Devices: What’s New and What Works: Glucometers, CGMs, and Insulin Pumps

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Carmen Yoldi, RN
Diabetes Therapeutic Education
Endocrinology Unit
Agenda

- Glucometers
- Continuous glucose monitoring (CGM)
- Insulin pumps (CSII)
Glucometers

- ISO
- Reading seconds
- Blood drop size
- Data software analyze
- Telemedicine platforms
- Tendencies
- Insulin dose calculator
- Ketonemia

Insulin dose Calculator

Ketonemia
Glucometers

Accuracy

- **ISO**: International Organization for Standardization
  New ISO 15197:2013; total Implementation on 2016
  (previous ISO: 2003)

- The new version accounts for **99% of results** (95% in 2003)
- Increased accuracy for glucose meter systems, in particular for glucose values greater than 75 mg/dl (4.2 mmol/l)
- Manufacturers of glucose meter systems must ensure their technology enables **accuracy ±15%** (20% in 2003)
- For the first time, the standard provides formal acceptance criteria for accuracy as regards testing by patients and assessment of interferents (including hematocrit).
Glucometers

What affect readings?

- Not washing hands
- Not drying hands
- Contamination by food / drink
- Temperature
- Size of blood drop (too small)
- Wiping first drop
Glucometers

Where to prick?

- **Finger**
- **Ear lobe, toe, arm, thigh, the palm**

- Controversy: Alternative site testing is found to not be as accurate as capillary blood: if eaten within the previous two hours.
Agenda

- Glucometers
- Continuous glucose monitoring (CGM)
- Insulin pumps (CSII)
Continuous Glucose Monitoring

- It consists in a continuous measure of glucose on the interstitial tissue by a specific sensor.
- Allows to know the glycemic profile during all 24 hours a day and the glucose variability.
Glucose on interstitial tissue (G2) is usually comparable to blood glucose (G1).

Continuous Glucose Monitoring

**Cannula**
Micro-filament combining metal and enzyme glucose-oxidase

**Enlite**
8,75mm
Medtronic

**Dexcom**
Oblique insertion

**FreeStyle Libre**
5 mm
Abbott
Under steady stable glucose values it could be said that Interstitial glucose are balanced with plasma glucose, but, changes on glucose concentration occur before in plasma glucose than in interstitial tissue. There is a delay time ~ 10 minutes (variable)
Differences between glucose values on plasma, capillary and interstitial (sensor)

- Plasma glucose (lab) is 100 mg/dl
- Sensor glucose reads 95 mg/dl at 7:25 AM
- Glucose value readed by meter is 120 mg/dl

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**Patient's blood glucose**

**Meter range**

**Sensor range**

Meter reads 120 mg/dl

Sensor reads 95 mg/dl

Patient sees difference of 25 mg between Meter and Sensor

Exact lab value is 100 mg/dl
Continuous Glucose Monitoring Systems

- Real time or interactive systems
  - Dexcom 4
  - Free Style Libre
    - Not approved < 18y
  - Guardian REAL-Time
  - Navigator

- Sensor Augmented System
  - Paradigm Veo
  - 640G
Continuous Glucose Monitoring

Where?

- Buttocks
- Abdomen
- Arm

Not approved < 18y
Why and when calibrate?

- It is necessary to introduce capillary glucose values into the device (except freestyle libre)
- Number of Calibration: differences between devices
- Best moment: stable values (wake up, before meals, bedtime)

Avoid calibration:

- Arrows in the device screen
- Just after exercising

Medtronic devices
Continuous Glucose Monitoring

When is needed a glucose value by meter?

- Before calibration
- Before insulin dose administration
- If “discordants” symptoms between patient and sensor values (i.e., in case of hypoglycemia symptoms and no low values shown on the device)
- When hypo or hyperglycemia
- **Alarms** occurred

**Important:** Differences between glucose concentration in blood and in interstitial tissue must be trained
Continuous Glucose Monitoring

Data download by a specific software (retrospective analysis)
Continuous Glucose Monitoring

Data on the device screen (real time analysis)

Predictive analysis
### Differences between CGM systems

<table>
<thead>
<tr>
<th></th>
<th>Guardian Real Time Paradigm VEO</th>
<th>Medtronic 640G</th>
<th>Dexcom 4</th>
<th>Freestyle libre</th>
<th>Freestyle Navigator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life of the sensor</td>
<td>6 days</td>
<td>7 days</td>
<td>14 days</td>
<td>5 days</td>
<td></td>
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<tr>
<td>Initial calibration period</td>
<td>2 hours</td>
<td>1 hour</td>
<td>2 hours</td>
<td>10 hours</td>
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<td>Nº calibrations</td>
<td>&gt;2-4/day</td>
<td>2-4 / day</td>
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<td>4 - 5 days</td>
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<td>Tendency arrows</td>
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<td>High/low alarms</td>
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<td>YES</td>
<td>NO</td>
<td>YES</td>
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<tr>
<td>Alarms of prediction</td>
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<td>YES</td>
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<td>YES</td>
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<tr>
<td>Stop insulin administration</td>
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<td>YES</td>
<td>NO</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>Readings</td>
<td>Each 5 minutes</td>
<td>Each 5 minutes</td>
<td>1 minut</td>
<td>1 minut, each scan</td>
<td>Each 5 minutes</td>
</tr>
</tbody>
</table>
Agenda

• Glucometers
• Continuous glucose monitoring (CGM)
• Continuous Subcutaneous Insulin Infusion (CSII) or Insulin pumps
Benefits vs. MDI

- Small insulin doses needed
- Hypoglycaemia unawareness and/or frequent
- Quality of life
- MDI not working
- Aversion to injections and/or needles: Less injections
- Unexpected situations

PUMP OPTIONS

- bolus wizard (calculator)
- tiny increments
- basal patterns
- tailor basal patterns for illness, sport, weekends

Disadvantages

- Be connected to a device
- When glucose values >250mg/dl (13.8mmol/dl), be sure pump is working. Read Ketones

Needs

- Be available to manage insulin dose algorithms
- Get familiar with technology
Thank you for your attention