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SYMPOSIUM

Improving Hyperglycemia in the Hospital: Outcomes of a Nursing In-Service to Evaluate Acceptance of a Web-Based Insulin Infusion Calculator

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Abstract

Background:

Many insulin infusion protocols are available for clinical use. We developed a Web-based, online intravenous insulin infusion calculator (IVIIC) for use in our intensive care and medical–surgical units.

Methods:

In September 2006, we implemented a quality improvement project: an online survey to evaluate the acceptance of this protocol by the nursing staff. Of the 103 registered nurses (RNs) who participated, there was no difference among experience levels of the RNs (≥ or <5 years) or among durations that RNs had been working within their unit (≥ or <2 years).

Results:

The nurses were surveyed regarding the use and interpretation of the protocol, their comfort with, confidence in, and experience in using the protocol. More than 80% of the RNs found the protocol easy to implement, easy to interpret, and successful in controlling the blood glucose levels. Approximately 71% (±9%) of the RNs were comfortable with the tight blood glucose levels of the protocol. The nurses' confidence with the protocol was 82% (±8%), likely because 70% (±9%) of the nurses believed the training to be adequate. Significantly less than 25% of the RNs (18 ± 7%) believed it was necessary to deviate from the protocol. More than 85% of the RNs appreciated the ability to make changes at their level of practice (92 ± 5%).

Conclusions:

In summary, the IVIIC is well accepted by RNs for care of hyperglycemia in a hospital setting.

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Abbreviations: (ADA) American Diabetes Association, (BG) blood glucose, (CDE) certified diabetes educator, (CTICU) cardiothoracic intensive care unit, (D50W) 50% dextrose in water, (DKA) diabetic ketoacidosis, (HDTF) hospital diabetes task force, (HHNK) hyperglycemic hyperosmolar nonketotic coma, (HTML) hypertext markup language, (ICU) intensive care unit, (IV) intravenous, (IVI) intravenous insulin, (IVIIC) intravenous insulin infusion calculator, (IVP) intravenous push, (MAR) medication administration record, (MUSC) Medical University of South Carolina, (RN) registered nurse, (SCIP) Surgical Care Improvement Project

Keywords: diabetes, hyperglycemia, hypoglycemia, intravenous insulin, nursing, patient safety

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Introduction

There is significant evidence that improved glycemic control in critical care leads to reduced morbidity and mortality.[1–4] Hyperglycemia in hospitals is prevalent: 38% of all patients hospitalized have hyperglycemia and, of those, 26% have diabetes and 12% have hyperglycemia.[5] Current recommendations of the American Diabetes Association (ADA) suggest that blood glucose (BG) values for the critically ill should be 110 mg/dl (6.1 mmol/liter) and generally <180 mg/dl (10 mmol/liter).[6] The American Association of Clinical Endocrinologists/The American College of Endocrinology guidelines for BG levels suggest 80–110 mg/dl for intensive care unit (ICU) patients.[7] For noncritically ill hospitalized patients, the ADA recommends targets for premeal BG of 90–130 mg/dl (5.0–7.2 mmol/liter), with a midpoint of 110 mg/dl, and postprandial BG <180 mg/dl.[6] These BG guidelines complement the efforts of national programs such as the Surgical Care Improvement Project (SCIP), which were created to reduce surgical complications by 25% by 2010.[8] At our institution, SCIP reporting is required for cardiac surgery patients: BG values are to be reported at 6 a.m. for postoperative days 1 and 2. Therefore, pressure exists to keep BG values <200 mg/dl for those 2 postoperative days. These goals have become a standard of care in most hospitals; frequently, an intravenous insulin (IVI) protocol is a suitable option for achieving BG goals.

Choosing an optimal IVI protocol involves consideration. There is concern about burdening the nurses' workload by increasing the frequency of BG monitoring. Also, the cost of purchasing and implementing a preexisting computerized IVI protocol is important. Time and commitment are involved in networking and training in the implementation of a house-wide IVI, in addition to the acceptance and compliance by medical staff regarding an IVI. Often, a generalized attitude of resistance to change and fear of hypoglycemia must be addressed and overcome. Finally, a computer-based system must be updated to evaluate outcomes of glycemic control and safety.[9]

Background

Design of Intravenous Insulin Infusion Calculator (IVIIC)

Our hospital diabetes task force (HDTF), a multidisciplinary team involving physicians, nurses, pharmacists, dieticians, and other medical personnel, identified five desirable protocol characteristics for our IVI.[10] These characteristics included physician ordering (requiring only a signature), ability to reach and maintain BG target range, low risk for hypoglycemic events, adaptability for use anywhere in the hospital setting, and acceptance and implementation by the nursing staff.[11]

The protocols used by Amarillo medical specialists (Amarillo, Texas), Dr. Joseph B. Hawkins in Fresno California, and the Georgia Hospital Association (based on the Atlanta Diabetes Associates protocol) best matched the desired characteristics.[12–14] Based on these protocols and after a thorough review of the literature, an intravenous insulin infusion calculator was developed for use at the Medical University of South Carolina (MUSC).

Nursing Perception of IVI

Before development began, in-house certified diabetes educators (CDEs) observed and then interviewed the nursing staff who actually carried out the existing IVI protocols that were being used before implementation of the IVIIC. These observations and interviews were conducted in the cardiothoracic intensive care unit (CTICU) at MUSC. Additionally, through a chart audit of 15–20 charts to review the previous intravenous (IV) insulin protocol, it became apparent that many nurses previously went "off protocol" to avoid hypoglycemia. The HDTF discussed at length the nursing observational findings and developed the following plan.

- A presentation would be made to the nursing staff regarding pertinent findings from the medical literature about the importance of tight glycemic control and this literature would be available to them.[15]
- The nurses would receive a detailed summary about factors affecting a hypoglycemic state and the subsequent outcome to overcome hypoglycemia concerns.[16]
- A nurse leader was identified by the nurse manager of the CTICU to act as a nurse champion to assist with the development and implementation of all aspects of this protocol.[17]
- The HDTF would place nursing autonomy as a focus of the protocol development.
- The nurses would receive extensive educational in-services.

The HDTF was successful at implementing this plan and presented data collected during a trial period in the CTICU to the medical executive committee at MUSC. It was then decided to implement the IVIIC protocol to all floors and units of the hospital, in sequential order. Our team was tasked with starting in the most needed areas first.

Protocol Development

A preprinted order set was developed and placed on the MUSC Web site that provided a direct link to an online calculator called the IVIIC. The IVIIC was designed to minimize the complexity of the calculations for nursing, thereby reducing errors in rate adjustments.[18] This protocol was launched by signature of a provider for every patient individually.

The order set and the calculator are based on the following parameters[10]:

- Target BG level: 80–120 mg/dl
- Start infusion for a random BG value >120 mg/dl
- Infusion is 250 units regular insulin/250 mg 0.9% NaCl
- IVIIC formula is 0.03 (multiplier) × (current BG – 60) = rate of insulin units/hour
- BG level is checked every 1–2 hours (or more frequently), and the IVIIC recalculates the infusion rate as follows:
  - » BG value is >120 mg/dl and BG decreases by ≥15%: multiplier remains the same
  - » BG value is >120 mg/dl and BG decreases by <15%: increase multiplier by 0.01
  - » BG value is >120 mg/dl and BG increases: increase multiplier by 0.01
  - » BG value is >80 mg/dl and <120 mg/dl: multiplier remains the same
  - » BG value <80 mg/dl: decrease multiplier by 0.01
- IVIIC will direct the nurse to treat the patient for hypoglycemia as follows:
  - » BG = 60–69 mg/dl, give 15 ml 50% dextrose in water (D50W) intravenous push (IVP), recheck in 15 minutes, and repeat as needed
  - » BG = 50–59 mg/dl, give 20 ml D50W IVP, recheck in 15 minutes, and repeat as needed
  - » BG = 30–49 mg/dl, give 25 ml D50W IVP, recheck in 15 minutes, and repeat as needed
  - » BG <30 mg/dl, give 30 ml D50W IVP, recheck in 15 minutes, and repeat as needed
- The IVIIC will direct the nurse to set the infusion rate to zero at a BG value of 65 mg/dl.

Programming language for the calculator is in Java Script.[10] The Web interface for the calculator code is in hypertext markup language (HTML).[10]

User Interface

The Web interface that nurses used for the calculator code is in HTML (**Figure 1**). A pop-up screen is used at the patient bedside computer. The user interface was formatted to obtain clinical information from the nurse and then programmed to advise the nurse on how to proceed.[19] The nurse would input the current BG value, the past 1-hour BG value, and the current multiplier. Then the IVIIC would calculate the insulin infusion rate and the new multiplier and output that data for the nurse to read.

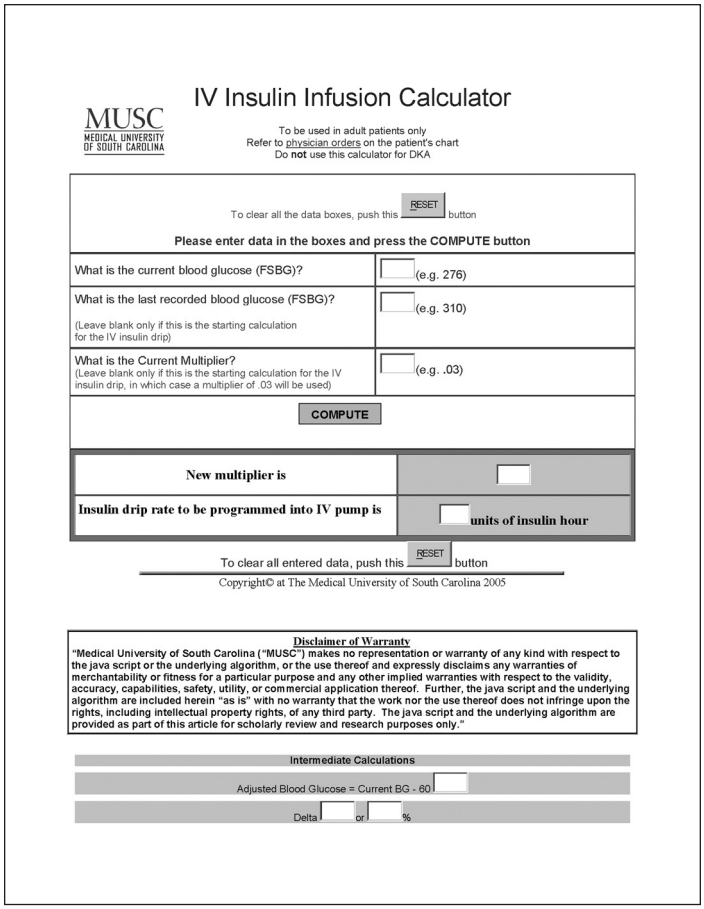


Figure 1. Intravenous insulin infusion calculator form.

Subjects and Methods

The adult MUSC Hospital Center is a 709-bed facility, with six medical–surgical units, an emergency room, and a labor and delivery unit. Six ICUs were trained to use the IVIIC, and training occurred from July 2006 to August 2006. The hospital pharmacy prepares all insulin drips at our institution, but at many smaller hospitals, the nurses mix the insulin infusion.

In September 2006 we implemented a quality improvement project, an online survey to evaluate the acceptance of this protocol by the nursing staff in the ICUs and medical–surgical units. RN CDEs developed the questions and nurses were invited by email to take the survey and were reminded of the survey at a nursing leadership meeting. Due to the simplicity of this questionnaire, no cross-check questions were included. This study was approved by the MUSC Institutional Review Board and informed consent was waived for participants. Of the 511 RNs asked to complete the survey, 103 RNs participated. There was no difference among experience levels of the RNs (≥ or <5 years) or in time in which they had been working on their unit (≥ or <2 years). This was the only demographic datum collected by this survey.

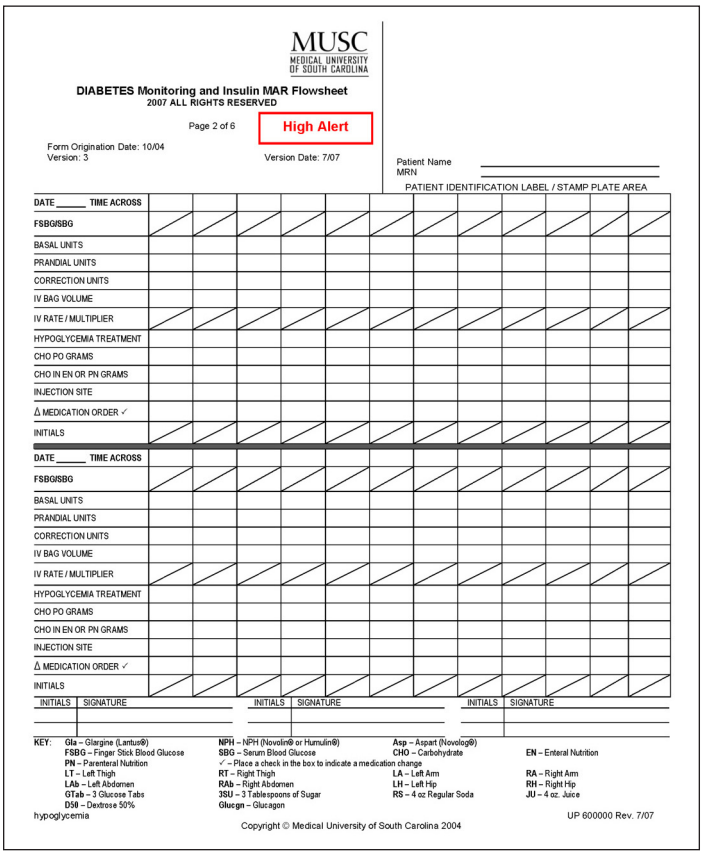
Education of Nurses

The same barriers to implementing the IVIIC protocol in the CTICU existed on all other units. These barriers were addressed to promote safe and efficient launch of the IVIIC.[20] Some of the barriers found were as follow: the skepticism of the nurses that this IV insulin protocol would work better than the previous protocol, the perceived increase of nursing time required to carry out this protocol, the nurses' fear of hypoglycemic events, the need for hourly BG checks, and flushing the IV tubing with 50 ml of insulin solution before using the IVIIC.

An attempt was made to address these barriers before implementation of the IVIIC. A similar plan as that conducted in the CTICU was used throughout the remainder of the hospital. Emphasis was placed on increasing nursing autonomy and this protocol was primarily "nurse driven." This concept was the greatest aid in acceptance by the nursing staff.

It was important to educate the nurses and key medical personnel regarding use of the IVIIC protocol. Many in-service sessions were conducted to outline the protocol and to troubleshoot any difficulties.[21] The key champion for training the nurses was a hospital RN CDE who was instrumental in obtaining in-hospital nursing support for the Web-based calculator. A series of 30- to 60-min in-service sessions were conducted for nursing staff on each unit before the IVIIC was launched. To ensure that these in-services were presented to as many staff as possible, the sessions were repeated at least two times for each shift. These sessions included training on the use of the IVIIC, standards for frequency of BG monitoring, standards for treatment of any BG <70 mg/dl, and basic diabetes information. A PowerPoint case presentation was made available to members of the nursing unit before use of the IVIIC. The hospital CDEs and endocrine attending physicians/fellows on call were available by pager for assistance with questions relating to the IVIIC.

The alerts for hypoglycemia were explained to the nurses to ensure patient safety. The importance of assessing hourly BG levels was stressed during the intensive training provided by the hospital CDEs. Flow sheets were developed so that the IVIIC multiplier and the insulin infusion rate could be charted along with the BG readings on the diabetes monitoring and insulin medication administration record (MAR) flow sheet (**Figure 2**). A cross-check to the insulin MAR was that two RNs must sign off on any insulin order. Any protocol deviations were captured by the CDE surveillance system


MUSC
MEDICAL UNIVERSITY OF SOUTH CAROLINA

DIABETES Monitoring and Insulin MAR Flowsheet
2007 ALL RIGHTS RESERVED

Page 2 of 6 High Alert

Form Origination Date: 10/04
Version: 3

Version Date: 7/07

Patient Name
MRN

PATIENT IDENTIFICATION LABEL / STAMP PLATE AREA

DATE _____ TIME ACROSS
FSBG/SBG
BASAL UNITS
PRANDIAL UNITS
CORRECTION UNITS
IV BAG VOLUME
IV RATE / MULTIPLIER
HYPOGLYCEMIA TREATMENT
CHO PO GRAMS
CHO IN EN OR PN GRAMS
INJECTION SITE
Δ MEDICATION ORDER ✓
INITIALS

DATE _____ TIME ACROSS
FSBG/SBG
BASAL UNITS
PRANDIAL UNITS
CORRECTION UNITS
IV BAG VOLUME
IV RATE / MULTIPLIER
HYPOGLYCEMIA TREATMENT
CHO PO GRAMS
CHO IN EN OR PN GRAMS
INJECTION SITE
Δ MEDICATION ORDER ✓
INITIALS

INITIALS | SIGNATURE
INITIALS | SIGNATURE
INITIALS | SIGNATURE

KEY: Gla – Glargine (Lantus®) NPH – NPH (Novolin® or Humulin®) Asp – Aspart (Novolog®)
FSBG – Finger Stick Blood Glucose SBG – Serum Blood Glucose CHO – Carbohydrate EN – Enteral Nutrition
PN – Parenteral Nutrition ✓ – Place a check in the box to indicate a medication change
LT – Left Thigh RT – Right Thigh LA – Left Arm RA – Right Arm
LAb – Left Abdomen RAb – Right Abdomen LH – Left Hip RH – Right Hip
GTab – 3 Glucose Tabs 3SU – 3 Tablespoons of Sugar RS – 4 oz Regular Soda JU – 4 oz. Juice
D50 – Dextrose 50% Glucgn – Glucagon
hypoglycemia

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UP 600000 Rev. 7/07

Figure 2. Diabetes monitoring and insulin medication administration record flow sheet.

for hypoglycemia and hyperglycemia. If any patient had one BG value <40 mg/dl, two BG values <70 mg/dl, or one BG value >300 mg/dl over a 24-hour period, a CDE chart check was performed and, if necessary, individual nurses using the IVIIC improperly were identified and were further educated on use of the IVIIC. If patients had hourly BG readings, then it was assumed they had been on the IVIIC. The best tool used to assess the effectiveness in training nurses on the use of the IVIIC protocol was CDE surveillance for hypoglycemia and hyperglycemia. A patient treatment course was not retained in the computer memory or linked to patient identifiers; however, it was part of the permanent medical record as recorded on the diabetes monitoring and insulin MAR flow sheet. A limitation of the IVIIC was that the calculator takes one time point at a time and does not retain sequential data unless the nurse minimizes it on the computer screen after the entry is made. Finally, emphasis was placed on the importance of safety regarding the use of the IVIIC in terms of patient quality and the reduction of medication errors made by nursing.

Because technical precision is critical to execute the IVIIC properly, a nursing pearls card was developed to highlight important elements and offer solutions to potential problems (**Figure 3**). Salient features of the nursing pearls were to deliberately waste 50 ml of the insulin solution initially from the IV insulin infusion bag, which was done with each new bag hung. Hourly BG assessments were important for the prevention of hypoglycemia. If the insulin infusion was turned off, infiltrated, or interrupted, it would be restarted as the "initiation" calculation.

Questionnaire

We developed an online survey to obtain nursing feedback over a 60-day period from September 2006 to October 2006 regarding their acceptance of the IVIIC (**Figure 4**). The survey instrument was developed by RN CDEs and the questions were reworded by our statistician for scoring and validity. Responses were dichotomized by the proportion of agree and strongly agree versus the proportion of disagree and strongly disagree. The survey was designed to be simple and rapid, requiring fewer than 5 minutes to complete. Some questions on the survey included the following: was it easy to implement interventions on a consistent basis, were they comfortable with the tight control over the BG values required by the protocol, and was the in-service training for this protocol adequate? Other questions included demographics such as on what unit were they working, for how long, how many years were they a RN, were they unit staff or hospital pool, had they used the protocol before, and did they know about the protocol before they used it?

- IV insulin is a STAT order
- Flush all NEW tubing with 50 ml of the insulin solution and then waste
- Check finger stick blood glucose (FSBG) every 60 minutes in all areas of the hospital except as written in the protocols for labor and delivery and the operating room
- Collect FSBG from an arterial line or by finger stick
- Edematous patients, those with poor peripheral blood circulation, and those with hemoglobinopathy symptoms may have erroneously low FSBG readings
- If FSBG is low or appears out of context, consider repeating FSBG or collect serum blood glucose
- **The risk of hypoglycemia may be reduced by using D5 solution as the primary maintenance fluid that the insulin solution runs into**
- Treat hypoglycemia as directed by the online calculator
- After treating for hypoglycemia, recheck FSBG in 15 minutes and use FSBG for new calculation
- When tube feeds or parenteral nutrition is stopped or started (a rapid change in FSBG can be anticipated) increase FSBG checks to every 30 minutes for the next 2 hours
- If the patient is on oral nutrition, verify that there is an order for subcutaneous-nutritional insulin coverage
- If the patient is receiving nutrition without nutritional insulin coverage, anticipate a rapid increase in FSBG for about 2 hours and then a sudden drop
- Run the insulin infusion through a separate channel of the IV pump and connect to the maintenance fluid closest to patient
- It is preferred that no other solutions be run below or above the IV insulin infusion in the same vein
- If the insulin infusion is turned off, infiltrated, or interrupted, it must be restarted as the "Initiation" calculation
- If the patient is on insulin infusion and is receiving **plasmapheresis** for type B insulin resistance syndrome or any other reason, call diabetes management service for recommendation of possible adjustment to the insulin infusion rate/multiplier (once insulin receptor autoantibodies are removed the patient may experience severe and rapid hypoglycemia)
- Record the FSBG results and the "current or starting" multiplier on the appropriate flow sheet
- For cardiothoracic surgery patients: At breakfast or supper closest to ≥72 hours postop make sure there is a written order to transition patient from IV insulin to subcutaneous insulin
- Record justification for any nursing decisions that affect this protocol on the appropriate flow sheet

Figure 3. Nursing pearls. IV insulin infusion calculator.

Results

All results are reported means ± standard error with confidence intervals set at 95%, and the response rate for the survey was 20%. Approximately two-thirds of the RNs were using the protocol for the first time (63.1 ± 9.3%) and about half of the RNs had prior knowledge of the protocol (48.5 ± 9.7%). The nurses were surveyed regarding the use and interpretation of the protocol and their comfort, confidence, and experience in using the protocol. More than 80% of the nurses found

Survey Questions

1. **This protocol allows me to easily implement interventions on a consistent basis.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
2. **There were no errors in implementing this protocol during this shift.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
3. **I was not comfortable with the tight control over blood glucoses that this protocol required.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
4. **The protocol is difficult to interpret.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
5. **The in-service training for this protocol was adequate.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
6. **The protocol does not successfully control the blood glucose levels.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
7. **I have a high level of confidence in this protocol.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
8. **I like the ability to make clinical changes at my level of practice.**
   a. Strongly Agree
   b. Agree
   c. Disagree
   d. Strongly Disagree
9. **Did you feel that it was necessary to go off the protocol?**
   a. Yes
   b. No
10. **If you answered "YES" to question 9, please explain the circumstances.**
11. **Please make comments on particular areas of this IV insulin infusion protocol that are unclear or may need revision. Please be detailed in your response.**
12. **How long have you worked on your unit?**
13. **How many years have you been an RN?**
14. **Have you used this protocol before?**
    a. Yes
    b. No
15. **Did you know about this protocol before you used it?**
    a. Yes
    b. No

Figure 4. Online survey.

the protocol easy to implement, easy to interpret, and successful in controlling the BG value. Approximately 71% (±9%) of the RNs were comfortable with the tight BG control of the protocol.

The nurses' confidence with the protocol was 82% (±8%), likely because 70% (±9%) of the RNs felt that the training was adequate. Significantly less than 25% of the RNs (18 ± 7%) felt that it was necessary to deviate from the protocol. Reasons for deviating from the protocol included using supplemental medicines mixed in D5W or using bolus tube feedings. However, there was no standardized hospital policy that covered adjustments that needed to be made when carbohydrate exposure changed. There were guidelines on some units that addressed alterations to be made in insulin dosing when using enteral or total parenteral nutrition. More than 85% of the RNs liked having the ability to make changes at their level of practice (92 ± 5%).

Discussion and Conclusions

The IVIIC is well accepted by nurses for care of hyperglycemia in a hospital setting. The IVIIC protocol is currently being used at MUSC in all the critical care units, labor and delivery, and on the majority of the medical–surgical floors. Nursing satisfaction is high for the IVIIC because it promotes autonomy for the nurses, is easy to use, and controls BG successfully.

There were some limitations to this study. Because this was a retrospective study, nursing input was obtained after implementation of the Web-based protocol rather than before. Outcomes from this study were dependent on RNs entering their findings; therefore, if no data were entered or if data were entered in error, this would have adversely affected the outcomes of the study. The small sample of 103 RNs included no control group utilizing the previous intravenous insulin protocol used at our institution. However, the objective of this study was not to show superiority of this protocol compared to another, rather it was to obtain nursing feedback regarding use of the calculator and to assess nursing satisfaction with a Web-based program to control hyperglycemia. The IVIIC has demonstrated significantly reduced hyperglycemia (BG >180 mg/dl and BG >250 mg/dl) and significantly increased percentage of hours at BG target (80–120 mg/dl).[10] There was no overall assessment of nursing competency in utilizing the protocol. However, the CDEs performed daily 24-hour BG surveillance for hypoglycemia and hyperglycemia, which provided further identification for errors made while using the

IVIIC. Therefore, a protocol deviation could be detected and the nurse using the calculator could be identified and given further instruction on proper use of the IVIIC.

Outcomes from this study demonstrate nursing satisfaction with a Web-based IVIIC and support the idea that a novel insulin infusion protocol-driven standard of care may achieve tight glycemic control by a well-supported intervention.

Since this study, we have made several upgrades to the MUSC IVIIC. There is now a choice of BG target ranges to match the level of care and those targets are as follow: ICU (80–110 mg/dl), labor and delivery (70–110 mg/dl), adult medical surgical floors (80–140 mg/dl), diabetic ketoacidosis (DKA)/hyperglycemic hyperosmolar non-ketotic coma (HHNK) (150–200 mg/dl), neurosurgery ICU (90–120 mg/dl), and perioperative patients (140–180 mg/dl). These BG targets were created to satisfy the clinical requests of specific departments at our institution. We have restricted starting the multiplier for DKA/HHNK at 0.01 to endorse a slower rate of change and starting the multiplier for all others at 0.03. There are pop-up warnings in the Web-based application for decimal placement errors if the multiplier is greater than 0.2. The warning instructs the user to correct the decimal placing and to repeat the calculation. The intention of the change was to reduce the error of misplaced decimals that was occurring across the different hospital services. A change to the calculation was made as follows: in the previous version, the multiplier would drop by 0.01 when the fasting BG value decreased below the specific target range. In the current version, the multiplier will decrease by 0.01 at 20 mg/dl higher than the previous level. This change was made with the intention of reducing the frequency of mild hypoglycemic events and to slow the rate of a rapidly declining BG value.

Nursing acceptance of the MUSC IVIIC was based on a nursing culture of standardized care while endorsing evidence-based medical practice.[15–17] It was important to encourage nursing to utilize a protocol-driven approach regarding the IVIIC. Resistance from the nursing staff was overcome by creating nurse champions for this project, familiarizing the nurses with studies endorsing tight glycemic control, overcoming a fear of hypoglycemia, and promoting nurse autonomy with a nurse-driven insulin infusion protocol. The CDEs were critical in monitoring the IVIIC use and providing ongoing education for the nursing staff, and CDEs used point-of-care testing BG data to indicate when errors were made. In addition, nursing educational preparation, perceptions, and experience with the IVIIC were addressed due to staff turnover so new nurses were trained appropriately on the use of the IVIIC before using it. We are currently upgrading our in-hospital system to an electronic medical record, which will precipitate an upgrade for the IVIIC so that it may retain sequential data and store patient identifiers. Once the IVIIC is upgraded, we will conduct another survey.

In summary, it is important to continually educate staff about the importance of inpatient intensive glycemic control and to develop evidence-based protocols that hospitals can use to achieve their standards of care. It is recommended to choose an intravenous insulin infusion protocol accepted by the medical staff. Hospitals must select their glycemic targets, endorse safety against hypoglycemia, and choose an intravenous insulin protocol that best matches their requirements to enhance patient safety and quality of care.

Disclosure:

Kathie Hermayer is on the Speaker's Bureau for sanofi-aventis, Novartis, NovoNordisk, and Eli Lilly and is a primary investigator (PI) for a sanofi-aventis clinical drug trial with Rimonabant and the PI on an American Diabetes Association grant. Tim Hushion has a "Metabolism Speaker Services Agreement" with sanofi-aventis and is participating on an ADA grant. Pam Arnold is on the Speaker's Bureau for sanofi-aventis and NovoNordisk. She is on the CDE advisory board for CDEs for Bayer Pharmaceuticals.

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