Outcomes of patients with DKA treated with subcutaneous insulin in the emergency department

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Introduction

- Diabetic ketoacidosis (DKA) is a life-threatening emergency that is characterized by a triad of hyperglycemia, metabolic acidosis, and ketonemia.[1,2]
- Historically, the primary treatment for DKA has been use of intravenous continuous insulin infusions.[1,3]
- However, recent studies have demonstrated the efficacy of use of long-acting and short-acting subcutaneous insulin for management of mild-moderate DKA.[4]
- Subcutaneous insulin use can reduce the need for ICU admission and monitoring requirements.
- A recent study following a hospital-wide subcutaneous insulin protocol found that there was a significant decrease in ICU need and readmission, with no increase in adverse events.[4]
- In the United States, DKA has an estimated annual cost of greater than $5 billion.[5] The use of subcutaneous insulin (Sub-Q) vs. continuous infusion insulin (CII) saves patients $34.08 per hour.[6]

Specific Aims

- The goal of this quality improvement (QI) study is to examine the outcomes of DKA patients being treated with subcutaneous insulin for DKA compared to patients treated with intravenous continuous insulin infusions.
- Primary outcomes include rates of ICU/PCCU admission, hospital length of stay (LOS), and time to DKA resolution.
- Secondary outcomes include rates of hypoglycemia.

Methods & Data Collection

- This study involved a retrospective chart review, using data from the Tucson Medical Center (TMC) Epic electronic medical record system.
- To be eligible for this study, subjects had to be adult patients with diabetic ketoacidosis who were admitted to the TMC emergency department (ED) from March 1st, 2022 to October 31st, 2022.
- Patients who were eligible for this study were stratified by DKA severity: mild, moderate, severe according to Kitabachi et al.[7]
- Data regarding primary and secondary outcomes was collected, de-identified, and analyzed using excel.
- Data for this QI study were exempt from University of Arizona Institutional Review Board (IRB) monitoring.

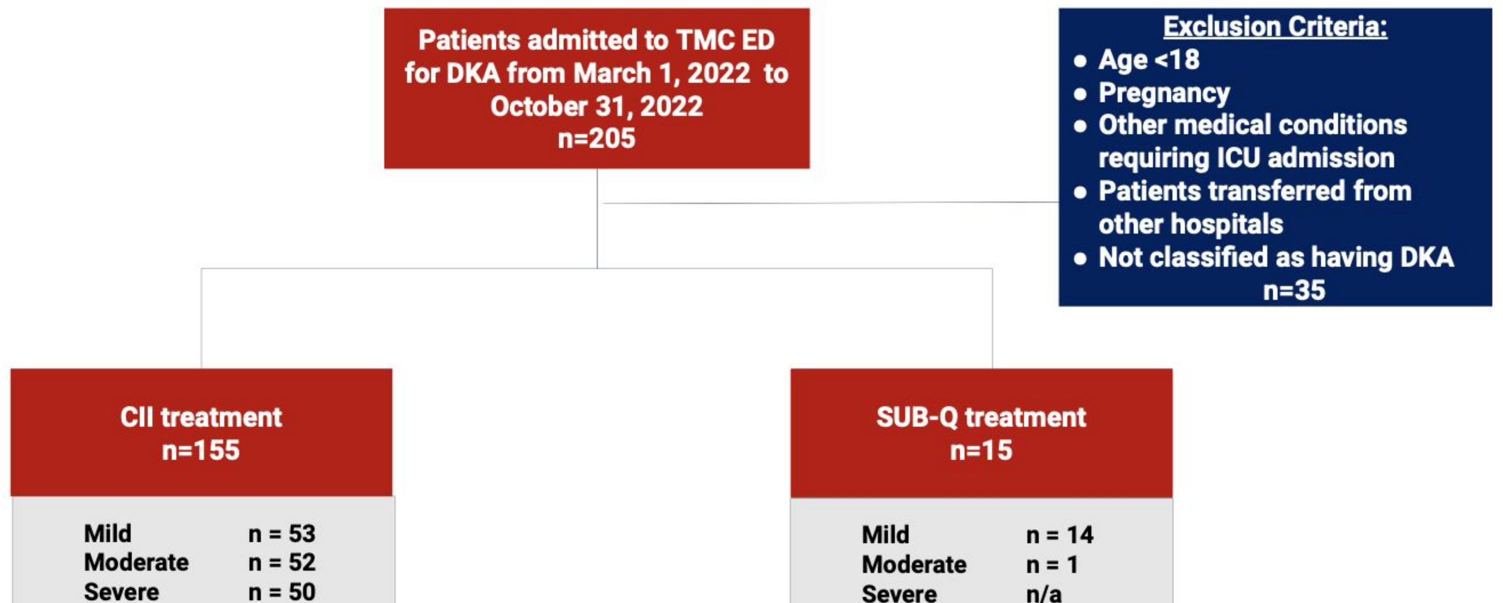

Diagram 1. Flowchart for Stratification of Study Subjects Including Inclusion and Exclusion Criteria

Results

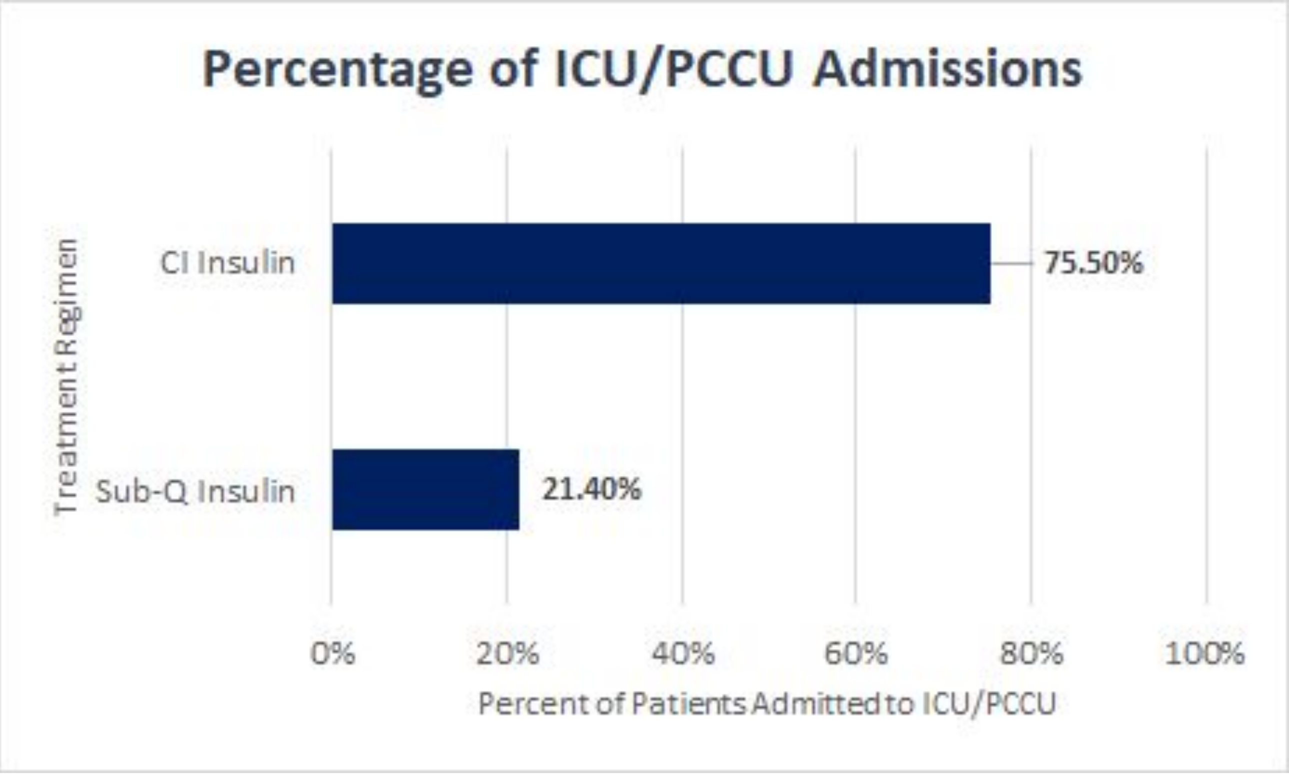

Figure 1. Percentage of ICU/PCCU Admissions of Patients in the Mild DKA Classification

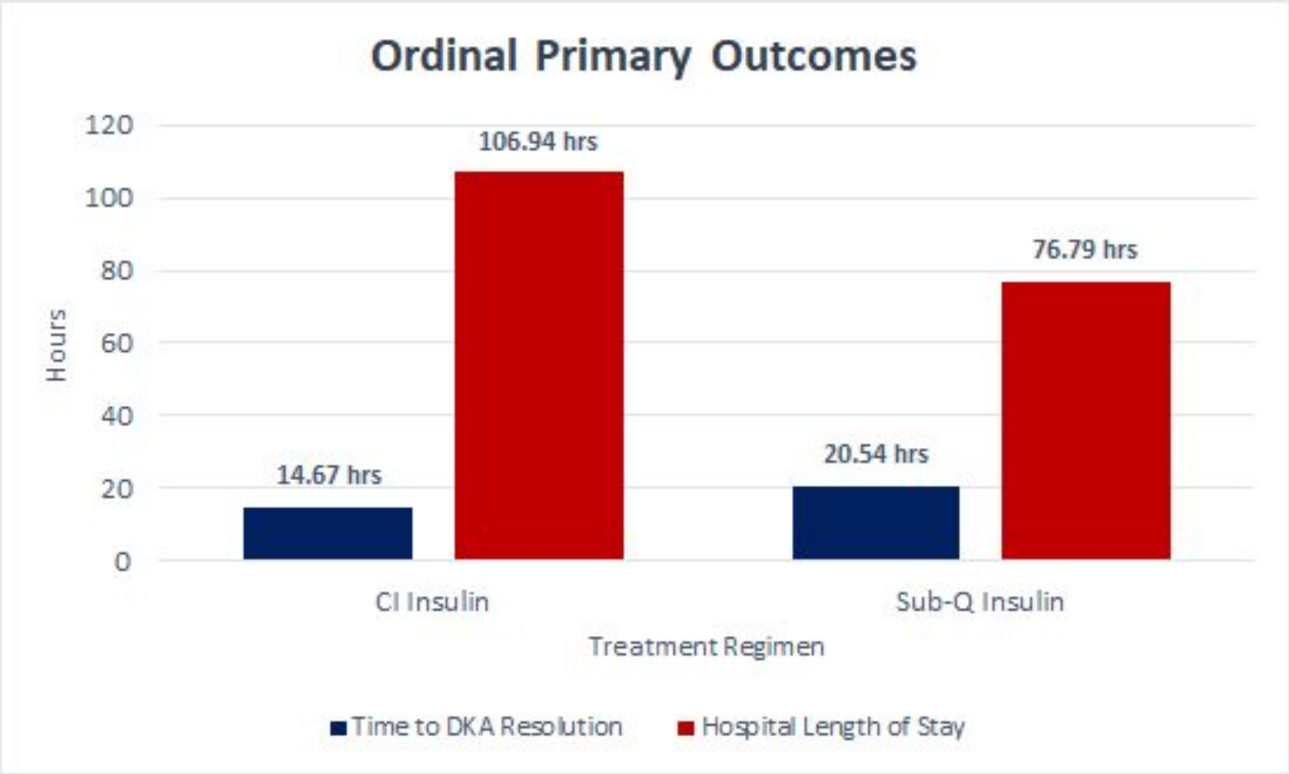

Figure 2. Time-Based Primary Outcomes Including Time to DKA Resolution and Hospital Length of Stay for Patients in the Mild DKA Classification.

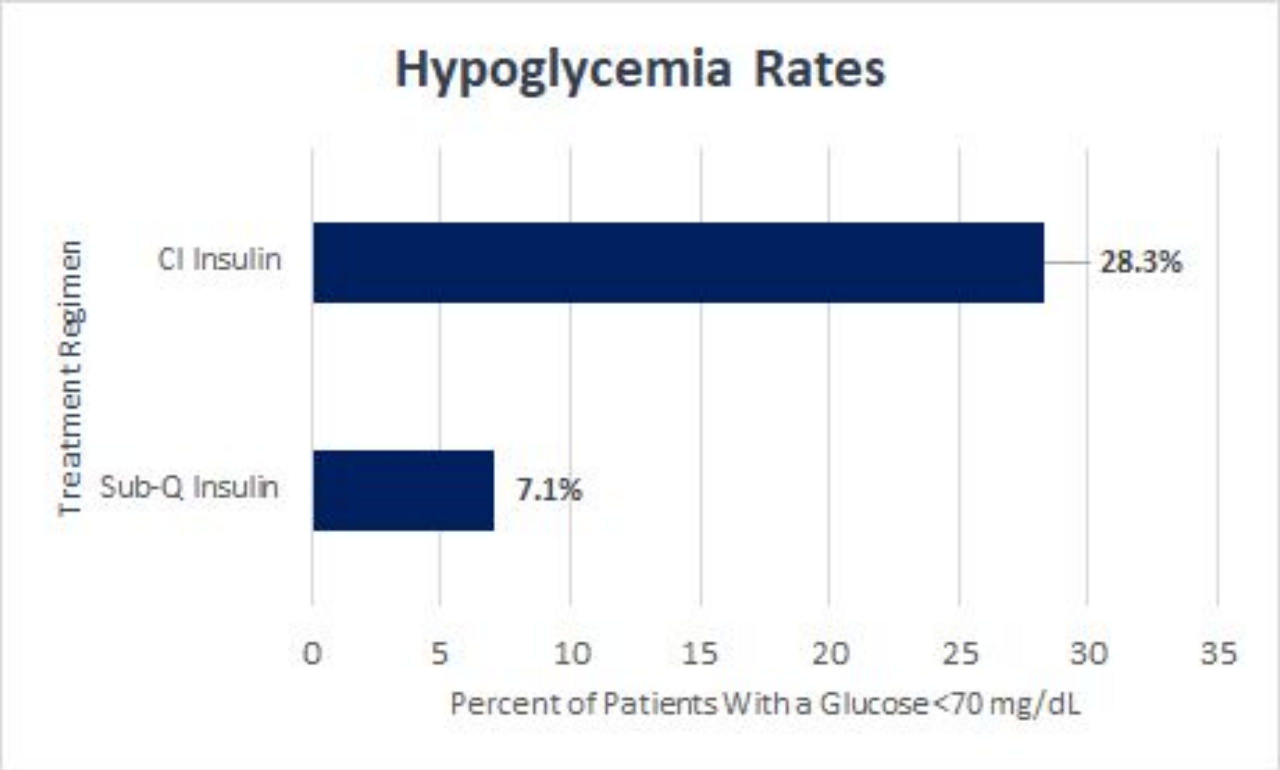

Figure 3. Rates of Hypoglycemia in Patients in the Mild DKA Classification.

Discussion

- In the mild DKA group, 14 patients were treated with Sub-Q insulin and 53 patients were treated with CII.
- The group that received CII had a higher rate of ICU/PCCU admissions (75.5%) compared to the Sub-Q group (21.4%).
- Sub-Q insulin was associated with a decreased LOS compared with CII: 76.69 hours vs. 106.94 hours, respectively.
- Time to DKA resolution was similar between the CII group (14.67 hours) and Sub-Q group (20.54 hours).
- Hypoglycemia occurred more frequently in the CII group (28.3%) compared to the Sub-Q group (7.1%).

Limitations

- Due to the retrospective study design, there is an increased risk of selection and recall bias.
- Although subcutaneous insulin may be beneficial in mild to moderate DKA, there was a lack of data in patients with moderate DKA. Therefore, the results of the study only reflect outcomes of the mild DKA group; future studies should focus on application of subcutaneous insulin on moderate DKA.
- The "time to DKA resolution" values recorded were made based on first available labs that met criteria and may not have reflected the true amount of time to resolution.
- Errors in treatment management including the lack of a subcutaneous insulin-based DKA order set for standardization of treatment management in the ED.

Conclusion

- Due to the time sensitive nature of treating DKA, subcutaneous insulin shows a promising future of treating patients outside of the ICU setting, while not sacrificing an increase in LOS, adverse events, and readmissions.[4]
- Based upon the results of this study, utilizing subcutaneous insulin for mild DKA can subvert the amount ICU/PCCU beds needed for management of this condition.
- In conclusion, subcutaneous insulin has shown to be a comparable treatment to continuous insulin infusion for patients with mild diabetic ketoacidosis.
- Future studies are warranted in order to implement an order set of subcutaneous insulin for mild DKA cases and to examine both the statistical and clinical significance of this implementation.

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