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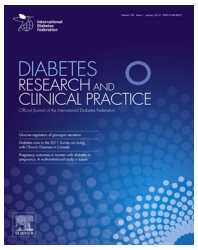

Real-time continuous glucose monitoring versus internet-based blood glucose monitoring in adults with type 2 diabetes: A study of treatment satisfaction

Tricia S. Tang [a,*], *Erica M. Digby* [b], *Anthony M. Wright* [c], *Jeremy H.M. Chan* [d], *Adel B. Mazanderani* [e], *Stuart A. Ross* [f], *Hamish G. Tildesley* [g], *Augustine M. Lee* [h], *Adam S. White* [a], *Hugh D. Tildesley* [a]

[a] *Department of Medicine, Faculty of Medicine, University of British Columbia, Vancouver, BC, Canada*
[b] *University of Idaho, Moscow, ID, USA*
[c] *University of Victoria, Victoria, BC, Canada*
[d] *Vanderbilt University, Nashville, TN, USA*
[e] *Saint George's University, Grenada, West Indies*
[f] *Department of Medicine, University of Calgary, Calgary, AB, Canada*
[g] *Dartmouth University, Hanover, NH, USA*
[h] *University of British Columbia, Vancouver, BC, Canada*

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ABSTRACT

Aims: To compare treatment satisfaction between real-time continuous glucose monitoring (RT-CGM) and internet-blood glucose monitoring (IBGM) in adults with type 2 diabetes treated with insulin.

Methods: This study recruited 40 patients who completed a parallel randomized controlled trial comparing a RT-CGM to an IBGM. Patients in the RT-CGM group monitored their blood-glucose levels bi-weekly and emailed results to their endocrinologist. Patients in the IBGM group also monitored their blood-glucose levels bi-weekly, but entered their data into an IBGM. Both groups used a secure website to submit blood-glucose readings and to receive feedback from their endocrinologist. Feedback included changes in therapy, suggestions on testing frequency, lifestyle modifications and/or encouragement to continue with no changes. At the end of 6 months, treatment satisfaction was measured using the 8-item Diabetes Treatment Satisfaction Questionnaire. In this study, "treatment" refers to the blood glucose monitoring system to which patients were randomized.

Results: Thirty-two of the 40 patients completed the treatment satisfaction questionnaire (80%). Compared to the RT-CGM group, the IBGM group reported a significantly higher level of overall treatment satisfaction (24.80 vs. 33.41, $p < 0.000$). Ratings of individual satisfaction components including convenience, flexibility, likelihood of recommending treatment to

* Corresponding author. Tel.: +1 604 875 4111x63449; fax: +1 604 875 4886.
E-mail address: tricia.tang@vch.ca (T.S. Tang).
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others, and willingness to continue with treatment were also found to be significantly higher in the IBGM group.

Conclusion: Patients using IBGM are more satisfied with their blood glucose monitoring system compared to those using RT-CGM.

1. Introduction

Technological advances in blood glucose monitoring have led to improvements in diabetes-related health outcomes [1–5]. Two such advances are real time-continuous glucose monitoring (RT-CGM) and internet-based blood glucose monitoring (IBGM). According to a systematic review and meta-analysis of 19 randomized trials, compared to self-monitoring blood glucose (SMBG), continuous glucose monitoring (CGM) was associated with significant improvements in HbA1c among adult patients diagnosed with type 1 and type 2 diabetes. Studies of IBGM have also yielded favorable results [6–10]. For instance, among patients with a baseline HbA1c $\geq$ 7% (53 mmol/mol), Kwon et al. [8] found that individuals randomized to an IBGM group had a significantly lower mean HbA1c compared to the control group 7.4% (57 mmol/mol) vs. 8.1% (65 mmol/mol).

In addition to clinical outcomes, patient-reported outcomes such as treatment satisfaction have also been examined with CGM and IBGM, although, primarily in the pediatric population [11–17]. The few studies of treatment satisfaction for CGM in the adult population have focused predominately on type 1 and were not randomized controlled trials (RCTs) [18]. Moreover, there has only been one RCT that has assessed treatment satisfaction for IBGM and this study targeted adolescents with type 1 diabetes [19]. To date, treatment satisfaction for CGM and IBGM has been largely overlooked in adults with type 2 diabetes.

For this reason, the objective of this study was to investigate treatment satisfaction for RT-CGM and IBGM among adults with type 2 diabetes and compare satisfaction levels between the two modalities. We hypothesize that patients randomized to the IBGM group will report higher treatment satisfaction ratings when compared to those in the RT-CGM group.

2. Methods and materials

This study was approved by the Providence Health Care Research Ethics Board and is part of a larger parallel randomized controlled trial (RCT) comparing the impact of RT-CGM to IBGM on glycemic control. To recruit patients we approached consecutive adult patients with type 2 diabetes (treated with insulin alone or in combination with oral anti-hyperglycemic agents) presenting to an endocrinology clinic from October 2010 to January 2012 in Vancouver, BC. To be eligible for the study, patients had to have (1) a recent HbA1c $>$ 7.0% (53 mmol/mol), (2) Internet access, (3) received prior training in self-monitoring of blood glucose (SMBG), and (4) been performing SMBG at a frequency of at least once per day prior to enrolling into the study. At the clinic visit, a research assistant described details of the study and what participation entailed. Interested individuals provided informed consent and enrolled into the study.

The randomization allocation sequence used a 1:1 ratio and was produced by a computer random number generator. Patients were informed of their group assignment (RT-CGM or IBGM) by a research assistant. All patients were equipped with a glucometer (Freestyle, Abbott) and test strips to test three times daily. Patients were required to obtain a laboratory blood test and attend a clinic visit at baseline, 3-months, and 6-months. At the end of the 6-month study, patients completed an 8-item survey assessing treatment satisfaction and administered by a trained research assistant. Patients were given the option to have the survey administered face-to-face in the clinic or via telephone.

2.1. RT-CGM group

The Guardian REAL-Time Continuous Glucose Monitoring System (Medtronic MiniMed, Inc., Northridge, CA) produces a seven-day visual tracking report that indicates blood glucose trends and excursions as well as daily summaries of mean blood glucose with highs, lows, and standard deviations. Patients randomized to the RT-CGMS group were trained by a Registered Nurse familiar with sensor technology to use this monitoring system. An alarm activates if the blood glucose level falls below 4 mmol/L. Patients were asked to save the ''sensor daily overlay'' report as a PDF and email it to their endocrinologist every two weeks.

2.2. IBGM group

Internet blood glucose monitoring is a facilitated method in which patients can communicate with their physicians through an online system with no geographic restrictions [6]. Patients randomized to the IBGM group were trained by the research coordinator to upload their glucose readings every two weeks to a secure, commercially available website (ALR Technologies Inc, Atlanta, Georgia). Patients were instructed to test their glucose levels 3 times per day before mealtimes. Glucose levels were presented in table and graph formats according to time of day with automatic calculations showing the mean, standard deviation and range for specific time periods. The system allowed patients to input medications, view summaries of readings, and contact their endocrinologist. The endocrinologist