatal ICU
  - HR = 0.48 (CI: 0.26-0.86)
- ↓ episodes of neonatal hypoglycemia requiring IV dextrose
  - HR = 0.45 (CI: 0.22-0.89)

Kravarusic, J; Aleppo, G. *Endocrinol Metab Clin North Am* 49;37
Feig DS *Lancet* 2017;390:2347
Professional Continuous Glucose Monitoring

Professional CGM is a way to introduce CGM technology to the patients

<table>
<thead>
<tr>
<th></th>
<th>Dexcom G6 Pro®</th>
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<th>Medtronic Enlite iPro2® Guardian Connect®</th>
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<tr>
<td>Sensor Life</td>
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<td>14 days</td>
<td>6/7 days</td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td>No</td>
<td>No</td>
<td>Yes, every 12-hrs</td>
</tr>
<tr>
<td>Freq of Readings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alert/Alarms</td>
<td>Yes, if unblinded</td>
<td>NA</td>
<td>NA/Yes</td>
</tr>
<tr>
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<td>12.3</td>
<td>13.6</td>
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Kravarusic, J; Aleppo, G. *Endocrinol Metab Clin North Am* 2020; 49;37
7.9/7.10 When used properly, **real-time continuous glucose monitors/intermittently scanned continuous glucose monitors** in conjunction with insulin therapy are useful tools to lower A1C levels and/or reduce hypoglycemia in adults with **type 1 diabetes who are not meeting glycemic targets, have hypoglycemia unawareness, and/or have episodes of hypoglycemia**. A/C

7.11 When used properly, real-time and intermittently scanned continuous glucose monitors in conjunction with insulin therapy are useful tools to lower A1C and/or reduce hypoglycemia in adults with **type 2 diabetes who are not meeting glycemic targets**. B
Continuous Glucose Monitoring

**Benefits**
- Improved glycemic control
- Decreased hypoglycemic events
  - Impaired hypoglycemic awareness
  - Nocturnal hypoglycemia
- Attenuate the fear of hypoglycemia events
  - Alarms/Alerts/Share features
- Attenuate diabetes-related stress
- Reduce need for finger sticks
- Shows glucose variability and patterns of hypo- and hyperglycemia

**Barriers**
- Time required education
- Cognitive restraints
  - Initial or during course of treatment
- Dexterity or physical decline
- Anxiety
- Visual/hearing impairments
- Alarm/alert fatigue
- Insurance coverage/Cost
- Clinical practice integration
- Aversion to wear a device
- Signal to others of having DM

Freckmann G. *J of Lab Med* 2020;44:71
Continuous Glucose Monitoring

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This can be time-consuming and may dissuade the busy provider, but with regular practice, interpretation of ambulatory glucose profiles becomes quite simple and can be effectively streamlined.

Be careful with device upgrades. Tell the patients to always check compatibility with their equipment PRIOR upgrading!

Therefore, improves quality of life.

Freckmann G. *J of Lab Med* 2020;44:71
7.8 When prescribing continuous glucose monitoring (CGM) devices, **robust diabetes education, training, and support are required** for optimal CGM device implementation and ongoing use. People using CGM devices need to have the ability to perform self-monitoring of blood glucose in order to calibrate their monitor and/or verify readings if discordant from their symptoms. E
Survey
Thanks to all who replied

- 79 Replies
  - 65% response rate
    - 69 adult endocrinologists
    - 10 pediatric endocrinologists
Patient NOT using CSII who are using CGM

**T1DM in CGM**
- <10%, 41%
- 10-25%, 28%
- 25-50%, 13%
- 50-75%, 16%
- >75%, 3%
- 19% in CGM 50% or more of the time

**T2DM in CGM**
- <10%, 55%
- 10-25%, 28%
- 25-50%, 16%
- 50-75%, 0%
- >75%, 1%
- 17% in CGM 25% or more of the time
Professional CGM and Patient’s Sharing Data

Professional CGM Use
- 12% using Pro CGM Over 4/week
- 4-10/Wk, 11%
- 2-3/Wk, 20%
- 1 per week, 34%
- Not Used, 34%
- >10/Wk, 1%

Data Sharing Method
- Printed, 35%
- Staff at Office, 44%
- Email, 5%
- Web Site, 8%
- Not Used, 3%
- Pte at Office, 5%
Ambulatory Glucose Profile

- You want FLAT, NARROW and IN RANGE

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**AGP Report**

**GLUCOSE STATISTICS**

- 26 Feb 2019–10 Mar 2019
- % Time CGM is Active

**Glucose Ranges**

- Target Ranges 70–180 mg/dl
- Below 70 mg/dl
- Below 54 mg/dl
- Above 180 mg/dl
- Above 250 mg/dl

Each 5% increase in time in range.

**Average Glucose**

**Glucose Management Indicator (GMI)**

**Glucose Variability**

Defined as percent coefficient of variation (%CV).

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**Battelino T. Diabetes Care 2019;42:1593**
CGM-based targets for different diabetes populations.

Battelino T. *Diabetes Care* 2019;42:1593
C也是CGM-based targets for different diabetes populations.

An increase in TIR of 10% (2.4 h per day) corresponds to a decrease in A1C of approximately 0.5-0.8%.
Suggested Approach to Ambulatory Glucose Profile (AGP)

1. Make sure there are **adequate data** for decision making

2. Identify:
   - Waking, breakfast, lunch, dinner and bedtime times
   - Medication and doses used
   - Exercise or snacking time

3. Ask the patient to tell you what do they see

4. Look for patterns of **low glucose readings**
   - Isolated or recurrent?
   - Weekends vs. weekdays?
   - Physical activity, missed meal, meal type, alcohol related, insulin & meal alignment?

5. Look for patterns of **high glucose readings**
   - How many times per week a medication may have been forgotten?
   - Is meal-time insulin taken before meals?
   - Check for differences in weekend vs. weekdays
   - Be conservative if there is hypoglycemia 12-18 hours later

Johnson ML, *Diabetes Technol Ther* 2019;21 Suppl 2:S217
6. Discuss areas where darker blue (50% of values) or lighter blue (90% of values) shaded areas are very wide (corresponding to high glucose variability).

7. Compare current AGP and CGM metrics to those from last visit (or contact), if available, and discuss progress.

8. Agree on an action plan consisting of one or two specific recommendations:
   - Treat hypoglycemia first

9. Print a copy of the marked-up AGP for the patient and store a PDF of the AGP into the EMR, if possible, or at least copy (snip) and paste the AGP into the EMR progress note.

Johnson ML, *Diabetes Technol Ther* 2019;21 Suppl 2:S217
To maximize the benefits of CGM sessions in clinical practice, patients should be advised to keep a blood glucose log, as well as medication, food and activity diary.

CGM data always need to be assessed in context to the patients’ carbohydrate intake, insulin dosing and physical activity.

Documenting events that may contribute to changes in glucose levels such as physical activity, stressors, illness, menses, special events, is also advised.
Frequent Behavior Pitfalls Identified Upon Evaluating the Continuous Glucose Monitoring

- Insulin dosing during or after meals
- Holding or delaying insulin doses for near-normal BG before a meal
- Overreliance on post-meal correction doses
- Multiple small corrective insulin boluses.
- Inaccurate carbohydrate counting
- Neglecting effects of protein and fat intake
Sensors’ Problems

- Skin Reactions
  - Skin protection barrier may help
  - Rotate sites to preserve skin integrity

- Early Detachment
Sensor Detachment and Skin Reactions

Detachment
- 29% having over 10% detachment
- >30%, 13%
- 25-30%, 7%
- 15-20%, 9%
- 5-10%, 24%
- <5%, 41%
- Not Used, 7%

Skin Reaction
- >20%, 0%
- Not Used, 5%
- 15-20%, 7%
- 5-10%, 16%
- <1%, 36%
- 1-4%, 37%
74-year-old male patient with T2DM Dx in 2008 using:
  - Glargine 60 units bedtime

Intolerant to metformin

Monitors CBG once or twice a week

A1c progressively increasing from 7.0% to 8.2% to 9.0% during last year

He refuses to add pre-prandial insulin or to monitor more frequently

Agreed to try FreeStyle Libre 14 days. No covered by his health insurance.
# CGM Glucose Pattern Summary

**September 27, 2019 - October 10, 2019 (14 Days)**

- **CGM Device:** FreeStyle Libre
- **[N/A]% Compliant w/Calibration:** [N/A]
- **87% Time Worn**

*Not applicable to FreeStyle Libre or FreeStyle Libre Pro which do not require calibration.*

## Summary

<table>
<thead>
<tr>
<th>Average Glucose</th>
<th>Time In Range</th>
<th>Coefficient of Variation (CV)</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>175 mg/dL</strong></td>
<td><strong>36%</strong></td>
<td><strong>22.5%</strong></td>
<td><strong>39.4 mg/dL</strong></td>
</tr>
<tr>
<td><strong>88-116</strong></td>
<td><strong>64%</strong></td>
<td></td>
<td><strong>19-25</strong></td>
</tr>
<tr>
<td><strong>Below 70 mg/dL</strong></td>
<td><strong>0%</strong></td>
<td></td>
<td><strong>10-26</strong></td>
</tr>
</tbody>
</table>

(above 250 mg/dL: 5%)

70-180 mg/dL

(below 54 mg/dL: 0%)
Glargine 60 units bedtime
VCR – Jan 2020

CGM Glucose Pattern Summary
January 8, 2020 - January 21, 2020 (14 Days)

CGM Device: FreeStyle Libre  [N/A]% Compliant w/Calibration*  91% Time Worn

*Not applicable to FreeStyle Libre or FreeStyle Libre Pro which do not require calibration.

Summary

<table>
<thead>
<tr>
<th>Average Glucose</th>
<th>Time In Range</th>
<th>Coefficient of Variation (CV)</th>
<th>Standard Deviation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>137 mg/dL</td>
<td>Above 180 mg/dL (above 250 mg/dL: 0%)</td>
<td>11%</td>
<td>23.4%</td>
</tr>
<tr>
<td>88-116*</td>
<td>In Target Range (70-180 mg/dL)</td>
<td>88%</td>
<td>32 mg/dL</td>
</tr>
<tr>
<td></td>
<td>Below 70 mg/dL (below 54 mg/dL: 0%)</td>
<td>1%</td>
<td>19-25*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-26*</td>
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</table>
VCR

Ambulatory Glucose Profile
Curves/plots represent glucose frequency distributions by time regardless of date

Oct → Jan
TIR: 64% → 88%
TAR: 36% → 11%
TBR: 0% → 1%

Powerful tool for Behavior Modification

FLAT, NARROW and IN RANGE
Case JOV
Pte JOV
Case Consult for Professional CGM

- 74-year-old male patient with T2DM using:
  - Glargine 300 unit/ml: 110 units AM
  - Aspart 25 units prior breakfast
  - Aspart 25 units prior lunch
  - Aspart 30 units prior dinner
  - Empagliflozin 12.5mg AM

- Monitoring capillary blood glucose (CBG) once daily AM with values 99-240mg/dL with a median and average of 176 mg/dL.

- A1c at 9.1%, estimated average glucose of 214mg/dL
Pte JOV

CGM Glucose Pattern Summary
January 17, 2020 - January 31, 2020 (15 Days)

CGM Device: FreeStyle Libre Pro  [N/A]% Compliant w/Calibration*  100% Time Worn

*Not applicable to FreeStyle Libre or FreeStyle Libre Pro which do not require calibration.

Summary

Average Glucose
217 mg/dL
(above 250 mg/dL: 36%)
88-116*

Time In Range
Above 180 mg/dL
64%
(above 250 mg/dL: 36%)

Below 70 mg/dL
0%
(below 54 mg/dL: 0%)

In Target Range
36%
70-180 mg/dL

Coefficient of Variation (CV)
36.1%
19-25*

Standard Deviation (SD)
78.4 mg/dL
10-26*

GMI
8.5%
His lunch and dinner are very similar

7:30 PM corn flakes with milk

He has been holding the Aspart Pre-lunch due to “light” lunch.

Too Much Basal Insulin

- Glargine 110 units AM
- Aspart 25 units prior breakfast
- Aspart 25 units prior lunch
- Aspart 30 units prior dinner
- Empagliflozin 12.5mg AM
Pte JOV

The provider was advised to either:

- Switch the aspart and glargine insulin to Concentrated U-500 insulin:
  - 110 units PRIOR breakfast
  - 50 units PRIOR PM dinner

OR

- Add Semaglutide weekly titrate according to glycemia up to maximal dosage and reduce glargine

OR

- Add aspart pre-lunch ~25 and reduce Glargine by the same amount
Patient FSC
66 year old male patient with T2DM (Dx 1997) for 23 years. s/p kidney (2012) and liver (2006) transplants. He denied hypoglycemic events

Patient Rx with glargine 33 units ~9PM and aspart prior each meal 10-6-16, adjusted according to CBG.

Monitor CBG twice daily.

<table>
<thead>
<tr>
<th>90 Days</th>
<th>30 Days</th>
<th>AM</th>
<th>PM</th>
</tr>
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<tbody>
<tr>
<td>Average</td>
<td>183</td>
<td>211</td>
<td>123</td>
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</table>

His eGFR has been ~ 45ml/min

A1c has been 6.9 to 7.4%; eAG: 151 to 166 mg/dL

Fructosamine 344 to 395 μmol/L (RR: 205-285)
Patient FSC - Jan 2020

CGM Glucose Pattern Summary
January 17, 2020 - January 28, 2020 (12 Days)

CGM Device: FreeStyle Libre Pro  [N/A]% Compliant w/Calibration*  100% Time Worn
*Not applicable to FreeStyle Libre or FreeStyle Libre Pro which do not require calibration.

Summary

Average Glucose

139 mg/dL
(above 250 mg/dL: 3%)

88-116*

Time In Range

Above 180 mg/dL
24% (above 250 mg/dL: 3%)

In Target Range
67%
70-180 mg/dL

Below 70 mg/dL
9%
(below 54 mg/dL: 2%)

Coefficient of Variation (CV)

39.4%

Standard Deviation (SD)

54.8 mg/dL

19-25*

10-26*

*Reference ranges calculated from population without diabetes.
Breakfast
- 50-70 gm CHO

“light” lunch
- 54-74gm CHO

Dinner
- 100 gm CHO

Glargine 33 units ~9PM
Aspart prior each meal 10-6-16
The glargine was reduced from 33 to 28 units bedtime, which he did not do it.

The aspart was left unchanged because he was holding aspart frequently:
- AM dosage because of CBG ~ 120mg/dL
- Lunch because it was light
- He decided to modify it to CBG/20 after breakfast and supper.

Capillary Blood Glucose

<table>
<thead>
<tr>
<th>30 days</th>
<th>90 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg</td>
<td>231</td>
</tr>
<tr>
<td>Test/Day</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Denied reported hypoglycemia
Patient Rx with glargine 33 units ~9PM and aspart prior each meal 10-6-16, adjusted according to CBG.

Monitor CBG twice daily.

- Average
  - 90 Days: 183
  - 30 Days: 211
  - AM: 123
  - PM: 226

- The glargine was reduced from 33 to 28 units bedtime.
- The aspart was left unchanged but he decided to modify it to CBG/20 after breakfast and supper.

Capillary Blood Glucose

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<td>2.2</td>
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</tr>
</tbody>
</table>

AGP Report
November 17, 2020 - November 30, 2020 (14 Days)

GLUCOSE STATISTICS AND TARGETS

<table>
<thead>
<tr>
<th>Range</th>
<th>Type 1 or Type 2 Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 70 mg/dL</td>
<td>Greater than 70% (19h 48min)</td>
</tr>
<tr>
<td>70 - 130 mg/dL</td>
<td>Less than 4% (58min)</td>
</tr>
<tr>
<td>130 - 180 mg/dL</td>
<td>Less than 1% (14min)</td>
</tr>
<tr>
<td>Above 180 mg/dL</td>
<td>Less than 25% (6h)</td>
</tr>
<tr>
<td>Above 250 mg/dL</td>
<td>Less than 5% (1h 12min)</td>
</tr>
</tbody>
</table>

Each 5% increase in time in range (70-100 mg/dL) is clinically beneficial.

Average Glucose: 163 mg/dL
Glucose Management Indicator (GMI): 7.2%
Glucose Variability: 49.5%

Very High: >250 mg/dL 14% (3h 22min)
High: 181 - 250 mg/dL 23% (5h 31min)
Target Range: 70 - 180 mg/dL 50% (12h)
Low: 54 - 69 mg/dL 8% (1h 55min)
Very Low: <54 mg/dL 5% (1h 12min)
Patient FSC

Jan 2020

Nov 2020

Too Much Basal Insulin

Needs more aspart PRE-lunch and PRE-dinner
Glucose Management Indicator (GMI)

- If the GMI is considerably different than the laboratory HbA1c, it may be important to take this difference into account when setting an HbA1c goal.

<table>
<thead>
<tr>
<th>A1C (%)</th>
<th>Mean plasma glucose (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 %</td>
<td>126 (100–152)</td>
</tr>
<tr>
<td>7 %</td>
<td>154 (123–185)</td>
</tr>
<tr>
<td>8 %</td>
<td>183 (147–217)</td>
</tr>
<tr>
<td>9 %</td>
<td>212 (170–249)</td>
</tr>
</tbody>
</table>

- Ex: The GMI estimates the HbA1c to be 7.4% and the laboratory HbA1c is 8%
  - The actual glucose levels are lower than one would typically associate with the laboratory HbA1c of 8%. Therefore, should be very carefully in trying to reach lower A1c and probably the goal should be 8%

Johnson ML, *Diabetes Technol Ther* 2019;21 Suppl 2:S217
Battelino T, *Diabetes Care* 2019;42:1593
64 years old male patient diagnosed with Type 1 DM in Mar 2018 when he presented with DKA and positive Anti GAD-65 antibodies.

He was trained in Dexcom G6 in Dec 2019 but did not start using it until the end of January due to detachment of the sensors and then problems with the reader that required the company to change the reader.

<table>
<thead>
<tr>
<th>Prior CGM</th>
<th>While in CGM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal</td>
<td>Glargine 16 at 9PM</td>
</tr>
<tr>
<td>Pre-Prandial Aspart</td>
<td>~ 8 units pre meal</td>
</tr>
<tr>
<td></td>
<td>Adjust per table for CBG</td>
</tr>
<tr>
<td></td>
<td>Adjust if overeating</td>
</tr>
</tbody>
</table>
Let the CGM highlight the effects of foods, exercise and insulin mismatch in the patient.
Working issues:

- Consistency of CHO intake per meal
  - Arroz con pollo overeating
    - Thought to increase the aspart when this happens
- The use of pre-prandial aspart PRIOR meals
- How to use the Aspart scale with the CGM arrows:
  - Under 80 mg/dL NO ASPART
  - 80-100 mg/dL Use 6 units
  - 101-140 mg/dL Use 8 units
  - 141-180 mg/dL Use 9 units
  - 181-240 mg/dL Use 10 units
  - 241-300 mg/dL Use 12 units
  - Over 300 mg/dL Use 14 units
# Rate of Change Trend Arrows

<table>
<thead>
<tr>
<th>Medtronic Guardian 3 or Connect</th>
<th>Dexcom G6</th>
<th>FreeStyle Libre 14 FreeStyle Libre 2</th>
<th>Sensonic Eversense</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑↑↑</td>
<td>≥3mg/dL/min</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>↑↑</td>
<td>&gt;2 but &lt;3mg/dL/min</td>
<td>&gt;3mg/dL/min</td>
<td>N/A</td>
</tr>
<tr>
<td>↑</td>
<td>≥1 but &lt;2mg/dL/min</td>
<td>&gt;2 but ≤3mg/dL/min</td>
<td>&gt;2mg/dL/min</td>
</tr>
<tr>
<td>→</td>
<td>N/A</td>
<td>1 to 2 mg/dL/min</td>
<td>1 to 2mg/dL/min</td>
</tr>
<tr>
<td>←</td>
<td>N/A</td>
<td>&lt; 1mg/dL/min</td>
<td>&lt; 1mg/dL/min</td>
</tr>
<tr>
<td>↓</td>
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</tr>
</tbody>
</table>
Comparison Feature of Dexcom with Clarity Software
Cost & Coverage

- **Local Cost**
  - FreeStyle Libre 14 days: ~ $60/14 days = $4.30/day
  - Dexcom G6: ~$118/10 day + ~ $230-500/90 days = $15 - $17/day

- **Medicare Coverage**
  - If using insulin and requiring frequent adjustments to the insulin regimen/dosage, including the need to:
    - Frequently check your blood sugar *(four or more times a day)*
    - Either use an insulin pump or receive **three or more insulin injections per day**
### Reimbursement

<table>
<thead>
<tr>
<th>CMS 2020 Fee Schedule</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td><strong>$56.00</strong></td>
<td><strong>$153.84</strong></td>
<td><strong>$36.87</strong></td>
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</table>

<table>
<thead>
<tr>
<th><strong>95249</strong>+ (Personal)</th>
<th><strong>95250</strong>+ (Professional)</th>
<th><strong>95251</strong>+</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Startup &amp; Training</td>
<td>- Patient education</td>
<td>- Healthcare provider interprets and reports, either personal or professional.</td>
</tr>
<tr>
<td>- Patient provides equipment</td>
<td>- Sensor placement</td>
<td>- Requires a minimum of 72 hours of data</td>
</tr>
<tr>
<td>- Patient education</td>
<td>- Sensor removal</td>
<td>- Requires a minimum of 72 hours of data</td>
</tr>
<tr>
<td>- Sensor placement</td>
<td>- Data download</td>
<td>- Once monthly per patient.</td>
</tr>
<tr>
<td></td>
<td>- Generate reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Requires a minimum of 72 hours of data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Once during the time period that patient owns device</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Once monthly per patient.</td>
<td></td>
</tr>
</tbody>
</table>

+Medicare does not reimburse for a CGM system if a smart device is used to display glucose data.

*E/M codes can be used with modifier “-25_ if significant and separately identifiable services took place above and beyond the services associated with CGM.*
## Reimbursement

### CMS 2020 Fee Schedule

<table>
<thead>
<tr>
<th>Code</th>
<th>Personal</th>
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</table>

- **95249+ (Personal)**
  - Startup & Training
  - Patient provides equipment
  - Patient education
  - Sensor placement
  - Requires a minimum of 72 hours of data
  - Once during the period that patient owns device

- **95250* (Professional)**
  - Patient education
  - Requires a minimum of 72 hours of data
  - Once monthly per patient.

- **95251* (Professional)**
  - Healthcare provider interprets and reports, either personal or professional.
  - Requires a minimum of 72 hours of data
  - Once monthly per patient.

### Medicare Advantage

- Inconsistent coverage
- Fee for professional is ~ $110 to 158

### Commercial Insurances

- Some of the plan reimburse at a lower rate.
- Most plan may not cover them at all.
- Fee for professional is ~ $50-60
  - Not cost effective
- 95251 reimbursed at $25-30

---

+ Medicare does not reimburse for a CGM system if a smart device is used to display glucose data.

*E/M codes can be used with modifier “-25_ if significant and separately identifiable services took place above and beyond the services associated with CGM.
Summary/Conclusions

- Continuous Glucose Monitoring (CGM) improves the glycemic control and quality of life of the patients with diabetes mellitus.
- CGM requires continuous education to derive its maximal benefit.
- The Ambulatory Glucose Profile provides a standardized quick summary of what is going on with the patient.

Cases:

- The role of CGM in behavior modification
- Examples of too much basal insulin
- Postprandial hyperglycemia due to:
  - CHO underestimate
  - Lack or misaligned rapid/short acting insulin administration related to meal intake
- Hypoglycemia unawareness
- Skin reactions and sensors detachment
The black line in the graph of the Ambulatory Glucose Profile (AGP), represents the:

A. Average glucose
B. Linear regression
C. Standard Deviation
D. Standard Error
E. Median glucose
Post-Test

An Increase in Time in Range of 10% corresponds to a decrease in A1c of approximately:

A. 0.00% to 0.49%
B. 0.50% to 0.74%
C. 0.75% to 0.99%
D. 1.00% to 1.49%
E. Over 1.49%
Although Continuous Glucose Monitoring has NOT been approved by the FDA to be used during pregnancy, if used, the recommended target range is:

A. 60-120 mg/dL
B. 63-140 mg/dL
C. 70-130 mg/dL
D. 74-140 mg/dL
E. 80-120 mg/dL
QUESTION?
COMMENT?
CONCERN?