An Evidence-Based Protocol for Managing Hypoglycemia

Seeing the need for change—and making changes.

Increased attention has been placed on glycemic management in the United States in response to the rising prevalence of diabetes and its associated economic burden. In 2008 the American Diabetes Association (ADA) reported that 17.5 million people in the United States have a diagnosis of diabetes and estimated that 2.2% of the non-institutionalized population has undiagnosed diabetes.

In general, patients with diabetes use more inpatient services and are at higher risk for a variety of complications than the general population, including infection and cardiovascular events. According to the ADA, in 2007, 22% of the 186 million inpatient hospital days were used by patients with diabetes and 13% of those days were directly related to diabetes. The average cost of diabetes-related care was reported to be $1,853 per inpatient hospital day, $331 per outpatient visit, $696 per emergency visit, and $132 per physician office visit.

Unfortunately, despite the growing national attention on achieving adequate glycemic control, that goal is often not reached. In 2006 the American Association of Clinical Endocrinologists, in collaboration with the ADA, published a consensus statement identifying barriers to achieving glycemic control in the inpatient setting; such barriers included health care professionals’ fear of hypoglycemia, the amount of nursing time it takes to follow protocols, and a lack of knowledge about diabetes and appropriate management strategies.

**Hypoglycemia**

Hypoglycemia, which is often defined as a blood glucose level of less than 70 mg/dL, can occur at any time in a patient with diabetes. Symptoms can develop rapidly, and the condition can be life threatening. There are a number of possible causes of hypoglycemia in the hospital setting, including (among others) an unexpected change to “nothing by mouth” status or a reduction in oral intake, a discontinuation of enteral feeding, the administration of insulin before a meal followed by little or no food consumption, unexpected transport from the nursing unit after the administration of rapid acting insulin, and a sudden reduction in a corticosteroid dose. Because many of the identified causes of hypoglycemia are difficult to predict, it’s in the best interest of the patient to have a standardized treatment protocol to ensure safe and effective treatment of hypoglycemia once it occurs.

**Evidence-based protocols.**

Evidence-based practice is a recognized approach to providing high-quality patient care. The Institute for Healthcare Improvement has recommended the use of evidence-based protocols (see http://bit.ly/a1OQGP), recognizing that protocol use optimizes the abilities of health care providers and can contribute to a reduction in errors.

At the Portland, Oregon, Veterans Affairs Medical Center, a tertiary care teaching center with Magnet designation, it was determined that an evidence-based hypoglycemia protocol for nurses was needed in order to provide safe and effective management of hypoglycemia across multiple clinical areas and support organizational efforts to achieve glucose control.

Nursing protocols within the organization are governed by the Clinical Practice Committee (CPC), a nursing committee charged with the oversight of all documents associated with nursing practice, including policies, procedures, protocols, and...
Protocols developed include project goals and a timeline.
• Review the available evidence and benchmark.
• Examine current practice and identify gaps as well as best practices.
• Develop the protocol and modify as needed, focusing on gaps.
• Initiate the approval process.
• Evaluate the availability of treatment options and modify as needed.
• Educate the staff.
• Implement the protocol.
• Evaluate protocol safety, effectiveness, and adherence.

We developed an action plan. Our first task was to collect and review the existing evidence. The ADA 2009 clinical practice recommendations served as a starting point.6 We then used our hospital’s library resources to obtain relevant literature.1, 7-11 Benchmarking (comparing practices within our health care system with others in the community and nationally) provided further insight into protocol-directed hypoglycemia management. A synthesis of the collected evidence revealed that sections of the existing protocol weren’t evidence based and that the protocol format could be enhanced to promote ease of use at the point of care. For example, the existing protocol directed nurses to administer 50 mL of dextrose 50%, which is the equivalent of 25 g of carbohydrate. The current evidence recommends administering 15 to 20 g of carbohydrate with reassessment in 15 minutes.6 Therefore, the revised protocol directs nurses to administer 25 mL of dextrose 50% (the equivalent of 12.5 g of carbohydrate), followed by reassessment in 15 minutes. If needed, a second dose of 25 mL of dextrose 50% can be administered. This tiered approach reduces the likelihood of overtreatment leading to hyperglycemia.

Defining hypoglycemia. The existing protocol didn’t contain a standard definition of hypoglycemia across care areas, which the
workgroup quickly realized was problematic. The existing protocol’s treatment recommendations were driven by the presence or absence of hypoglycemic symptoms, and blood glucose values ranged from 40 to 100 mg/dL, depending on the care area. We presented our findings to the Inpatient Glycemic Control Team with a request for an organization-wide definition of hypoglycemia. In response to the presentation, the organization adopted the ADA’s 2009 definition of hypoglycemia as a blood glucose level lower than 70 mg/dL. Treatment options could now be determined relative to a single blood glucose value (although hypoglycemia symptoms can appear in the presence of a higher blood glucose value, as discussed below).

Defining areas of use. The next crucial task was to identify the treatment areas in which the protocol would be used. Historically, the protocol had been applied only in acute care areas.

We identified two factors that prohibited use in other particular care areas. First, in acute care areas, the existing hypoglycemia protocol directed treatment if a patient became symptomatic; in intensive care, however, a blood glucose level of 80 to 110 mg/dL was considered optimal glycemic control, and even if the patient had symptoms of hypoglycemia, no treatment was initiated if the patient was within that range. Second, other clinical areas, such as postanesthesia care and ambulatory surgery, had no supply of the items that are necessary for hypoglycemia treatment, such as medications and necessary foods. The workgroup concluded that staff in these areas would also require education in order to use the new protocol.

Modifications. The existing protocol was further evaluated and modified to reflect current research. The revised protocol contains treatment options for the following patient categories: those who are able to swallow or have gastrointestinal (GI) access, those with IV access only or who have an order to take nothing by mouth, and those who don’t have IV access but require it.

Treatment for patients who can swallow or who have GI access reflects the ADA’s 2009 clinical practice recommendations to administer glucose 1.5 to 20 g (although any form of carbohydrate that contains glucose may be used), followed by blood glucose reassessment in 15 minutes.

Treatment for patients with IV access only or who have an order to take nothing by mouth includes the administration of 25 mL of dextrose 50% by slow (one-to-three minute) IV push, followed by repeated blood glucose testing in 15 minutes.

Treatment for patients without IV access. Patients with confusion or who are unconscious are given 1 mg glucagon (which is ordered immediately from the pharmacy) intramuscularly or subcutaneously, and IV access is ordered immediately; once a response is obtained, oral glucose can be provided. In patients with mild symptoms, IV access is ordered immediately and instructions for the second group are followed.

The protocol accounts for the fact that some patients will experience hypoglycemia symptoms when their blood glucose level is 70 mg/dL or higher. In these instances, the nurse is directed to collaborate with the provider and patient to develop a treatment plan. This provision supports individual patient needs.

It must be noted that the revised protocol doesn’t contain provisions for administering glucose tabs. Glucose tabs (15 g) are an effective treatment and can be used in place of glucose gel in patients who can swallow adequately. (Our institution doesn’t supply glucose tabs for inpatient use because they’re only available in multiple-dose packaging and our pharmacy promotes single-dose packaging only.)

Documentation of protocol use. Before we developed the new hypoglycemia protocol, we had no formal standard for documenting hypoglycemic events (which also meant there was no way to measure adherence to a protocol). Nurses are now required to document a variety of data associated with each episode of hypoglycemia, including blood glucose values, signs and symptoms, interventions used, and the patient’s response to treatment. Our organization uses an electronic medical record that supports the development of customized note templates. In an effort to promote thorough documentation, we asked nurses what information they thought was necessary; we used those preferences to develop a template for a hypoglycemia episode.

Once the protocol modifications were complete, the workgroup focused its attention on redesigning the format to ease implementation at the point of care. Staff feedback revealed several problems with the existing hypoglycemia protocol; it contained too much detail, was difficult to follow, and was too long (at two pages). To address those issues, the workgroup consulted with the Medical Media department. A one-page treatment algorithm (see Figure 1) was developed for use at the point of care. Nurses were given the opportunity to test the algorithm, and refinements were made on the basis of their feedback.

Approval process. Protocol approval was a multiple-step
**Figure 1. Hypoglycemia Treatment Algorithm**

**STEP 1**
- CBG < 70 mg/dL

**STEP 2**
- Swallows or eats or has GI access
  - Yes: Proceed to **STEP 3 A**
  - No: CBG ≥ 70 mg/dL or signs or symptoms of hypoglycemia
    - Notify provider immediately to determine treatment plan

- NPO
  - Yes: IV
  - No: Proceed to **STEP 3 B**

**STEP 3**

**A. Patient swallows or eats or has GI access**
- A1. Treat with 15 g simple carbohydrates (choose one):
  - 1 tube glucose gel (preferred)
  - ½ c (6 oz.) nondiet soda
  - ½ c (4 oz.) fruit juice
- A2. Remeasure CBG in 15 min.
- CBG < 70 mg/dL
  - Repeat A until CBG ≥ 70 mg/dL
  - (If CBG remains < 70 mg/dL after 2 attempts, notify provider)

**B. Patient has IV access only or has NPO status**
- B1. Administer 25 mL dextrose 50% by slow IV push (1–3 min.)
- B2. Flush IV after administration
- B3. Remeasure CBG in 15 min.
- CBG < 70 mg/dL
  - Administer 25 mL dextrose 50% by slow IV push (1–3 min.)
  - Flush IV after administration
  - Remeasure CBG in 15 min.
  - (If CBG remains < 70 mg/dL after 2 attempts, notify provider)

**C. No IV access**
- C1a. In patients with confusion or a loss of consciousness, prepare and administer, intramuscularly or subcutaneously, 1 mg Glucagon (ordered immediately from pharmacy) and order immediate IV (if IV started, go to C2); turn patient on side after administration to protect airway; notify provider immediately
- C1b. In patients with mild symptoms, order immediate IV and go to B
- C2. Remeasure CBG every 15 min. and go to B for treatment when IV access is obtained
- C3. Once a response to Glucagon has been obtained, provide oral carbohydrate (see A3; don’t give nutrition orally if patient has NPO status); consult with team

CBG = capillary blood glucose; GI = gastrointestinal; NPO = “nothing by mouth.”
process that included concurrent review by the Inpatient Glycemic Control Team and the CPC. Subsequently, the protocol underwent review by the hospital pharmacy and therapeutics committees. Final approval was obtained from the deputy director of Patient Care Services.

IMPLEMENTATION
After approval of the protocol, the Hypoglycemia Workgroup focused on a plan for implementation. We determined that two things were crucial for successful implementation: a process to ensure that staff had rapid access to food and medication necessary for treatment, particularly in clinical areas that hadn’t used a hypoglycemic protocol in the past; and education of the nursing staff in the use of the protocol.

perform daily inventories of appropriate food items and medications, respectively, and restock as needed.

Education. Members of the workgroup conducted 30-minute training sessions over a period of two weeks, timed to accommodate nurses on all shifts. In areas that had experience with the older protocol, the focus was on reviewing the changes. In areas unfamiliar with the old protocol, the focus was on protocol-driven hypoglycemia management. All sessions highlighted the evidence base supporting the protocol. Large posters with supporting information were displayed on the walls of each unit, as well.

Two concepts included in all education sessions were that protocols aren’t intended to replace clinical judgment and that because an individual patient’s insulin resistance or history of glucose control can vary, protocols aren’t “one size fits all” but rather “one size fits most.” Therefore, during the training sessions, an emphasis was placed on what to do if deviation from the protocol is necessary. For example, a patient has had several episodes of hypoglycemia over the past three days. Each episode has required two 25 mL doses of dextrose 50% to achieve normoglycemia. With the next hypoglycemic episode, the nurse makes the decision to administer 50 mL of dextrose 50% in a single dose. In other words, the sessions stressed, the process for deviation should be planned for and should be congruent with organizational policy.

RESULTS OF IMPLEMENTATION
As a measure of the effectiveness and safety of the protocol, we evaluated rates of severe hypoglycemia (a capillary blood glucose value of less than 40 mg/dL) before and after implementation of the new protocol. The measurement of severe hypoglycemia was selected because the protocol is aimed at timely, effective treatment—not prevention—of hypoglycemia and we therefore expected to see a reduction in rates of severe hypoglycemia. Data from two medical and two surgical units showed that in the five months before implementation, rates varied widely from month to month (on three of the four units in particular) but settled down to acceptably low levels across all four units in the five months after implementation. This suggests that implementation of the evidence-based hypoglycemia protocol was an effective and safe strategy for the management of hypoglycemic episodes in our hospital system.

DISCUSSION
This project was designed with two goals in mind. First, we wanted to develop an evidence-based hypoglycemia protocol for use across clinical areas that provides safe and effective management of hypoglycemia. Second, we wanted to develop a protocol that’s easy to implement at the point of care.

Adopting an organizational definition of hypoglycemia provided the foundation for achieving our goals and enhanced our...
ability to identify episodes of hypoglycemia and subsequently compare rates of hypoglycemia between different clinical areas. We encourage other organizations to adopt the ADA’s 2009 definition of hypoglycemia, which would allow for comparison across organizations.

Next steps. Sustaining this initial success will require the monitoring of three measures. First, monthly review of hypoglycemia occurrences at the unit level is needed to evaluate trends within and between units. Second, it’s important to ensure that the protocol is followed in order to link it to outcomes (such as the effective, timely treatment of hypoglycemia). In order to determine whether interventions and reassessment were performed as directed by the protocol, a process for evaluating the documentation of hypoglycemic events is required. Finally, evaluating posthypoglycemia blood glucose trends is vital to ensure that the protocol supports the organization’s glucose-control efforts. This specifically includes the protocol’s effect on occurrences of posttreatment hyperglycemia.

The national picture. Diabetes is most often a secondary diagnosis for patients receiving inpatient care or ambulatory services and requires appropriate treatment to prevent adverse outcomes. “Manifestations of poor glycemic control,” which include hypoglycemic coma (as well as diabetic ketoacidosis, nonketotic hyperosmolar coma, secondary diabetes with ketoacidosis, and secondary diabetes with hyperosmolarity), constitute one of 10 categories of hospital-acquired conditions selected by the Centers for Medicare and Medicaid Services that are no longer eligible for reimbursement (http://bit.ly/avZMi5). Recently, the National Quality Forum released Safe Practices for Better Healthcare—2009 Update: A Consensus Report, which also addresses glycomic control. The update specifically recommends taking “actions to improve glycomic control by implementing evidence-based intervention practices that prevent hypoglycemia and optimize the care of patients with hyperglycemia and diabetes.”

The use of an evidence-based hypoglycemia protocol facilitates the attainment of national objectives aimed at improving glycomic control and provides a mechanism for reducing barriers associated with poor hypoglycemia management. Our evidenced-based hypoglycemic protocol, standardized across clinical care areas, is contributing to safer and more effective management of hypoglycemia.

We encourage other organizations to adopt the ADA’s 2009 definition of hypoglycemia.

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