

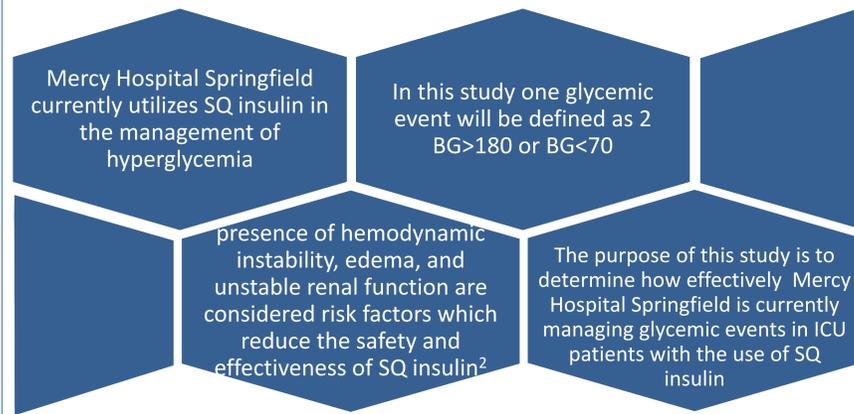


Assessment of the effectiveness of subcutaneous insulin in the management of hyperglycemia in the intensive care unit at Mercy Hospital Springfield

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Background

- Hyperglycemia in hospitalized patients is defined as blood glucose (BG) levels greater than 140 mg/dL per The American Diabetes Association (ADA).¹
- Hypoglycemia is defined as BG less than 70mg/dL and severity by respective BG levels.¹
- Persistent elevation in BG levels can lead to life threatening diabetic ketoacidosis (DKA) or hyperosmolar hyperglycemic state (HHS).
- Neurological symptoms will begin to occur when BG levels are 54mg/dL or less, with severe events occurring at BG of 40mg/dL or less.¹
- Proper use of insulin is imperative in the management of patients with hyperglycemia in the intensive care unit (ICU) in order to prevent adverse events as mentioned above.
- The use of an intravenous (IV) insulin infusion protocol (IIP) is recommended by The ADA and The American Association of Clinical Endocrinologists (AACE) above the use of subcutaneous (SQ) insulin, despite limited evidence.¹
- A recent study has displayed that ICU patients treated with IIP were able to achieve better BG control and lower occurrence of hypoglycemia compared with SQ insulin regimens.²
- Per the NICE-SUGAR study, insulin therapy is recommended to be initiated when persistent BG levels >180mg/dL with a target <180mg/dL for intensive care unit (ICU) patients.³



Methods

Primary Objective:

- To determine the number of glycemic events experienced by ICU patients that are receiving subcutaneous insulin.

Secondary Objectives:

- To determine average BG range maintained in patients receiving subcutaneous insulin in the ICU
- To measure the time to target glucose control in patients receiving subcutaneous insulin in the ICU
- To document and compile adverse events experienced due to glycemic events in patients receiving subcutaneous insulin in the ICU
- To measure glycemic events in patients receiving only sliding scale insulin
- To assess the risk factors for use of subcutaneous insulin (hemodynamic instability, edema, and unstable renal function)
- To determine the cost difference between the use of subcutaneous insulin and IV insulin therapy

Inclusion Criteria:

- A 13-month report of ICU patients receiving SQ insulin was reviewed from 1/01/2019 to 1/21/2020.
- Descriptive statistical analysis was completed to determine if Mercy Hospital Springfield is effectively controlling BG levels in the ICU.

Exclusion criteria:

- Less than one glycemic event
- Patients presenting with DKA and/or HHS
- Pregnancy
- Patients admitted with primary diagnosis of psychiatric event

Results

Preliminary results of 84 from 1911 total eligible patient charts have been reviewed and of those 54 patient charts met the inclusion criteria.

Table 1: Baseline Patient Characteristics:

Female	Avg Age	Hemodynamic Instability	Edema	GFR < 60mL/min	Average BMI	Average A1c	Average ICU LOS	Average LOS
55% (30)	65	46% (25)	41% (22)	52% (28)	33.12	7.4	5.7 days	11 days

IRB Protocol defined unstable renal function in alignment with KDIGO 2012 guidelines, as GFR < 90mL/min.⁴ Due to EMR limitation's, unstable renal function was defined as GFR < 60mL/min for data collection.

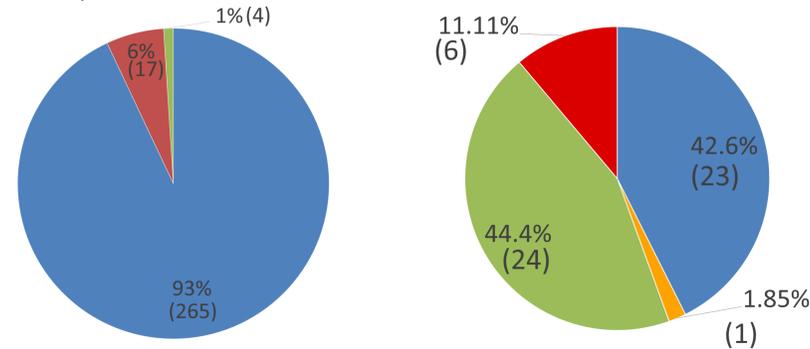


Figure 1: Primary Objective of number of glycemic events; average of 5 hyperglycemic events per patient

Figure 2: Type of insulin regimens used

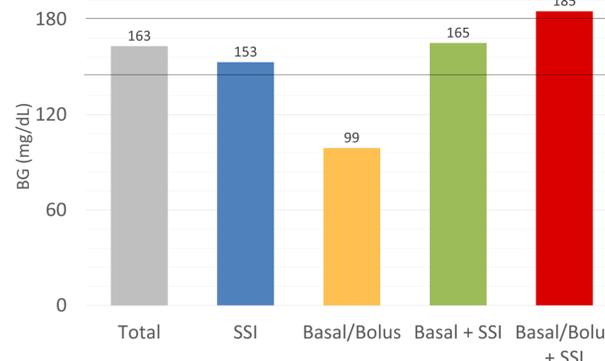


Figure 3: Average blood glucose per type of insulin regimen used

Adverse events experienced due to glycemic events was unable to be obtained due to lack of EMR documentation.

Table 2: Total BG measurements and average time measurements

Total BG	Avg time outside goal (hours)	Avg time to correct BG (hours)
1,944	21.49	11.45

Table 3: Assessment of risk factors which reduce the safety and efficacy of SQ insulin

Risk Factors:	0	1	2	3
AVG BG (mg/dL)	139	160	166	173
SSI	3	12	6	2
Basal/Bolus	0	1	0	0
Basal + SSI	4	10	5	5
Basal/Bolus + SSI	1	2	2	1
Hypoglycemic events	3	10	3	4

Results Continued

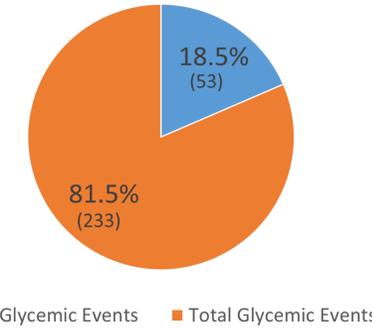


Figure 4: Glycemic events in SSI patients



Figure 5: Cost difference between the use of SQ and IV insulin therapy per LexiComp

Discussion

- Sole utilization of SQ insulin for BG control led to increased number of glycemic events as shown in Figure 1.
- Average BG maintained was moderately elevated above guideline recommendations of BG < 180mg/dL in patients receiving Basal/Bolus + SSI as shown in Figure 3. This outcome was expected as pharmacists report therapy initiated with SSI alone. If ineffective scale titration is completed followed by basal addition, with or without bolus dosing.
- Average BG maintained was within guideline recommendations below 180mg/dL in all insulin other regimens.
- The average time measurements as depicted in Table 2 highlights the decreased ability to achieve BG control with SQ insulin regimens, as seen in previous studies.²
- As seen in the literature, our study also saw a trend towards increased patient risk factors and poor BG control, as seen in Table 3.²
- A large portion of glycemic events in SSI patients alone accounted for total glycemic events, as depicted in Figure 4. Following ADA recommendations against sole use of SSI.¹

Limitations:

- No true comparator group so power was not set
- Wide range of BG levels
- Documentation of regular BG checks

Future Direction:

- This is the baseline data that can be used to start discussions on transitioning to IIP in our facility with future research comparing pre-and post-IIP outcomes.

Conclusions

This study identified 286 glycemic events in patients receiving SQ insulin, resulting in an average of 5 hyperglycemic events per patient. A majority of patients were receiving SSI only or Basal + SSI. The average time spent outside of BG control was 21.49 hours with an average time to correction of 11.45 hours. Utilization of IIP in ICU patients per ADA and AACE recommendations would likely result in a decrease in glycemic events and more effective management of BG levels.

Disclosure Statement

None of the authors have any financial or professional conflicts to disclose.

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References

- American Diabetes Association. 15. Diabetes care in the hospital: Standards of Medical Care in Diabetes 2019. Diabetes Care 2019;42(Suppl. 1):S173-S181
- Kenneth K. Tran, PharmD, Jeffery L. Kibert II, PharmD, BCPS, Evan D. Telford, PharmD, and Andrew J. Franck, PharmD, BCNSP, BCCCP. Intravenous Insulin Infusion Protocol. 2019; Annals of Pharmacotherapy 2019, Vol. 53(9) 894-898.
- NICE-SUGAR Study Investigators, Finfer S, Chittock DR, et al. Intensive versus conventional glucose control in critically ill patients. N Engl J Med. 2009;360(13):1283-1297. doi:10.1056/NEJMoa0810625
- KDIGO 2012. Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Volume 3 issue 1. January 2013. Accessed 12/26/2020