Evaluation of a Novel Tool to Adjust Insulin Boluses based on CGM Trend Arrows (Trend Arrow Adjustment Tool) in Children and Youth with Type 1 Diabetes using Insulin Pump Therapy

E. Heffernan1,2, M. L. Lawson2, C. Richardson2, J. Courtney2, B. Bradley2 for the JDRF Canadian Clinical Trial Network CCTN1101 and CGM TIME Trial Study Group 1Children’s Hospital of Eastern Ontario, Ottawa, Canada 2CHEO Research Institute, Ottawa, Canada

Abstract

- Continuous Glucose Monitoring (CGM) measures interstitial glucose and displays trend arrows.
- Trend Arrows provide dynamic data on the direction & rate of change of glucose, and provide an opportunity to make adjustments to prevent hypo and hyper-glycaemia.
- Effective strategies for adjusting insulin for trend arrows are lacking.
- The JDRF CGM Study Group recommended a 10/20% adjustment (10% for 1 arrow; 20% for 2 arrows). Bolus dose is increased for up arrows, and decreased for down arrows. This requires a mathematical calculation with each arrow, limiting the tool’s uptake in paediatrics.
- We developed a Trend Arrow Adjustment Tool, based on the insulin sensitivity factor (ISF). The child only needs to remember 2 numbers, the adjustment for 1 arrow and the adjustment for 2 arrows.

Trend Arrow Adjustment Tool

<table>
<thead>
<tr>
<th>ISF mmol/L</th>
<th>1 or T (units insulin)</th>
<th>T1 or T1 (units insulin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1.5</td>
<td>1.5</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>2.75</td>
<td>1.5</td>
</tr>
<tr>
<td>2.5</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>3</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>3.5-4</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>4.5-5</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>5-6</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>7</td>
<td>0.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Methods

- Counterbalance crossover study
- 20 subjects from CHEO diabetes clinic
- Eligibility criteria:
  - Age 5-18 years
  - Type 1 diabetes > 1 year
  - Medtronic pump & CGM for > 3 months
- Hospital visit - trend arrows triggered through exercise/juice. Standardised meal with insulin bolus adjusted for arrows using TAAT/10/20%
- Home based assessment - subjects used TAAT/10/20% ignored arrows for 1 week each; arrows recorded in logbook
- CareLink used to collect sensor glucose data for 4 hours after each arrow
- Analysed to determine % time glucose:
  - in target 4-10 mmol/L
  - low < 3.9 mmol/L
  - high >10.1 mmol/L

Results

- Postprandial glucose, when starting sensor glucose was ≤ 8 mmol/L
- Postprandial glucose, when starting sensor glucose was >12 mmol/L

Conclusions

- TAAT as effective as 10/20% adjustment in achieving postprandial glucose targets.
- Trend towards less hypoglycaemia with use of either tool vs ignoring arrows.
- Significantly fewer errors when TAAT used compared to 10/20% method.
- TAAT was the preferred method for future use by children/youth and by parents.
- TAAT is simple, well received method of adjusting insulin for CGM trend arrows.

References

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