I, Jennifer Hessling, hereby submit this original work as part of the requirements for the degree of:

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Carbohydrate Consumption, Insulin Dosing and Glucose Abnormalities in a Hospitalized Population

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Carbohydrate Consumption, Insulin Dosing and Glucose Abnormalities in a Hospitalized Population

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Abstract

A frequently cited concern is the occurrence of hyperglycemia in the inpatient hospital setting in patients with or without pre-diagnosed diabetes. Existing evidence shows when compared to patient with normal glucose levels, patients experiencing hyperglycemia and have another comorbidity requiring hospitalization need two to four times the length of stay and also an increased risk of developing other complications including morbidity and mortality. This study identifies the possible gaps in care that may result from poor glucose management by examining the diet, blood glucose levels and insulin administration. Eighty-two participants were drawn from the general medical ward and tray tickets, 24 hour food recall, the MAR and patient charts were used to collect data. Referrals from the floor dietitian were made based on exclusion and inclusion criteria and interviews conducted. Data obtained from the chart review of insulin dosing and administration, food recalls and patient interviews. Insulin should ideally be adjusted based on the amount of the meal consumed and what proportion of the meal is carbohydrate but findings were consistent with the hypothesis in that insulin dose was not being adjusted based on carbohydrate consumption as insulin administration usually takes place before the meal. An understanding of carbohydrate content in foods may help nursing, dietetics and all medical professionals optimize care for this patient population. Data from this study highlighted research gaps that may be taken into consideration for future research studies to optimize insulin administration for improved glucose control.
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Introduction

A large portion of the American population is affected by diabetes. Nearly 7.8% or 23.6 million people have diabetes as estimated by The Center for Disease Control and Prevention ("Centers for Disease Control and Prevention", 2007). Accordingly, rates of diabetes among hospitalized patients are also high, and the prevalence of hyperglycemia in hospitalized patients, per se, is estimated to be nearly 30 percent. This includes previously diagnosed diabetics, those undiagnosed, and those that are not diabetic but experience hyperglycemia during their stay (Clement S., Smith E. P., Braithwaite S. S., Magee M. F., Ahmann A., Schafer R. G., et al. 2004). Those patients experiencing hyperglycemia, defined as a blood glucose level over 180 mg/dL, with or without existing diabetes, and have another condition which requires hospitalization, will require two to four times the length of stay compared to a patient not experiencing hyperglycemia. This estimates an increase from one day length of stay to three days depending on admission diagnosis ("American College of Endocrinology", 2004). Other issues can arise because of diabetic patients being admitted for reasons other than diabetes when hyperglycemia occurs. Neglecting to continue treatment of the patient’s diabetes while addressing other, more prominent issues, can put a patient at risk (Smiley D., Umpierrez G. E., 2008).

Hyperglycemia increases the risk of complications in hospitalized patients. Many studies show that the risk of morbidity and mortality is increased in patients who experience hyperglycemia during their hospitalization (Capes S. E., Hunt D., Malmberg K., Pathak P., Gerstein H. C. 2001; Golden S. H., Peart-Vigilance C., Kao WH., Brancati F. L. 1999; Umpierrez G. E., Isaacs S. D., Bazargan N., You X., Thaler L. M., Kitabchi

In recent years, preventing hyperglycemia in hospitalized patients has been a focus of various professional organizations and guidelines for optimal blood glucose have been published. Recent trials however, highlighting the potential harm from hypoglycemia, often the result of trying to establish “tight” glycemic control, have resulted in modifications of treatment guidelines. Currently the American Diabetes Association and the American College of Endocrinology advises blood glucose levels not exceed 180 mg/dL nor drop lower than 110 mg/dl. Hospitalized patients are generally considered to be hyperglycemic when their blood glucose level is above 180 mg/dL. While these targets are useful, it is important to consider all aspects of patient care in the hospital setting that could affect blood glucose levels including medications and diet changes.
Other factors may be conducive to hyperglycemia, thus making maintenance of blood glucose levels a challenge. Decreased appetite, erratic schedules due to diagnostic tests and treatments, enteral or parenteral feeding, and surgery can cause proper treatment of hyperglycemia to be a challenge. (Swift C. S., Boucher J. L. 2005). It is necessary to know the type and amount of food the patient consumes in order to give the proper dose of insulin. If hospital staff is not aware of this and gives insulin without consideration of intake, blood glucose levels, and ultimately patient health can be affected.

In the past decade, the prevalence of diabetes and hyperglycemia among hospitalized patients has increased, and efforts have been made in recent years to develop measures and approaches to improve diabetes care. However, these approaches generally consist of a specialized diabetes care nurse, without support from nutrition professionals. Research points to the need for collaborative teams of healthcare professionals including physicians, nurses, and nutrition specialists to combine efforts and develop protocols and treatment strategies that will provide consistent glycemic control (Conner T. M., Flesner-Gurley K. R., Barner J. C. 2005; Cavan D. A., Hamilton P., Everett J., Kerr D. 2001; Flanagan D., Moore E., Baker S., Wright D., & Lynch P. 2008; Sampson M. J., Crowle T., Dhatariya K., Dozio N., Greenwood R. H., Heyburn P. J. et al. 2006; Manchester, C.S. 2008).

Literature and recent studies both address the need to improve patient care, but do not demonstrate specific problems in institutions that cause treatment of diabetic patients to be substandard. It is necessary to define the problem before a proper, effective solution can be found. Without establishing the nature of the problem, creating protocols to improve care are of little use. This study will examine the diet of hospitalized patients, in
order to find if the management and recognition or awareness of diet is a factor contributing to gaps in patient care.

Specifically, the consideration of diet and nutrition is critical in the care of individuals with diabetes, especially when insulin is used. In non-diabetic individuals, the physiologic secretion of insulin is coordinated tightly with ingestion and composition of a meal. Close attention should be paid to timing and dose adjustment for quantity and carbohydrate content in meal when insulin is administered to hyperglycemic or diabetic patients. Although there are practical limitations in the hospital setting, lack of consideration for diet in the administration of insulin can result in poor glucose control and make it more difficult for effective patient care.

It is necessary to identify if a problem exists in the management of insulin and food intake in order for the optimization of treatment protocols for patients with hyperglycemia to occur. This study will examine the diet of hospitalized patients, to find if the management, recognition, and/or awareness of diet are factors contributing to gaps in patient care. Our experience with the inpatient glycemic control program at a major University Hospital, suggests that the consideration of meals in the timing and dosing of insulin administration may be suboptimal.

The overall working hypothesis for this research is that the relationship of diet and insulin administration in hospitalized patients influences inpatient glycemic control. This overall hypothesis is further developed to consider three areas and specific aims.

Aim 1. In order for insulin to be effective, it must be given at the appropriate time when the meal is consumed. Guidelines recommend in hospitalized patients giving fast-acting insulin at the time the meal is consumed. Insulin given outside this time frame is
not especially effective in reducing blood glucose levels and potentially harmful in causing hypoglycemia. In the hospital setting the amount of insulin is often approximated based on the average carbohydrate content of each meal. This can be difficult due to hospital staff and patients giving an estimation of how much they will eat at each meal, and it is often unclear how well the meal will be tolerated, if eaten at all. Furthermore, there are many challenges related to aspects of food tray delivery; often the meal is delivered at a time when the patient is away for a test, and the communication between food service and nursing is difficult. The aim is to study how frequently the timing of insulin administration is appropriate in relation to a meal. The hypothesis is that there is a low rate of adherence of correct insulin timing with meals, and these mis-timings result in poor glucose control.

**Aim 2.** For safe and effective glycemic control, correct insulin dosing is imperative. Hospital staff should adjust scheduled dose according to a) the amount of the meal consumed and ideally b) what proportion of the meal consumed is carbohydrate. It is unclear if hospital staff consistently adjusts the insulin if only a proportion of the meal was consumed. It is also not known if hospital staff can knowledgably make assessments of the carbohydrate content of the meal consumed and adjust insulin accordingly. Attention is usually given to amount consumed, but the carbohydrate content of that portion can significantly alter the individual’s insulin requirement. Aim two will examine how frequently insulin dose is adjusted based on the percentage of food and the carbohydrate content consumed. The hypothesis is that the proportion of carbohydrate of the meal does not always result in the insulin dose to be adjusted.
**Aim 3.** Another possible issue facing glucose management is awareness of a patient’s intake outside of approved meals and snacks from the hospital. Non-hospital sources such as family may bring snacks and drinks to patients, and they may consume these without notifying staff that are aware of their insulin regimen. Also, extra items such as fruit juice which are high in carbohydrate and will raise blood sugar accordingly, are often obtained from the hospital staff and consumed in great quantity. Intake that is unscheduled can have a pronounced effect on blood glucose levels and should be considered in insulin management. Aim three focuses on the occurrence and amount of unscheduled snacks and drinks that are consumed and how often insulin is given to account for this. The hypothesis is that the unscheduled intake of snacks and drinks is not being covered by insulin, and that this contributes to poor glucose control.

The overall purpose of the study was to identify possible gaps in care that result by poor glucose management by examining the diet of patients with diabetes in the inpatient setting. By closely analyzing the diet, blood glucose levels, and insulin administration in these patients, we will see which patients are receiving correct insulin dosing. Through the identification of potential causes of hyperglycemia, we will assist in improving inpatient care and overall reduce the occurrence of it. The purpose of this thesis will be to focus on aim 2 specifically.
Methods

Participants

This observational study was based on data from patients admitted for inpatient treatment to a major university hospital located in an urban environment, n=82. The study was approved by the Institutional Review Board of the institution where the research was conducted. The subjects were drawn from the general medical ward. Inclusion criteria included subjects over the age of 18 with no gender or ethnicity limitations. Subjects must also have been consuming meals on a consistent carbohydrate diet and must be on the hospital standard basal-bolus correction subcutaneous insulin treatment regimen. Exclusion criteria from the possible subject group included intensive care, transplant, neonatal and obstetric patients. Patients receiving total parenteral nutrition, enteral nutrition, or on a liquid diet were also excluded. Subject’s length of stay was at least 24 hours in order to receive complete 24 hour glucose and diet data.

Instruments

Each patient’s tray tickets from the foodservice department were saved in order to assess the nutritional information served to each subject. A 24 hour recall tool was used to collect dietary data by the research team from direct face to face interviews with the patient. The food information from the tray ticket and 24 hour recall was analyzed using NutriCalc, a nutrition information program database (NutriCalc, 2009). Demographic information and blood glucose records were taken from medical charts using the Lastword data system at the hospital. Insulin dosing information was taken from each patient’s Medication Administration Record (MAR). Standardized questions developed from the Nutrition Data System for Research (NDSR) were used for the 24 hour recall.
The NDSR software, developed by the Nutrition Coordinating Center at the University of Minnesota, utilizes the multiple-pass system of the interview methodology. Interview prompts guide and standardize data entry (Schakel SF. 2001). The following is an example of the questions that will be asked to obtain the recall:

1. After midnight, when was the first time you had something to eat or drink?
   a. What did you have at that time?
   b. How much of that item did you have?
   c. Did you add anything to the item? (sugar, salt, milk?)
   d. Did you have anything else at this time?
      i. If so, repeat b & c.

2. When was the next time you had something to eat or drink?
   a. What did you have at that time?
   b. How much of that item did you have?
   c. Did you add anything to the item? (sugar, salt, milk?)
   d. Did you have anything else at this time?
      i. If so, repeat b & c.

3. When was the next time you had something to eat or drink?
   a. What did you have at that time?
   b. How much of that item did you have?
   c. Did you add anything to the item? (sugar, salt, milk?)
   d. Did you have anything else at this time?
      i. If so, repeat b & c.

This process will be repeated until the subject did not have additional intake to add.
Procedure

Patients falling under inclusion criteria were referred to the research team by the hospital staff dietitian. Tray tickets from the previous day for each possible subject were given to research team. The research team then interviewed each patient after informed consent was obtained. The interview took place no later than 24 hours after the third meal was given. During the interview, demographic information, co morbidities if applicable, and admission diagnosis were obtained using a standardized form. A 24 hour food recall was also obtained using a standardized form created from the NDSR system. The interviewer reviewed what the subject consumed, allowing the subjects to go back and add any intake they may have forgotten. 24 hour recalls were aided by the tray tickets from the meals of the day before to assist with memory recall.

Following the interview, chart review was used to obtain the rest of the information. After logging on to LastWord, the electronic charting system used by the hospital, data was researched. Demographic information was verified, as well as point-of-care (POC) blood glucose levels from the previous day. Insulin administration information was found in the MAR of each patient. Insulin type, dosing and timing was recorded on a standardized form. Any dextrose containing infusions were also noted on this form in order to see any additional glucose each subject was receiving.

Data Analysis

1. Microsoft Excel was used to perform preliminary descriptive analysis of the data.

2. Nutricalc software (NutriCalc, 2009) was used to analyze the patient’s nutritional intake including calorie, carbohydrate, protein and fat consumption.
Results

Demographics

Data from 82 participants was analyzed. The average age for participants was 56.74 years. Sixty percent of participants were female and 40% were male. Thirty-four percent were single, 18% were divorced, 37% married and 11% widowed. The largest race population was non-Hispanic African American represented by 54% of participants. White, non-Hispanic participants represented 42% and 2% was white Hispanics. Asians represented 1% as well as ‘other’. American Indians and Native Hawaiian/Pacific Islander were not represented in this study.

Ten percent of participants had an education level of 11th grade or less. Seventy-seven percent were high school graduates. Eight percent had completed some college and 5% had a college degree. Eighty-eight percent of participants were unemployed or retired. Twelve percent of participants were currently employed with 70% working full time and 30% working part time. All participants were diagnosed with diabetes prior to their hospital stay with 98% being diagnosed with type 2 diabetes and 2% with type 1.

Calories served and consumed at each meal

The average number of calories served for breakfast was 761.2 kcals but 526.7 kcals were actually consumed. Average lunch calories served was 735.9 kcals with only 494.6 kcals being consumed. At dinner, an average of 673.9 kcals was consumed served with 478.6 kcals eaten. Average calories consumed were 69.19% at breakfast, 67.2% at lunch, and 71% at dinner. The group average of total calories served each day was 2171 kcals with an average of 1509 kcals eaten.
Carbohydrate content reported, served and consumed in each meal

Carbohydrate content of the meal was reviewed, including grams of carbohydrate served and consumed. Carbohydrates reported and carbohydrates served were examined. Carbohydrates reported data describes carbohydrate amount in grams on food service tickets and the amount which insulin dosing was based. Carbohydrates served data describes the analyzed number of carbohydrates in grams the food actually contained, which potentially differed from the reported amount. Carbohydrates eaten data describes the amount in grams the patient actually consumed. The group average of total carbohydrates reported each day was 225.6 g, with 253.4 g served and 187.8 g eaten.

Figure 1 compares carbohydrates reported, carbohydrates served and carbohydrates eaten for each participant. The meal tickets stated either 60, 75, or 90 grams were served at each meal and may or may not have been represented correctly with the food that was served. According to meal tickets, an average of 74.29 grams, 75.36 grams, and 76.46 grams were reportedly served for breakfast, lunch and dinner respectively. When each meal was analyzed for actual nutrient content, breakfast served an average of 83.7 grams of carbohydrate and 63.1 grams eaten. An average of 93.9 grams of carbohydrate was served at lunch with only 68 grams eaten. At dinner an average of 75.8 grams of carbohydrate was served and 56.7 grams eaten.
Figure 2 shows the percent of breakfast calories eaten compared to the amount of calories served for each participant. It also compares the percent of calories served and eaten to the group average of 69.2% calories eaten. Figure 3 shows the percent of carbohydrates eaten from what was served at breakfast. The average of 74.69 is depicted to show the varying levels of carbohydrates actually eaten by patients. Figure 4 depicts the reported carbohydrates in grams served by foodservice and compares it to what was actually served as determined by the nutrient analysis program. The amount of carbohydrate grams eaten is also shown.
Figure 2. Percent of calories eaten at breakfast compared to served for each participant and group average (n=82)

Figure 3. Percent of carbohydrates eaten at breakfast compared to served for each participant and group average (n=82)
The percent of lunch calories eaten compared to the lunch calories served is depicted in figure 5. The group average of 67.2% is also shown. The percent of carbohydrates in grams eaten compared to served at lunch is shown in figure 6. The average of 72.6% of carbohydrates in grams is also depicted to show the varying levels of carbohydrate grams eaten by each participant. Figure 7 shows the reported carbohydrates in grams served by foodservice. It also shows the amount in grams that was actually served and how many grams of carbohydrate was eaten.

Figure 8 shows the average calories eaten at dinner, 71%, compared to the percent calories eaten versus served by each participant. The percent of carbohydrates in grams eaten at dinner compared to served is depicted in figure 9. The group average of 76.3% is also shown. Figure 10 shows the actual and reported amount of carbohydrates in grams served at dinner and the amount in grams eaten by each participant.
Figure 5. Percent of calories eaten at lunch compared to served for each participant and group average (n=82)

Figure 6. Percent of carbohydrates eaten at lunch compared to served for each participant and group average (n=82)
Figure 7. Comparison of carbohydrates reported, served and eaten at lunch for each participant (n=82)

Figure 8. Percent of calories eaten at dinner compared to served for each participant and group average (n=82)
Figure 9. Percent of carbohydrates eaten at dinner compared to served for each participant and group average (n=82)

Figure 10. Comparison of carbohydrates reported, served and eaten at dinner for each participant (n=82)
Table 1 shows the number of participants where were served more, equal to and less than carbohydrates reported. Total carbohydrates served and reported were examined. Sixty-seven participants were served more carbohydrates than reported, 4 were served the same amount of carbohydrates as reported, and 11 were served fewer carbohydrates than reported. Of the 67 participants who were served more carbohydrates than reported, 359 blood glucose checks were done. Forty-six percent indicated hyperglycemia and 2% checks resulted in hypoglycemia. Twenty-one blood glucose checks were completed for the four patients served the same amount of carbohydrates reported. Thirteen percent of those checks indicated hyperglycemia and 2% showed hypoglycemia. Of the 11 participants served less than reported carbohydrates, blood glucose levels were checked 58 times. Forty percent of the checks indicated in hyperglycemia, and 2% showed hypoglycemia.

<table>
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<th>Table 1. Comparison of Participants Served More, Equal and Less Carbohydrates than Reported and Number of Occurrences of Hyperglycemia(^1) and Hypoglycemia(^2)</th>
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<td><strong>Number of Participants (n=82)</strong></td>
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<tr>
<td>More carbohydrates served than reported(^3)</td>
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<td>Equal amounts of carbohydrates served and reported(^3,4)</td>
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<td>Less carbohydrates served than reported(^3)</td>
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</table>

1- Hyperglycemia is defined as blood glucose levels ≥180  
2- Hypoglycemia is defined as blood glucose levels <70  
3- Total carbohydrates of group at breakfast, lunch and dinner  
4- Same amount was defined as served carbohydrates within 5 grams of reported

Table 2 shows the number of participants who had eaten more, equal and less carbohydrates than reported and the number of occurrences of hyperglycemia and
hypoglycemia in each of those populations. Twenty participants ate more carbohydrates than reported. That population had their blood glucose checked a total of 108 times, 61% of the time indicating hyperglycemia and 3% of the time showing hypoglycemia. One person ate the same amount of carbohydrates reported and had their blood glucose checked five times. Twice the blood glucose checked showed hyperglycemia and zero checks showed hypoglycemia. Sixty-one participants ate fewer than reported carbohydrates and had their blood glucose checked a total of 325 times. Of those 325 checks, 41% indicated hyperglycemia and 2% showed hypoglycemia.

<table>
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<th>Table 2. Comparison of Participants Who Had Eaten More, Equal and Less Carbohydrates than Reported and Number of Occurrences of Hyperglycemia¹ and Hypoglycemia²</th>
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<td><strong>Number of Participants</strong></td>
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<td>More carbohydrates eaten than reported³</td>
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<td>Equal amounts of carbohydrates eaten and reported¹,⁴</td>
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<td>Less carbohydrates eaten than reported³</td>
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¹- Hyperglycemia is defined as blood glucose levels ≥180
²- Hypoglycemia is defined as blood glucose levels <70
³- Total carbohydrates of group at breakfast, lunch and dinner
⁴- Same amount was defined as served carbohydrates within 5 grams of reported
Discussion

As assumed by the hypothesis of aim 2, insulin dose is not adjusted based on carbohydrate intake. Upon analysis of the diet and insulin regimen, patients are possibly receiving incorrect dosing of insulin. Insulin is given based on the doctor’s order and ideally adjusted based on the amount of carbohydrate served and consumed. Although the nursing staff records the amount of food eaten after each meal, insulin is not adjusted based on the amount of carbohydrate consumed. Insulin is usually given before the meal and the nursing staff is unsure of how many carbohydrates the person will eat beforehand.

Carbohydrate intake is being estimated by the foodservice department based on height and weight of a patient. A larger person will receive more carbohydrates per meal than a smaller person. For example, a smaller framed person would receive 4 or 5 servings, or 60-75 g of carbohydrate at each meal and a larger person would get 5 or 6 servings, or 75-90 g of carbohydrate.

After analyzing the diet it has been found that the actual carbohydrate amount of the meal is not always the same as what is allegedly provided by the foodservice department. In other words, a person may be getting more or less grams of carbohydrate than what is estimated which could cause insulin dosing and blood glucose issues. If a person is assumed to be getting 5 servings, or 75 g of carbohydrate at each meal, and is actually getting 100 g, the insulin dose is too low. This could cause hyperglycemia and should be adjusted. However, many patients are not eating the entire portion of their meal, including carbohydrates. This could be a potential cause of hypoglycemia and also needs to be examined further.
The group average, 253.4 g of carbohydrate was actually served each day. The group average of reported carbohydrate was 225.6 g based on the content foodservice estimated in meals with only 187.8g eaten. The 225.6 g group average would be what the hospital staff would ideally use to calculate the dose of insulin. It was found that on average 83.7 g of carbohydrate were served at breakfast, but the estimated carbohydrate serving, upon which dosing of insulin would ideally be based, was only an average of 73.7 g. At lunch, the average amount of carbohydrate served was 93.9 g, but estimated carbohydrate servings upon which insulin would ideally be dosed was only an average of 75.4 g. These underestimates of carbohydrates served at breakfast and lunch could be a cause for hyperglycemia in the hospital setting. At dinner however, the carbohydrate amount served and amount estimated by foodservice was quite accurate. An average of 75.8 g of carbohydrate was actually served and an average of 76.5 g was estimated.

Another finding worth noting was the amount of food consumed. It was hypothesized patients were eating all the food served, if not more. By analyzing the diets it was found that patients actually on average only consumed 69% of the calories served each day. At breakfast, an average of 69% of calories was eaten based on what was served. At lunch only 67% of calories were eaten and only 71% was eaten at dinner. It should also be noted that patients only consumed an average of 74% of the carbohydrates served at each meal. This would suggest that hypoglycemia would be a risk for these hospitalized patients. It is possible that the decreased carbohydrate consumption is balanced by the excess serving of carbohydrate and so patients were spared from either hypoglycemia or hyperglycemia.
These findings can be linked to a knowledge deficit of the foodservice and both medical and nursing staff. Although the nutrient database may differ slightly from our study to the hospital system, carbohydrates were usually underestimated by hospital foodservice. This could be causing hyperglycemia. Conversely and ideally, the nursing staff is aware that insulin dose needs to be adjusted based on amount of carbohydrate consumed not amount assumed to be eaten or served; since we found that patients consumed considerably fewer carbohydrates than were served, not decreasing the insulin dose accordingly could lead to hypoglycemia. This finding also suggests that perhaps rapid-acting insulin may be safer to administer directly after the meal so that nurses can adjust the dose based on what was consumed. Although rapid-acting insulin is ideally given directly before the meal in the ambulatory setting, the risk of hypoglycemia in the hospital from giving the dose before knowing how much carbohydrate was consumed may outweigh the benefits of ideal timing.

Since hyperglycemia is a common problem in this population, and most participants were consuming less food and carbohydrates than reported, it is unclear what the ultimate cause of hyperglycemia is in the inpatient population studied as hypoglycemia would be the assumed result. In the 61 participants who ate fewer carbohydrates than reported, 41% of blood glucose checks from that group indicated hyperglycemia and only 2% resulted in hypoglycemia. From these findings, one possibility is the higher amount of served carbohydrates when compared to reported is a main cause of the hyperglycemia, as insulin dosing is based on reported. Another possibility could be even though fewer carbohydrates were consumed on average compared to eaten, the reported amount served was still too high for the inpatient
population. The insulin was based on the reported amount, and though the possibility of balance between overestimation and under consumption might exist, this could still be too high of an amount needed for this population. More research is needed on how many carbohydrates this population needs and how to adjust insulin dose based on carbohydrates eaten.

Limitations of the study include the information on the calorie and carbohydrate prescribed and served was not measured by researcher, rather it was obtained from tray tickets. In addition, the amounts of carbohydrates served and consumed were not actually measured. Portion sizes are also difficult to estimate as different people may serve different amounts to different patients. Therefore, calorie and carbohydrate amounts are not exact in this study.

Avoiding high and low excursions in blood glucose is important in the care of any hospitalized patient as this has been shown to improve clinical outcomes. As such, it may be necessary for an increased awareness among hospital staff of the amount of food consumed, especially carbohydrates. Increased awareness to standardize the serving sizes served from the food service staff may also help. With such knowledge, the appropriate amount of insulin can be administered and both hyperglycemia and hypoglycemia can be avoided.


