Canadian Agency for Drugs and Technologies in Health

# RAPID RESPONSE REPORT: SUMMARY OF ABSTRACTS

**TITLE: Continuous Glucose Monitoring Systems for Pediatric Patients with Type 1 Diabetes: Clinical and Cost-Effectiveness**

**DATE:** 06 December 2016

## RESEARCH QUESTIONS

1. What is the clinical effectiveness of continuous glucose monitoring for pediatric patients with type 1 diabetes?

2. What is the cost-effectiveness of continuous glucose monitoring for pediatric patients with type 1 diabetes?

## KEY FINDINGS

Four systematic reviews and meta-analyses, two randomized controlled trials, and five non-randomized studies were identified regarding continuous glucose monitoring systems for pediatric patients with type 1 diabetes.

## METHODS

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, ECRI Institute (Health Devices Gold), Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit retrieval by publication type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2011 and November 28, 2016. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

## SELECTION CRITERIA

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

| Table 1: Selection Criteria | |
|---|---|
| **Population** | Children with type 1 diabetes mellitus (subgroups of interest: children less than 10 years of age, children less than five years of age) |
| **Intervention** | Continuous glucose monitoring systems (e.g., standalone systems [Dexcom], combined with insulin pump [Medtronic Veo System or Animas/Dexcom System]) |
| **Comparator** | Self-monitoring of blood glucose (test strips), other, no comparator |
| **Outcomes** | Clinical benefits and harms, effect on blood sugar stability, cost-effectiveness |
| **Study Designs** | Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, economic evaluations |

## RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials, non-randomized studies, and economic evaluations.

Four systematic reviews and meta-analyses, two randomized controlled trials, and five non-randomized studies were identified regarding continuous glucose monitoring systems for pediatric patients with type 1 diabetes. No economic evaluations were found.

Additional references of potential interest are provided in the appendix.

## OVERALL SUMMARY OF FINDINGS

Four systematic reivews[1-4] were identified regarding continuous glucose monitoring (CGM) systems in pediatric patients with type 1 diabetes. One systematic reivew[1] aimed to assess the effects of CGM on glycemic control in pediatric patients with type 1 diabetes and found that real-time CGM can be more effective than self-monitoring of blood glucose in these patients. Another systematic review[2] aimed to assess systematic reviews comparing CGM with self-glucose monitoring but the authors were unable to identify any relevant reviews. Another systematic review[3] comparing CGM to self-monitored blood glucose found no significant effect in children. The final systematic review,[4] also comparing CGM with self-glucose monitoring, found that CGM, particularly real-time CGM, had favourable effects on glycemic control and decreased the incidence of hypoglycemic episodes.

Two randomized controlled trials[5-6] (RCTs) were identified regarding the use of CGM in pediatric patients with type 1 diabetes. One RCT[5] found that CGM in 4-9 year olds did not improve glycemic control despite a high degree of parental satisfaction with the method. One RCT[6] aimed to evaluate the efficacy of short-term CGM versus self-monitored blood glucose in type 1 diabetic pediatrics. The study found that CGM can be valuable in treating these patients, but the

authors suggested that further research was needed to accurately estimate if it outperforms self-monitoring of blood glucose.

Five non-randomized studies[7-11] also examined CGM in pediatric patients with type 1 diabetes. One study[8] compared CGM to self-monitoring blood glucose and found that glycemic parameters did not differ significantly between the groups during follow-up periods. Four non-randomized studies[7, 9-11] were pre-and-post treatment studies. One study[7] concluded that CGM was effective in improving glycemic control in children, adolescents, and young adults aged 7-21 years. Another study[9] found that CGM was not associated with a significant reduction in hemoglobin A1c in children and hypoglycemic events were not reduced. Another study[10] concluded that CGM demonstrated frequent hyperglycemic excursions, with a large variability in glucose readings. The final study[11] found that a CGM-based overnight predictive low-glucose suspend system can substantially reduce overnight hypoglycemia without an increase in morning ketosis.

## REFERENCES SUMMARIZED

### Health Technology Assessments

No literature identified.

### Systematic Reviews and Meta-analyses


1. Poolsup N, Suksomboon N, Kyaw AM. Systematic review and meta-analysis of the effectiveness of continuous glucose monitoring (CGM) on glucose control in diabetes. Diabetol Metab Syndr [Internet]. 2013[cited 2016 Dec 5];5:39. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3728077
   PubMed: PM23876067

2. Matsuda E, Brennan P. The effectiveness of continuous subcutaneous insulin pumps with continuous glucose monitoring in outpatient adolescents with type 1 diabetes: a systematic review. JBI Libr Syst Rev. 2012;10(42 Suppl):1-10.
   PubMed: PM27820140

3. Gandhi GY, Kovalaske M, Kudva Y, Walsh K, Elamin MB, Beers M, et al. Efficacy of continuous glucose monitoring in improving glycemic control and reducing hypoglycemia: a systematic review and meta-analysis of randomized trials. J Diabetes Sci Technol [Internet]. 2011 Jul 1 [cited 2016 Dec 5];5(4):952-65. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3192603
   PubMed: PM21880239

4. Wojciechowski P, Rys P, Lipowska A, Gaweska M, Malecki MT. Efficacy and safety comparison of continuous glucose monitoring and self-monitoring of blood glucose in type 1 diabetes: systematic review and meta-analysis. Pol Arch Med Wewn. 2011 Oct;121(10):333-43.
   PubMed: PM22045094


### Randomized Controlled Trials


5. Mauras N, Beck R, Xing D, Ruedy K, Buckingham B, Tansey M, et al. A randomized clinical trial to assess the efficacy and safety of real-time continuous glucose monitoring in the management of type 1 diabetes in young children aged 4 to <10 years. Diabetes Care [Internet]. 2012 Feb [cited 2016 Dec 5];35(2):204-10. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3263860
   PubMed: PM22210571

6. Bukara-Radujkovic G, Zdravkovic D, Lakic S. Short-term use of continuous glucose monitoring system adds to glycemic control in young type 1 diabetes mellitus patients in the long run: a clinical trial. Vojnosanit Pregl. 2011 Aug;68(8):650-4.
   PubMed: PM21991787


### Non-Randomized Studies


7. Lewis KR, McCrone S, Deiriggi P, Bendre S. Effectiveness of continuous glucose monitoring in children, adolescents, and young adults with poorly controlled type 1 diabetes. J Spec Pediatr Nurs. 2016 Oct 14.
   PubMed: PM27739620

8. Rachmiel M, Landau Z, Boaz M, Mazor AK, Loewenthal N, Ben-Ami M, et al. The use of continuous glucose monitoring systems in a pediatric population with type 1 diabetes mellitus in real-life settings: the AWeSoMe Study Group experience. Acta Diabetol. 2015 Apr;52(2):323-9.
PubMed: PM25223531

9. Ludwig-Seibold CU, Holder M, Rami B, Raile K, Heidtmann B, Holl RW, et al. Continuous glucose monitoring in children, adolescents, and adults with type 1 diabetes mellitus: analysis from the prospective DPV diabetes documentation and quality management system from Germany and Austria. Pediatr Diabetes. 2012 Feb;13(1):12-4.
PubMed: PM22128781

10. Tsalikian E, Fox L, Weinzimer S, Buckingham B, White NH, Beck R, et al. Feasibility of prolonged continuous glucose monitoring in toddlers with type 1 diabetes. Pediatr Diabetes [Internet]. 2012 Jun [cited 2016 Dec 5];13(4):301-7. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665108
PubMed: PM22151826

11. Buckingham BA, Raghinaru D, Cameron F, Bequette BW, Chase HP, Maahs DM, et al. Predictive low-glucose insulin suspension reduces duration of nocturnal hypoglycemia in children without increasing ketosis. Diabetes Care [Internet]. 2015 Jul [cited 2016 Dec 5];38(7):1197-204. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4477332
PubMed: PM26049549

**Economic Evaluations**
No literature identified.

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## APPENDIX – FURTHER INFORMATION:

### Health Technology Assessment – Mixed Population

12. Health Quality Ontario. Continuous glucose monitoring for patients with diabetes: an evidence-based analysis. Ont Health Technol Assess Ser [Internet]. 2011 [cited 2016 Dec 5];11(4):1-29. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3377575
PubMed: PM23074416

### Systematic Reviews and Meta-analyses – Mixed Population

13. Yeh HC, Brown TT, Maruthur N, Ranasinghe P, Berger Z, Suh YD, et al. Comparative effectiveness and safety of methods of insulin delivery and glucose monitoring for diabetes mellitus: a systematic review and meta-analysis. Ann Intern Med. 2012 Sep 4;157(5):336-47.
PubMed: PM22777524

### Randomized Controlled Trial – Mixed Population

14. Battelino T, Conget I, Olsen B, Schutz-Fuhrmann I, Hommel E, Hoogma R, et al. The use and efficacy of continuous glucose monitoring in type 1 diabetes treated with insulin pump therapy: a randomised controlled trial. Diabetologia [Internet]. 2012 Dec [cited 2016 Dec 5];55(12):3155-62. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3483098
PubMed: PM22965294

### Non-Randomized Study – Alternate Population

15. Landau Z, Rachmiel M, Pinhas-Hamiel O, Boaz M, Bar-Dayan Y, Wainstein J, et al. Parental sleep quality and continuous glucose monitoring system use in children with type 1 diabetes. Acta Diabetol. 2014;51(3):499-503.
PubMed: PM24370924

### Review Articles

16. Englert K, Ruedy K, Coffey J, Caswell K, Steffen A, Levandoski L, et al. Skin and adhesive issues with continuous glucose monitors: a sticky situation. J Diabetes Sci Technol [Internet]. 2014 Jul [2016 Dec 5];8(4):745-51. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4764227
PubMed: PM24876416

17. Patton SR, Clements MA. Continuous glucose monitoring versus self-monitoring of blood glucose in children with type 1 diabetes- are there pros and cons for both? US Endocrinol [Internet]. 2012 [cited 2016 Dec 5];8(1):27-9. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3848052
PubMed: PM24312136

18. Vazeou A. Continuous blood glucose monitoring in diabetes treatment. Diabetes Res Clin Pract. 2011 Aug;93 Suppl 1:S125-S130.
PubMed: PM21864744