Abstracts

A Web-Based Insulin Algorithm in the Emergency Department Management of Diabetic Ketoacidosis

Joseph Aloi, MD; Marion Butsavage, RN; Raymie McFarland, BS;
Courtenay Harrison, MD

Eastern Virginia Medical School
Norfolk, Virginia, USA
aloija@evms.edu

Objective:

Glycemic control has been shown to reduce complications and length of stay. A concomitant move exists to improve the quality of inpatient glycemic control while reducing health care costs. Successful experience with Glucommander®, a Web-based insulin algorithm, in inpatient insulin protocols suggested that its use in the emergency department (ED) would be safe. Our plan was to study the effectiveness of the Glucommander system for the treatment of mild-to-moderate diabetic ketoacidosis (DKA) in the ED.

Methods:

This 12-month study is being conducted at Sentara Health care System in Southeast Virginia, with Virginia Beach General, at 300+ beds, serving as our study site. On admission to the ED, patients with moderate hyperglycemia or DKA were placed on the Glucommander protocol. Patients were then monitored for readiness to be discharged or admitted.

Result:

Inpatient units using the Web-based algorithm were able to manage hyperglycemia effectively (average blood glucose = 141 mg/dl ± 34), with low rates of hypoglycemia (blood glucose < 70; rate of 0.4%). Fifteen patients with DKA were treated in the ED during this same quarter 1 period. Approximately 40% of patients treated with the

protocol were able to be discharged from the ED directly or were kept for short stay observation.

Conclusion:

Use of a Web-based insulin infusion algorithm in the ED can decrease admissions for DKA by 40%. Our preliminary results suggest that Glucommander is a safe and efficient tool for use in the ED to manage mild-to-moderate DKA.

Inpatient Glycemic Management: Team Approach in Diabetes Education and Discharge Planning

Crisamar J. Anunciado, PhD, FNP-BC

Sharp Chula Vista Medical Center
Chula Vista, California, USA
crisamar.anunciado@sharp.com

Objective:

The aim was to assess association between discharge planning (education and treatment modification) and care coordination by the glycemic management team (GMT) and physician (MD) for inpatients.

Design/methods:

A retrospective cohort study was conducted on 800 patients (400 each group) with diabetes/hyperglycemia admitted in a Southern California hospital. Chi-square analyses and analysis of variance were used to determine associations in patient characteristics, diabetes services, and provider group. Logistic regression analyses were used to identify factors associated with the probability of receiving education, treatment modification, and 30-day readmission.

Results:

Fifty-three percent of patients were females. The average age was 66 ± 14.8 years. Top admission diagnoses were 26% circulatory, 11% respiratory, 10.4% kidney/urinary tract, 8.5% nervous, and 7.8% musculoskeletal/connective tissue. Patients were 48% Latino, 18% white, 8% Asian, 6% black, and 21% other. A total of 61.6% of GMT patients received education versus 38.4% of MD patients. A total of 53.2% of GMT patients had treatment modification compared with 46.8% of MD patients. For admission glycated hemoglobin (A1C) levels ≥ 8.1%, 54.9% of GMT patients received services compared with 45.1% of MD patients. High A1C, treatment modification, and care coordinated by

GMT increased likelihood of receiving education. High A1C and receipt of education increased likelihood of treatment modification. Longer hospital stays were associated with 30-day readmission.

Conclusions:

The GMT patients received more education and treatment modification than their MD counterparts, and GMT provided more services for A1C ≥ 8.1%. No difference was found between groups in care coordination for patients with 30-day readmission. Study findings provide data for health care organizations considering the use of inpatient GMTs to improve overall discharge planning and care coordination for inpatients. Further research is needed to explore definitive inpatient glucose control, economic costs, and post-discharge outcome differences between provider groups.

Successful Change in Glycemic Control

Dee M. Brown, MSN, RN, CDE; Amy Wyatt, RD, CDE; Caroline Huang, MD, FACE; Giang Bach, MD; John Fox, CPHQ

Virginia Hospital Center
Arlington, Virginia, USA
deebrown@virginiahospitalcenter.com

Objective:

The aim was to use evidence-based medicine and the standards of care recommendations to provide better glycemic control for the hospitalized patient. The goal was to decrease the number of patients experiencing hyperglycemia with blood glucose levels greater than 299 mg/dl without increasing the number of hypoglycemic events below 70 mg/dl.

Method:

A multidisciplinary team was formed. Following the 2010 clinical guideline recommendations from the American Diabetes Association (ADA), the American Association of Clinical Endocrinology (AACE), and the Society of Hospital Medicine, the subcutaneous insulin order set and insulin infusion order set was redesigned. A diabetes resource nurse group was formed. These nurses were trained in basic diabetes education and how to teach diabetes survival skills to the patient. In February 2011, the Virginia Hospital Center applied to and was accepted into the Society for Hospital Medicine Glycemic Control Mentorship Initiative. Through this program, we were able to gain access to valuable resources to aid in the journey toward better control of the hospitalized patient. We developed and executed physician and nursing education.

Result:

In comparing January–June 2011 with January–June 2012, we found that percentage of stays 70–180 mg/dl increased 26.4% (28.33 to 35.8%), percentage of stays >299 mg/dl

decreased 22.5% (29.66% to 23%), percentage of stays <70 mg/dl decreased 43% (15.8% to 9%), and percentage of stays <40 mg/dl decreased 61.3% (3% to 1.16%).

Conclusion:

Following ADA/AACE guidelines, using basal, bolus, and correction insulin will provide better glycemic control in the hospitalized patient.

A Computer Program, Directed by Clinicians for Outpatients, which Readjusts Subcutaneous Basal–Bolus Multiple Daily Injections of Insulin, Achieves an Improvement of 2.5 Glycated Hemoglobin Percentage Points

Paul C. Davidson, MD; Bruce W. Bode, MD; John G. Clarke, RN;
Harry R. Hebblewhite, MS; Robert Booth

Atlanta Diabetes Associates
Atlanta, Georgia, USA
Paul_C_Davidson@MSN.com

Objective:
This study examines the performance of a computerized algorithm for adjusting subcutaneous basal–bolus multiple daily injection (MDI) insulin regimens for outpatients.

Method:
This algorithm determines the meal bolus for the current meal by applying an adjustment to the previous day's similar-time meal bolus based upon its blood glucose (BG) response. Basal dosing is adjusted in the same manner based upon the lower of either the pre-breakfast BG tested earlier on the same day or any immediately preceding nighttime lower BG if available. Dosing data were collected by the patient's reporting of insulin dosing and BG data daily.

Result:
In a total of 30 patients, there were 21 patients, treated for 120 days, who had paired before-and-after glycated hemoglobin (A1C). Mean A1C before was 10.0%, and mean A1C after was 7.5% ($p < .00004$). Of a total of 5446 BG tests, the percentage less than threshold was 1.0% < 60, 0.3% < 50, and 0.0% < 40 mg/dl. In alternate analysis, all 30 patients were treated for an average of 93 days and had starting A1C averaging 7.8%. The mean of the last 12 BGs of all patients was 135, which correlates to an estimated final A1C of 6.3%, yielding $p < .00001$.

Conclusion:

This algorithm, known as Glucommander SubQ, showed itself to be a valuable tool for adjusting subcutaneous basal–bolus MDI regimens. It has been incorporated into a Web-based platform for ongoing dosing guidance.

Implementing a Performance Improvement Tool to Improve Inpatient Glycemic Control: A Quality Improvement Initiative

Latha Dulipsingh, MD, FACE, FACP; Madura Saravana, MD, FACP;
Linda Krikawa, RN, MSN, CDE; Marie Heslin, MSN, ANP-BC;
Karen McAvoy, RN, MSN, CDE; Michael Hauser, BA; Benjamin Garcia, BBA

The Hospital of Central Connecticut
New Britain, Connecticut, USA
ldulipsingh@thocc.org

Objective:

Inpatient diabetes management, effectively championed, can reduce length of stay and improve outcomes. In 2012, the American Association of Clinical Endocrinologists presented guidelines to improve care of hospitalized patients with diabetes. The purpose of this project was to identify, determine, evaluate, and analyze (or IDEA) to achieve glycemic targets and create excellence in diabetes care, every patient, every time.

Method:

In February 2012, a hospital-wide multidisciplinary task force was formed at the Hospital of Central Connecticut to develop uniform policies and procedures on glucose management and educate staff on current clinical practice guidelines. The goal was for staff to identify individuals with blood sugars <70 or >300 mg/dl, determine providers responsible for taking corrective action, evaluate patients, and analyze causes.

Result:

A work order was initiated identifying inpatients with blood sugars <70 or >300 mg/dl. This list was generated daily, and root cause analysis was performed by our inpatient glycemic control team. Once patterns were established, implementation of a hospital-wide performance improvement tool began. Policy acceptance and use was supported by targeted educational and clinical decision infrastructure. Nursing staff identified patients

with blood sugars <70 or >300 mg/dl and then determined the provider who evaluated and treated accordingly. Eventually, the tool was completed to analyze root cause. Using real-time information, the inpatient glycemic control team will continue to educate and empower staff to improve processes of care and outcomes to achieve excellence in diabetes care.

Conclusion:

Inpatient glycemic control has been identified as essential for patient safety and quality improvement. A team approach is required to establish hospital pathways, insulin protocols, and evaluation tools to achieve glycemic targets effectively and safely.

Standardizing Insulin Management in the Hospitalized Cancer Patient

Marina George, MD; Christine Hollenberg, MHA, CPHQ; John Terrell, MS;
Norman Brito-Dellan, MD; Krystyna Brown, MLS(ASCP);
Danielle DiMonda, MHA, CPHQ; Josiah Halm, MD; Shana Palla, MS;
Victor Lavis, MD; Anita Ying, MD

University of Texas MD Anderson Cancer Center
Houston, Texas, USA
mgeorge1@mdanderson.edu

Objective:

Cancer patients are at risk of suboptimal blood sugar management due to competing and complicated medical issues. National guidelines for a physiological approach to blood glucose management with insulin as a basal–bolus regimen have been recommended and are widely utilized in non-cancer hospitals. Standardization of insulin management could potentially improve blood glucose control and provide benefits to hospitalized cancer patients similar to those observed in non-cancer patients. The objectives of this pilot project were (a) to increase usage of basal–bolus insulin order sets on the hospitalist service of a comprehensive cancer hospital and (b) to identify barriers to implementation of basal–bolus order sets.

Methods:

We collected baseline data on the practice of blood glucose management on the hospitalist service for 6 months before intervention. We provided education on the basal–bolus insulin order sets to the clinicians and staff such as nursing and dietary service. Using quality improvement tools, we measured post-implementation utilization and barriers to usage of the new order set.

Result:

The proportion of insulin orders written as basal–bolus order sets rose from 5% at baseline to 68% in the first 3 months after implementation. After the intervention, there was no statistically significant change in mean daily blood glucose between the basal–bolus and sliding scale groups (p = .97). Barriers identified included aligning bedside finger sticks with meal delivery.

Conclusion:

We helped establish equitable care and build an infrastructure for use of the basal–bolus insulin order sets for hospitalized cancer patients. Challenges were identified to start proactive measures and widen implementation of this protocol. Hospitalists in a comprehensive cancer center can be leaders in clinical change management using a platform of cross-functional support teams.

First Case Report of Daptomycin-Induced Hypoglycemia

Maher S. Ghawji, BS; Maher Ghawji, MD, FACE

University of Tennessee, Knoxville
Memphis, Tennessee, USA
mghawji@utk.edu

Background:

A 55-year-old male patient was admitted for multiple implantable cardioverter defibrillator shocks from recurring atrial fibrillation with low thyroid-stimulating hormone levels. His original PermCath was malfunctioning, causing his hemodialysis to be delayed for 4 days, resulting in fluid overload, moderate hyponatremia to 126 mmol/liter, and mild metabolic acidosis. At initial evaluation by his admitting physician, he was suspected to have right arm cellulitis, and 400 mg intravenous daptomycin every 48 h was initiated as the drug of choice. Within 48 h of his initial daptomycin dose, the patient developed moderate hypoglycemia, for which we were consulted. The objective is to exhibit the theory that daptomycin, with a patient having certain, several mitigating factors, can induce moderate–severe insulin-mediated hypoglycemia.

Method:

The patient was put in the intensive care unit for closer observation after 36 h of the first daptomycin dose. Over the next 48 h and two more doses of daptomycin, despite several measures, including initiation of D10 and one dose of 2 mg Decadron, his hypoglycemia did not abate. Two doses of Solu Medrol at 125 mg each and cessation of daptomycin were required to prevail over the persistent, moderately severe hypoglycemia.

Result:

We suggest blood glucose monitoring be instituted when daptomycin is used in end-stage renal disease patients with or without diabetes. Our observation documented potential

daptomycin-induced insulin release, which could lead to severe hypoglycemia, especially when there are mitigating factors such as lower caloric intake, extended fast, sepsis, or disruption of hemodialysis schedule.

Conclusion:

Further surveillance and data collection in end-stage renal disease patients, where mild increase of daptomycin-induced insulin release might have a noticeable impact in inducing clinically significant hypoglycemia, is needed. Furthermore, *in vitro* studies with daptomycin–beta cell interaction would be a simple study to pursue.

Reducing Inpatient Hypoglycemia: The Huddle

Bethany Grommesh, MD; Anna Vannelli, MS, RD, CDE;
Marisa Hlavka, BSN, RN, OCN; Colleen Fischer, RD, CDE;
Mary Droogsma, BSN, RN, CDE; Susan Henderson, RN; Susan Rock, BAN, RN

Park Nicollet Methodist Hospital/International Diabetes Center
St. Louis Park, Minnesota, USA
Bethany.Grommesh@ParkNicollet.com

Objectives:

This quality improvement project was initiated at a 426-bed Midwest hospital. The primary objectives were to determine contributing factors to blood glucose (BG) events ≤ 50 mg/dl (2.77 mmol/liter), defined here as severe hypoglycemia, as well as to reduce the incidence of severe hypoglycemia and identify prevention strategies.

Methods:

Adult nursing units, excluding intensive care, obstetrics, and emergency, participated. After treating a patient with severe hypoglycemia, the following steps occurred: (1) a bedside registered nurse (RN) electronically paged both the physician and a hypoglycemia huddle pager; (2) a certified diabetes educator (CDE) or rapid-response RN responded and collected data; (3) staff was educated regarding appropriate hypoglycemia management; (4) CDEs performed timely review of event and provided physician with medication management suggestions; (5) all severe hypoglycemia values were extracted using the electronic health record database; and (6) data were analyzed by a RN diabetes practice specialist.

Results:

Monthly severe hypoglycemia rates per 1000 patient days gradually declined from 18.9 in July 2011 to 8.3 in June 2012. Common factors contributing to hypoglycemia included excess background insulin (38%), excess mealtime/correction factor insulin (26%), and

renal failure (17%). In addition to the hypoglycemia huddles, strategies that potentially aided in reducing hypoglycemia included physician daily review of BG patterns/insulin adjustment, 1 h BG check after hypoglycemia resolved, and increased nursing knowledge of hypoglycemia management.

Conclusions:

Reduction in severe inpatient hypoglycemia was achieved through a multidisciplinary hypoglycemia huddle process.

Silica-Encapsulated Glucose Oxidase for Glucose Sensing: *In Vitro* Testing in Serum and Blood and the Effect of Condensation pH

James M. Harris, PhD; Gabriel P. Lopez, PhD; William M. Reichert, PhD

Duke University
Chapel Hill, North Carolina, USA
jh291@duke.edu

Objectives:

The objectives of this study were to examine whether silica-encapsulated glucose oxidase (GOx) was suitable for glucose monitoring in whole blood and to determine whether the flexibility of silica sol-gel chemistry could be exploited to improve glucose sensor performance and stability.

Method:

A Clark-type amperometric glucose sensor was produced by deploying silica-encapsulated GOx on platinized platinum wire. These sensors were tested using buffered glucose calibration standards as well as glucose-spiked human serum and whole blood. All serum and whole blood measurements met the minimum Food and Drug Administration requirement of falling within the "A+B region" of the Clarke error grid. To our knowledge, this is the first report of using silica-encapsulated GOx to measure glucose in whole blood. The effect of condensation pH on sensor performance was assessed by encapsulating GOx in silica at pH 3, 7, and 12 and then testing the sensor response against glucose calibration standards.

Results:

The pH 12 silica sensors had statistically faster response time, higher sensor sensitivity, and longer half-life than did glutaraldehyde cross-linked sensors and the pH 7 and pH 3 silica sensors. Membranes of the pH 12 silica also had statistically higher diffusion coefficient than the pH 7 and 3 sensors.

Conclusion:

We hypothesize that the gel-like pH 12 silica gels provided reduced barriers to glucose diffusion, and the more aqueous microenvironment provided greater stability for the enzyme.

GlucoTab: A Portable Glucose Management System Supporting In-Hospital Glycemic Control for Patients with Type 2 Diabetes

Bernhard Höll, MSc; Stephan Spat, MSc; Georg Petritsch, BSc; Peter Beck, PhD; Julia K. Mader, MD; Katharina M. Neubauer, BSc; Johannes Plank, MD; Thomas R. Pieber, MD

Department of Internal Medicine, Division of Endocrinology and Metabolism
Medical University of Graz
Graz, Austria
bernhard.hoell@medunigraz.at

Objective:

Glycemic control is often neglected during a hospital stay, even though hyperglycemia has been associated with poor clinical outcome. Our goal was to develop a portable glucose management system for type 2 diabetes patients with the aim of improving in-hospital glycemic control. The system is intended for use by medical staff to support the entire glucose management workflow during a hospital stay, including insulin dose adjustment.

Method:

The glucose management system complied with the medical device directives for software and was developed in several cycles. Medical staff was strongly involved in functional specifications and user interface design. Each development cycle resulted in increasingly detailed prototypes, which were always evaluated by medical staff. In parallel, with the support of endocrinologists, we adapted an already published algorithm for insulin titration to be incorporated in the newly developed glucose management system.

Result:

The user interface was implemented as an application on a portable Google Android 3.2-based tablet. The core functionality was limited deliberately to cover only the essential aspects of glucose management, including blood glucose measurement, insulin administration, and insulin dose adjustment. The application provides insulin dosage advice, visualizes the course of treatment, and automatically keeps track of outstanding tasks to support completion of all required actions. Redundant data entries were avoided by supporting standard health level 7 hospital information systems interfaces for administrative, demographic, and laboratory data.

Conclusion:

Usability trials indicated that all end users, including those who were not experienced in the use of portable touch-screen devices, were receptive to the new glucose management system. Almost all end users indicated that the system would simplify their tasks related to in-hospital glycemic control.

Better Glycemic Control in a Community Hospital with a Basal–Bolus Insulin Protocol

Kathie Hopkins, MSN, RN, ACNS-BC; Gina Harper, PharmD, BCPS;
William B. Austin, DO

Poudre Valley Hospital
Fort Collins, Colorado, USA
kmh2@pvhs.org

Objective:
We aimed to convert to a basal–bolus insulin protocol and to determine patient-day-weighted mean and hypoglycemia rates for patients on the protocol.

Method:
A quality improvement project included a team of dietitians, nutrition staff, pharmacy, physicians, nurses, a diabetes educator, advanced practice nurses, and quality improvement staff. The team determined best practice on managing hyperglycemia in the hospitalized non-intensive care unit patient and developed a basal–bolus insulin protocol. Baseline measures of patient-day-weighted mean blood glucose, blood glucose results less than 70 mg/dl, and blood glucose results less than 40 mg/dl were calculated for medical units at two separate hospitals and a cardiac unit, which continued use of the sliding scale insulin and was used as a comparison unit.

Result:
At 13 months after implementation, 395 patients had been on the basal–bolus insulin protocol. The patient-day-weighted mean in medical unit A decreased from 179 to 175 mg/dl, the patient-day-weighted mean in medical unit B decreased from 176 to 170 mg/dl, and the patient-day-weighted mean in the cardiac unit (comparison unit) was unchanged. The percentage of patient days with at least one event of blood glucose < 70 mg/dl decreased from 6.23 to 5.38 in medical unit A and decreased from 7.54 to

5.32 in medical unit B. The percentage of patient days with at least one event of blood glucose < 40 mg/dl decreased from 0.98 to 0.82 in medical unit A and decreased from 0.7 to 0.18 in medical unit B.

Conclusion:

The use of a basal–bolus insulin protocol demonstrated improved glycemic control and safety with less hypoglycemia than patients on sliding scale insulin.

Self-Monitoring of Blood Glucose Associated with High Glycemic Goal and Low Adverse Events in Discharged Patients with Insulin Therapy

Tzu-Fan Huang; Jhao Kun Liou; Yi-Ping Chen; Ching-Hui Chen; Pei-Jhen Liang; Li-Jung Cheng; Ching-Wen Wu; Shih-Te Tu; Ming-Chia Hsieh

Changhua Christian Hospital
Changhua City, Taiwan
88456@cch.org.tw

Background and Purpose:
Self-monitoring of blood glucose (SMBG) is an important component of modern therapy for type 2 diabetes patients on insulin therapy. But until now, there has been no important research to investigate the role of discharge patients on insulin therapy using SMBG.

Methods:
We collected 199 discharged patients with insulin therapy and diabetes education in Changhua Christian Hospital from March 2011 to April 2012 and isolated them into two groups, using SMBG or not. Characteristics, hemoglobin A1c (HbA1c) at admission and discharge, the occurrence of severe hypoglycemia in emergency, and rehospitalization were investigated through electronic chart review.

Result:
In this retrospective study, participants were 3.3 years old; 49% and 51% were male and female, respectively; and occurrence of diabetic ketoacidosis and hyperglycemic hyperosmolar nonketotic coma in the hospitalized proportion were 3% and 6%, respectively. In a survey on discharged patients (n = 100), 51% used a glucose meter. We found two groups—using SMBG or not —in which HbA1c was reduced by 4.3 ± 2.7 and 1.8 ± 2.2, respectively (p < .001); those with HbA1c less than 7.0% were 61% and 10.1%, respectively (p < .001); discharge patients reentering the emergency were 2 and 0 times, respectively; and readmissions were 25 and 10 patients, respectively.

Conclusion:

In our findings, SMBG was associated with high glycemic goal and low adverse events in discharged patients on insulin therapy. We expect more participants to be included in this study and be observed for a longer time.

Relationship between Diabetes and Its Treatment with Risk of Colorectal Adenoma in an American Population Receiving Colonoscopy

Kanadiya Mehulkumar, MBBS, MPH; Gohel Tushar, MD; Sanaka Madhusudan, MD, FACG; Shubrook Jay Jr, DO, FACOFP, FAAFP

Heritage College of Osteopathic Medicine
Ohio University
Athens, Ohio, USA
mehulkanadiya@gmail.com

Objective:

Diabetes is a risk factor for colorectal cancer. An adenoma of the colon is a well-established premalignant lesion of colorectal cancer. Many studies have shown beneficial effect of metformin on colorectal cancer in persons with diabetes. The aim of this study was to explore the relationship between diabetes, its treatments (use of metformin), and the development of colorectal adenoma.

Methods:

Colonoscopy reports from a total of 66 endoscopists in one big hospital in the Midwest during 2008–2009 were reviewed. Colonoscopy findings, including quality of preparation, polyp size, location, morphology, pathology, and history of diabetes and metformin treatment were retrieved.

Results:

Of the 7382 colonoscopy reports reviewed, 3465 average-risk patients were included in our final analysis. The pathologically proven adenoma detection rate in the total population was 24.6% (30.2% in men and 19.2% in women). Mean age of study population was 60.63 ± 9.2 years. Old age and male sex were significantly associated with increasing risk of colorectal adenoma. Diabetes was associated with increased risk of colorectal adenoma (odds ratio 1.32; 95% confidence interval 1.06–1.66; p = .014

< .05). A total of 426 (12.29%) patients in our study have diabetes. There was no significant difference in risk of adenoma in type 1 and type 2 diabetes. Within the diabetes patient group, people who were taking metformin had significantly lower risk of colorectal adenoma (odds ratio 0.55; 95% confidence interval 0.34–0.87; $p = .011 < .05$).

Conclusion:

Diabetes subjects have increased risk of developing colorectal adenoma. Our study also supports the beneficial effect of metformin in the development of colorectal adenoma and thus in development of colorectal cancer.

Optimizing Hypoglycemia Management and Monitoring for Hospitalized Patients

Gwen E. Klinkner, MS, RN, APRN, BC-ADM, CDE

University of Wisconsin Hospital and Clinics
Madison, Wisconsin, USA
gklinkner@uwhealth.org

Objective:

Despite consistently low hypoglycemia rates hospital-wide, a gap was identified related to documentation of hypoglycemia causes. Our primary objective was to improve documentation of hypoglycemia cause. Secondary aims were to better understand post-hypoglycemia monitoring practices and to introduce glucose tablets as an additional treatment option.

Method:

This is an ongoing quality improvement project involving retrospective chart review to monitor documentation of hypoglycemia causes and post-hypoglycemia glucose monitoring. Enhancements were made to the electronic health record to prompt hypoglycemia cause documentation. In addition, glucose tablets were made available on one inpatient surgical unit to pilot an alternative treatment option to intravenous dextrose 50% for patients who could swallow safely but who had fluid restrictions or intolerances.

Result:

Hypoglycemia cause documentation is difficult to capture if documented only in clinician progress notes. Improvements occur if data entry is prompted by a discrete field, but multiple barriers still exist that reduce reporting rates. Providing timely chart audit data to nursing staff about documentation and glucose monitoring performance has the potential to improve outcomes. Glucose tablets were successfully piloted as a new treatment option and subsequently implemented house-wide.

Conclusion:

Hypoglycemia management and processes should be optimized even when overall hypoglycemia rates are low. Gaining a better understanding about hypoglycemia causes and post-hypoglycemia monitoring practices will help to target more effective quality improvement activities.

From Sliding Scale to Carbohydrate Counting: Transforming a Hospital One Discipline at a Time

Debra Lesin, MSN, RN-CDE

Northridge Hospital
Northridge, California, USA
Debra.norman@chw.edu

Objective:

Glucose control in the hospital has been challenged by illness, medications, and variance in routine. The goal of insulin delivery in the hospital is to administer insulin to maintain an appropriate glucose target that supports healing. Studies show that this is accomplished when the insulin is delivered in a proactive physiological manner. The purpose of this review was to examine how practice within a community hospital moves from traditional reactive sliding scales to proactive physiological insulin replacement.

Method:

This descriptive review evaluated how small incremental changes in the development of insulin order sets, adjustment of menus and meals by nutritional services, along with real-time adjustment of prandial insulin by nurses decreased the use of sliding scales and improved the major limiting factor in glucose control, which is hypoglycemia. Retrospective chart review was used to assess the percentage of sliding scale prescribed relative to basal/bolus or basal insulin-to-carbohydrate ratio. All results were compared with overall episodes of hypoglycemia and in-target glycemic rates, recorded on the medical–surgical and telemetry units. Satisfaction with carbohydrate counting pre- and post-implementation was assessed by questionnaire to nurses and prescribers.

Result:

There was an overall decrease on the reliance in sliding scales of insulin, a hospital-wide decrease in overall hypoglycemia, and an increase of within-target glucose control, along with increases in both physician–patient and nursing satisfaction

Conclusion:

A stepwise approach toward a finely tuned physiological insulin replacement involves multidisciplinary teams with a committed driver of practice. Change in practice included nurses adjusting insulin at bedside to actual intake of food, fostering collaboration with patient, nursing that modeled actual self-management of insulin, improved rates of glucose within target with less variability, and hypoglycemic rates of less than 0.11% (less than 40 mg/dl).

Influence of Blood Glucose Transcription Errors on Insulin Dosing Using a Control Algorithm in Hospitalized Type 2 Diabetes Patients

Julia K. Mader, MD; Katharina Neubauer, BSc; Lukas Schaupp, PhD;
Johannes Plank, MD; Thomas R. Pieber, MD

Medical University of Graz
Graz, Austria
julia.mader@medunigraz.at

Objective:

Accuracy of blood glucose values is essential for correct insulin dosing and dose adjustment. One major source of error is data transcription from the point-of-care testing (POCT) device to paper charts. The objective of the study was to assess the risks that possibly result in insulin dosing errors.

Methods:

A paper-based insulin dosing algorithm for hospitalized patients with type 2 diabetes was applied. Insulin therapy consisted of once-daily basal and up to four bolus insulin injections. Blood glucose was measured four times daily (premeal and bedtime) by nursing staff using a POCT device. Glucose values were manually transcribed to the chart. Data transcription errors were analyzed, and the influence on dose adjustment was assessed. Erroneous values were divided in the following categories: no influence, erroneous dose without adverse outcome, and erroneous dose with adverse outcome.

Result:

In total, 37 patients (11 female, age 69 ± 12 years, body mass index 30 ± 7, diabetes duration 15 ± 12 years, hemoglobin A1c 9.1% ± 2.8%, creatinine 1.5 ± 0.5 mg/dl) were included. Mean study duration was 6.2 ± 4.6 days. In total, 1166 glucose measurements were collected (3.5 ± 0.4 measurements/patient/day). In total, 70 transcription errors occurred (6% of the readings). Six values led to erroneous dose adjustment; the changes

in insulin dose ranged from 0–4 IU. Only two cases had relevant clinical implications: one resulted in hypoglycemia (<70 mg/dl) and the other led to consecutive hyperglycemia > 250 mg/dl after reduction of total daily dose by an assumed hypoglycemia.

Conclusion:

Data transcription errors occurred in the clinical setting. Clinically relevant errors seldom occurred, and adverse decisions based on those errors were even less frequently observed. Automated transcription of blood glucose values to a decision support system might mitigate the risk of dose adjustments based on erroneous glucose readings.

Effectiveness of an Inpatient Glucose Management Team in Discharge Planning

Rita M. McCarthy, MSN, NP; Patricia Underwood, PhD, NP; Margo Hudson, MD

Brigham and Women's Hospital
Boston, Massachusetts, USA
rmccarthy@partners.org

Objective:

Prior studies indicate that hospitals fail to provide adequate discharge management for hospitalized patients with poorly controlled diabetes. The role of inpatient glucose management teams (GMTs) in providing appropriate discharge recommendations for individuals with poorly controlled diabetes is unknown. We describe GMT-initiated diabetes discharge plans conducted within one large urban-based academic hospital.

Methods:

A retrospective chart review was conducted in 43 inpatients with poorly controlled diabetes [hemoglobin A1c (HbA1c) > 8%] seen by the GMT April–June 2012. Glucose therapy intensification (GTI), defined as initiating insulin, adding a new agent, or increasing total insulin dose by >20% on discharge, was identified. Secondary measures included correlation between GMT discharge recommendations and discharge team orders, follow-up appointment recommendations, and evidence of communication with patient and primary care physician (PCP).

Results:

A total of 88% of patients had type 2 diabetes, mean age was 57.6 years (range 31–83), and 67% had a HbA1c greater than 9%. A total of 53% had GTI, and 10% had bariatric surgery, with a reduction made at time of discharge from usual home treatment. In 21%, outpatient medication noncompliance was identified. Only 16% had no changes made without a reason given. A total of 79% of discharge recommendations by the discharging team correlated with GMT recommendations, 79% had written recommendations for a

diabetes follow-up visit in 1–4 weeks, and 53% had electronic patient instructions provided by the GMT that served as communication to the patient and the outpatient provider.

Conclusion:

In an urban-based, academic hospital, a GMT addressed discharge treatment, including GTI, in the vast majority of patients with poorly controlled diabetes. These discharge recommendations were adequately communicated to the treating team, the patient, and the PCP. A GMT might improve transitions of care.

Overutilization of Hemoglobin A1c in the Inpatient Setting

Aleksandar Mijailovic, BS; Margo Hudson, MD; Stacy Melanson, MD, PhD;
Alexander Turchin, MD, MS; David Bates, MD, MSc; Kathleen Kelly, NP;
Milenko Tanasijevic, MD, MBA

Brigham and Women's Hospital
Boston, Massachusetts, USA
amijailovic@partners.org

Objectives:

Recent studies have suggested that overutilization of hemoglobin A1c (HbA1c) might be common in the inpatient setting. Sequential HbA1c testing within a 1-month period is considered redundant. In the present study, we examine the frequency of redundant HbA1c testing of inpatients at our institution.

Methods:

We extracted all HbA1c results for tests performed between January 2000 and December 2011 from our laboratory information system (175,688 results from 70,592 patients) and calculated the intervals between sequential tests. For data between January 2002 and December 2011, the proportion of redundant HbA1c tests was calculated for all patients and analyzed separately for those with previous HbA1c < 7% (low HbA1c group) and those with HbA1c ≥ 7% (high HbA1c group). The change in HbA1c levels between tests was determined, with significant differences in levels defined as >±0.5% HbA1c.

Results:

In the study period, 51% (n = 21,548) of inpatient HbA1c results were redundant. Overordering was more frequent among low HbA1c inpatients (57% within 30 days, n = 13,373) as compared with high HbA1c inpatients (39% within 30 days, n = 7517). We observed that a minority (8.9%, n = 10,626) of redundant tests had a change of >±0.5% HbA1c. The frequency of redundant HbA1c testing remained constant over time.

Conclusions:

Our results indicate that overutilization of HbA1c tests in the inpatient setting has been a consistent occurrence for at least a decade. Only a small proportion of redundant HbA1c levels showed a significant change from the previous result. Further steps, such as revision of ordering templates and staff reeducation, should be taken to reduce unnecessary testing.

MIMURA V Dimension Healing on Pico Quantum Technology

Satoru Mimura, B/Law Medical, MBA

Union of Thai-Traditional Medicine Society
Ichikawa, Chiba, Japan
satorumimura@ymail.com

Objective:

MIMURA positive energy into H_2O cluster of colloidal mineral metals with nitrogen, carbon, toxin, bacteria, virus in a cell for mitochondrias of healing (1) DNA/RNA of memorial bases, (2) ATP/GRP120 on Insulin & Grease & Lactic-acid, (3) Apoptosis/P53 against RAS21, (4) Immunity/Blood on hemoglobin, myoglobin, CHOP, lymph, T helper CD4/8, (5) Enzymes/thyroxine,nordrenalin, serotonin etc. to resolve multiple metabolic failures. Diabetes is a standard-bearer of oxygen deficit on insulin to be linked with blood flow through central & autonomic nerves& Bacteria/Virus for incurable diseases.

All diseases, cardiac infarction, cancer etc are caused by cellular oxygen deficit at pico quantum dimension.

Method:

(M) MIMURA Energy Water: 1~ 1.5L per day for QOL, drinking.

Quality: Much oxygen, Non-oxidization, Non-free radical, Nano-cluster, Hardness CaCO3/Mg over 50% melt down , Colloidal-mineralsNO3/SO4-compound, Low-surface tension, High-penetration, High-electric conduction, Self-destruction of bacteria & virus, Air infective protection, ammonia resolution, Methane volatilization, pH for low, Ion radiation (S) Super ATORU Liquid: 40 ~60 cc per day. Morning/Evening Huge oxygen & colloid minerals energy in nano- tornado cluster of low pH.

Result:

(M) for 3 months: Diabetes w/hypertension, Atopy, Kidney stone, Menstrual dark HDA1C 6.7% - 5.8% Healthy, Skin normal, Stone melt, blood fresh color No pain.

(M & S) for 4 months: (1) Before HIV/RNA 373,455/ml CD4 148 After 20 days - 186,915/ml CD4 62 and healing for Healthy Fat. (2) Cancer (Brain Glio-Blastome Multiformae Stage 3) w/colon cancer DNA, After 2 months – Restrain & Stop tumor-expand and decrease for Recovery w/ refresh hair, skin (3) Diabetes w/ hypertension and cardiac & kidney diseases & much neutral fat: Before glycogen 270 After 2months 110 for healthy recovery. (4) Myocardial & Cerebral infarction, Cancer (Breast/ Womb/ Stomach), Leukemia, Hepatitis, Vertebra carries, Articular leumatism, Arthritis, Neuralgia, Asthma, Alzheimer, Alcoholic etc since 1997 R&D on clinical tests.

Conclusion:

M&S would be able to extend the average of healthy life span for 22 century's hope.

Intelligent Self-Care System for Diabetes Support and Management

Nonso Nnamoko, MSc; Farath Arshad, PhD; David England, PhD; Jiten Vora, PhD

Liverpool John Moores University
Liverpool, United Kingdom
N.A.Nnamoko@2011.ljmu.ac.uk

Objective:

In this information age, health care services have taken a radically new shape with more emphasis on out-of-hospital care and a strong participatory component from patients. The overarching priority is to reduce cost while maintaining high quality of care, especially in long-term and lifestyle-related conditions such as diabetes mellitus (DM). Accumulating evidence has identified that lifestyle adjustments help delay or prevent long-term diabetes complications. However, due to the controversial nature of lifestyle measures, its integration with pharmacologic therapy into intelligent management systems for DM has received little implementation. Lifestyle education is often delivered as a supplement. This effort looks to bridge this gap for better support and management in a user-centric manner.

Method:

An intelligent system is proposed with dual user interface: one for patients and the other for care providers. For personalized care, system design will take a user-modeling approach, utilizing both. In the absence of cases, the system relies on preset rules for inference and established patterns stored for each user. Subsequent reasoning considers both stored patterns and preset rules, and new patterns are stored for future inference.

Result:

User modeling helps reduces the classification complexities of similar patterns that may exist between individuals requiring different health care paths. The combined reasoning approach helps extract hidden or likely destructive patterns.

Conclusion:

Bridging the gap between lifestyle and pharmacologic therapy in intelligent systems holds huge promise in DM management and better outcomes.

Enhancement of an Insulin Infusion Therapy Protocol Using Simulation

Edward A. Ortiz, MD; Stephen D. Patek, PhD; Marc D. Breton, PhD;
Leon S. Farhy, PhD; Boris P. Kovatchev, PhD

University of Virginia
Charlottesville, Virginia, USA
eao7r@virginia.edu

Objective:

Computer simulation has proven to be valuable in the development of insulin dosing algorithms for type 1 diabetes, where *in silico* preclinical trials are now a normal part of the validation of closed-loop control algorithms. It remains to be seen whether computer simulation can play a similar role in enhancing insulin therapy in critical care settings, for example, by adjusting the blood glucose (BG) target range of a protocol to reduce the frequency of hypoglycemia without adversely affecting other outcome measures.

Method:

Based on an intensive care unit (ICU)-enhanced version of the oral glucose–insulin model of Dalla Man and colleagues, we simulated an insulin infusion protocol designed for tight glycemic control in a burn ICU. Three simulation runs involving 600 virtual ICU patients were performed with different process control thresholds. The baseline run used the original protocol's process control thresholds, where BG values <80 or >110 mg/dl triggered insulin infusion rate changes. Simulation run 1 used 90 and 110 mg/dl thresholds, and run 2 used 90 and 100 mg/dl thresholds. For each simulation run, the mean of per-patient percentage of time in the 80–110 mg/dl range, percentage of time in hypoglycemia (BG < 60 mg/dl), and BG mean were calculated.

Result:

For baseline and run 1 and 2 simulations, the mean per-patient outcome measures were, respectively, time in target 42.5%, 38.15%, and 42.6%; time in hypoglycemia 0.59%,

0.44%, and 0.44%; and BG mean 118.2, 121.8, and 119.3 mg/dl. Thus, narrowing the range of process control thresholds reduced the frequency of hypoglycemia while keeping mean BG close to its original value

Conclusion:

Although the differences of these results were not statistically significant ($p < .07$), the ease in discerning trends with the simulator illustrates its usefulness in evaluating insulin infusion protocols for stress hyperglycemia.

Development of a Comprehensive Simulation, Training, and Clinical Decision Support System to Support Optimization of Glycemic Control in the Hospital/Critical Care Setting

Scott M. Pappada, PhD; Thomas J. Papadimos, MD; Brent D. Cameron, PhD; Alan Carlin, PhD; William N. Depriest, BS; Alexandra Geyer, PhD; Jason Sidman, PhD

Aptima Inc.
Woburn, Massachusetts, USA
spappada@aptima.com

Objective:

Our objective is to develop a system integrating a neural network model (NNM) and a partially observable Markov decision process (POMDP) model for real-time prediction of glucose and clinical decision support in the hospital/critical care setting.

Method:

Thirteen patients admitted to the intensive care unit (ICU) at the University of Toledo Medical Center with elevated blood glucose (≥150 mg/dl) were subjected to continuous glucose monitoring (CGM; CGMS iPro, Medtronic Diabetes) and documentation of electronic medical records (EMRs) throughout their ICU length of stay. This data set contained over 1596 h of CGM and EMR data. Eighty-five percent of the data set was used to train both the NNM and the POMDP model for real-time prediction of CGM values (prediction horizon = 75 min) and clinical decision support, respectively. The remaining 15% of the data set was utilized to validate model accuracy in a simulated real-time setting. Accuracy of the NNM was evaluated via Clarke error grid analysis, calculation of overall error (mean absolute difference percentage) between predicted and reference CGM values, and percentage of hyperglycemia (≥150 mg/dl), hypoglycemia (≤70 mg/dl), and normoglycemia (>70 and <150 mg/dl) predicted successfully. Accuracy of the POMDP model was evaluated by comparing POMDP decisions with reference

decisions to increase/decrease/maintain insulin infusion rates/dosages as defined by the ICU insulin infusion protocol/expert clinical staff.

Result:

Clarke error grid analysis revealed that 99.7% of model predictions fell within regions A (90.8%) and B (8.9%) of the error grid. Overall model error was calculated as 8.3%. The model successfully predicted 94.7%, 38.3%, and 77.9% of normal, hypoglycemic, and hyperglycemic CGM values, respectively. The POMDP model's decisions agreed with reference decisions 97.6% of the time.

Conclusion:

Given further development/optimization, the comprehensive simulation, training, and clinical decision support system may provide significant utility in optimization of glycemic control.

The Abbott Freestyle Navigator Continuous Glucose Monitor Achieves Accuracy in Intensive Care Unit Patients Comparable to That in Healthy Subjects When Calibrated at 6 h Intervals

Steven J. Russell, MD, PhD; Catherine C. Beauharnais, BA; David M. Nathan, MD; Hui Zheng, PhD

Massachusetts General Hospital
Boston, Massachusetts, USA
sjrussell@partners.org

Objective:

Studies of intensive insulin therapy in the intensive care unit (ICU) have been confounded by hypoglycemia. Continuous glucose monitoring could allow automated, closed-loop blood glucose (BG) control. We tested the accuracy of the Abbott Diabetes Care Freestyle Navigator continuous glucose monitor (CGM) in the ICU setting.

Method:

Navigator sensors were worn for up to 72 h by 60 patients receiving insulin (neuro ICU n = 27, medical ICU n = 16, cardiac ICU n = 12, surgical ICU n = 6). Blood glucose measurements on arterial blood were used to calibrate CGM voltage traces *post hoc*. Calibration schemes included the stock algorithm (calibrations at 1, 2, 10, and 24 h) and algorithms retaining the 1 and 2 h calibrations with additional calibrations at 24, 12, 8, 6, 4, or 2 h intervals. Reference BGs were paired with the nearest CGM values; BG values used for calibrations were paired with the preceding CGM values.

Results:

The stock algorithm gave mean absolute relative deviations (MARDs) higher in the ICU population (14.2%) than found in healthy subjects with type 1 diabetes (~12–13%). However, calibrating at 6 h intervals gave a MARD of 12.7%. Accuracy was not significantly affected by peripheral edema, pressor dependence, or ICU.

Conclusion:

We conclude that the Freestyle Navigator can achieve accuracy in ICU patients comparable to that in healthy subjects with type 1 diabetes. This accuracy is sufficient for effective closed-loop glucose control in subjects with type 1 diabetes, suggesting that the Navigator could also provide the input to a closed-loop BG control device for use in the ICU.

Bridging the Gap from Hospital to Home for Patients with Diabetes

Linda C. Schofield, RN, BSN, MSN, PhD; Kathy Bowers, BSN

McLaren Northern Michigan
Petoskey, Michigan, USA
lschofield@northernhealth.org

Objective:

The purpose of this study was to evaluate the effectiveness of guided care in managing diabetes patients by the diabetes educator.

Methods:

This was a prospective, randomized trial. We hypothesized that hospitalized diabetes patients receiving guided care will manage their disease better.

Control group: At discharge, the nurse provided standard diabetes education and completed their medication reconciliation form. At days 10 and 30 post discharge, patients (1) received a call from the diabetes educator who assessed medications, compliance, follow-up appointments, documented blood glucose levels and any emergency department (ED) visits or hospital readmissions, and (2) completed a satisfaction survey.

Intervention group: At discharge, the diabetes educator provided in-depth individualized education and completed their medication reconciliation form. At days 2, 7, 10 and 20 post discharge, patients received a call from the diabetes educator who coached patients on medication compliance, follow-up care, blood glucose levels, and any ED visits or hospital readmissions. At days 10 and 30, a satisfaction survey was completed.

Results:

Sixty patients were enrolled in the study: 31 guided-care patients and 29 standard-of-care

patients. For guided-care patients, 100% maintained a blood glucose level <200 mg/dl, 100% rated their care and education "very good" to "excellent," 100% adhered to suggestions to follow up with their primary physician, and 100% received medication reconciliation coaching. For standard-of-care patients, 26% maintained a blood glucose level >200 mg/dl (17% chose not to check levels), 91% followed up with their primary physician (these patients rated their care and education "poor" to "fair"), and 74% received medication reconciliation coaching.

Conclusions:

Diabetes patients who have in-depth individualized diabetes education from a diabetes educator understand and can manage their medical condition much better and are more satisfied communicating with their providers.

Hypoglycemia Elevated: Experience at University of Utah Hospital

Gitana Staskus, MD; Debra L. Simmons, MD, MS

Division of Endocrinology
Department of Medicine
University of Utah School of Medicine
Salt Lake City, Utah, USA
Gitana.Staskus@hsc.utah.edu

Objective:

Attempts to achieve tight glycemic control in hospitalized patients increases the risk of hypoglycemia and may be associated with higher mortality. The Inpatient Glucose Management Service (IGMS) was established at the University of Utah Hospital in November 2011 to improve the quality of glycemic control on selected surgical and medical services.

Methods:

We identified and analyzed causes of hypoglycemic events in patients managed by the IGMS from January to June 2012. Hypoglycemia was characterized as mild for blood glucose (BG) 60–69 mg/dl, moderate for BG 40–59 mg/dl, and severe for BG < 40 mg/dl.

Results:

A total of 363 patients with BG > 140 mg/dl were seen by the IGMS. There were 64 episodes of hypoglycemia identified in 40 patients during 1598 patient days in the hospital. Only one episode of severe hypoglycemia with BG 39 mg/dl was observed. The hypoglycemia incidence was 1.0%. The causes of hypoglycemia were (1) changes in caloric intake, (2) uncoordinated BG testing and administration of meal insulin, (3) nursing error in insulin dose administration, (4) changes in insulin resistance due to intensive physical therapy without identifiable glycemic patterns predicting

hypoglycemia, (5) failure to follow IGMS recommendations by primary services, (6) coadministration of sulfonylurea and supplemental insulin, and (7) patient self-management of diabetes. Spontaneous episodes of hypoglycemia were likely due to the unidentified changes in caloric intake and poor nutrition in patients with chronic kidney disease. Most episodes of hypoglycemia were observed on Thursdays. Fasting hypoglycemia was the most common.

Conclusion:

Most causes of hypoglycemia were preventable. Placement of appropriate early intervention protocols, early recognition of hypoglycemia, nursing and patient education and training, and individual patient approach may prevent a significant number of episodes of hypoglycemia in the hospital.

Preoperative Hyperglycemia as Predictor of Adverse Postoperative Outcomes in Patients without Diabetes

Rui Wang, BA; Maria Theresa Panizales, MSN, RN; Margo S. Hudson, MD;
Angela M. Bader, MD, MPH; Selwyn Rogers, MD, MPH;
Jeffrey L. Schnipper, MD, MPH

Department of Surgery, Brigham and Women's Hospital
Boston, Massachusetts, USA
rwang11@partners.org

Objective:

Although diabetes mellitus significantly influences postoperative outcomes, the implications of unrecognized preoperative hyperglycemia are not clearly understood. We investigated whether preoperative glucose can be useful to predict postoperative outcomes in nondiabetic patients.

Method:

We obtained information from the National Surgical Quality Improvement Program Brigham and Women's Hospital database for 9758 patients who underwent nonemergent vascular and general surgery at Brigham and Women's Hospital from January 1, 2005, through April 5, 2010. We used last glucose measured within 30 days prior to surgery as the primary independent variable. The primary outcome was any postoperative infection within 30 days. Analyses were performed using Student's *t*-test and logistic regression in STATA 12.

Result:

The postoperative infection rates for nondiabetic patients with preoperative glucose <70, 70–100, 100–140, 140–180, and >180 mg/dl were 5.3%, 5.8%, 9.0%, 10.2%, and 6.3% respectively, showing an increasing then decreasing trend. Patients above 100 mg/dl had higher infection rates (9.1% versus 5.7%; $p < .0001$) than those with lower glucose levels

(odds ratio = 1.6 [1.35–1.99]). Patients with preoperative glucose > 180 mg/dl had a decrease in glucose postoperatively (3-day postoperative mean 51.3 mg/dl lower than the preoperative level) whereas those with preoperative glucose < 180 mg/dl had an increase (23.8 mg/dl higher; $p < .0001$).

Conclusion:

Mild preoperative hyperglycemia (i.e., >100 mg/dl) in nondiabetic patients is a significant marker for postoperative infections. The drop in infection rates in the group with preoperative glucose >180 mg/dl possibly reflects recognition and treatment of hyperglycemia, as suggested by our postoperative glucose data. Further studies are needed to determine whether screening and identification of hyperglycemia in nondiabetic patients would lead to improved postoperative outcomes.