DATA OVERLOAD: EMBRACING AND DECODING EMERGING DIABETES TECHNOLOGY

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Disclosures to Participants

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Cara Schrager, MPH, RDN, LDN, CDE – None
Nicole Patience, MS, RDN, LDN, CDE, CEDRD – None

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Outline

• Introduction to diabetes technology and its advancements
• Overview of continuous glucose monitors and insulin pump technology
• How patients engage with technology
• Data reporting

Objectives

• Differentiate the continuous glucose monitoring (CGM) systems available
• Compare innovative insulin pump technologies
• Describe how individuals engage with technology
• Analyze the data to guide nutrition recommendations

Managing diabetes – walking a tight rope

Hypoglycemia consequences:
- Psychosocial
- Financial
- Morbidity
- Mortality

Hyperglycemia consequences:
- Retinopathy
- Nephropathy
- Neuropathy
- Vascular complications

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Drivers of new diabetes technology

- Improve A1C
- Move beyond A1C
- Reduce complications
- Reduce costly acute events
- Improve quality of life
  - Flexibility
  - Safety

Therapy options available for PWD Today

<table>
<thead>
<tr>
<th>MDI</th>
<th>CSII (Traditional &amp; Patch)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal CGM</td>
</tr>
<tr>
<td></td>
<td>Intermittent CGM</td>
</tr>
<tr>
<td></td>
<td>Integrated CSII &amp; CGM</td>
</tr>
<tr>
<td></td>
<td>Suspend Before Low</td>
</tr>
<tr>
<td></td>
<td>Predictive Low-Glucose</td>
</tr>
<tr>
<td></td>
<td>Suspend</td>
</tr>
<tr>
<td></td>
<td>Hybrid Closed Loop</td>
</tr>
</tbody>
</table>

Continuous glucose monitors

- Identify % Time In Range (TIR)
  - Can reduce time spent in hypoglycemia
  - Can reduce A1C
  - Recognize direction of BG levels
  - Can be used as entry-level technology to illustrate need for pump

How does CGM work?

- Still recommended to check BG if sensor readings do not match symptoms
- Trend arrows offer predictive blood glucose information

BG trend arrows

Laffel et al., J Endo Soc. 2017

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Using trend arrows in dosing mealtime insulin

Laffel et al., J Endocr Soc. 2017

Set CGM expectations

- Finger sticks still required for some devices
  - Calibrations
  - Confirm outlier data
  - If symptoms do not match BG readings
  - CGM failure
- Potential for information overload
- Access
  - Cost and Insurance coverage varies

The Diabetes Educator Role in Continuous Glucose Monitoring, AADE Practice Paper, 2018

Beyond A1C

- Goals Should Be Individualized
- More Time In Range the Better
- No more than 3% of the day (43 minutes) less than 70 mg/dl and no more than 1% (14 minutes) less than 54 mg/dl

Time spent

- HIGH
- IN RANGE
- LOW

CGM device choices

<table>
<thead>
<tr>
<th>Device</th>
<th>Alerts</th>
<th>Warns</th>
<th>Constant glucose visualization</th>
<th>Calibration required</th>
<th>Finger stick</th>
<th>1 Button Insert</th>
<th>Sensor life</th>
<th>Pump pairing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dexcom G6</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>0</td>
<td>•</td>
<td>10 days</td>
<td>Tandem</td>
<td>Omnipod (dash)</td>
</tr>
<tr>
<td>Dexcom G5</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>•</td>
<td>7 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freestyle Libre</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>0</td>
<td>•</td>
<td>10 or 14 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardian</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>•</td>
<td>7 days</td>
<td>670G</td>
<td></td>
</tr>
<tr>
<td>Eversense</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>2</td>
<td>•</td>
<td>3 months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continuous subcutaneous insulin infusion (CSII): Insulin pump

How a Pump Works

Indications for pump therapy

Clinical Indications
- High glucose variability, dawn phenomenon, high sensitivity to insulin
- Elevated A1C
- Recurrent hypoglycemia or hyperglycemia
- Pregnancy, renal transplant, gastroparesis

Lifestyle Indications
- Varying schedule, travel or work shifts
- Inconvenience of multiple daily injections

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Pump expectations

- Willing to check BG at least 4 times/day or wear CGM
- Insight and ability to problem solve and make pump adjustments
- Cost considerations, managing supplies
- Potential for weight gain
- May reduce insulin requirement compared to MDI

Pumps options

<table>
<thead>
<tr>
<th>Pumps options</th>
<th>Tubing</th>
<th>Link to CGM</th>
<th>App to manage data/link to clinic</th>
<th>Insulin storage capacity</th>
<th>Waterproof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulet Corp: Omnipod</td>
<td>Linked</td>
<td>*</td>
<td>300 units</td>
<td>*</td>
<td>up to 25 ft for 60 min</td>
</tr>
<tr>
<td>Medtronic MinMed 670G with Guardian</td>
<td>*</td>
<td>Integrated</td>
<td>300 units</td>
<td>*</td>
<td>up to 12 ft for 24 hr</td>
</tr>
<tr>
<td>Medtronic MinMed 630G, 530G</td>
<td>*</td>
<td>Linked</td>
<td>300 units</td>
<td>*</td>
<td>up to 12 ft for 24 hr</td>
</tr>
<tr>
<td>Tandem: Basal IQ tslim X3, t:flex</td>
<td>*</td>
<td>Integrated</td>
<td>300-480 units</td>
<td>*</td>
<td>up to 3 ft for 30 min</td>
</tr>
<tr>
<td>OpenAPS (Artificial Pancreas System) DIY</td>
<td>*</td>
<td>Linked/Integrated</td>
<td>Depends on pump used</td>
<td>Depends on pump used</td>
<td></td>
</tr>
</tbody>
</table>

Common features of pumps

- Calculate pre-meal insulin dose
  - Carbohydrate ratio pre-set
  - BG correction factor/sensitivity factor
- Track insulin on board (IOB)
  - Helps prevent stacking of insulin
- Basal rates to better match biologic needs
- Adjust for exercise, stress, illness
- Data download

Basal insulin comparison

Insulin delivery technology

- InPen
  - Bluetooth pen
  - Novolog or Humalog
  - Records insulin doses, IOB, calculations, reminders
  - Download app to simulate

- V-Go
  - Insulin delivery
  - Daily use
How do patients engage with technology?

Interaction with technology differs

Persons with diabetes may choose to embrace technology, and their attachment to it

How patients interact with technology

• Use of CGM
  • Guide to dosing
  • Observe impact of food/exercise/stress on BG
  • Rely on alarms for safety overnight

• Pumps
  • Bolus wizard to calculate insulin dose based on grams of carb and current blood glucose
  • Manual insulin push for convenient dosing

Would you share your continuous glucose monitor (CGM) data with your partner, parents, or kids?

A. Yes
B. No
C. Maybe

Apps to explore the digital interface

• Medtronic

• Tandem

• Omnipod

• InPen

Why did the tomato blush?

Because it saw the salad dressing!
How many carbohydrates are in this restaurant salad?

How many carb grams are in the salad?

A. 25
B. 50
C. 75
D. 100

Smartphone apps

Bluetooth meter app

Traditional pattern management data

Current: CGM report patterns

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Current: CGM hourly report patterns

Time in range

<table>
<thead>
<tr>
<th>Time</th>
<th>Low 6%</th>
<th>8%</th>
<th>10%</th>
<th>15%</th>
<th>20%</th>
<th>25%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>12am-6am</td>
<td>95%</td>
<td>8%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>6am-12pm</td>
<td>82%</td>
<td>7%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>40%</td>
<td>50%</td>
<td>60%</td>
<td>70%</td>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>12pm-6pm</td>
<td>71%</td>
<td>6%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
<td>40%</td>
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<td>70%</td>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
<tr>
<td>6pm-12am</td>
<td>81%</td>
<td>7%</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>30%</td>
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<td>60%</td>
<td>70%</td>
<td>80%</td>
<td>90%</td>
<td>100%</td>
</tr>
</tbody>
</table>

What can dietitians do with this data?

• May recommend diet changes based on
  • CGM, % Time in range
  • Interview
  • Patterns
    • Overnight highs?
    • Post meal lows?
• May recommend medication adjustments

Glycemic index

• System that ranks foods on a scale from 1-100 based on their effect on blood-sugar levels
• Can use CGM to understand the impact of food on glucose
• Glycemic Index is individualized

Factors that influence GI

<table>
<thead>
<tr>
<th>Lowing GI</th>
<th>Raising GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity</td>
<td>Cooking time</td>
</tr>
<tr>
<td>Fiber</td>
<td>Ripeness</td>
</tr>
<tr>
<td>Protein and fat</td>
<td>Processing food</td>
</tr>
<tr>
<td>Solid foods</td>
<td>Liquid foods</td>
</tr>
</tbody>
</table>

Glycemic response to a meal

Macronutrient digestion time:
• Carbohydrate: 1-2 hours
• Protein: 2-4 hours
• Fat: 4-6 hours
Rapid acting insulin action:
• Peaks 60-90 minutes and last 3 to 4 hours

Insulin/glucose after lower-GI meal

Glucose after medium GI meal

Meal & bolus

Glycemic Index (GI)
Insulin/glucose after high-GI meal

Glucose response to a high fat meal

Impact of a meal rich in saturated fatty acids

Advanced pump features
• Standard (Normal) Bolus
• Square Wave Bolus
• Combination, Extended (Dual) Bolus

Integrated report: Pump + CGM
# Reports: what to consider

- **Timing of Insulin**
  - Bolus before vs. after meal
  - Combo bolus/Extended/Dual Wave
  - Insulin delivery

- **Amount of Carbs in the meal**
  - Consider portion size of meal
  - Consider meal composition:
    - High carb/ type of carb
    - Fat content
    - Amount of protein/type of protein

- **Effect of exercise**
  - Duration, frequency, intensity

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# Art vs. Science

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>A.</td>
<td>Diabetes is all science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.</td>
<td>Diabetes is all art</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.</td>
<td>Diabetes is 40% art and 60% science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.</td>
<td>Diabetes is 60% art and 40% science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.</td>
<td>All of the above</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.</td>
<td>None of the above</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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# What is DANA? Diabetes Advanced Network Access

DANA is a robust, always-current destination where AADE members can participate in a variety of areas:

- **Products:** Research and review the latest technology products, devices and mobile apps
- **Education:** Access tech-focused continuing education and device training
- **Innovation:** Participate in innovation-shaping research and learn the latest news
- **Resources:** Search a repository of curated evidence-based research and information

[www.danatech.org](http://www.danatech.org)

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# Summary

- Technology reports offer RDs more targeted discussion points
  - Exciting opportunity for pattern management and data interpretation
  - Longer RD appointments allow for detailed interview to match CGM tracings to behaviors
  - Medication dose and time of delivery (if not on CGM integrated pump)
  - Impact of food, exercise, alcohol on blood sugar
  - Opportunity to fine-tune insulin dosing, timing

- Not all individuals will be receptive to or engage with technology in the same way