Journal of Diabetes Science and Technology
Volume 7, Issue 1, January 2013
© Diabetes Technology Society

ORIGINAL ARTICLE

Automated Glycemic Pattern Analysis: Overcoming Diabetes Clinical Inertia

Frank L. Schwartz, M.D.,[1] Cynthia R. Marling, Ph.D.,[2] and Jay Shubrook, D.O.[1]

Abstract

The OneTouch® Verio™ IQ Meter with PatternAlert™ Technology has been approved by the U.S. Food and Drug Administration as the first self-glucose monitor that can automatically determine glycemic patterns [high and low pre-meal blood glucose (BG)] for health care providers (HCPs) and patients. In this issue of *Journal of Diabetes Science and Technology,* Katz and coauthors demonstrate that this device was more accurate and quicker in detecting abnormal glucose patterns than the review by HCPs of 30-day handwritten BG logs and that its interpretations were positively accepted by the HCPs. Continued development of automated pattern analysis and decision-support software to overcome the "data-overload" associated with intensive glucose monitoring and diabetes management will reduce clinical inertia and could dramatically improve diabetes outcomes.

J Diabetes Sci Technol 2013;7(1):167–169

One of the major barriers to successful diabetes management is the time requirement, both for the patient and the patient's health care provider (HCP). A survey of certified diabetes educators estimated that it takes approximately 3 h per day for a person with type 2 diabetes mellitus to perform all of the self-care needed to manage the disease[1]. When it comes to self-glucose monitoring and problem solving, the time it takes for the HCP to analyze the data critically, see abnormal glucose patterns, and change treatment at the time of an appointment is a major burden that often leads to clinical inertia. In the article entitled "Automated Glycemic Pattern Analysis Can Improve Healthcare Professional Efficiency and Accuracy," Katz and coauthors[2] reviewed the performance of the OneTouch Verio™ IQ meter (LifeScan, Inc., Milpitas, CA) in determining glycemic patterns compared with HCPs' reviews of handwritten blood glucose (BG) logbooks. They demonstrated that the OneTouch Verio IQ meter could assess 30-day glucose data more rapidly than HCPs could review handwritten BG logbooks with the same data (0.9 vs 7.3 min, respectively), and could detect specific glucose patterns (high and low pre-meal BG) more accurately compared with the HCPs' 43% error rate. They also noted a high acceptance rate by the HCPs of such technology for diabetes management. This is the first commercially available automated system for BG pattern detection in a glucometer. It highlights the potential benefits of this technology for HCPs and their patients both in terms of time savings and pattern-recognition accuracy.

Author Affiliations: [1]The Diabetes Institute, Heritage College of Osteopathic Medicine, Ohio University, Athens, Ohio; and [2]School of Electrical Engineering and Computer Science, Russ College of Engineering and Technology, Ohio University, Athens, Ohio

Abbreviations: (4DSS) 4 Diabetes Support System, (BG) blood glucose, (CGM) continuous glucose monitoring, (HCP) health care provider

Keywords: automated glucose pattern detection, diabetes management decision support

Corresponding Author: Frank L. Schwartz, M.D., FACE, Heritage College of Osteopathic Medicine, The Diabetes Institute at Ohio University, 331 Academic Research Center, Athens, OH 45701; email address schwartf@ohio.edu

Diabetes is a complex disease that requires frequent glucose monitoring and problem solving. Many patients diligently keep self-glucose logs or bring in their meters to download at appointments. Too few patients actually evaluate their own glucose records to identify trends in glucose control, and, unfortunately, time is rarely available for their HCPs to critically review these records as well, thereby perpetuating the inertia. At the time of an appointment, three things can happen: (1) BG records are ignored and treatment is based on hemoglobin A1c; (2) BG records are reviewed and treatment is adjusted based on one or two easily apparent abnormal patterns (especially hypoglycemia); and (3) Doctor and patient review BG records simultaneously, with consideration of life-event factors that might be contributing to abnormal patterns, and sequential adjustments to the treatment regimen are made by the doctor and patient together. While scenario 3 is the preferred option for the authors, this step really requires substantial time, which is rarely available. Any method that could facilitate BG pattern analysis and the decision-making process is welcome. Furthermore, saving 6 min in each office visit is a significant improvement.

Unfortunately, therapeutic suggestions are not available with the OneTouch Verio IQ meter for the patient or the HCP. From reviews of patient blogs about this meter on the Internet, we have learned that there are generic "guidelines" for insulin adjustments for hyperglycemia and hypoglycemia published by the manufacturer and available on request; however, the guidelines are paper-based and general rather than automated, they are neither based on the pattern analysis performed by the meter nor tailored to individual patient needs. A major theme of the 2012 Diabetes Technology Meeting was the need for more information that is automatically collected, analyzed, and made actionable. The OneTouch Verio IQ meter detects pre-meal hyperglycemia and hypoglycemia; however there are multiple, additional types of abnormal glucose patterns that need to be detected. Also, specific and actionable advice regarding these abnormal patterns needs to be automated and presented to both the HCP and the patient to really change the diabetes treatment inertia paradigm.

Attempts to automate diabetes management over the past 5 years have ranged from the development of "diabetes dashboards," which place all pertinent diabetes information (including clinical treatment algorithms) in one easily usable format in electronic medical records, to the development of automated glucose pattern recognition software. We have developed the 4 Diabetes Support System™ (4DSS) (Ohio University, Athens, OH), which uses the CareLink® platform (Medtronic, Inc., Minneapolis, MN) to automatically detect multiple, additional types of BG control problems and offers case-based decision support to correct them in patients using insulin pumps and continuous glucose monitoring (CGM).[3] However, we have also shown that inclusion of life-event data (timing and composition of meals, exercise, stress, etc.) nearly doubles the capacity of the 4DSS to determine the cause of a specific glucose excursion as well as to offer more targeted therapeutic advice.[4] For example, life-event data help pinpoint the lows that are exercise-induced, while CGM facilitates detection of post-meal highs. Automated software systems can be used between or during appointments to facilitate diabetes management. Patients now use smartphone applications for diabetes self-management (entering life-event data, food intake, and BG readings). Skrøvseth and coauthors[5] have demonstrated that use of a smartphone with an application that supplies automated data analysis/pattern recognition directly to their users has provided relevant insight into their disease and has been accepted by many patients. In the near future, smartphones will be capable of compiling this information as well as transmitting additional information (CGM data and pump functions/settings) via the Internet "cloud" for analysis between office visits for diabetes management. In fact, "real-time CGM telemetry" could become a reality in the near future, with the capacity to communicate directly with patients by text messaging.

Katz and coauthors[2] have taken important first steps by demonstrating the efficacy of automated BG pattern recognition in a commercially available meter. Twenty-first century HCPs should not be encumbered by inefficient, outmoded paper logbooks. We hope that more diabetes device manufacturers will incorporate automated pattern recognition and analysis capabilities into their systems and that cloud technologies will soon render these systems more interoperable.

Funding:

Funding for our research has been received from Medtronic MiniMed, Inc.; National Science Foundation; Ohio University Russ College Biomedical Engineering Fund; Ohio University College of Osteopathic Medicine Research and Scholarly Affairs Committee; Ohio University Diabetes Research Initiative; and J. O. Watson, D. O., Endowed Research Chair, Diabetes Research Endowment of the Ohio Osteopathic Heritage Foundation.

Disclosures:

The software and methodology implemented in the 4 Diabetes Support System have been submitted to the U. S. Patent and Trademark Office, application number US60/901,703, and rights are co-owned by the Ohio University Technology Transfer Office, Dr. Marling, and Dr. Schwartz.

References:

1. Shubrook JH, Schwartz FL. Estimated time demands for diabetes self-care. Abstract number 0855P. Presented at American Diabetes Association 66th Scientific Sessions 2006.
2. Katz LB, Dirani RG, Li G, Randoll RA, Mahoney JJ. Automated glycemic pattern analysis can improve health care professional efficiency and accuracy. J Diabetes Sci Technol. 2013;7(1):163–6.
3. Schwartz FL, Shubrook JH, Marling CR. Use of case-based reasoning to enhance intensive management of patients on insulin pump therapy. J Diabetes Sci Technol. 2008;2(4):603–11.
4. Schwartz FL, Vernier SJ, Shubrook JH, Marling CR. Evaluating the automated blood glucose pattern detection and case-retrieval modules of the 4 Diabetes Support System. J Diabetes Sci Technol. 2010;4(6):1563–69.
5. Skrøvseth SO, Arsand E, Godtliebsen F, Hartvigsen G. Mobile phone-based pattern recognition and data analysis for patients with type 1 diabetes. Diabetes Technol Ther. 2012;14(12):1098–104.