

# Evaluation of Several Electronic Glycemic Management Systems

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## Abstract

Computerized insulin dosing software provides decision support in the form of pattern management identification, standardized dosing, and ease of use in both the inpatient and outpatient settings. The purpose of this analysis article is to review the features of all three electronic glycemic management systems available in the United States and to discuss the potential benefits of an automated insulin dosing system compared to a paper protocol or electronic order set. Four articles will be presented in this inpatient focused issue that examine the safety and efficacy of the Glytec® eGlycemic Management system in a variety of patient populations.

## Keywords

electronic glucose management system, insulin, glucose, inpatient

Computerized insulin dosing software provides decision support in the form of pattern management identification, standardized dosing and ease of use in both the inpatient and outpatient settings. Four articles are presented in this inpatient-focused issue of the *Journal of Diabetes Science and Technology* that examine the safety and efficacy of the Glytec eGlycemic Management system in a variety of patient populations. The purpose of this analysis article is to review the features of all three electronic glycemic management systems available in the United States and to discuss the potential benefits of an automated insulin dosing system compared to a paper protocol and/or electronic order set.

The following is a brief summary of each of the three commercial systems: Glytec®, Glucostablizer®, and EndoTool®.

Glytec eGlycemic Management system (eGMS) featuring Glucommander™ algorithms is a cloud-based glycemic management system that offers HIPAA-compliant software for both the inpatient and outpatient setting. This decision support system has a variety of FDA-cleared options including intravenous, subcutaneous, and pediatric insulin dosing algorithms. The company website claims seamless integration with the electronic health record (EHR) and other proprietary connected devices. The hope is that a standardized, well-validated insulin dosing algorithm will lead to a decrease in rates of hypoglycemia and hyperglycemia by analyzing the data and providing efficacious real-time dosing recommendations. The software aids in easy access to patient glycemic management information (SmartClick®), early patient identification (GlucoSurveillance®), intravenous (IV) and subcutaneous (SubQ) dosing recommendations (Glucommander), and data analysis (GlucoMetrics®).<sup>1</sup>

Glucostablizer by Medical Decision Networks is a glycemic management system operating through a secure server that networks glucose results so that they can be accessed easily from any computer within the hospital network. Patients can be followed on an insulin infusion across settings from the operating room to intensive care unit (ICU) to a step-down unit. IV insulin doses are auto-calculated according to patient response along with nurse confirmation and documentation to foster safer dosing compared to the variations in nurse interpretation with a paper protocol. Much like the other automated glucose management systems, Glucostablizer purports to reduce average time to reach glycemic target, reduce frequency of hypoglycemia, and increase number of patients achieving target glycemic goals. Glucostablizer software is HIPAA-compliant and easy to use, offering proprietary ADT (admit, discharge, transfer) and HL7 information interfacing with the EHR. Glucostablizer also provides a Glucostablizer Subcutaneous Insulin Program (CGS-SQ) for the management of SubQ insulin therapy.<sup>2</sup>

EndoTool Glucose Management System by Monarch Medical Technologies is a HIPAA-compliant clinical decision support software offering personalized insulin dosing

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recommendations for IV and SubQ insulin delivery. EndoTool IV is designed for IV insulin delivery in adults and a separate algorithm for children age 2 and older. EndoTool SubQ calculates SubQ insulin dose recommendations based on multiple patient variables such as blood glucose, insulin order, A1c, type of diabetes, height, weight, creatinine, age, gender, and carbohydrate intake.<sup>3</sup> When using EndoTool SubQ to calculate a mealtime insulin dose, the program can take into consideration the contribution of enteral and parenteral nutrition and IV dextrose in addition to the meal tray. The method of carbohydrate counting can be customized by institution (eg, carbohydrate servings vs grams) and the program can calculate the total daily dose for each patient.

### Why Use Computerized Glycemic Management Systems?

One clear advantage of using an automated system is the availability of alerts to remind the nurse to check or recheck the BG to make timely insulin adjustments or adequately treat hypoglycemia. In addition, the phenomena of greater nursing adherence to an automated protocol compared to a paper one is well known. An Austrian open, noncontrolled intervention study published in 2015 by Neubauer et al implementing a GlucoTab standardized glycemic management computerized decision support program for 99 patients on four non-critical care wards showed a high percentage of physician and nurse adherence to a SubQ insulin protocol. Nurse adherence was 96.7% for basal and 96.5% for bolus insulin dosing. More importantly, in a poststudy questionnaire, 91% (n = 65) of the clinicians felt confidence in the computerized program, 89% felt it was practical to use in their workflow, and 80% believed it was able to prevent insulin medication errors.<sup>4</sup>

In a US retrospective observational crossover study, the eGMS nurse-directed Glucomander dosing algorithm made available in the EHR was compared to provider ordered basal-bolus SubQ insulin therapy in 993 patients in a variety of non-critically ill settings in nine hospitals. In this crossover design, patients were treated with basal/bolus insulin therapy using an order set before and/or after use of the nurse-directed eGMS system.<sup>5</sup> One advantage of the automated system is a series of on-screen prompts identifying times when the insulin order needs adjustment such as the patient not eating or hyperglycemia requiring a correction dose, then auto-calculates the new dose for the nurse. Changes in patient status such as these as well as interruptions in enteral feedings and titration or holding of steroids often lead to insulin dosing errors. Artificial intelligence built into the software has the potential to avoid many of these mishaps. This study found that patients managed with eGMS had less hypoglycemia and were more likely to safely achieve glycemic targets. The authors and others have concluded that a safe and effective computerized dosing algorithm in the inpatient setting could reduce clinical inertia with insulin initiation and titration, standardize dosing, and improve nursing workflow.

The following four studies using Glytec® eGlycemic Management system are included in this issue:

1. Bode et al<sup>6</sup>  
Purpose: Bode et al utilized connected blood glucose meters and Glytec Decision Support Software to streamline insulin dose titrations for Atlanta outpatients between office visits, thus improving workflow, time to blood glucose targets, and quality of care.
2. Newsom et al<sup>7</sup>  
Purpose: Newsom et al describe a quality improvement project in a large California community teaching hospital aiming to improve inpatient glycemic management outcomes by converting from provider managed IV and SubQ insulin therapy to a more standardized nurse-directed computerized Glucomander software.
3. Rabinovich et al<sup>8</sup>  
Purpose: Rabinovich et al compared glycemic control, time in target blood glucose range, and rates of hypoglycemia in critically ill patients in several ICUs managed with a paper insulin infusion protocol versus an automated protocol (eGMS).
4. Ullal et al<sup>9</sup>  
Purpose: Ullal et al investigated the efficacy of Glucomander (Glytec) computer-based software versus a paper-based insulin infusion protocol in the treatment of patients with diabetic ketoacidosis (DKA).

### Abbreviations

ADT, admit, discharge, transfer; BG, blood glucose; CGS-SQ, Glucostabilizer Subcutaneous Insulin Program; DKA, diabetic ketoacidosis; eGMS, eGlycemic Management system; EHR, electronic health record; ICU, intensive care unit; IV, intravenous; SubQ, subcutaneous.

### Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: NA has nothing to disclose. JJS is a consultant for Johnson&Johnson Diabetes Institute (JJDI) and has attended Advisory Board Meetings for Abbott Nutrition, AstraZeneca, Boehringer-Ingelheim/Lilly, and Sanofi.

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