Subcutaneous Insulin Protocol Implementation for Non-severe Diabetic Ketoacidosis

Nguyen, Tony PharmD, Krusenoski, Sara PharmD, Nazir, Saif MD, Aggarwal, Nimit MD

THE UNIVERSITY OF CHICAGO
Center for Healthcare Delivery Science and Innovation
UChicago Medicine

Problem

- ICU beds and resources are used for all diabetic ketoacidosis (DKA) cases including cases of non-severe disease.
- Dedicating resources to non-severe cases leads to ICU crowding, higher costs, ED boarding delays.
- At Ingalls, current standard of care for DKA treatment involves insulin infusion as the sole method of insulin delivery Frequency glucose monitoring (every 1 hour).
- Emerging evidence and leading guideline support the use of subcutaneous insulin for the treatment of patients in non-severe DKA.

Goal

- Implement a subcutaneous insulin protocol to treat patients with mild-to-moderate DKA.
- Reduce ICU utilization without compromising patient safety
- Improve or prevent complications of hypokalemia and hypoglycemia compared to current process.
- Achieve goals by spring protocol safety review.

Intervention Design

- **Outcomes:** ICU length of stay, ED board time, total length of stay
- **Safety:** Evaluate rates of hypokalemia and hypokalemia prior to and after protocol implementation.
- **Implementation:**
- **Pilot phase (current)**
  Location: Ingalls ED and ICUs
  - Ordering is structured and standardized for laboratory, nursing, and medication via AgileMD clincal pathways
  - Protocol "tip sheet" is provided to nursing staff
  - Pharmacist availability clinical support for questions and DKA resolution transition and post-treatment monitoring.
  - Aggressive hydration per protocol or provider directed fluid resuscitation.
  - Electrolyte replacement per protocolized thresholds.

Recommend to not initiate for:
- Age < 18 years
- Pregnant
- Glasgow Coma Score < 8
- Critically ill or requiring intensive care for concurrent issues
- ESRD or on intermittent hemodialysis (IHD)
- Hyperosmolar hyperglycemia syndrome (HHS)

Hydration	Lactated Ringers
	KCl 40 mEq/L + D5/0.45NS

Electrolytes	Potassium, Magnesium, Phosphate
	RN to replace per protocol

Insulin	Glargine – home or 0.3U/kg Q24H
	Lispro – 0.3U/kg x1 + 0.2U/kg Q4H

| Monitoring	Basic Metabolic Panel Q4H
	Glucose Q2H x 2, then Q4H

Results to Date

Insulin SQ protocol when compared to insulin infusion protocol
- **Median resolution time** was similar. Insulin SQ was numerically shorter (11.5 vs. 16.2 hours).
- **Median hospital length of stay** was similar with insulin SQ, insulin SQ was numerically slightly shorter (3 vs 3.9 days).
- **Time to DKA resolution** was similar, SQ insulin (11.5 vs 16.2 hours).
- *Safety outcomes* were comparable. Percentages shown highly susceptible to fluctuate due to small sample.

Table 1. Outcomes

	Insulin Infusion (Median, IQR)	Insulin SQ (Median, IQR)
Time to DKA Resolution (hrs)	16.2 (10.2 – 27.7)	11.5 (7.9 – 23.8)
ED Board time(hrs)	16.1 (8.1 – 25.0)	19.1 (10.6 – 28.3)
Hospital LOS (days)	3.9 (2.1 – 6.2)	3.0 (2.2 – 4.0)

Figure 1. Safety Outcomes
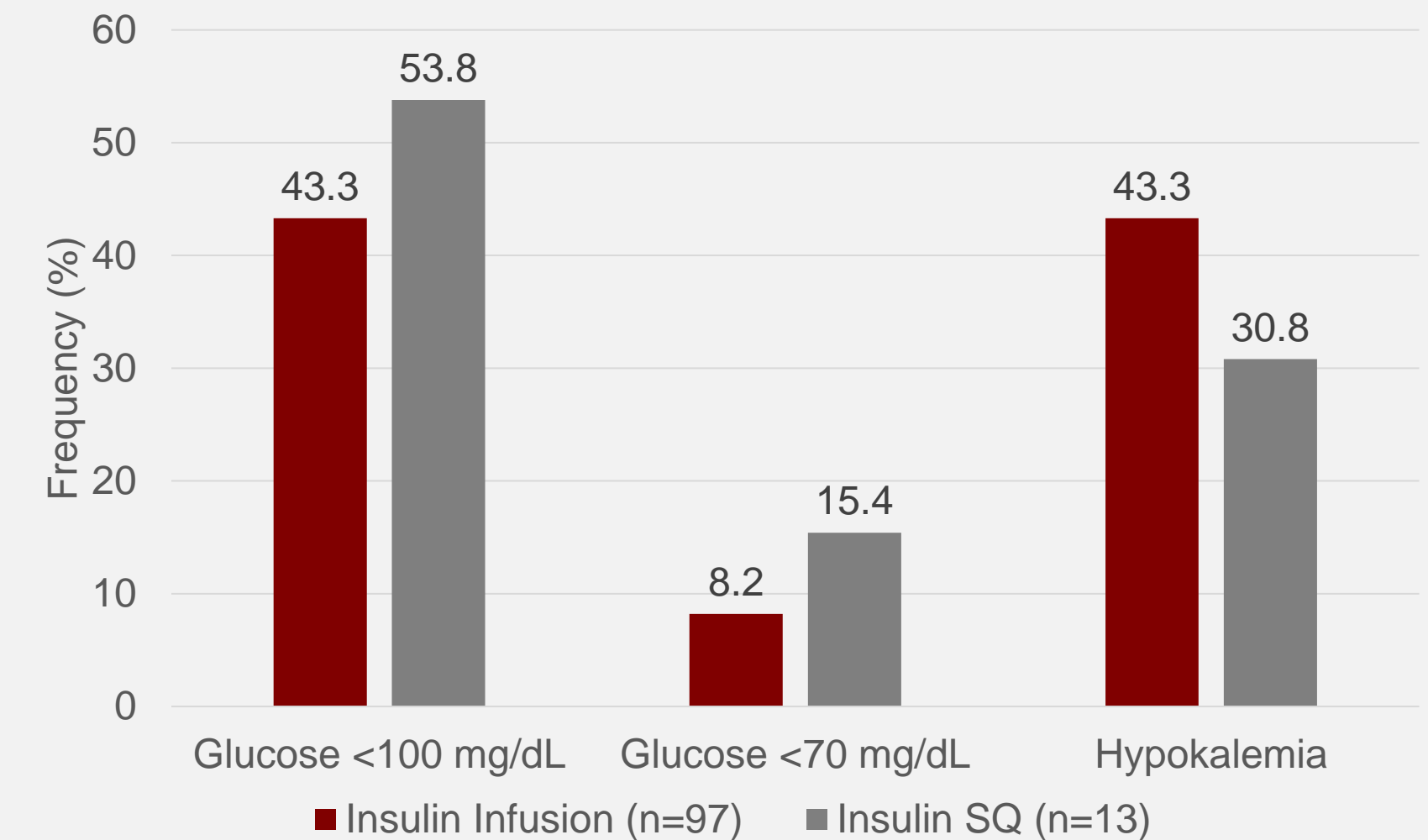
Lessons Learned and Next Steps

- Limited sample size, more data is needed to gain further insight to feasibility, safety, and efficacy.
- Further dosing modification of medications and fluids may be warranted.
- Hypokalemia is frequent in both protocols change is necessary.
- Discussions needed for assessment of feasibility of pilot expansion to general ward/medicine floors.
- Subgroup analysis needed of non-severe DKA patients in infusion group.
- Need identified for streamlining protocol ordering mechanics when ordering via clinical pathways
- Electrolyte replacement protocol updates needed to avoid overuse of phosphate replacement and lower rates of hypokalemia.
- Evaluation of current-status for patient diabetic education, outpatient diabetes treatment and access to care may be needed.

Acknowledgements

- Ingalls Emergency Department and Intensive care unit
- Ingalls Pharmacist and technicians
- Quality & Safety for assistance with clinical pathway development