CONTINUOUS GLUCOSE MONITORING IN ELDERLY PATIENTS WITH DIABETES MELLITUS

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Objective

• Upon completion of this activity, participants will be able to identify the benefits of continuous glucose monitoring in elderly patients with diabetes mellitus
Let’s start with a case

- 78 year old male with type 2 diabetes mellitus since 1982
- Currently on glargine 11 units at night and lispro with a carbohydrate ratio of 1 unit for every 10 grams of carbohydrate and correction scale of 1 unit for every 50 in BG over 150
- His hemoglobin A1c has ranged from 6.8-8.1% over the last 2 years
- He has hypoglycemia awareness and has hypoglycemia 1-2 times/week on average
- He checks his fingerstick BG 4-6 times daily
- In the last several years he has had 3 episodes of nocturnal hypoglycemia that required EMS to be called
<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Result</th>
<th>Event Marker</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/18/2017 8:28:00 AM</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>1/18/2017 10:54:00 AM</td>
<td>257</td>
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</tr>
<tr>
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</tr>
<tr>
<td>1/18/2017 5:47:00 PM</td>
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<td></td>
</tr>
<tr>
<td>1/18/2017 9:15:00 PM</td>
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</tr>
<tr>
<td>1/19/2017 8:10:00 AM</td>
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</tr>
<tr>
<td>1/19/2017 11:10:00 AM</td>
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</tr>
<tr>
<td>1/19/2017 2:04:00 PM</td>
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<td></td>
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<tr>
<td>1/19/2017 5:16:00 PM</td>
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<td>1/20/2017 11:30:00 AM</td>
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<td>1/20/2017 4:04:00 PM</td>
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<td></td>
</tr>
<tr>
<td>1/20/2017 9:16:00 PM</td>
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<tr>
<td>1/21/2017 7:50:00 AM</td>
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<td>1/21/2017 10:56:00 AM</td>
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<td>1/21/2017 2:16:00 PM</td>
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<td>1/21/2017 5:14:00 PM</td>
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<td>1/21/2017 9:04:00 PM</td>
<td>154</td>
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<td>1/22/2017 8:03:00 AM</td>
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<td>1/22/2017 10:46:00 AM</td>
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</tr>
<tr>
<td>1/22/2017 9:14:00 PM</td>
<td>414</td>
<td></td>
</tr>
</tbody>
</table>
Top Patterns

1. Patient had a pattern of nighttime highs
   - Patient had a pattern of significant highs between 9:25 PM and 12:50 AM.

2. Patient had a pattern of daytime highs
   - Patient had a pattern of significant highs between 4:25 PM and 5:10 PM.

3. Patient's best glucose day was March 9, 2019
   - Patient's glucose data was in the target range about 79% of the day.

This graph shows your data averaged over 14 days.
Review of available CGM’s

Freestyle Libre

Medtronic Guardian 3

DexCom G6

Integrateddiabetesservices.com
## Summary of CGM systems available

<table>
<thead>
<tr>
<th></th>
<th>Freestyle Libre</th>
<th>DexCom G6</th>
<th>Medtronic Guardian 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicated wear life</td>
<td>14 days</td>
<td>10 days</td>
<td>7 days</td>
</tr>
<tr>
<td>Calibration with FSBG required</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Immediate access to glucose values</td>
<td>Only when scanned by device</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alters/alarms</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Trend arrows</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Integration with insulin pump</td>
<td>No</td>
<td>Yes, Tandem t:slim X2</td>
<td>Yes, Medtronic MiniMed 670G or 630G</td>
</tr>
<tr>
<td>Integration with smart phone</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Share CGM data with others</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Adapted from Adolfsson, Eur Endocrinol. 2018
Cost of CGM

• Patients who are covered by Medicare can expect to cover 20% of the costs, although this additional amount may be covered by secondary insurance. Medicare will cover the remaining 80%.

• DexCom G6
  • Box of sensors (3 sensors that last 10 days/sensor): $349 (same as G5, though you get three sensors lasting 10 days, vs. four sensors lasting 7+ each)
  • Two transmitters: $475 per bundle (compared to $599 per bundle for G5)
  • Touchscreen receiver: $365

• Freestyle Libre
  • 10-day Libre sensor - $35.99 (about $108 per month)
  • Reader (one time purchase) - $69.99

Blood glucose test strips can cost between $0.50-$1/strip
Medicare requirements to obtain CGM

The beneficiary has to meet all requirements:
1. Testing BG 4 or more times daily
2. Treated with 3 or more daily injections or using an insulin pump
3. Insulin regimen requires frequent adjustments
4. Had a visit to assess diabetes within 6 months of initiating CGM
5. Must have a visit every 6 months to assess diabetes
How can CGM help older patients with diabetes

- Prevention of hypoglycemia
- Reduction in hyperglycemia
- Quality of Life
Hypoglycemia is common in older patients

- Insulin is the 2nd most frequent medication associated with ED visits in people over 65 in the US
- Hospital admissions for hypoglycemia are more common than hospital admissions for hyperglycemia in Medicare beneficiaries
- Hypoglycemia rates have been reported to be as high as 41.9% in long-term care facilities

Budnitz, Ann Intern Med. 2007  
Lipska, JAMA Intern Med. 2014  
Chen, J Am Geriatr Soc. 2008
Older patients may not react to hypoglycemia

**Hypoglycemia aware**
- 72 mg/dL
- Onset of autonomic symptoms

**Hypoglycemia unaware**
- older patients
- patients with frequent hypoglycemic episodes
- patients with diabetic autonomic neuropathy

**Blood glucose**
- 72 mg/dL
- 54 mg/dL
- 36 mg/dL
- 18 mg/dL
- Onset of CNS dysfunction
- Coma/seizure
- Onset of autonomic symptoms

Holt, Essential Endo and Diabetes. 2007
How often do you experience symptoms of hypoglycemia?

- No severe hypoglycemia in the last 3 years
- Severe hypoglycemia in the last year

Percentage of Participants

<table>
<thead>
<tr>
<th>Hypoglycemic Symptoms</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>6%</td>
</tr>
<tr>
<td>Rarely</td>
<td>0%</td>
</tr>
<tr>
<td>Sometimes</td>
<td>6%</td>
</tr>
<tr>
<td>Often</td>
<td>19%</td>
</tr>
<tr>
<td>Always</td>
<td>42%</td>
</tr>
</tbody>
</table>
What blood glucose level do you experience symptoms of hypoglycemia?

- Case subjects
  - No severe hypoglycemia in the last 3 years
  - Severe hypoglycemia in the last year

- Percentage of Participants
  - 60-69: 46%
  - 50-59: 32%
  - 40-49: 25%
  - <40: 20%

Weinstock, Diabetes Care. 2016
The effects of hypoglycemia in older adults

- Cardiovascular events
- Cognitive dysfunction/dementia
- Falls
- Fractures
- Hospitalizations
- Increased mortality
Hypoglycemia: A risk factor for dementia

CNS manifestations of hypoglycemia

Radiopaedia
CGM decreases hypoglycemia

- Reduced nocturnal hypoglycemia (<70 mg/dL) in T1DM on MDI by 48%
- Reduced nocturnal hypoglycemia (<54 mg/dL) in T1DM on MDI by 65%
- Reduced daytime hypoglycemia (<54 mg/dL) in T1DM on MDI by 54%

Olaffsdottir, Diabetes Technol Ther. 2018
CGM reduces hypoglycemia in older adults

- Wireless innovation for Seniors with Diabetes Mellitus (WISDM) Study
  - Patients with T1DM wore a DexCom CGM for 6 months
  - Less time with BG less than 70 mg/dL
  - Decreased episodes of severe hypoglycemia
  - 2 more hours per day in range (70-180 mg/dl) by the end of the six months vs. fingersticks
  - Benefits were noted in both insulin pump and in patients on multiple daily injections

ADA Scientific Sessions, 2019
CGM in patients with hypoglycemia unawareness

Choudhary, Diabetes Care. 2013
CGM can also decrease hyperglycemia

Charler, JCEM. 2018
CGM can also decrease hyperglycemia

Charler, JCEM 2018
CGM and fear of hypoglycemia

Chamberlain, J Diabetes Sci Technol 2016
# Quality of life with CGM

<table>
<thead>
<tr>
<th>SF-36</th>
<th>Before Reimbursement (n = 448)</th>
<th>12 Months of Reimbursement (n = 362)</th>
<th>P Value</th>
<th>Effect Size²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical functioning</td>
<td>79.4 (21.1)</td>
<td>82.7 (21.2)</td>
<td>&lt;0.0005</td>
<td>0.16</td>
</tr>
<tr>
<td>Role-physical</td>
<td>62.5 (27.1)</td>
<td>68.0 (26.8)</td>
<td>&lt;0.0005</td>
<td>0.20</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>71.8 (26.2)</td>
<td>74.4 (27.0)</td>
<td>0.033</td>
<td>0.10</td>
</tr>
<tr>
<td>General health</td>
<td>49.5 (21.5)</td>
<td>54.1 (22.5)</td>
<td>&lt;0.0005</td>
<td>0.21</td>
</tr>
<tr>
<td>Vitality</td>
<td>54.5 (19.3)</td>
<td>57.4 (19.5)</td>
<td>0.003</td>
<td>0.15</td>
</tr>
<tr>
<td>Social functioning</td>
<td>70.0 (26.1)</td>
<td>76.3 (24.9)</td>
<td>&lt;0.0005</td>
<td>0.24</td>
</tr>
<tr>
<td>Role-emotional</td>
<td>70.8 (28.1)</td>
<td>76.4 (26.7)</td>
<td>&lt;0.0005</td>
<td>0.20</td>
</tr>
<tr>
<td>Mental health</td>
<td>65.2 (17.8)</td>
<td>68.8 (18.1)</td>
<td>&lt;0.0005</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Charler, JCEM. 2018
What patients should CGM be used in?

- Patients who are on multiple daily injections or insulin pumps
- Patients who have a good understanding of how to adjust insulin doses/activity/food intake based on CGM data
- Patients with hypoglycemia unawareness or recurrent especially severe hypoglycemia
- Patients who meet insurance carriers requirements to receive CGM
- Patients with cognitive dysfunction, visual or hearing impairments, or dexterity problems may not benefit as much from CGM