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Correlation of Population Specific Risk Factors and Prevalence of Developing Severe Hypoglycemia

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Background

Tendency for tighter glycemic control using sliding-scale and long-acting (LA) insulin in hospitalized patients leads to higher risk of severe hypoglycemia. Commonly, we don't use validated strategies for calculating insulin requirements in admitted patients and infrequently complete the recommended follow-up after insulin initiation or adjustments. Centers for Medicare and Medicaid Services (CMS) defines blood glucose of <40 mg/dL within 24-hours of administration of anti-diabetic medication as preventable harm.¹ The FADOI-DIAMOND study in 2016 showed mortality increased by 2-3 times after an inpatient hypoglycemic event.² Covenant Medical Center (CMC) had a severe hypoglycemia rate of 8.97% in 2021, almost double the Providence ministry goal of 4.5% based on a threshold of blood glucose <50 mg/dL with at-risk patients being all with anti-diabetic medication orders. Elliott, et al, validated a weighted risk score calculator to identify patients for intervention using age, renal function (CrCl), weight, and insulin dose in units/kg/day.³ When applied to our population, it did not show association of risk in known hypoglycemic patients from a previous MUE. That MUE also showed that patients have decreasing blood glucose trends before severe hypoglycemic event.

Purpose

- Identify population specific risk factors for experiencing severe hypoglycemia in patients admitted to CMC
- Utilize the data to develop clinical surveillance tools for more accurate recognition of patients for intervention

Methods

- **Primary outcome** - Measure association of patients experiencing severe hypoglycemia while admitted to CMC with various independent variables
 - Increased age
 - ESRD/CKD
 - Steroid use/taper
 - LA insulin dosed BID
 - >0.5 units/kg/day of LA insulin
 - Low body weight
 - SU use
 - NPO/decreased intake
- **Design** - Retrospective chart review, multiple linear regression
- **Population** - 1304 at risk patients, 736 patients reviewed, 88 excluded [Figure 1]
- **Period** - Quarter 1 of 2021
- Post-hoc analysis done to compare incidence based on pharmacist rounding versus surveillance floor.

Results

- Statistically significant associations were found with developing severe hypoglycemia and use of LA insulin, BMI categories <18.5, 18.5 to 24.99, and 30 to 34.99, and CrCl <60 ml/min. [Figure 3]
- No difference was found in BID use of LA insulin, SU use, steroid use or tapering, or diet.
- 33.95% with CKD diagnosis compared to 52% of patients with CrCl <60 mL/min.
- 14 (39.5%) patients had a blood glucose of <90 within the previous 24 hours.
- Only 14 of 43 (32.6%) patients who experienced a severe hypoglycemic event were on floors with a pharmacist rounding daily. [Figure 2]
 - 7 of those 14 were on the nephrology unit

Limitations

- Dataset not fully representative of population with severe hypoglycemia incidence of 6.63% compared to reported rate of 8.67% for quarter 1.
- Data collection cut short due to transitions in EHR leading to 70 severe hypoglycemic events not included.
- Large COVID population affects average age, steroid use, insulin use, and co-morbidities, as well as large change in workload on staff.
- ICD-10 coding unreliable or AKI on date of patient admission analyzed causing inconsistencies.

Discussion

The cause of inpatient severe hypoglycemia is complex and requires clinical judgement to determine patients requiring intervention. Patients admitted to CMC with BMI <18 to 24.9 kg/m² with renal dysfunction on LA insulin are at highest risk of severe hypoglycemia. More timely review of patients with down-trending blood glucose, especially after starting or adjusting LA insulin, can greatly improve the incidence of severe hypoglycemia. Pharmacists can be more utilized to address these events and improve management of inpatient insulin dosing.

Future Implications

- Surveillance tools that flag patients for review when blood glucose is <90 mg/dL with high-risk characteristics can guide preventative interventions.
- Development and implementation of a pharmacist-led insulin management protocol.

Figure 1: Patient selection.

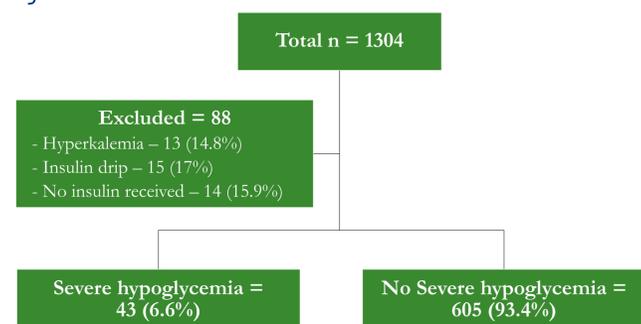


Table 1: Patient demographics.

	All patients (n = 648)
Age (years) [median (IQR)]	65 (18)
Female Sex (%)	292 (45.1%)
Weight (kg) [median (IQR)]	86 (30)
BMI [median (IQR)]	29.98 (9.7)
CKD diagnosis (%)	220 (33.9%)
CrCl [median (IQR)]	65 (56)
BG <50 mg/dL (%)	43 (6.6%)
Location - ICU (%)	87 (13.4%)
Diabetes (%)	522 (80.6%)

Table 2: Statistically significant results.

	P-value
Long-acting insulin	0.0444
BMI	
<18.5	0.0073
18.5 - 24.99	0.04
30 - 34.99	0.0359
Creatinine clearance <60 ml/min	0.0061

Figure 2: Breakdown of hypoglycemic events based on floor and pharmacist coverage.

