INTERPRETING CGM DATA

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DISCLOSURES
- I have participated in clinical research, been a member of a scientific advisory board, or served as a consultant for Abbott Diabetes Care, Dexcom, Eli Lilly and Company, Hygieia, Johnson & Johnson, Medtronic, Novo Nordisk, Onduo, Roche, Sanofi, and United HealthCare.
- I have been a stock shareholder in Merck.
- I am a volunteer for the American Diabetes Association and JDRF.
- My institution receives National Institutes of Health funding for closed-loop studies.
- My employer, the nonprofit HealthPartners Institute, contracts for my services, and I receive no personal income from these activities.

INTERPRETING CGM DATA
Using CGM data to guide:
- Starting and adjusting diabetes medications
- Establishing a therapeutic action plan
- A plan to: TIR and TiHypo
- Use CGM to: A1C and TiHypo
CONTINUOUS GLUCOSE MONITORING—AMBULATORY GLUCOSE PROFILE

CGM—AGP

ONE CASE

• Metrics: definitions and targets
• AGP patterns: 9 steps to agree on a management plan
  – Daily views: refining the management plan

American Diabetes Association.
Optimal Sampling Duration for Continuous Glucose Monitoring to Determine Long-Term Glycemic Control


CGM Metrics

**CGM Glucose Pattern Summary**

February 27, 2018 - March 11, 2018

<table>
<thead>
<tr>
<th>Summary</th>
<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></td>
<td>173 mg/dL</td>
<td></td>
<td>43%</td>
<td>49.4%</td>
</tr>
<tr>
<td></td>
<td>1.88-116*</td>
<td></td>
<td>47%</td>
<td>85.4 mg/dL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Target Range 70-180 mg/dL</td>
<td>10%</td>
<td>10-25*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Below 70 mg/dL</td>
<td>10%</td>
<td>10-25*</td>
</tr>
</tbody>
</table>

*Reference ranges calculated from population without diabetes.
Most studies agree that AG is 99–100 mg/dL in normals.

Estimated A1C (eA1C) 7.7% (61 mmol/mol)

Glucose Management Indicator (GMI) * 7.7% (61 mmol/mol)

*Reference ranges calculated from population without diabetes.

GMI proposed to FDA and diabetes community to replace eA1C
Level 2 hyperglycemia
Level 1 hyperglycemia
Level 1 hypoglycemia
Level 2 hypoglycemia
(Hypoglycemia Alert)
(Immediate Action)

TIME IN RANGE AND A1C CORRELATION

<table>
<thead>
<tr>
<th>Measured TIR</th>
<th>A1C</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>40%</td>
<td>8.1%</td>
<td>7.1-9.1%</td>
</tr>
<tr>
<td>50%</td>
<td>7.7%</td>
<td>6.7-8.7%</td>
</tr>
<tr>
<td>60%</td>
<td>7.3%</td>
<td>6.3-8.3%</td>
</tr>
<tr>
<td>70%</td>
<td>6.9%</td>
<td>5.9-7.9%</td>
</tr>
<tr>
<td>80%</td>
<td>6.5%</td>
<td>5.5-7.5%</td>
</tr>
</tbody>
</table>

Does Time-in-Range Matter? Perspectives From People With Diabetes in the Success of Current Therapies and the Drivers of Improved Outcomes


First Choice Preference Rankings – by diabetes type

Glucose Management Indicator (GMI) * 7.7% (61 mmol/mol)

GMI proposed to FDA and diabetes community to replace eA1C

Stable Glucose Profile <36%

Coefficient of Variation (CV) 49.4%
Standard Deviation (SD) 85.4 mg/dL
Average Glucose 173 mg/dL

Stable Glucose Profile SD < AG/3

Measures of Glucose Variability

Summary

NINE STEPS TO INTERPRETTING AN AGP

Interpreting an AGP: Nine Steps

Step 1: Check for adequate data.

Step 2: Mark up the AGP, noting factors that may affect the management plan.

62 yr.; T2D for 15 yrs.; No hx. of known CVD; 90 kg; eGFR 760
Step 3: Ask the patient “What do you see?” Listen.

Step 4: Look for patterns of low glucose levels.

Treat the CLOUD! Verify with daily views if you have time.
Step 4: Look for patterns of low glucose levels.

Step 5: Look for patterns of high glucose levels.

Ambulatory Glucose Profile

62 yr. T2D for 15 yrs.; No hx. of known CVD; 90 kg; eGFR >60

Daily Glucose Summary
**Step 6: Look for areas of wide glucose variability.**

GV is about timing or amount

- **Timing:** insulin and meals, weekday and weekend, snacks, exercise, stress
- **Amount:** insulin (daily dose or carbs counting), insulin/carb ratio, exercise intensity

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**Step 7: Compare to past AGP and reinforce successful strategies.**

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**Step 8: Agree on an action plan with patient.**

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**Action Plan:**

1. Get rid lows overnight: long-acting insulin + correction factor
2. Reduce variability: insulin timing, amount of food, consider carb counting
3. As you treat the cloud, remember to look forward 12–18 hours for secondary effects on glucose
4. As you treat lows first, small or no in TIR initially so schedule repeat look at 2-week profile soon to address highs (series of 3–4 adjustments)
5. Continue using CGM (real-time or retrospective intermittently)
   - If real-time CGM: also teach how to use trend arrows

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Step 9: Copy the AGP for the patient and the EMR.

62 yo. T2D for 15 yrs.; No hx. of known CVD; 90 kg; eGFR >60

Thank You