Health technologies for monitoring and managing diabetes: a systematic review
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CRD summary
The authors stated that self-monitoring of blood glucose was an effective tool for management of diabetes, wireless technologies can improve diabetes self-care and pedometers were effective lifestyle modification tools. Further research was needed. The review had some methodological problems that limited the reliability of the conclusions.

Authors' objectives
To determine the strength of evidence for the effectiveness of self-monitoring devices and technologies for individuals with type 1 or type 2 diabetes mellitus based on specific health-related outcome measures.

Searching
EMBASE, MEDLINE, CINAHL, The Cochrane library, PsycINFO, SportDiscus and Scirus were searched from 1985 to May 2008 for articles in English. Search terms were reported. Clinical guidelines, relevant journals, health-related evidence-based practice centre websites and unpublished literature sources were searched.

Study selection
Randomised controlled trials (RCTs) and non-randomised observational studies of any type of self-monitoring device in adults (over 14 years) and youths (seven to 14 years) with type 1 or type 2 diabetes mellitus were eligible for inclusion. Studies had to report on clinical outcomes such as blood pressure, body mass index (BMI), haemoglobin A1c (HbA1c), weight, compliance and low density lipoprotein.

Studies were excluded if they included fewer than 10 participants and were cross-sectional data, primary interventions with medications, studies that assessed device accuracy, telemedicine applications, continuous glucose monitoring devices and where the self-monitoring device was not part of the main intervention assessed. Studies that scored below 20 on the quality criteria were excluded.

The included studies considered self-monitoring devices and technologies such as self-monitoring of blood glucose devices, wireless data technologies such as mobile messaging, pedometers and accelerometers, devices that use web-enabled technologies and global information technologies in patients with type 1 or type 2 diabetes mellitus. Most studies were conducted in USA; other countries included France, South Korea, UK, Canada and Norway.

All authors were involved in study selection.

Assessment of study quality
Three reviewers assessed study quality using the Downs and Black instrument to score RCTs out of a possible 28 points and non-RCTs out of a maximum 25 points. Studies were deemed poor quality if they scored fewer than 15, fair if they scored 15 to 19, good if they scored 20 to 25 and excellent (RCTs only) if they scored 26 to 28 points.

Strength of evidence was estimated using a hierarchical system based on study design: 1a (very strong evidence based on two or more excellent quality studies), 1b (strong evidence based one excellent quality study), 2a (moderate evidence based on two or more studies of good quality), 2b (limited evidence based on one good quality study), 2c (weak evidence based on one study of fair to poor quality) and 3 (expert opinion).

Data extraction
Data were extracted on clinical outcomes such as blood pressure, BMI, HbA1c, weight, compliance and low density lipoprotein and lifestyle outcomes such as steps, oxygen uptake and activity levels.

The authors did not state how many reviewers performed data extraction.

Methods of synthesis
A narrative synthesis was presented. Studies were grouped by intervention type: self-monitoring of blood glucose,
pedometers and cell phones and wireless devices.

**Results of the review**

Eighteen trials were included in the review (2,091 participants, sample size 30 to 689). Trial quality ranged from 19 to 26.

**Self-monitoring of blood glucose** (five trials): There was moderately strong evidence from four trials that self-monitoring of blood glucose was an effective way to improve glycaemic control in patients with non-insulin treated type 2 diabetes mellitus. There were no effects on weight and BMI. One trial reported that total cholesterol significantly improved with self-monitoring of blood glucose.

**Pedometers** (four trials): There was limited evidence from one trial that pedometers had an effect on improving overall fitness and metabolic control. One trial provided limited evidence that the First Step Program increased daily activity.

**Mobile phones and wireless devices** (nine trials): There was moderately strong evidence from four trials that mobile phones may have helped lower HbA1c levels in patients with type 2 diabetes mellitus. There was limited evidence from one trial that text messaging may have improved self-efficacy and adherence in adolescents.

**Authors’ conclusions**

The authors stated that self-monitoring of blood glucose was an effective tool diabetes management, wireless technologies can improve diabetes self-care and pedometers were effective lifestyle modification tools. Further research was needed.

**CRD commentary**

Inclusion criteria were clearly defined. Several relevant data sources were searched. There was potential for language bias, as only English-language articles were included. Publication bias was not assessed and could not be ruled out, although the extensive searches and inclusion of unpublished studies limited the risk. Two or more reviewers were involved in study selection and quality assessment, but it was unclear whether this was carried out independently. The authors did not report how many reviewers performed data extraction.

Quality assessment of the included trials was undertaken using a standard tool, but only summary scores were provided, which made it difficult to determine quality issues. Quality assessment was used as an inclusion criteria (only trials that scored at least 20 were eligible for inclusion); it might have been more appropriate to include all relevant studies and consider the impact of methodological quality on findings. The authors included one trial that scored 19 points (in violation of their inclusion criteria). Trials were narratively synthesised, which appeared appropriate given the type of data available and clinical heterogeneity.

Overall, the review had some methodological problems that limited the reliability of the authors’ conclusions. The authors’ call for further research appeared appropriate.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated that there was a need for further studies on the usability, feasibility, adherence and costs of self-monitoring devices for diabetes. Further trials on the effectiveness of remote patient monitoring devices on key health outcomes and lifestyle changes were needed in diabetes patients. Studies of blood pressure devices and heart rate monitors were needed, as no studies were found.

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