CLINICAL RESEARCH STUDY

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Insulin Order Sets Improve Glycemic Control and Processes of Care

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ABSTRACT

OBJECTIVE: The study objective was to evaluate the impact of a standardized preprinted subcutaneous correctional insulin order set on glycemic control, processes of care, and nursing satisfaction.

METHODS: This was a controlled before/after, qualitative study using focus group interviews. The intervention group consisted of patients with diabetes who were admitted to the cardiovascular surgery ward. The control group consisted of patients with diabetes who were admitted to the vascular surgery ward. Registered nurses on the cardiovascular surgery floor participated in focus groups and completed surveys. We used a multifaceted intervention including standardized insulin order sheet, educational workshops, verbal and printed reminders, printed enabler, reference sheet, and overnight helpline. Glycemic control and hypoglycemia were assessed through chart review, and nursing satisfaction with the insulin order sets was assessed through surveys and nursing focus groups, performed before and 6 months after implementation of the insulin order set.

RESULTS: There was a 39% reduction in proportion of blood glucose > 11.0 mmol/L (198 mg/dL) in the intervention group compared with the control group (0.17 vs 0.28, $P = .03$). The proportion of hypoglycemia (blood glucose < 4.0 mmol/L [72 mg/dL]) was no different between the 2 groups. Nurse satisfaction increased significantly ($P < .02$); order sets were easy to use and improved glycemic control, processes, and efficiency of care, and reduced the number of pages between nursing and medical staff.

CONCLUSIONS: Standardized insulin order sets reduced hyperglycemia and improved nursing satisfaction and processes of care. Successful implementation required stakeholder engagement, identification of barriers and facilitators in local practice, and tailoring the intervention to target these factors.

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KEYWORDS: Attitude of health personnel; Diabetes mellitus; Hyperglycemia; Inpatients; Insulin; Interprofessional relations; Order sets

Avoidance of hyperglycemia in the perioperative period decreases length of stay and recurrent ischemia and wound infection, and enhances survival.[1] These benefits are often achieved with intravenous insulin infusions while patients are not eating.[1,2] Once patients are eating, insulin regimens are converted in a nonsystematic fashion to subcutaneous insulin.[3] Although subcutaneous regimens may be appropriate, they are often characterized by the use of correctional insulin in the absence of a scheduled antihyperglycemic order,[3,4] limited uptake of standardized protocols,[5] and delayed initiation of basal antihyperglycemic regimens on transition from intravenous insulin.[6,7] This results in not only poor glycemic control but also increased risk of transcription errors, disruptive frequency of communications

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Conflict of Interest: C. Yu has received an honorarium from Shoppers Drug Mart. H. Halapy is on an Advisory Board for Eli Lilly and has received an honorarium from Shoppers Drug Mart. K. Sun and R. Nisenbaum have no conflicts of interest associated with the work presented in this manuscript.

Authorship: All authors had access to the data and played a role in writing this manuscript.

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between the nursing and medical staff, and subsequent staff frustration.[8-10]

Preprinted subcutaneous insulin order sets have been used to overcome these challenges,[3-6,10-17] resulting in modest and variable improvements in glycemia. Schnipper et al[4,12] reported an absolute increase of 4% to 6% of blood glucose (BG) in target (60-180 mg/dL), whereas Hermayer et al[10] reported a 10% increase in the percentage of time spent in target (70-180 mg/dL). Likewise, Maynard et al[13] found an absolute reduction of 3.9% in the percentage of patient-days of uncontrolled BG (≥180 mg/dL) with the use of a structured order set. Postulated reasons for this include the use of generic sliding scales.[15] In addition, uptake of order sets is variable, ranging from 31% to 91%.[5,16,17] Reasons for lack of uptake include knowledge[18-20] and fear of hypoglycemia.[5,7,18]

The purpose of this study was to determine whether a tailored standardized correctional insulin order set can be implemented successfully through a multifaceted interprofessional intervention and improve processes of care, nurse satisfaction, and glycemic control of perioperative cardiovascular surgery subjects.

CLINICAL SIGNIFICANCE

- A standardized correctional insulin order set (which incorporated customization to the patient's insulin sensitivity) reduced the proportion of hyperglycemia (blood glucose > 11.0 mmol/L [198 mg/dL]) and improved nursing satisfaction and processes of care on an inpatient cardiovascular surgery unit.
- Universal uptake of the order set was facilitated by a comprehensive implementation strategy that included stakeholder engagement, institutional support, case study-driven educational sessions, and printed reminders and enablers.

MATERIALS AND METHODS

We used Graham et al's "Knowledge to Action" framework[21] to design our study (Supplemental Methods). A controlled before and after study was conducted to assess the impact on glycemic control and processes of care before and after the intervention. Focus groups evaluated nurse satisfaction and processes of care.

Setting and Participants

The study took place at an urban tertiary care academic health science center.

Patient Selection. A total of 136 consecutively admitted patients with diabetes mellitus (type 1 or 2) were identified from the Cardiovascular Surgery floor (intervention unit) and the Peripheral Vascular Surgery floor (control unit) at 2 predefined time periods: 6 months preimplementation and 6 months postimplementation. There were no exclusion criteria. Data were abstracted from these patients' charts for the duration of the hospital admission.

Nurse Recruitment. All registered nurses working on the intervention floor were recruited by announcements at staff meetings and word of mouth. There were no exclusion criteria.

Intervention Development and Implementation

Barriers and facilitators to knowledge uptake were assessed through a literature search and focus groups with nurses working on the cardiovascular surgery unit. Barriers to uptake include lack of knowledge and comfort with insulin,[18,19,20] lack of awareness of institutional policies and preprinted order sets,[18,19,20] fear of hypoglycemia,[5,7,18] severity of patients' other diseases,[5] and desire to titrate oral medications.[5] Facilitators to knowledge uptake include strong institutional support,[22,23] dedication of an interprofessional team,[22] programmed introduction of order sets,[22] and structured educational programs.[22]

Nursing focus groups and surveys identified the following barriers to BG management: the need to contact the prescriber for order clarifications, inconsistent transitioning of patients from intravenous to subcutaneous insulin, and technical difficulties with and lack of sufficient numbers of glucometers. Preprinted order sets for subcutaneous insulin were identified as a facilitator for BG optimization.

On the basis of these points, a multifaceted interprofessional intervention was developed, including a longitudinal education program, a preprinted correctional insulin order set, and organizational changes including a helpline and access to a nurse practitioner. Correctional insulin was targeted initially because focus groups identified this as a large practice deficit and use of "sliding scales" was consistent with user knowledge base and ability, both factors that contribute to ease of implementation.[24] The education intervention was designed by an interprofessional planning committee. The committee consisted of 1 nurse specialist in cardiovascular care, 1 diabetes nurse educator, 1 pharmacist, and 2 endocrinologists. The education intervention targeted administrative, medical, and nursing staff and included case-based learning in small group workshops for staff, residents, and nurses; repetition through various media including the initial introduction, workshops, verbal and printed reminders; an enabler for the medication administration record (a sticker of the selected correction factor that can be appended to the medication administration record, rather than having to be hand-transcribed by the nurse); and a reference sheet for frequently asked questions. Strong institutional and programmatic support was obtained, including provision of additional glucometers, protected time for team members to develop the program, and mandated training and use of the order set.