Fall 12-12-2015

Improving Management of Inpatient Blood Glucose

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August 2015

Abstract

Epidemiologic studies indicate blood glucose management in the hospitalized patient population is not adequate; with approximately 30% of patients reporting values >180mg/dl. Patients with increased blood glucose levels pose a higher mortality risk as well as increased risks for dehydration, hypotension, renal injury, decreased wound healing, immunosuppression, and an overall increase in hospital length of stay (AACE, 2015). This project aims to improve inpatient management of blood glucose levels by facilitating MD-RN communication through a reduction in the current reportable blood glucose level. This project took place on a 17 bed adult medical-surgical unit at a large academic hospital in the San Francisco Bay Area. Data collection demonstrated hypoglycemia rates of 1.85%, normoglycemia rates of 56.5%, and hyperglycemia rates of 41.6%, which lead to the implementation of a new addition to the subcutaneous insulin order-set. Education regarding this new order has been provided to the medical-surgical staff nurses in addition to the conduction of a formal presentation to the Nurse Educator Forum and Diabetes Champion Committee for hospital wide dissemination.

Improving Management of Inpatient Blood Glucose

Clinical Leadership Theme

This project aims to highlight the role of the Clinical Nurse Leader (CNL) as a Team Manager by designing, implementing, and evaluating bedside point of care provided on a general care medical-surgical unit at a large academic teaching hospital in the San Francisco Bay Area. This project will focus on the CNL curricular element of Clinical Outcomes Management through the utilization of an existing database to analyze and aggregate care outcomes for the microsystem to drive changes in nursing practice and improve patient outcomes by improving inpatient blood glucose management.

Statement of the Problem

The American Association of Clinical Endocrinologists (2015) state that epidemiologic studies indicate blood glucose management in the hospitalized patient population is not adequate; with approximately 30% of patients reporting values >180mg/dl. Patients with increased blood glucose levels pose a higher mortality risk as well as increased risks for dehydration, hypotension, renal injury, decreased wound healing, immunosuppression, and an overall increase in hospital length of stay (LOS).

Nurses on the general care medical-surgical unit care for a variety of patients with multifaceted medical needs, including those with Complicated Diabetes Mellitus. Data gathered from bedside glucometers has been aggregated into percentage values to better identify monthly trends of hypoglycemia, normoglycemia, and hyperglycemia within the microsystem. The analyzed data identified average hypoglycemia rates of 1.85%, normoglycemia rates of 56.5%, and hyperglycemia rates of 41.6%. These numbers fall well below the institutional target of maintaining normoglycemia rates of 85% on the general care units.

In an attempt to combat the issue of mismanaged dysglycemia, this project will focus on lowering the current standard Provider notification threshold glucose level as well as enhancing the current subcutaneous insulin order-set with the addition of a new nursing communication order. This new standard of reporting will require nurses to notify Providers of trends in hyperglycemia that may otherwise go untreated.

Literature Review

For patients admitted to the medical-surgical unit, how does lowering the current reportable glucose level to >300mg/dL compare to the current standard of only reporting levels >400mg/dL affect the total number of recorded hyperglycemic (>180mg/dL) episodes within the next 6 months.

In an attempt to answer this question and thoroughly investigate the importance of inpatient blood glucose management and its influence on diabetes related health outcomes, an electronic review of the literatures was conducted utilizing the databases CINAHL, Medline, and Google Scholar for articles published between the years 2000 and 2015 with no limits applied to study type. The initial key term searched was "inpatient blood glucose management" which yielded over 32,000 articles. The key term search was then further refined by using the terms "inpatient blood glucose", "inpatient hyperglycemia", and "inpatient glycemic target" which yielded a total of 69 related articles that were relevant to the stated question. Of those 69 articles, 6 have been chosen as primary supporting evidence for this project.

The literary consensus amongst the experts is that management of inpatient blood glucose is a serious matter which has a significant impact on patient care outcomes if left unaddressed. Diabetes mellitus ranks as one of the most costly chronic conditions with an estimated associated care cost of $40 billion per year (Patel & Doughty ,2008). Along with this severe financial

burden to the US healthcare system, inpatient dysglycemia has also been associated with

increases in mortality, hospital associated complications, readmission rates, and hospital length

of stay(Schmeltz, 2010).

In response to this, the American Association of Clinical Endocrinologists (2015) have

published a consensus statement highlighting recommendations for the treatment of inpatient

dysglycemia. The AACE endorses the need to identify inpatient elevations in glucose, utilization

of a multidisciplinary approach to inpatient diabetes management, implementation of structured

protocols glucose control, and the creation of education programs for hospital staff charged with

caring for dysglycemic patients (Schmeltz, 2010). The AACE also outlined their recommended

inpatient prandial glucose targets to be below 140mg/dL and all random glucose levels to be

below 180mg/dL (Moghissi et al., 2009). Oftentimes, this is difficult to achieve considering the

majority of inpatients with dysglycemia have been admitted to the hospital with a more pressing

primary problem, resulting in glycemic management falling to the wayside.

The best way to achieve proper inpatient glucose management is through the use of basal-

bolus insulin dosing and maintaining recommended best practice techniques when collecting

blood glucose samples (Louie, Tang, Sutton, et al., 2000). To accomplish this, it is important for

multidisciplinary collaboration to occur between physicians, nurses, and pharmacists to promote

education and increase awareness of the need for, and desire to change current cultural practices

(Moghissi, 2010).

Rationale

To better assess the current state of blood glucose management on the medical-surgical

unit, an analysis of daily data collected by bedside point of care glucometers was performed.

This data is readily available to all hospital employees via the diabetes team care site found

within the hospital's intranet. The collected data is aggregated at the end of each month, broken down by department, and categorized as either hypoglycemic (<70mg/dL), normoglycemia (71mg/dL-180mg/dL), or hyperglycemic (>181mg/dL). The aggregated data for the medical-surgical unit for the months of April 2015 – June 2015 indicate mean hypoglycemia rates of 1.85%, normoglycemia rates of 56.5%, and hyperglycemia rates of 41.6% (Appendix G).

To investigate barriers that may have contributed to these results, a 5 question survey was distributed to the nurses on the medical-surgical unit. Survey results yielded an 80% response rate that indicated a lack of understanding regarding proper management of inpatient blood glucose, uncertainty of when to notify the physician of poor glucose management due to confusion surrounding current insulin order-set (Appendix E). Results of data analysis and staff survey were discussed with the Diabetes Nurse Education Specialist and resident Endocrinologist to demonstrate a need for action to improve diabetes related patient outcomes. The multidisciplinary team validated the need for the project's implementation and encouraged the utilization of a cause and effect (Appendix B) analysis and SWOT analysis (Appendix C) to identify any potential barriers and strengths prior to moving forward with the proposed interventions.

Cost Analysis

Estimated time spent towards project implementation will be approximately 200 hours that includes research, intervention development and implementation, stakeholder meetings, staff education, data analysis, and generating reports. Working on this project as a graduate student will result in zero monetary compensation needed from organization with an associated compensatory cost of $0. As a result, the institution will greatly benefit from the implementation

of this project based on the potential cost savings associated with improved inpatient glycemic management.

To aid in the business case for this project, a literary review produced evidence to illustrate the financial incentives associated with proper inpatient glucose management. A study performed at a large teaching hospital in Virginia found a correlation in the frequency of catheter-associated urinary tract infections (CAUTI), central line infections (CLABSI), ventilator associated pneumonia (VAP), and surgical site infections (SSI) (Fogel & Baker, 2013) with decreased blood glucose levels. For some financial perspective, Scott (2009) estimates costs associated with various healthcare associated infections to be: $754 per CAUTI, $10,443 per SSI, $22,939 per CLABSI, and $25,072 per VAP.

Similar conclusions have also been met by the American Association of Clinical Endocrinologists and American Diabetes Association. A 2009 article summarized various studies like the Portland Diabetic Project that found an achievement in target blood glucose levels reduced the prevalence of sternal wound infections by 66% which resulted in a savings of approximately $4,638 per patient (Moghissi, et al, 2009). The same article also cited another study conducted at a large tertiary care trauma center which found that a reduction in the organization's monthly mean blood glucose level by 26mg/dl resulted in a substantial decreased in length of stay (LOS) with an associated cost savings of over two million dollars per year (Moghissi, et al, 2009).

In light of study results such as these, it is important to consider that effective October 1, 2008 the Centers for Medicare and Medicaid (CMS) will no longer reimburse for certain Hospital Acquired Conditions, including manifestations of poor glycemic control (CMS, 2014). This pertains to specific conditions such as diabetic ketoacidosis (DKA), nonketotic

hyperosmolar coma, hypoglycemic coma, secondary diabetes with ketoacidosis, and secondary

diabetes with hyperosmolarity.

While monetary gain is always a driving force in quality improvement, the primary aim

of this project is to improve patient outcomes. As nurses, the primary concern is always for the

health and wellbeing of the patients. If the organization can make financial gains from a nurse

driven practice change, that is a bonus that will rank second to improving patient outcomes.

Project Overview

This project took place at a large teaching hospital in the San Francisco Bay Area. The

institution is comprised of a multitude of unique microsystems that service an extremely diverse

patient population. The microsystem of focus for this project is a 17 bed general care medical-

surgical unit dedicated to the care of adult patients ages 18-100+ who present with a variety of

medical needs. Common diagnosis observed within the microsystem include Diabetes Mellitus,

Cystic Fibrosis Related Diabetes (CFRD), Adult Cystic Fibrosis, transplant rejection, chronic

renal failure, and liver failure. The majority of patients are admitted directly from the

Emergency Department or transferred from sister units with a higher level of care.

The unit is comprised of a core staff of 26 registered nurses, 6 nursing assistants, 4 unit

secretaries, and the patient care management team who work closely with their multidisciplinary

colleagues to provide holistic patient centered care. The majority of nurses on the medical-

surgical unit are recent nursing graduates with <5 years of experience, hailing from a variety of

specialty backgrounds with varying levels of nursing expertise.

Based on literary evidence citing the importance of reducing inpatient blood glucose

levels, the aim of this project is to improve blood glucose management in patients admitted to the

medical-surgical unit by decreasing the reportable blood glucose threshold from >400mg/dL to

>300mg/dL in addition to enhancing the current subcutaneous insulin order-set with the addition

of a nursing communication order that will instruct nurses to "notify MD of 3 blood sugar levels

>250mg/dL in 24 hours."

Methodology

Utilizing the PDSA (Plan-Do-Study-Act) model, the improvement process began by

gathering 3 months' worth (April 2015 – June 2015) of baseline blood glucose data collected by

bedside point of care glucometers on the medical-surgical unit to assess current rates of

hypoglycemia (<70mg/dL), normoglycemia (71mg/dL-180mg/dL), and hyperglycemia

(>180mg/dL). Concurrently, a survey was distributed to the staff nurses and informal interviews

were conducted in an attempt to identify barriers in treating inpatient dysglycemia (Appendix D).

Data gathered from the survey and interview questions promoted a change to the current

default insulin order-set that was proposed for implementation. The current standard of practice

on the medical-surgical unit is for the nurse to check a patient's blood glucose level within 1

hour prior to eating a meal, or as ordered by the Provider. Based on the blood glucose level, the

nurse will open the Electronic Medication Administration Record (EMAR) and determine the

type and dose of subcutaneous insulin to administer based on the ordered insulin sliding scale.

Located within the sliding scale insulin administration order is a comment that states to give the

ordered insulin based on the patient's blood glucose level and to notify the MD of a blood

glucose level >400mg/dL.

This order to "notify MD if blood glucose >400mg/dL" has led to confusion amongst the

nurses who believe the Provider should be notified at a lower threshold (Appendix E) but fail to

do so because of this communication order. This failure to notify the Provider of blood glucose

levels that are not adequately maintained has resulted in overall poor management of inpatient glucose on the medical-surgical unit.

In order to improve the management of inpatient blood glucose on the medical-surgical unit, the proposed change to decrease the reportable blood glucose threshold from >400mg/dL to >300mg/dL was discussed with the Diabetes Nurse Education Specialist, MD's on the Inpatient Endocrinology Service, and the nursing lead Diabetes Champion Committee members. Debate between the nurses and the Endocrinologists regarding this threshold reduction has yet to reach a consensus. However, all were in agreement with the proposed addition of a nursing communication order which specifies to "notify MD of 3 blood sugar levels >250mg/dL in 24 hours."

The next step in the change process was to submit an EPIC (EHR) ticket with the proposed order-set change. Collaboration with the Senior Clinical Nursing Informatics Specialist saw the implementation of the proposed change July 20th following approval of clinical experts. A mid-project assessment occurred August 1st to evaluate the status of the project and identify any barriers they may prevent a timely completion. The project will conclude at the end of the calendar year with the collection of 3 months' worth of data (post change implementation) collected by bedside point of care glucometers on the medical-surgical unit to compare new rates of hypoglycemia, normoglycemia, and hyperglycemia.

This process is expected to improve inpatient blood glucose management through the achievement of normoglycemia rates of 65% or higher for 3 months, reducing hyperglycemia rates to 35% or lower for 3 months, and maintaining the current rates of hypoglycemia for 3 months. Accomplishing these target goals will lead to an improvement in overall patient

outcomes, decrease the average length of stay, and reduce costs associated with poor glucose management.

Change Theory

The change theory utilized throughout this project is Lewin's Change Management Model Theory. Lewin's Model successfully accomplishes change through the completion of three phases: unfreezing, moving, and refreezing (Kritsonis, 2005). These phases focus on strengthening contributing factors that will support the proposed change as well as restricting factors that may interfere with the proposed change.

During the unfreezing phase, surveys were sent out and informal interviews were conducted with the medical-surgical staff nurses in an effort to better understand their perceived barriers to adequate inpatient diabetes management. Based on results of the survey and interviews, many of the nurses articulated that their current practice is woefully inadequate when it comes to managing blood glucose levels. Almost all expressed desire for more education regarding diabetes management to result in the best possible outcomes for their patients. This response indicates that the staff nurses successfully accomplished the unfreezing phase by demonstrating readiness for change and willingness to improve the current standards of practice.

The moving phase of Lewin's Change Model commenced when the proposed change is implemented and education was provided to the staff nurses regarding the new change in practice. Following successfully implementation, the refreezing phase will begin with the incorporation of the change into daily workflow. For this phase to be successful, follow-up education will be provided to the staff nurses along with data visualization to demonstrate either the success or failure of the change. If the post intervention data indicates a statistically

significant improvement, the staff nurses will be more likely to "refreeze" their behavior to ensure a permanent practice change

Timeline

The project began May 2015 with the collection and analysis of monthly data from April 2015 – June 2015. In the beginning of June 2015 surveys and informal interviews were conducted with the medical-surgical staff nurses. By the end of June, responses from surveys and interviews were analyzed and the proposed interventions were based on the results. July saw the project shift focus to facilitate collaboration with the nursing informaticist to make the requested changes in the EHR. A mid-project check-in occurred August 1st to assess the current status of the project and identify any potential barriers to implementation. The go-live date for the inclusion of the "notify MD" order to the EHR insulin order-set ensued July 20th with dissemination of information to the hospital wide Nurse Educator forum occurring on July 28th. The project will conclude December 1st, 2015 with final data collection and analysis taken from the months following the interventional implementation (September – November). Refer to Appendix A for an outline of the project timeline.

Nursing Relevance

The successful implementation of this project has numerous implications for the nursing profession. Improving the management of inpatient blood glucose will result in an elevation in the overall quality of care provided within the hospital with the added bonus of optimizing patient healthcare outcomes.

While there are currently no studies available to provide official recommendations for insulin reporting thresholds, this project will hope to add to the literature by demonstrating better

inpatient glucose management as a result of increased MD awareness of dysglycemia resultant of increased communication with the nursing staff.

Expected Results

Currently there is a disconcerting laissez faire cultural attitude on the medical-surgical unit amongst the nursing staff and physicians when it comes to managing dysglycemia. The proposed changes have been formulated to promote a sense of urgency in reporting and managing inpatient hyperglycemia. Following implementation of the interventions, a gradual increase in the rates of normoglycemia to 65%, are expected to reflect within the monthly glucose data as a result of this new and heightened awareness.

Sustainability

The sustainability of a process improvement project is critical to its longevity and in the end, will determine the effect of change on the desired patient population. In order to maximize the sustainability of this project and reinforce the invested time and effort, staff education concerning the EHR changes and data awareness will continue to be a priority.

While disseminating information regarding the new "notify MD" order, supplemental education will also be provided to all staff nurses demonstrating how to quickly and easily review a graph of glucose trends through the utilization of a preexisting flow-sheet in the EPIC EHR which easily identifies when a patient has had more than 3 blood glucose levels >250mg/dL in 24 hours. In addition to educational reinforcement, data trends will be added to monthly staff newsletters as well as prominently displayed on the unit visibility wall. This display of monthly glucose trends aim to promote data literacy as well as visually translating data correlations between nursing action and patient outcomes.

Evaluation

At the time of this report, only one of two proposed changes has achieved "go-live" status. The addition of the order stating "Notify MD of 3 blood sugar levels >250mg/dL in 24 hours" has been successfully included to the default subcutaneous insulin order-set and now appears on the EPIC EHR RN order summary page. Education regarding this new order has been presented to the Nurse Educator forum who will in turn diffuse the information to the nurses on their respective units. Post-change data collection will begin September 1st in order to give the nurses time to receive education regarding new order implementation and develop an efficient utilization process.

Three months of post implementation data will be collected for the months of September, October, and November. Data will be aggregated on December 1st and analyzed for trends in glucose management. It is expected that the data review process will demonstrate a decrease in hyperglycemia rates which will in turn reveal an increase in the percentage of normoglycemia rates.

In addition to the above mentioned "notify MD" order, this project proposed a change in the reportable prandial blood glucose from that of >460mg/dL to a more reasonable >250mg/dL. This proposed order change has been a topic of contention between the Diabetes Nurse Champion Committee and the MD Inpatient Endocrinology team. The Diabetes Nurse Specialists believe 460mg/dL is an unacceptably high number and as a result may be effecting patient care when less experienced nurses fail to report hyperglycemia as a result of this physician order. On the other hand, the endocrinologists feel that a reduction in the reportable threshold will lead to an increased number of pages to the covering intern/resident and as a

result, inhibit the development of a healthy nurse-physician relationship. This topic is currently under review and will aim to seek a resolution by the end of August.

Conclusion

Carly Fiorina (2004), president of Hewlett-Packard once said "the goal is to transform data into information, and information into insight." Improving the management of inpatient blood glucose is only one small part of an extremely complex plan of care for the diabetic patient. By utilizing data systems currently in place to illustrate and drive the need for process improvement initiatives, nurses can feel empowered to advocate for changes that will improve the care they provide and positively impact their patient's health outcomes.

References

American Association of Clinical Endocrinologists. (2015). *Rationale for achieving glycemic control*. Retrieved from http://inpatient.aace.com/rationale-for-achieving-glycemic-control

CMS. (2014). Hospital acquired conditions. Retrieved from http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalAcqCond/Hospital-Acquired_Conditions.html

Fiorina, C. (2004). Information: the currency of the digital age. Retrieved from http://www.hp.com/hpinfo/execteam/speeches/fiorina/04openworld.html

Fogel, S., & Baker, C. (2013). Effects of computerized decision support systems on blood glucose regulation in critically ill surgical patients. *Journal of the American College of Surgeons,* 828-833.

Kritsonis, A. (2005). Comparison of change theories. *International Journal of Scholarly Academic Intellectual Diversity. 8(1).*

Louie, R., Tang, Z., Sutton, D., et al. (2000). Point of care glucose testing: effects of critical care variables, influence of reference instruments, and a modular glucose meter design. *Arch Pathol Lab Med. 124.* 257-266

Moghissi, E. (2010). Reexamining the evidence for inpatient glucose control: new recommendations for glycemic targets. *American Society of Health-System Pharmacists, 67.*

Moghissi, E. S., Korytkowski, M. T., DiNardo, M., Einhorn, D., Hellman, R., Hirsch, I. B.,Umpierrez, G. E. (2009). American association of clinical endocrinologists and diabetes association consensus statement on inpatient glycemic control. *Diabetes Care*, *32*(6), 1119–1131. doi:10.2337/dc09-9029

Patel, K. & Doughty, D. (2008). Impact of tight glucose control on postoperative infection rates

and wound healing in cardiac surgery patients. *Journal of Wound, Ostomy and

Continence Nursing. 35(4),* 397-404

Schmeltz, L. (2011). Management of inpatient hyperglycemia. *Lab Medicine*, *42*(7), 427-434.

doi 10.1309/LMU72V7QWUDUYQIJ. Retrieved from

http://labmed.ascpjournals.org/content/42/7/427.full.pdf+html

Scott, R. (2009). The direct medical costs of healthcare associated infections in U.S. hospitals

and the benefits of prevention. Center for Disease Control. Retrieved from

http://www.cdc.gov/HAI/pdfs/hai/Scott_CostPaper.pdf

Appendix A

Gantt Chart

	May	June	July	August	September	October	November	December
Microsystem Assessment	▨							
Data Collection	▨							
Survey Development		▨						
Survey Distribution		▨						
Informal Interviews		▨						
Survey Data Analysis		▨						
Propose EPIC EHR Change			▨					
Implementation of EIPIC EHR Change			▨					
Mid-project Check-in				▨				
EHR changes Go Live					▨	▨	▨	
Data collection post change							▨	
Data Analysis								▨

Appendix B
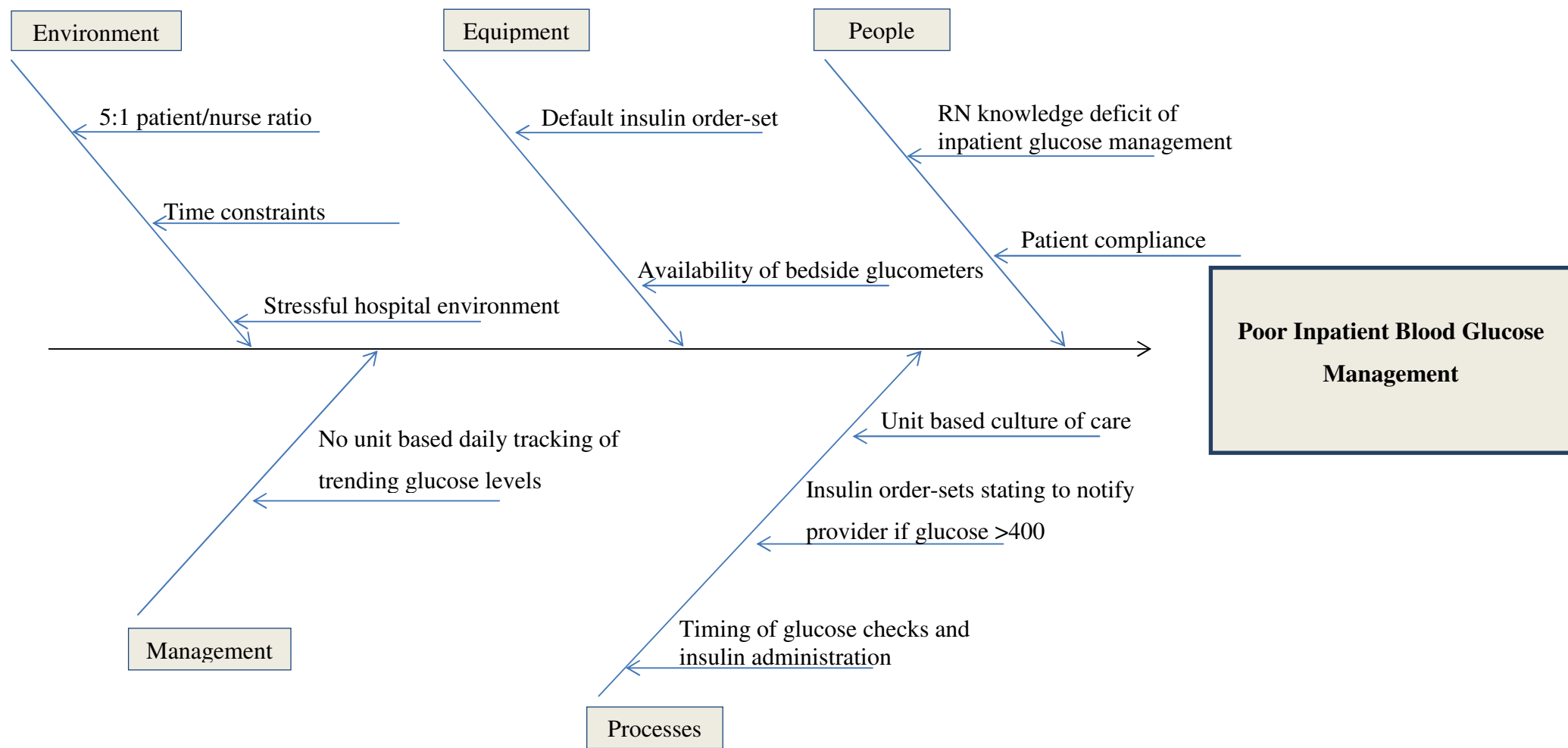
Appendix C
SWOT Analysis

Strengths	*Weaknesses*
➢ High levels of RN staff engagement ➢ Small unit with few nurses ➢ RNs dedicated to improving patient outcomes ➢ Minimal costs associated with proposed change	➢ Busy unit 5:1 nurse/patient ratio ➢ Multiple insulin administration orders placed in electronic health record (basal, bolus, carb correction, etc…) ➢ Utilization of float/travel nurses ➢ Frequent turnover of interns, residents, and attending physicians ➢ Achieving sustainable results
Opportunities	*Threats*
➢ Improve communication between nurses and providers ➢ Empower nurses to advocate for better inpatient glucose control ➢ Improve staff knowledge of diabetes and inpatient glucose management ➢ Utilize unit diabetic champion as an information resource	➢ Achieve adequate Provider buy-in for proposed intervention ➢ Fail to achieve closed-loop communication between Providers and staff nurses ➢ Potential unforeseen interferences with daily workflow

Appendix D
NURSE SURVEY
INPATIENT BLOOD GLUCOSE MANAGEMENT

1. At what blood glucose level do you think microvascular damage occurs?
   - ☐ 227mg/dl
   - ☐ 181 mg/dl
   - ☐ 126 mg/dl
   - ☐ 305mg/dl

2. At what blood glucose level do you typically notify the MD/Provider
   - ☐ 185mg/dl
   - ☐ 275mg/dl
   - ☐ 400mg/dl
   - ☐ Whatever number the order tells me too
   - ☐ Other (please specify) _____

3. At what blood glucose level do you *THINK* we should notify the MD/Provider
   - ☐ 301 mg/dl
   - ☐ 251mg/dl
   - ☐ 181 mg/dl
   - ☐ Other (please specify) _____

4. What are some barriers you face when treating hyperglycemia?
   - ☐ Confusion regarding insulin types and their acting time
   - ☐ Presence of MD/Provider order to notify if >400mg/dl
   - ☐ Timing of insulin administration
   - ☐ Other (please specify) _____

5. Are there any specific topics you would like further education on regarding inpatient diabetes management?

Appendix E

At what blood glucose level do you think microvascular damage occurs?

At what blood glucose level do you typically notify the MD/Provider?

What are some barriers you face when treating hyperglycemia?
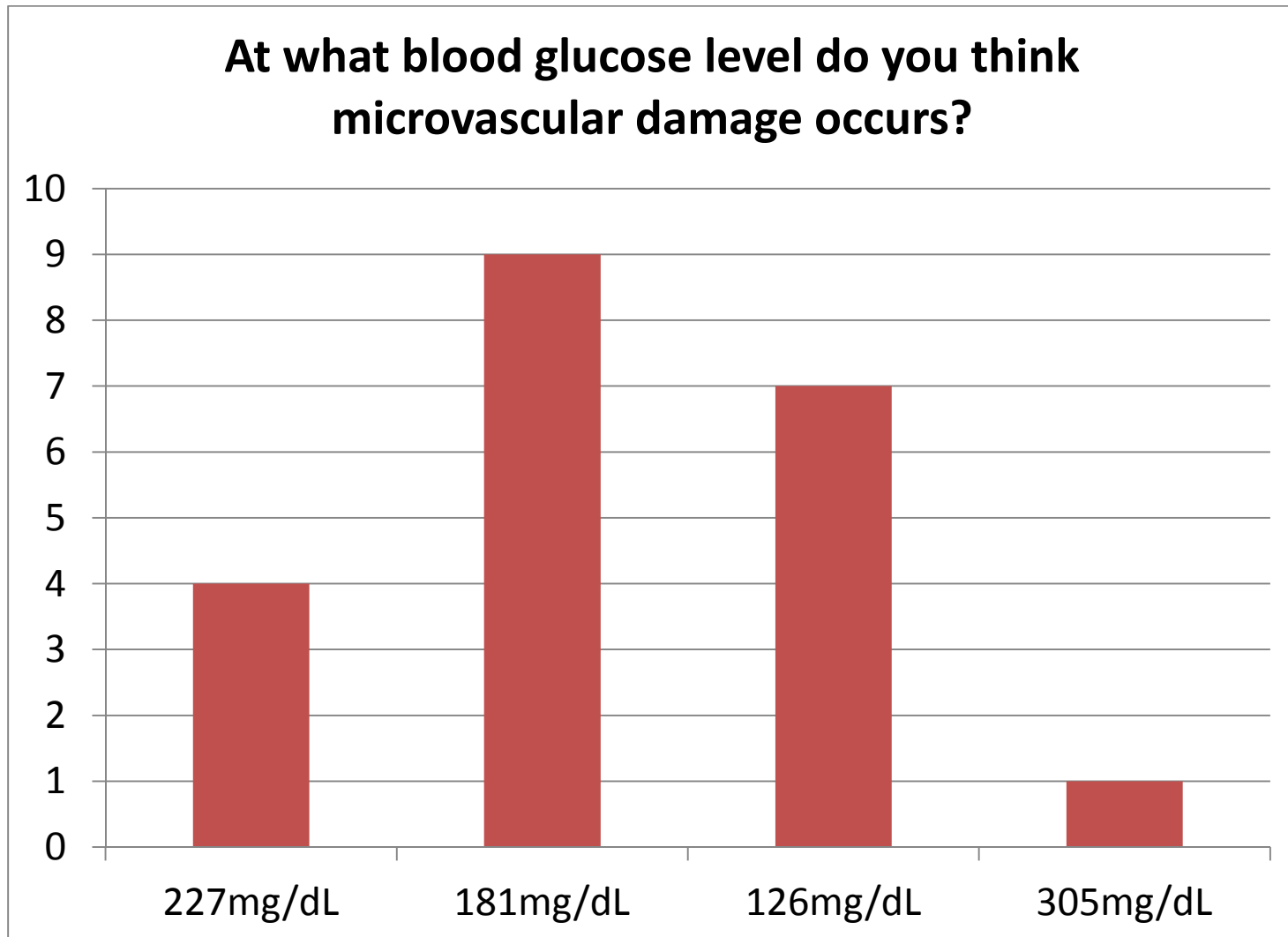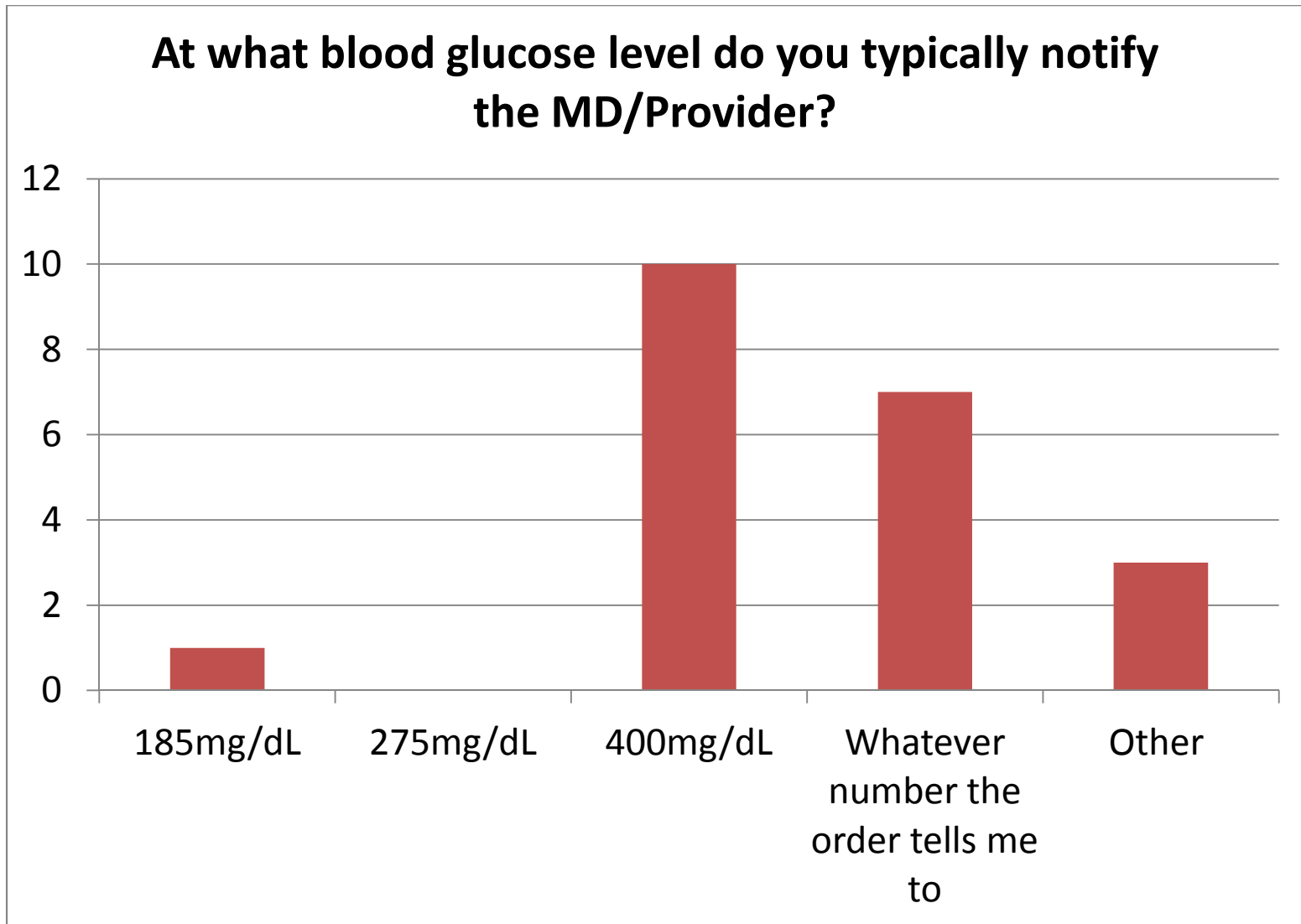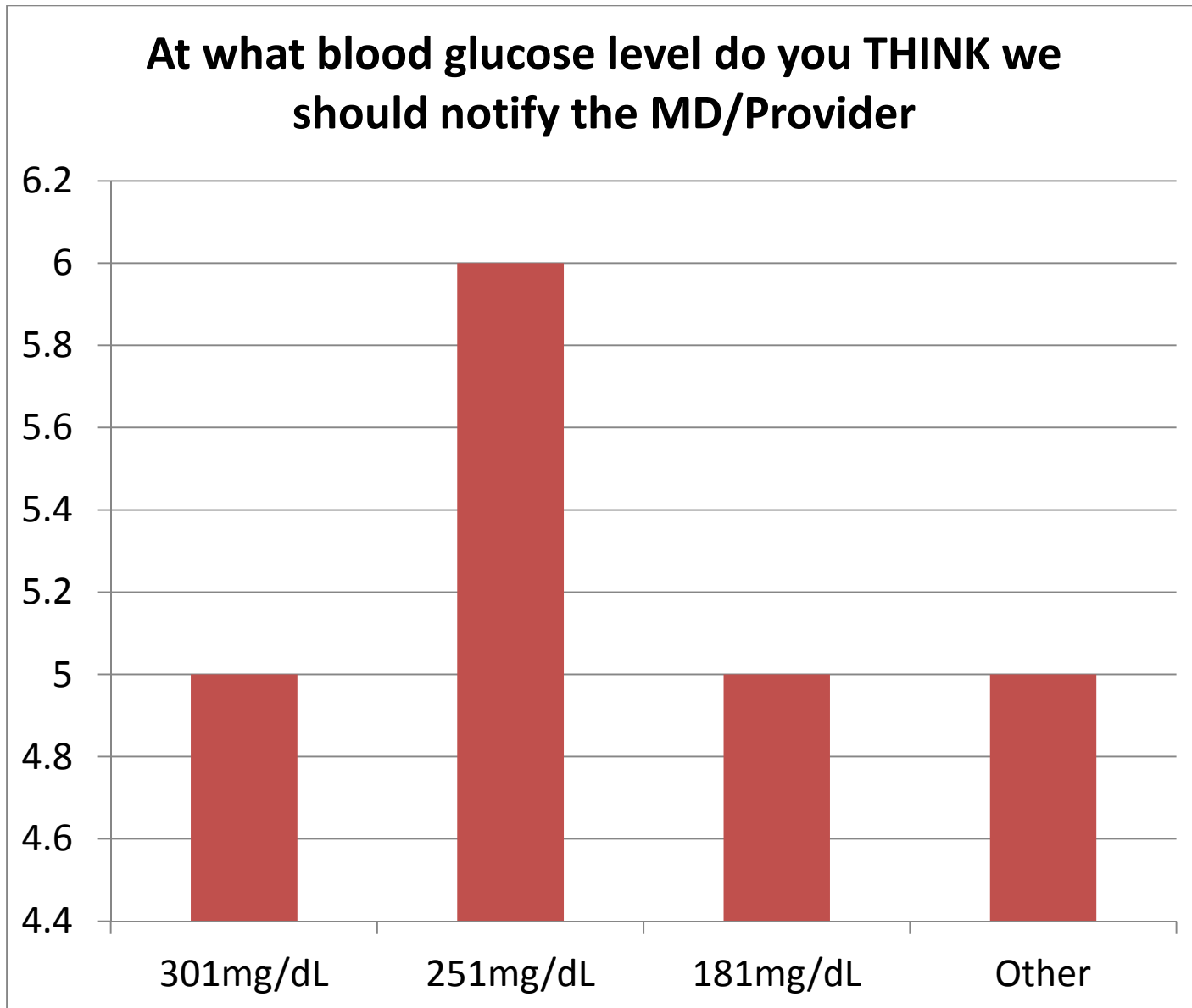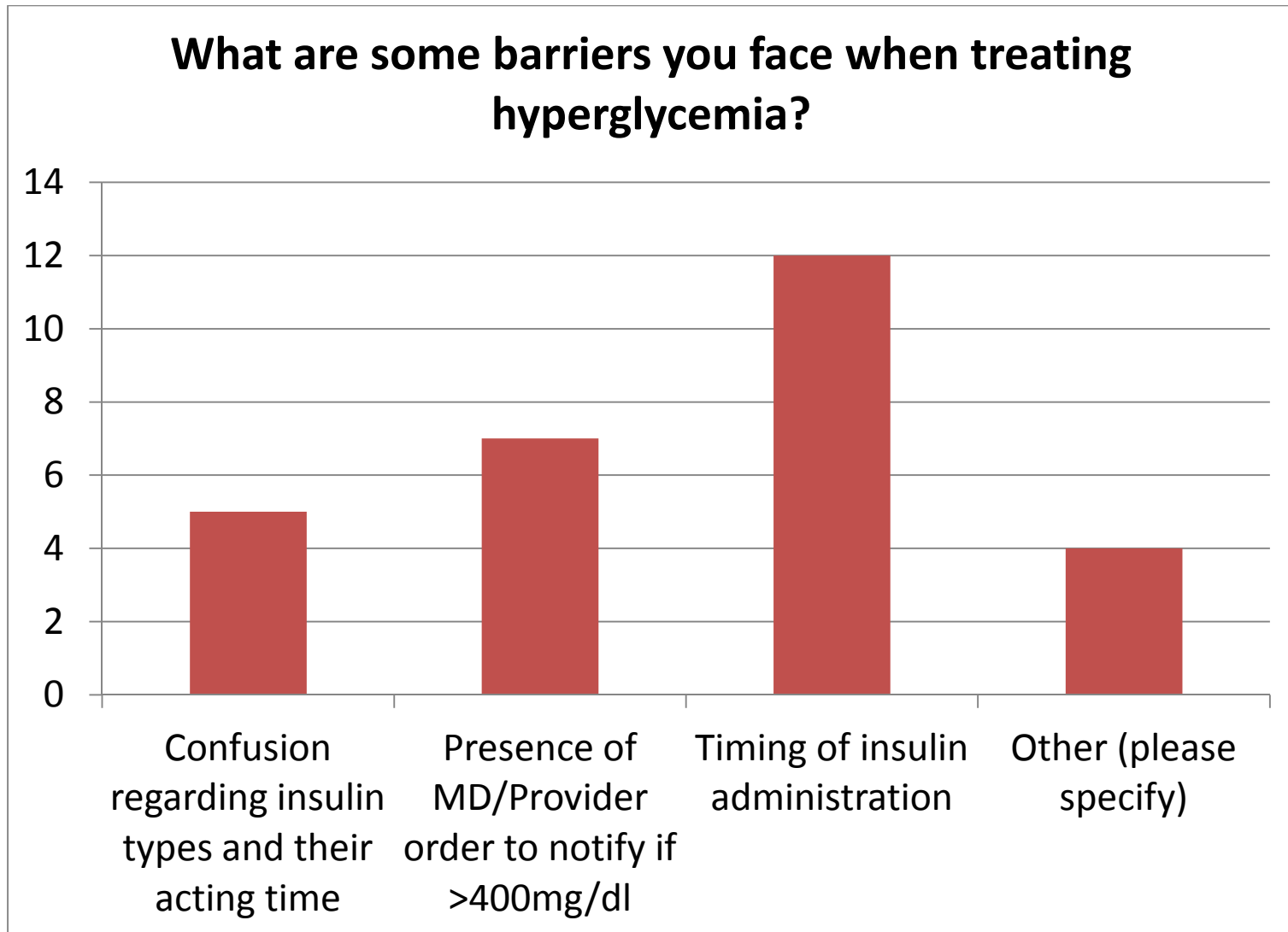
Appendix F

2015 Inpatient Blood Glucose Trends
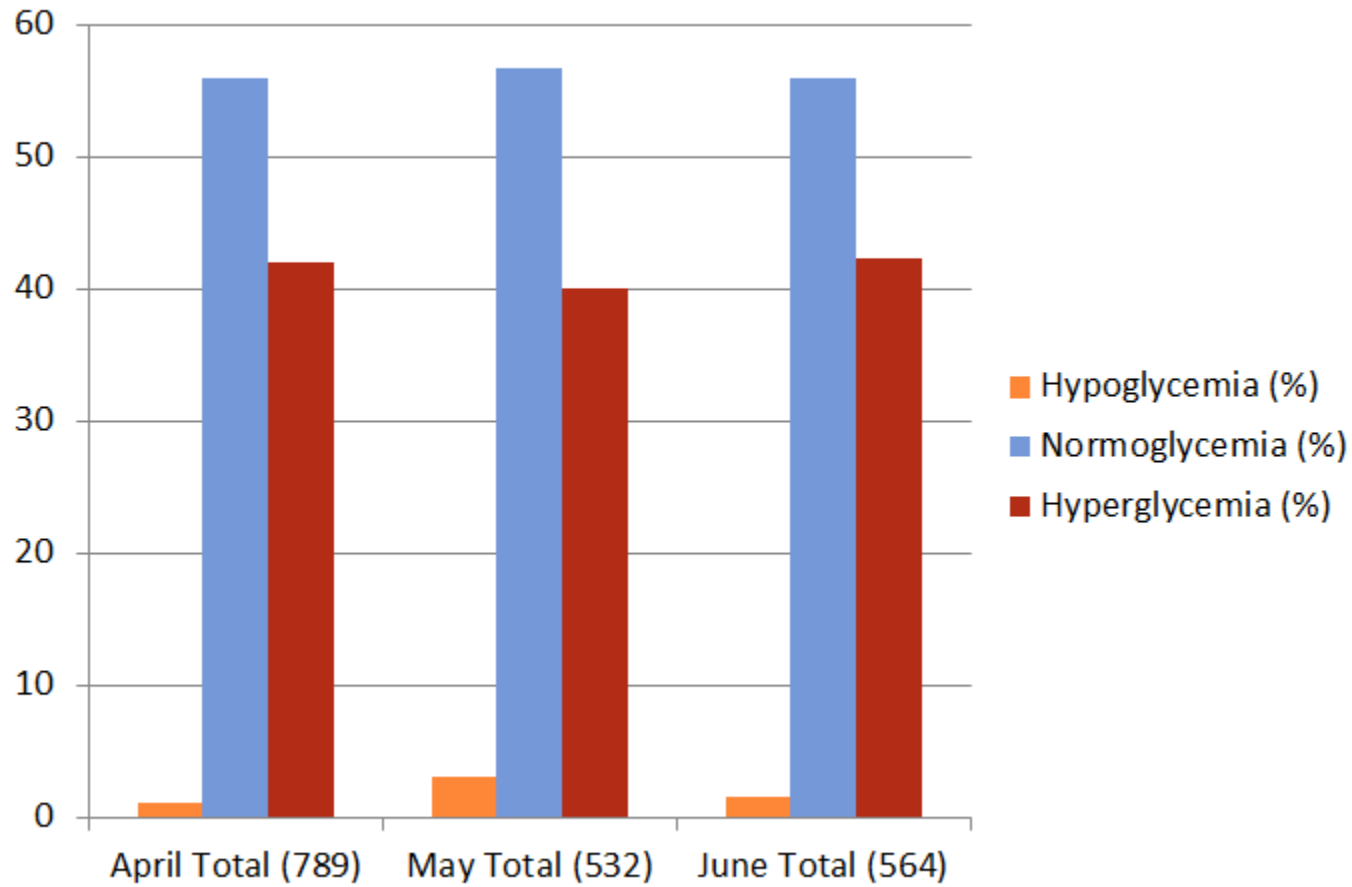
Appendix G

2015 Three Month Average Inpatient Blood Glucose Trend
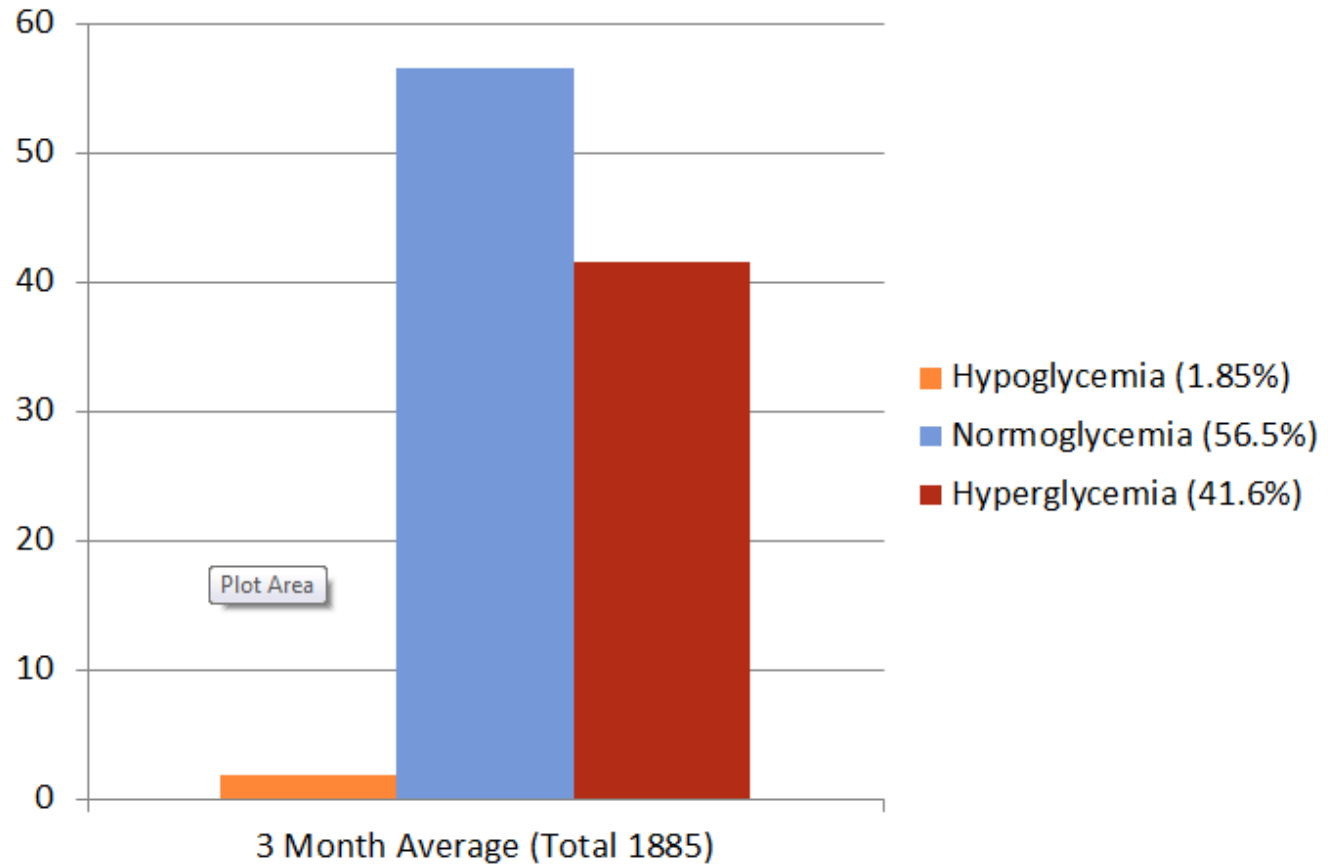
Appendix H

Subcutaneous Insulin Order Set