Comparison of Insulin Regimens and Timing on Hypoglycemia Rates in Hospitalized Patients

Poster #11

Kristen Butler, Pharm.D.[1], Lynn Kassel, Pharm.D., BCPS[2,3]

[1]MercyOne Des Moines Medical Center; [2]Drake University College of Pharmacy and Health Sciences; [3]MercyOne West Des Moines Medical Center

Background

Over 5.5 million patients with diagnosed diabetes are admitted to the hospital, and 20% of those patients require an unplanned readmission to the hospital within 30 days.[1-2] Diabetes causes various negative patient outcomes such as:
-   increased infection rates
-   increased length of hospital stay
-   neuropathy/retinopathy
-   mortality.[3]

Following the American Diabetes Association (ADA) guidelines for diabetes care in hospitalized patients, insulin is the preferred agent for treatment of hyperglycemia.[4] Hypoglycemia remains a concerning side effect, with complications of: confusion, visual disturbances, seizures, and death. There is a delicate balance of treating hospitalized patients with diabetes to correct their elevated blood sugars, while avoiding dropping the patient's blood sugar too low.

The ADA offers multiple insulin regimens options such as basal, bolus, correction scale, or a combination. Most often, patients will have basal insulin administered either once daily in the morning or night, or twice a day. Previous studies, have evaluated if the timing of insulin administration plays a role in the patient's risk of hypoglycemia.[5-7] Contrary to this study's aim, previous studies mainly focused on patients with type 1 diabetes. All three studies concluded that there was no clinically relevant difference in efficacy between dosing times. Bedtime dosing of insulin had numerically more events of hypoglycemia, but the researchers suggested it might not be clinically relevant. The most recent study by Grelle, et al concluded insulin administered as a once-daily in the evening correlated to an increased occurrence of hypoglycemia.[8] Of note, these studies included smaller populations, with the least being 28 patients and the most being 381.

Current data suggests that insulin is effective in managing blood glucose regardless of when administered; however, once daily evening dosing increases the patient's risk of a hypoglycemic event. Unfortunately, previous studies had low patient populations. The aim of this study is to re-evaluate if timing of insulin administration, specifically insulin glargine, correlates to hypoglycemic events in a larger patient population.

Purpose

The primary objective of this study is to analyze the percentage of patient days with any occurrence of hypoglycemia. Patients in both ICU and general medicine floors will be collected to evaluate if a certain area is more prone to hypoglycemic events.

Secondary outcomes include: percentage of patient days with an occurrence of hypoglycemia in both the ICU and general medicine floor, percentage of patients who experience a hypoglycemic event, incidence of severe hypoglycemia, and hypoglycemia requiring treatment.

Hypothesis: There is no difference in timing of insulin administration on the frequency of hypoglycemia in hospitalized patients.

Description

This was a retrospective, chart review study of patients admitted to MercyOne Des Moines or MercyOne West Des Moines Medical Centers between January – December 2020, who received insulin for 2 – 10 days.
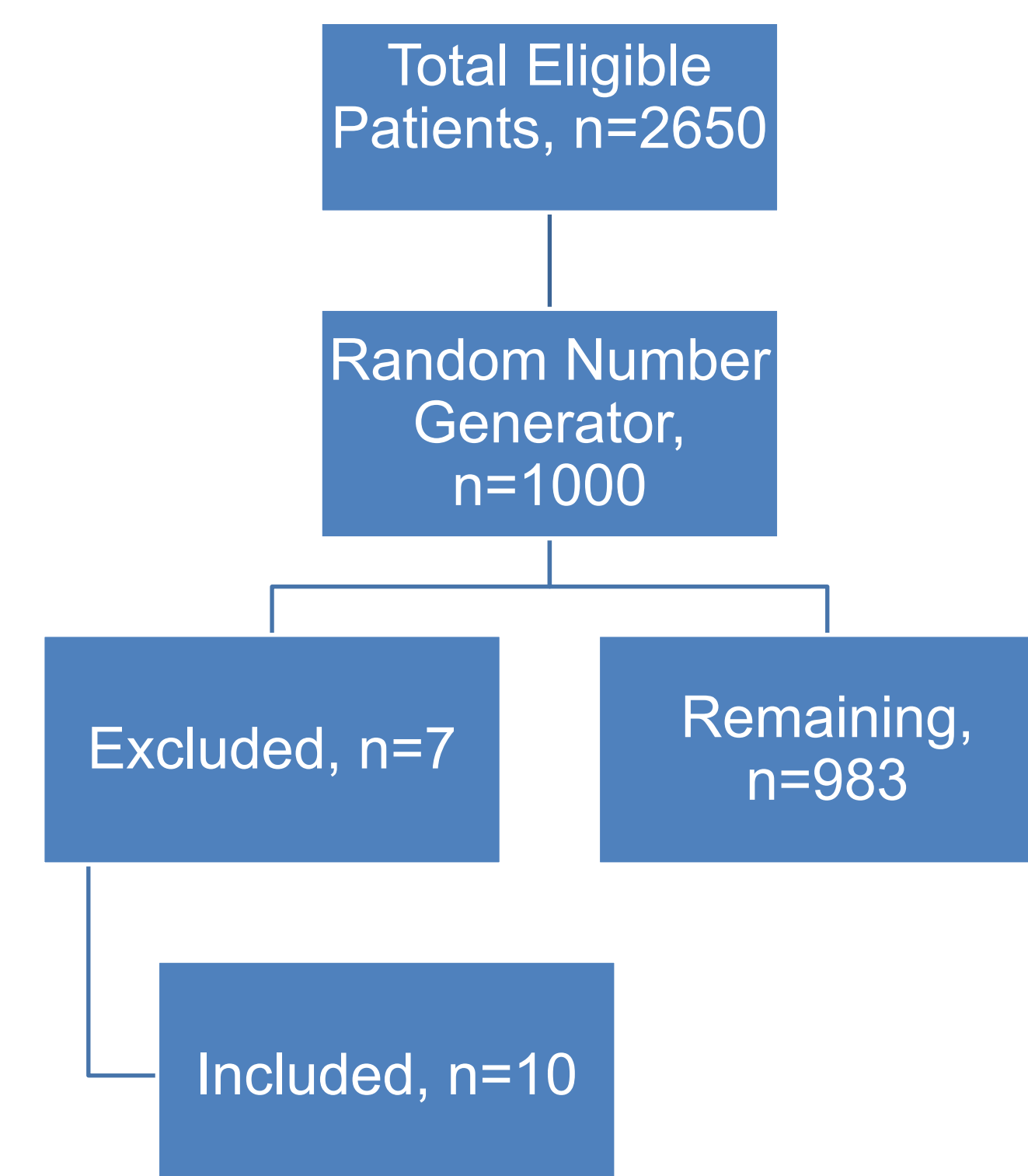
Inclusion criteria:
-   Patients admitted to MercyOne Des Moines or MercyOne West Des Moines who received insulin for at least 48 hours
-   Adult patients, who are at least 18 years old

Exclusion criteria:
-   Patients receiving continuous insulin infusion
-   If insulin administration times were ever modified during the period of administration
-   If the patient moves from an intensive care unit to a general medical floor during the period of administration

Figure 1: Patient Enrollment

In this pilot data, only 10 patients (1% of target population) have met the inclusion criteria for data collection at this time.

˙ Table 1: Patient Demographics

	Total, n (%)
Age (years)	67 ± 13.6 (45 – 90)
Gender (male)	8 (80)
Weight (kg)	95 ± 23.1 (68 – 135)
SCr (mg/dL)	1.4 ± 1.1 (0.6 – 4.3)
Length of Stay	6 ± 1.9 (2 – 9)
Glucose at Admission (mg/dL)	251 ± 138.5 (107 – 517)
A1c (%) at Admission	9.1 ± 1.1 (7.6 – 11.3)
Glucose at Insulin Initiation (mg/dL)	256 ± 137.5 (107 – 517)

Purpose, Cont.

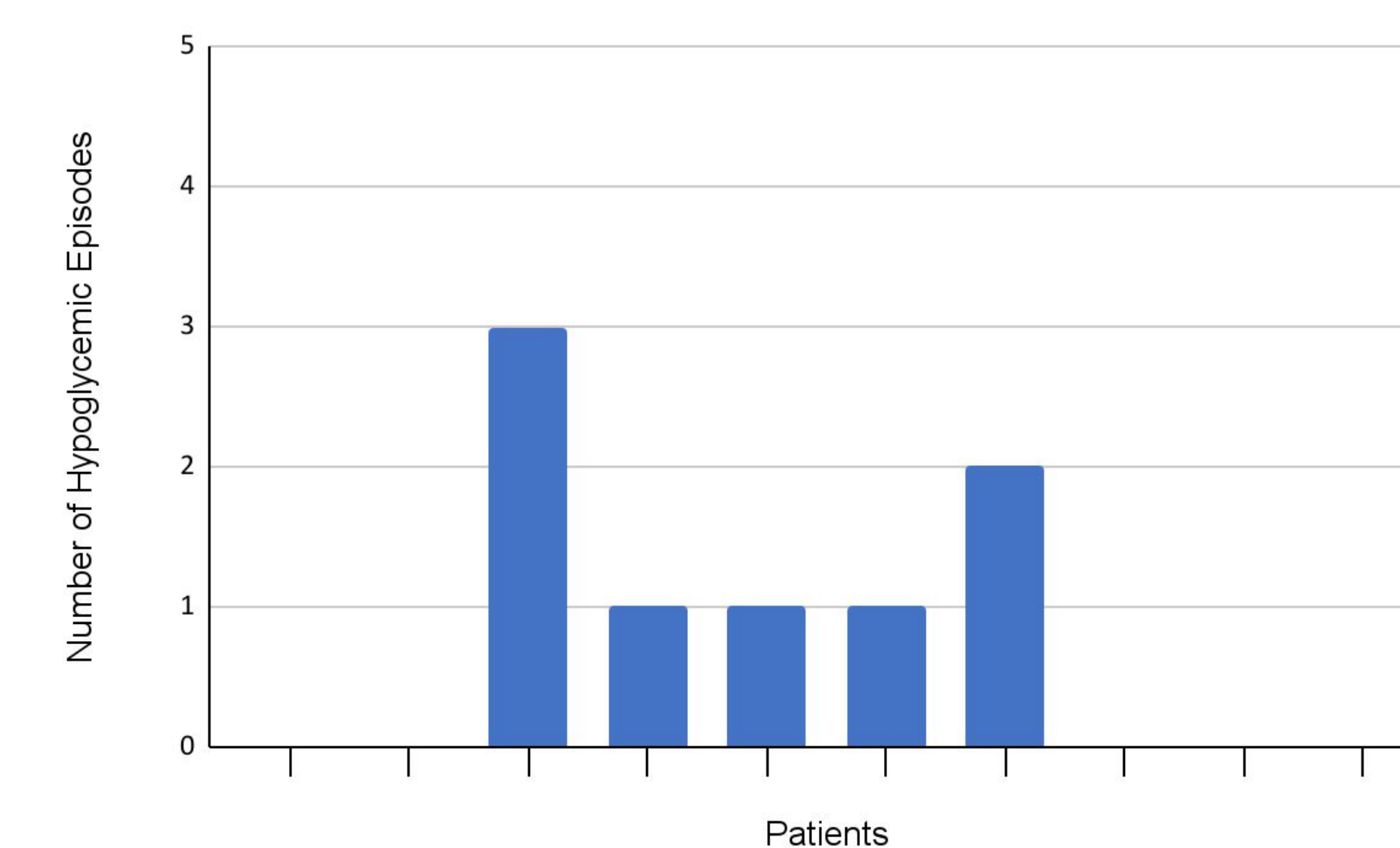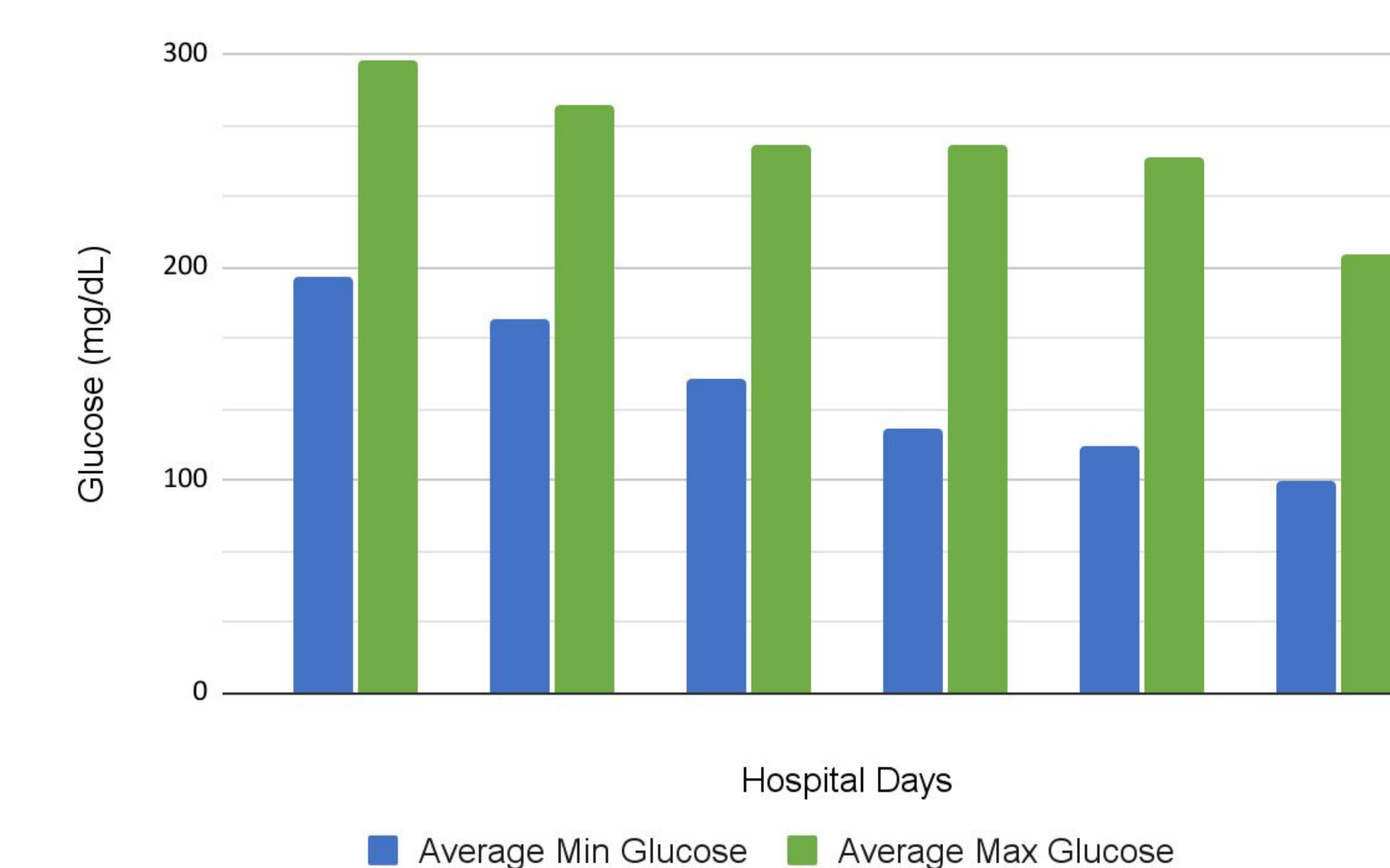**Figure 2: Hypoglycemic Episodes, per patient**

Figure 3: Blood Glucose Ranges, per hospital day

There were eight episodes of hypoglycemia (BG ≤ 70 mg/dL) in the ten patients analyzed to date. None of these eight episodes was classified as severe hypoglycemia (BG ≤ 40 mg/dL). These episodes occurred in patients with morning (0600-1159), evening (1800-2359), and twice daily dosing of insulin glargine. Hypoglycemic episodes occurred on days 3, 4, 5, 6, and 7.

Conclusion

This preliminary data from 1% of the target population suggests hypoglycemic events are prevalent within acutely ill patients with diabetes, who are treated with insulin. Of the five patients who did have a hypoglycemic event, two of those patients had more than one event. One patient had 3 hypoglycemic events during their 3 day hospitalization. This particular patient received the home insulin dose but had a nothing by mouth (NPO) diet ordered. These events possibly could have been prevented with further evaluation of the patient's insulin requirements while NPO. At this time, there is no predictable association with timing of insulin, as 3 patients received insulin in the morning, 3 in the evening, and 4 had twice daily dosing. Average insulin glargine units per day trended up as the average on day 1 was 7 units and on day 6 was 19 units.

Conclusion

The increase in daily insulin is reflective of the average daily minimum and maximum glucose readings. Patient's average minimum and maximum glucose readings downtrended with each day. This is significant as the patient's blood glucose did not get better controlled, as the minimum average daily glucose also down-trended, putting the patients at risk for hypoglycemic events.

This preliminary study data confirms that providers should continue to assess patients' insulin requirements daily and take into account their diet order and confounding medications that might alter their serum glucose. This preliminary data also indicates that clinicians should re-evaluate home insulin orders to determine if a 20 - 25% dose reduction needs to be implemented, reflective of the American Association of Clinical Endocrinologists guidelines for diabetes care plan.[9] Since the patient's day-to-day hospital course is variable, clinicians should be diligent in modifying insulin orders and utilizing corrective or sliding scale insulin to correct blood glucose levels, rather than increasing basal insulin as the only method of controlling blood sugar.

Limitations

-   The data presented here represents 1% of the target population in this project
-   Data was collected by retrospective chart review so if hypoglycemic events were not documented, they were not collected

Future Studies

-   Complete the data collection for this project to see if this trend of hypoglycemic events continues
-   Evaluate if an insulin drip in ICU settings reduces the risk of hypoglycemic events
-   Evaluate hypoglycemic event trends from patients who move from the ICU setting to the general medicine floors

References

1. https://www.diabetes.org/resources/statistics/statistics-about-diabetes
2. https://www.thewellnessnetwork.net/health-news-and-insights/blog/inpatient-diabetes-education/
3. Kodner C, Anderson L, and Pohlgeers K. Glucose Management in Hospitalized Patients. *AAFP.* 201; 96: 648-653
4. American Diabetes Association 15. Diabetes Care in the Hospital: Standards of Medical Care in Diabetes – 2019. *Diabetes Care 2019;42* (Suppl. 1): S173-S181
5. Hamann, A. et al. A Randomized Clinical Trial Comparing Breakfast, Dinner, or Bedtime Administration of Insulin Glargine in Patients with Type 1 Diabetes. ADA. 2003. 26:1738 – 1744
6. Haw, J.S., et al. Comparison of Basal Insulin Regimens on Glycemic Variability in Non-Critically Ill Patients with Type 2 Diabetes. AACE. 2014. 21(12): 1333 – 1343
7. Goksen-Simsek, D., et al. A Randomized Clinical Trial Comparing Breakfast and Bedtime Administration of Insulin Glargine in Children and Adolescents with Type 1 Diabetes. J Clin Res Ped Endo. 2008. 1(1): 15 – 20
8. Grelle J.L., et al. Impact of Insulin Detemir Administration Times on Hypoglycemia Rates in Hospitalized Patients. Poster presented at Texas Society of Health-System Pharmacists Annual Seminar. 2016
9. AACE/ACE Comprehensive Diabetes Management Algorithm. *Endocr Pract.* 2015; 21 (No. 4)