Systematic review and meta-analysis of the effectiveness of continuous glucose monitoring (CGM) on glucose control in diabetes

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CRD summary
This well-conducted review concluded that real-time, but not retrospective, continuous glucose monitoring could be more effective than self-monitoring of blood glucose, for children with type 1 diabetes. Continuous glucose monitoring improved glycaemic control, compared with self-monitoring, for adults with type 2 diabetes. These conclusions are likely to be reliable.

Authors' objectives
To assess the effects of continuous glucose monitoring on glycaemic control, in children with type 1 diabetes, and adults with type 2 diabetes.

Searching
MEDLINE, CINAHL, Scopus, Web of Science and The Cochrane Library were searched in May 2013; search terms were reported. The reference lists of relevant randomised controlled trials (RCTs) and systematic or narrative reviews were searched for additional relevant studies. No language restrictions were imposed.

Study selection
RCTs, lasting at least eight weeks, comparing the available continuous glucose monitoring devices with self-monitoring of blood glucose, for children (aged 18 years or younger) with type 1 diabetes or adults (aged 18 years or older) with type 2 diabetes, were eligible for inclusion. Trials had to report glycated haemoglobin (HbA1c) as an outcome measure. Trials of pregnant women, critically ill patients, patients after surgery or transplant, or patients in intensive care, were excluded.

The included trials were conducted in the UK, Europe, the USA, Australia or Korea, and were published between 2001 and 2012. Trials lasted from three to twelve months. They assessed either real-time or retrospective continuous glucose monitoring. Where stated, the devices were MiniMed, DexCom, FreeStyle Navigator, Guardian REAL-Time or the GlucoDay system. The trials varied in the frequency and duration of continuous monitoring. The average initial glycated haemoglobin level was over 8% in all trials of adults. Most patients received insulin pump therapy, insulin injection therapy, oral hypoglycaemic agents, or a combination of these; two trials included patients who were not treated with insulin.

The authors did not state how many reviewers assessed studies for inclusion.

Assessment of study quality
Two reviewers independently assessed trial quality using the Maastricht Amsterdam Scale, which was based on the Jadad scale and the Delphi list. Disagreements were resolved by a third reviewer. Trials that met six or more of the eleven criteria were considered to be high quality; those meeting fewer than six were considered to be low quality.

Data extraction
The mean difference in final glycated haemoglobin level, between the continuous monitoring group and the self-monitoring group, was extracted from each trial.

Two authors independently extracted the data, and disagreements were resolved by a third reviewer.

Methods of synthesis
Trial data were combined using meta-analysis; a random-effects model was used in the presence of significant statistical heterogeneity, and a fixed-effect model was used in the absence of significant heterogeneity. Heterogeneity was assessed using Cochran's Q and I².
Subgroup analyses were undertaken based on real-time versus retrospective monitoring, initial glycated haemoglobin level (under 8%, 8 to 10%, or over 10%), and trial quality. Sensitivity analyses were undertaken by excluding trials reporting fewer usable continuous monitoring data. Publication bias was assessed using a funnel plot and the Egger regression test.

Results of the review
Fourteen RCTs were included; 10 were of children with type 1 diabetes (817 patients; range 11 to 156), and four were of adults with type 2 diabetes (228 patients; range 25 to 100).

Children: Seven trials were considered to be high quality, and three were low quality. There was no statistically significant difference between continuous glucose monitoring and self-monitoring (MD -0.13%, 95% CI -0.38 to 0.11; 10 RCTs). There was evidence of significant heterogeneity (I²=71%) and publication bias. The results of subgroup analyses of initial glycated haemoglobin level and trial quality were similar to those for the main analysis. Real-time continuous monitoring was superior to self-monitoring for improving glycaemic control (MD -0.18%, 95% CI -0.35 to -0.02; five RCTs), but retrospective continuous monitoring was not (MD -0.05, 95% CI -0.46 to 0.35; five RCTs). Heterogeneity was not substantial for real-time monitoring (I²=48%), but was substantial for retrospective monitoring (I²=72%).

Adults: Two RCTs were considered to be high quality, and two were low quality. Continuous glucose monitoring was statistically significantly superior to self-monitoring in glycated haemoglobin reduction (MD -0.31%, 95% CI -0.6 to -0.02; four RCTs). There was no evidence of heterogeneity (I²=0) and publication bias.

Authors’ conclusions
Real-time, but not retrospective, continuous glucose monitoring could be more effective than self-monitoring of blood glucose, for children with type 1 diabetes. Continuous monitoring improved glycaemic control, compared with self-monitoring, for adults with type 2 diabetes.

CRD commentary
The review question and inclusion criteria were clear. Relevant sources were searched for published trials, in any language. Unpublished data were not sought; publication bias was assessed and found to be present, meaning that some trials with negative results may have been missed. Data extraction and quality assessment were duplicated, reducing the potential for reviewer error and bias, but it was unclear whether the same methods were used for study selection.

Trial quality was assessed and the results were used for subgroup analysis. The methods used to pool the data and assess heterogeneity appear to have been appropriate, including the subgroup and sensitivity analyses. The results of trials of adults were consistent, but one trial of real-time monitoring for children found no difference in effectiveness between continuous monitoring and self-monitoring. If additional trials with negative results were missed due to publication bias, this result might no longer be statistically significant.

This was a well-conducted systematic review and the conclusions are likely to be reliable, particularly for adult patients.

Implications of the review for practice and research
Practice: The authors stated that real-time continuous glucose monitoring devices could be effective for children with type 1 diabetes, and continuous glucose monitoring devices could be effective for adults with uncontrolled type 2 diabetes.

Research: The authors stated that trials should aim to determine the appropriate frequency and duration of continuous glucose monitoring, and assess the benefit of the devices in people with nocturnal hypoglycaemia. More adequately powered RCTs were required to assess continuous glucose monitoring for patients with type 2 diabetes.

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