Original Article

INPATIENT GLYCEMIC CONTROL ON THE VASCULAR SURGERY SERVICE

Brenda M. Theilen, APRN,[1] Kevin A. Gritzke, MHA,[5] P. Gaye Knutsen, APRN,[2] Amy E. Riek, MD,[3] Janet B. McGill, MD, FACE,[2] Gregory A. Sicard, MD,[1,4] and Garry S. Tobin, MD[2]

ABSTRACT

Objective: To describe a structured inpatient insulin management protocol and order set for glycemic control on a vascular surgery service.

Methods: Patients admitted to the vascular surgery service with underlying diabetes were enrolled in a study of use of a preprinted basal-bolus insulin order set based on a total daily dose of 0.5 U/kg (0.25 U/kg of insulin glargine and 0.25 U/kg of insulin aspart divided into 3 equal mealtime doses). Outcomes included the mean glycemic control at each of 5 established time intervals, the percentage of blood glucose measurements within the target range of 70 to 180 mg/dL, the incidence of hypoglycemia, and the insulin dosages. Historical control patients with diabetes from the same hospital service were used for comparison.

Results: Both the study group and the control group consisted of 26 patients. The number of finger-stick blood glucose measurements performed was 871 in the control group and 896 in the intervention group. The mean blood glucose level (± SD) for the intervention group was 149.4 ± 50.7 mg/dL, in comparison with 165.2 ± 64.4 mg/dL for the control group. The incidence of hypoglycemia decreased 50% in the intervention group—from 32 (4% of the finger-stick assessments in the control group) to 19 (2% of the finger-stick blood glucose measurements in the study group). The blood glucose target range of 70 to 180 mg/dL was achieved in 75% of the measurements in the study group versus 61% in the control group. The basal insulin dose was unchanged in 65% of the patients, and of the 9 patients requiring a change in the dose, 5 had the dose decreased by 10% and 4 had the dose increased by 10%.

Conclusion: The use of a standardized basal-bolus weight-based insulin regimen was successful at achieving improved glycemic control as well as reducing the incidence of hypoglycemia in an inpatient population with diabetes. **(Endocr Pract. 2008;14:185-192)**

Abbreviations:
A1C = hemoglobin A1c; **BKA** = below-knee amputation; **ICU** = intensive care unit

INTRODUCTION

The management of inpatient hyperglycemia and the potential benefits of improved blood glucose control for stress hyperglycemia have resulted in considerable efforts to design and implement improvements in the detection and treatment of hyperglycemia in the hospital. The benefits of glycemic control in the outpatient setting have been shown in the Diabetes Control and Complications Trial (1) and the Epidemiology of Diabetes Interventions and Complications study (2) for type 1 diabetes and the United Kingdom Prospective Diabetes Study (3) for type 2 diabetes. These findings have led to more stringent criteria and aggressive guidelines for the treatment of diabetes (4,5). In addition, the 2004 position statement from the American College of Endocrinology for the management of hyperglycemia in the hospitalized setting suggested setting goals or targets for glycemic management (6). This guideline has prompted several institutions across the United States to implement a more standardized approach to glycemic control in the inpatient setting (7,8).

The diabetes team at Washington University and Barnes Jewish Hospital in St. Louis, Missouri, has successfully implemented a weight-based algorithm for the use of subcutaneously administered insulin on medical and surgical wards. A pilot project assessing the safety of the order set was instituted as a proof-of-concept principle on the vascular surgery service. This hospital unit was chosen because of the urgent nature of the cases, the stable

Submitted for publication April 13, 2007
Accepted for publication August 10, 2007
From the [1]Department of Surgery, [2]Division of Endocrinology, Metabolism and Lipid Research, [3]Department of Internal Medicine, and [4]Division of General and Vascular Surgery, Washington University School of Medicine, and [5]Barnes Jewish Hospital, St. Louis, Missouri.
Address correspondence and reprint requests to Dr. Garry S. Tobin, Washington University School of Medicine, Division of Endocrinology, Metabolism and Lipid Research, Washington University Diabetes Center at Barnes Jewish Hospital, 4921 Parkview Avenue, 13th Floor, Suite B, St. Louis, MO 63110.

patient profile, and the stable physician and nursing core. The order set developed was designed as a basal-bolus approach that used an initial insulin dosing algorithm based on 0.5 U/kg, with subsequent adjustments to be made in response to the bedside blood glucose levels. Of interest, in a previous retrospective analysis, postoperative blood glucose levels in vascular surgery patients were shown to be an independent risk factor for wound infections (9).

The institution of the order set and its systemwide implementation were a secondary goal of this pilot project. After approval of the educational material by the Inpatient Diabetes Committee, instructions on the use of the order set were presented in training sessions for the staff on the pilot ward. This pilot study was implemented by the floor team on the vascular surgery service after they received training from the endocrine diabetes team, and then insulin adjustments were made without input from the diabetes team. The data reported support the utility of the order set and its superiority in terms of safety and overall blood glucose control. The ability to train staff members to adjust and use basal and postprandial insulin independently was also confirmed.

STUDY SUBJECTS AND METHODS

The study protocol was approved by the Washington University Human Studies Committee, and written informed consent was obtained from all participants. The order set was approved by the Pharmacy and Therapeutics Committee and the Forms Committee at Barnes Jewish Hospital.

Patient and Control Groups

The patient population included patients with preexisting diabetes admitted to the vascular surgery service at Barnes Jewish Hospital in St. Louis, Missouri, during the period spanning September 2005 to April 2006. The control group was selected from the hospital database for the same division (vascular surgery) with a corresponding time frame of September 2004 to April 2005; the control subjects had an *International Classification of Diseases, Ninth Revision* diagnostic code for diabetes mellitus (250.xx). This patient list was randomized by using computer-generated random number selection, and patients were selected sequentially until a matching data set of equal numbers was obtained. Patients were excluded from the control group if no bedside blood glucose monitoring was available or any of the following exclusion criteria applied: the planned hospital stay was projected to be less than 24 hours, diabetic ketoacidosis was present, the patient was receiving glucocorticoids, consent was not provided, the patient was receiving total parenteral nutrition in conjunction with intravenously administered insulin, or the patient's outpatient dose of insulin exceeded 2.0 U/kg, suggesting severe insulin resistance.

Study Protocols

Preprinted order sheets were used, outlining insulin dosing based on weight. The order set (see Appendix 1) allowed for dosing every 6 hours or 4 times a day. This study specified the use of insulin dosing 4 times a day, and dosing every 6 hours was not used. The expected insulin dosing was 0.5 U/kg, with 50% given as long-acting basal insulin (insulin glargine) and the other 50% given as insulin aspart (1 patient substituted insulin lispro because of personal preference) divided into 3 equal mealtime doses. The nursing staff had the discretion to administer half the dose at mealtime if patients were eating less than 50% of the meals or to withhold the premeal dosing if the patient was receiving nothing by mouth. A high, medium, or low sliding scale was chosen on the basis of the daily dose and the patient's weight. The adjustment scale used insulin aspart. The diet allowed for 60 g of carbohydrates based on our standardized carbohydrate diet. The nursing staff was not formally trained in carbohydrate counting but did receive dietary instructions describing common food items and their carbohydrate content.

Bedside monitoring of blood glucose levels was performed with use of the Life-Scan Hospital Sure Step Pro. The policy and procedures followed for use of the meter were based on the manufacturer's and the hospital's policy and procedure manuals. The blood specimens were obtained by finger-stick technique by the nursing staff and floor nurse assistants. The information obtained was logged into the hospital database. Insulin dosing and administration were performed by the registered nursing staff, and all insulin dosages were logged into the hospital database.

Hypoglycemia (defined as a blood glucose level <70 mg/dL by finger-stick technique) was treated on the basis of instructions in the insulin order set in a stepwise fashion. The blood glucose measurements were grouped into 5 time intervals: 10 AM to 2 PM, 3 PM to 7 PM, 8 PM to 12 AM, 1 AM to 4 AM, and 5 AM to 9 AM.

The primary end points of the study were the mean glycemic control during the hospital stay and the insulin dosages. Secondary end points included the occurrence of hypoglycemia and the distribution of the bedside measurements of blood glucose as less than 70, 70 to 180, or more than 180 mg/dL.

Demographics obtained on the study participants included age, weight, wound infection, duration of hospital stay, nature of the operation, admission diagnosis, serum creatinine at baseline, and the admission blood glucose level. Discharge sheets and information on the regimen used in the hospital were supplied to the patients at the time of dismissal from the hospital.

Statistical Analysis

Statistical analysis was based on the mean of the blood glucose measurements at each of the time intervals. Statistical significance was determined with a *t* test of the

means; the equation with pooled variances was used. The statistical analysis of the frequency of blood glucose measurements in the distribution was done with use of a binomial distribution hypothesis.

RESULTS

Twenty-six patients were enrolled in the study group and in the control group. Each patient was admitted for a vascular surgery diagnosis or procedure (or both). The surgical interventions included amputations and revascularization procedures. Demographic data for the control and study populations are summarized in Table 1. The groups were remarkably similar, despite the random nature of the selection process for the control group. In both groups, more than 90% had type 2 diabetes and more than 70% were male. For the study population, 50 potential candidates were identified, and 26 patients were enrolled. The reasons for exclusion from the study group were failure to give informed consent, duration of hospital stay less than 1 day, and admission when the study coordinators were unavailable. The control group selection was based on a randomized list of admissions to the vascular division for the previous year, and exclusion was based on the duration of hospital stay and the absence of bedside monitoring of blood glucose in the hospital database despite a diagnosis of diabetes mellitus.

The initial insulin glargine dose was unchanged in 65% of the study patients. Of the 9 patients requiring adjustment in the dose of insulin glargine, 5 had hypoglycemia, 2 of whom had renal compromise postoperatively. The other 4 patients required an increase in the insulin dosage by 10%. The mean (± SD) duration of hospital stay was 8 ± 6.9 days, and the mean (± SD) insulin glargine dose was 19.1 ± 4.9 U. In addition, the mean ratio of bolus to basal insulin was 87% (SD 44%). The nursing staff withheld a mean of 6.7 doses of mealtime insulin, showing a good understanding of the prandial dosing of insulin. The reasons for missed doses included failure to eat, having no oral intake in preparation for a procedure, or absence from the ward for studies or other reasons. We did not specifically track whether the patients were receiving nothing by mouth relative to the results, in light of the difficulty in comparison with the control group. When the next blood sample was obtained, the insulin dosage was compensated by use of the adjustment scale, if needed, as documented in the order set. The nursing staff was successful in implementing and dosing insulin in compliance with the basal-bolus protocol and order set, and they were able to compensate for inadequate carbohydrate intake to prevent low blood glucose values by using supplemental carbohydrates. If mealtime insulin was administered and the patient did not eat a full complement of carbohydrates, supplemental carbohydrates were administered. On the refrigerator in the division, the nurses posted a diet sheet that outlined the carbohydrate content of the common stock items in the refrigerator and kitchen. As previously discussed under "Study Protocols," the nurses were not formally trained in carbohydrate counting, and the standard carbohydrate exposure on the meal trays was between 60 and 80 g based on the standardized carbohydrate diet order. Quality control analysis showed that the trays had a minimum of 60 g of carbohydrates.

The control group participants were treated with a variety of regimens. Of the 26 control subjects, 8 received some form of basal insulin or a continuation of oral medications with a sliding scale of regular insulin. The other 18 patients in the control group were treated with sliding

Table 1
Summary of Demographics for Control and Study Populations

Factor	Control group	Study group
Number of patients	26	26
Number of patients screened	55	50
Diabetes		
Type 1	1	2
Type 2	25	24
Sex		
Male	20	19
Female	6	7
Number of finger sticks	871	896

scale insulin every 4 hours, every 6 hours, or 4 times a day. The basal insulin was either 70/30 or NPH insulin twice a day, reflecting home dosing.

The number of finger-stick blood glucose measurements performed was 871 in the historical control group in comparison with 896 in the study group. This information showed that the average monitoring order in the institution for the vascular surgery service was a 4-times-a-day schedule in 2004. The 25 extra blood glucose measurements in the study group were related to the 2 AM bedside glucose assessments done for safety in the study. The overall distribution of the blood glucose values for both groups is shown in Table 2. In the study group, 75% of the glucose values were within the target range of 70 to 180 mg/dL, in comparison with 61% in the control group. The control group had 3.7% of the bedside blood glucose values in the hypoglycemic range (<70 mg/dL), in comparison with 2.1% in the study group. This difference was statistically significant ($P < 0.005$). The preponderance of the hypoglycemia was seen in the time intervals of 5 to 9 AM and 1 to 4 AM (Table 3). Nineteen episodes of hypoglycemia occurred in the study group; in contrast, 32 occurred in the control group. The use of the every-4-hour schedule of bedside blood glucose assessments accounted for the preponderance of the blood glucose values in the 1 to 4 AM time interval in the control group. The difference between the study population and the control group was again statistically significant ($P < 0.005$) for the time intervals of 5 to 9 AM and 1 to 4 AM.

The mean blood glucose values for the various time intervals throughout the day for both the study group and the control group are shown in Figure 1. Statistically significant improvements ($P < 0.001$) were seen in the finger-stick blood glucose values in the study group versus the control group during the following time intervals: 10 AM to 2 PM (148.0 ± 54.7 versus 171.3 ± 55.4 mg/dL); 3 PM to 7 PM (147.1 ± 45.9 versus 170.6 ± 65.5 mg/dL); and 8 PM to 12 PM (160.3 ± 50.6 versus 190.4 ± 72.9 mg/dL). No significant difference in the overall glycemic control between study and control groups was seen in the finger-stick glucose values during the 1 AM to 4 AM (142.3 ± 53.4 versus 142.6 ± 59.3 mg/dL) and 5 AM to 9 AM (147.3 ± 49.0 versus 140.9 ± 51.9 mg/dL) intervals. The overall mean blood glucose level for the intervention group was 149.4 ± 50.7 mg/dL, in comparison with 165.2 ± 64.4 mg/dL for the control group—a difference that was statistically significant ($P < 0.005$).

The study did not have sufficient statistical power to determine an improvement in the outcome of the surgical procedures or wound healing. The 26 patients in the intervention arm had the following procedures: 2 had aortic aneurysm repairs, 5 had miscellaneous procedures for wound débridement and were given antibiotics, 10 had amputations—6 were below-knee amputations (BKA) and 4 were amputations of digits on the foot for infection or severe peripheral vascular disease (or both)—and 9 had revascularization procedures, predominantly involving the lower extremities. One patient in the last group had a thoracic outlet decompression. The 26 patients in the control group had the following procedures: 4 had aneurysm repairs, 6 had miscellaneous procedures for wound débridement and received antibiotics, 8 had amputations—4 were either BKA or above-knee amputations—and 10 had revascularization procedures, again predominantly involving the lower extremities. Two patients in the last group had upper body procedures including a right subclavian steal repair, and one patient underwent removal of an infected dialysis shunt. In the control group, 2 patients were counted twice because they underwent both amputations of digits and a revascularization procedure. We did not specifically analyze glycemic control in relationship to the actual surgical procedure, in order to avoid the confounding factors related to intensive care unit (ICU) admissions. The study was designed to assess the blood glucose control with a subcutaneous insulin regimen on the vascular surgery service and not to look at the effect of intravenously administered insulin on glycemic control and outcomes.

Table 2
Overall Blood Glucose Distribution
Relative to the Target Range, Stratified by Study Group[a]

Group	Total no. of BG values	Below target (<70 mg/dL)		Within target (70-180 mg/dL)		Above target (>180 mg/dL)	
		No.	%	No.	%	No.	%
Study	896	19	2.1[b]	674	75.2[b]	203	22.7[b]
Control	871	32	3.7	529	60.7	310	35.6

[a]BG = blood glucose.
[b]$P < 0.005$. The P value was calculated by using a binomial distribution hypothesis for the frequency of the finger-stick assessments in the distribution in comparison with the control group.

Table 3
Frequency and Distribution of Hypoglycemic Blood Glucose Values, Stratified by Time Interval and Study Group[a]

Time interval	Mean blood glucose (mg/dL)[b]		SD (mg/dL)		Number of finger-stick glucose values <70 mg/dL	
	Study	Control	Study	Control	Study	Control
5 AM-9 AM	60.8	64.2	6.9	5.5	5	11[c]
10 AM-2 PM	65.4	58.2	5.6	8.6	8	5
3 PM-7 PM	60.5	62.5	10.7	3.1	4	4
8 PM-12 PM	68	63.5	NA	4.9	1	2
1 AM-4 AM	63	58.8	NA	16.3	1	10[c]

[a]NA = not applicable (1 measurement).
[b]No significant differences between groups.
[c]Frequency was significantly different ($P < 0.005$) between groups.

Of the 26 study patients, 23 had hemoglobin A1c (A1C) values. The range of their A1C values was 5.1% to 10.6%, with a mean (± SD) of 6.95% ± 1.36%. The study patients had a mean weight (± SD) of 95.5 ± 16.56 kg. Nine patients were receiving one or more oral medications or dietary treatment (or both) before admission. The remaining patients were taking insulin before admission, including 2 who had combination treatment with insulin plus oral medications. Available data on home dosing were incomplete in 4 patients. The range of insulin dosing was 0.20 to 1.00 U/kg (mean ± SD, 0.46 ± 0.21 U/kg).

Of the 26 control patients, 12 had A1C values. The range of their A1C values was 5.9% to 11.8% (mean ± SD, 7.67% ± 1.95%). The mean weight (± SD) of the control patients was 78.94 ± 18.74 kg. Incomplete data were found on 3 control patients in regard to their home dosing. Of the 26 control patients, 7 had been receiving insulin at home in a variety of regimens. The mean insulin dose (± SD) was 0.34 ± 0.12 U/kg. Before admission to the hospital, 16 control patients were using oral medications or diet therapy for their diabetes.

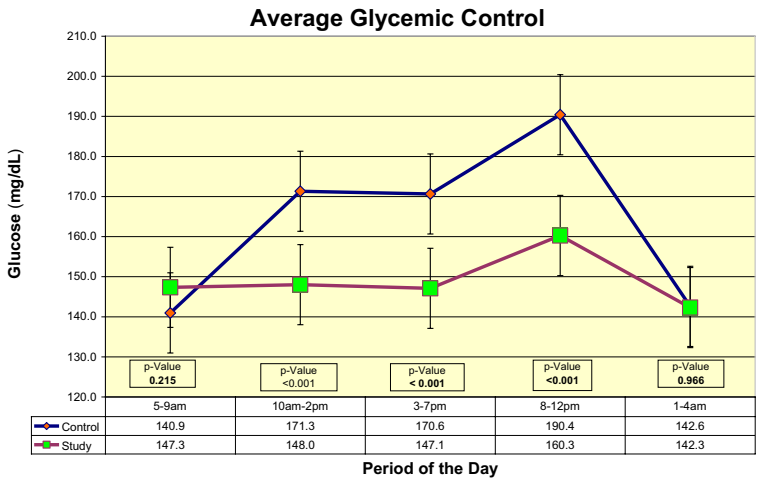
DISCUSSION

The management of inpatients with diabetes presents many logistic and therapeutic challenges that are not present in the outpatient setting. These include patient-centered variables related to their illnesses and appetite as well as system-related issues related to the need for maintaining patients without oral intake for testing as well as dietary variability in the timing of food intake and the carbohydrate composition of the meals. One proposal is that the use of a standardized approach to management of glycemic control within an institution would facilitate a more proactive interaction between the patient with diabetes and the medical staff. Moreover, the involvement of the patient in the dosing of insulin seems necessary to prevent hypoglycemia.

Our intervention relied on an intensive educational program, directed at the nursing staff and the surgical house staff, regarding the use of a physiologic insulin algorithm. This approach is similar to that described by Baldwin et al (7) directed at training the medical house staff at Rush-Presbyterian Hospital in the use of a physiologic insulin regimen. An ancillary benefit found in their study was an improvement in the use of insulin by the surgical house staff as well. The reported insulin regimen used at that institution was primarily based on NPH as a basal insulin and regular insulin at meals. Their results showed an overall mean blood glucose level of 150 mg/dL, in comparison with 200 mg/dL in a historical control group. The number of blood glucose measurements less than 60 mg/dL was increased in the intensively treated group (3.60% versus 1.40%), but the number of hypoglycemic episodes necessitating the use of 50% dextrose was unchanged.

DeSantis et al (8) reported the experience at Northwestern Memorial Hospital (Chicago, Illinois) with a diabetes consultation team and use of protocols with insulin glargine and insulin aspart. They showed a substantial improvement in the mean blood glucose control and a decreased frequency of hypoglycemia. They achieved a mean blood glucose level (± SD) of 145.6 ± 55.8 mg/dL and had a decrease in hypoglycemia to 1.3% of the blood glucose measurements. This use of a formal consultation team may be difficult to replicate in other institutions, although their cost analysis suggests that this approach is viable.

Our study achieved a mean blood glucose level (± SD) of 149.4 ± 50.7 mg/dL, which is remarkably similar



Overall Glycemic Average by Period of Day	Study	SD	Control	SD	P value
milligrams/dL	mg/dL(#)	mg/dL	mg/dL(#)	mg/dL	
5-9am	147.3(188)	49.0	140.9(193)	51.9	0.215*
10am-2pm	148.0(179)	54.7	171.3(187)	55.4	<0.001*
3-7pm	147.1(187)	45.9	170.6(182)	65.5	< 0.001*
8-12pm	160.3(195)	50.6	190.4(200)	72.9	< 0.001*
1-4am	142.3(147)	53.4	142.6(109)	59.3	0.966*

Overall Glycemic Average for all time points	Study mg/dL(#)	SD mg/dL	Control mg/dL (#)	SD mg/dL	P value
	149.4(896)	50.7	165.2(871)	64.4	<0.005*

*The P values were calculated using a pooled variance assumption on the means.

Fig. 1. Distribution of the mean blood glucose values for various time intervals throughout the day and overall glycemic average for all time points for the study group and the control group.

to that in the Northwestern group. A benefit of a more regimented approach to insulin and glucose in our intervention was a decrease in hypoglycemia and, more importantly, a decrease in the frequency of nocturnal hypoglycemia. This effect may reflect the use of NPH and mixed insulin before implementation of the order set. The insulin glargine dose was also stable, with only a small percentage of patients requiring a dose adjustment in the range of 5% to 10% of the predicted dose based on weight. Whether the incidence of hypoglycemia could have been decreased with a less aggressive approach is difficult to answer because the lower basal dosing or meal dosing (or both) would necessitate a higher dose of the adjustment insulin being used to compensate for the hypoglycemia. With our management intervention, the number of hypoglycemic blood glucose values was decreased from 32 in the historical control group to 19 in the study group.

The limitations of our study are the size of the sample group and the use of historical controls. Our study has shown, however, that the use of a weight-based approach to insulin dosing in the hospital setting is safe in a population of patients with advanced complications of diabetes on a vascular surgery ward. The study had insufficient statistical power to show that the outcome in these patients, including postoperative infections, was improved by better overall glycemic control. It does show that glycemic control is a modifiable factor in patients undergoing vascular surgical procedures.

Vriesendorp et al (9), who retrospectively analyzed postoperative hyperglycemia in patients undergoing peripheral vascular operations, showed that the quartile of glycemic control was an independent risk factor for postoperative infection, independent of the duration or extent of the surgical procedure. Future larger scale trials would be needed to confirm this retrospective work.

The nature of our study was also limited in its ability to show a decrease in rate of infections because of the presence of a limb or digit infection in more than 40% of our patients at the time of presentation. The wide variability in the procedures performed in this study precluded analysis of the effect of glucose control on the outcome of the operative interventions. Additionally, some patients

did require admission to the ICU. The blood glucose data from the ICU were excluded from our analysis because the primary outcome of the study was to evaluate the effectiveness of use of a subcutaneous insulin regimen on a vascular surgery ward.

An approach that combines a formal diabetes consultation team and systemwide staff education for the management of diabetes is the intervention implemented at Washington University. The insulin order set is present on all surgical and medical wards. The use of the order set has ongoing monitoring for safety and errors in either implementation or orders. Any issues are forwarded to the diabetes consultation service, and remedies are applied. Ongoing educational initiatives (including a tutorial entitled "Sugar Sleuths") are maintained for system-based learning on the hospital's cable television channel for new nurses and house staff.

CONCLUSION

The results of our pilot project and the subsequent implementation of the insulin order set have been well received by the medical community at our institution. Future research will be needed to establish the benefit of targeted blood glucose strategies on the hospital wards. The improved safety, as documented, will enhance this research and should encourage analyses of specific subsets of patients on both surgical and medical wards.

ACKNOWLEDGMENT

We acknowledge the support of the Inpatient Diabetes Committee at Washington University School of Medicine and Barnes Jewish Hospital as well as the administrative support from Sharon O'Keefe, Chief Operating Officer, Barnes Jewish Hospital.

DISCLOSURE

This study was not funded by outside sources and was performed with use of insulin preparations available on the hospital formulary. Dr. Garry Tobin is on the speakers' bureaus for sanofi-aventis U.S. and Novo Nordisk Inc. P. Gaye Knutsen is on the speakers' bureau for sanofi-aventis U.S. and is a consultant for Novo Nordisk Inc. The other authors have no conflicts of interest to disclose.

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APPENDIX 1
SUBCUTANEOUSLY ADMINISTERED INSULIN ORDER SET AND DIRECTIONS FOR USE

BARNES-JEWISH Hospital BJC HealthCare

Washington University in St. Louis SCHOOL OF MEDICINE

STANDARD SUBCUTANEOUS INSULIN ORDERS

ADDRESSOGRAPH

UNLESS THE WORD SPECIFIC IS WRITTEN AFTER A DRUG ORDER BY TRADE NAME, A GENERIC EQUIVALENT DRUG APPROVED BY THE PHARMACY AND THERAPEUTICS COMMITTEE MAY BE DISPENSED IN ACCORDANCE WITH THE MEDICAL STAFF BYLAWS.

Please check (✔) the appropriate box (☐) and fill in the blank(s) as needed.

DATE	TIME	ORDERS
		All medications are prescribed for treatment of: ☐ Type 1 Diabetes ☐ Type 2 Diabetes
		Monitoring: Fingerstick Blood Glucose (BG): Nurse to discuss each BG test result & insulin dose with patient and instruct patient in proper injection of insulin. Call MD if the patient requests a change in the dose that is ordered. ☐ Patients who are eating, check BG 4 times daily: 30 minutes before meals and 21:00 ☐ NPO patients, Q 6 hours at 0600-1200-1800-2400 ☐ Check BG at 0200 daily, do not give sliding-scale insulin at 0200, call MD for BG greater than 250mg/dl ☐ Call MD if blood glucose is greater than 250 mg/dl twice in one day for a change in orders.
		Medications: (See reverse side for dosing recommendations) **Basal (intermediate or long-acting) insulin: (Continue if NPO, required for Type 1 patients)** ☐ Insulin Glargine (Lantus) _____ Units Sub-Q daily at 22:00 (recommended) or at_____ *Do not mix Insulin Glargine (Lantus) with any other insulin preparation in the same syringe.* ☐ Human NPH: give Sub-Q, and combine with premeal/sliding scale doses if ordered ☐ _____ Units Sub-Q every _____ hours ☐ _____ Units before Q breakfast **AND** _____Units **choose one:** ☐ Q supper or ☐ at Q 2100 ☐ _____ Units Sub-Q two hours prior to cycled tube feeds; if tube feedings are interrupted after insulin administration administer D10W IV infusion at tube feed rate and notify MD.
		Pre-meal/Bolus insulin: (Hold if NPO for procedures, unable to eat, or if BG less than 70 mg/dl) *If BG greater than100, give immediately before meals. If BG less than 100 mg/dl, give after meals/tube feeds. If patient is not eating the majority of their meal, call MD for an adjustment in patient's insulin dose* ☐ **Insulin Aspart (NovoLog)** ☐ **Insulin Lispro (Humalog)** ☐ Human Regular Insulin ☐ _____ Units Sub-Q daily immediately prior to breakfast, lunch & supper **(Hold if NPO)** ☐ _____ Units Sub-Q daily immediately prior to each intermittent tube feeding Q____ hours **Supplementary (Sliding Scale) insulin:** (See reverse side for ordering recommendations) ☐ **Low-Dose** ☐ **Mid-Dose** ☐ **High-Dose** *Give SubQ with basal/pre-meal insulin doses at times ordered. Do not mix with Lantus.*

Glucose values:	Low-Dose	Mid-dose	High-Dose
140-175 mg/dl	1 unit	2 units	3 units
176-200 mg/dl	1 unit	3 units	5 units
201-250 mg/dl	2 units	4 units	7 units
251-300 mg/dl	3 units	6 units	9 units
301-350 mg/dl	4 units	8 units	11 units
greater than 351mg/dl	5 units	9 units	13 units

		☐ **Hypoglycemia: For BG less than _____mg/dl** Treat as follows: If patient is able to eat/drink, give 4 glucose tablets or one juice (4 floz). If patient is NPO or unresponsive give 250ml of D10W over 15 minutes (preferred) or 25ml of D50W IVP over 2 minutes. If no IV access, give Glucagon, 1mg Sub-Q & then follow with either oral or IV treatment above. Recheck BG in 10 minutes and 1 hour. Repeat treatment until BG is greater than 100mg/dl. Call MD for each episode of hypoglycemia.
		MD: _____ (SIGNATURE REQUIRED) _____ (PRINTED NAME REQUIRED) Telephone #/Pager #_____

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DO NOT WRITE BELOW THIS LINE

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