Development of a Clinical Decision Tool and Protocol for Identification and Treatment of Corticosteroid Induced Hyperglycemia

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Background. Patients who receive high dose corticosteroids are at increased risk of developing prolonged hyperglycemia and adverse effects, including reports demonstrating as high as a 16% increase in mortality when compared to a normoglycemic population. There is currently no universal workflow or protocol to identify and treat these patients in the hospital setting. An xgboost model was developed and integrated into a novel workflow as a decision support tool for an interdisciplinary team of endocrinologists and pharmacists to identify and intervene on patients at risk of developing corticosteroid-induced hyperglycemia in the hospital.

Model Development. A cohort of 11995 patients with 30155 inpatient encounters at Duke University Hospital (DUH) between Oct 2014 and Aug 2018 was selected to train a model to predict corticosteroid-induced hyperglycemia. Patients in this cohort were ≥ 18 years old and received high dose corticosteroids (≥ 20mg/day of prednisone equivalents). Model features included eight laboratory and four vitals values collected in the 24 hours prior to corticosteroid administration as continuous variables and the presence of a lactate result in this period as a binary indicator variable. Additionally, five comorbidities, four inpatient medications, and four outpatient medications were included as binary variables in the analysis. These features were chosen based upon the expertise of an interdisciplinary team including an inpatient endocrinologist and pharmacist. The outcome of prolonged hyperglycemic events was defined as patients having two blood glucose values above 180 mg/dL within 12 hours of corticosteroid administration. The model was tested on 5707 encounters from DUH and validated on two external data sets from two local community hospitals which consisted of 6135 and 4803 encounters respectively. Model performance was evaluated using AUROCs and AUPRs.

Protocol and Workflow Development. The model identifies patients at-risk of hyperglycemic events in the twelve hours following corticosteroid treatment; at the time of prediction, the interdisciplinary team at our institution screens these patients and determines if they are appropriate for endocrinology consultation and intervention. The possible interventions, determined by the interdisciplinary team, include continued blood glucose monitoring, medication adjustments, diabetes education, and close outpatient endocrinology follow up following discharge. Ten hours were spent in the development and validation of this novel protocol, with protocol specifics available in Figure 1. The outcome metrics used to evaluate performance and effect of the pilot workflow include but are not limited to hospital length of stay, ICU transfers, readmission rates, and rates of hyper and hypoglycemia. The initial roll out is planned for the Bone Marrow Transplant Unit at DUH with a first round of performance metrics captured three months following roll out.

Results. The AUROCs for the test and validation sets were 0.899, 0.898, and 0.836 respectively; the corresponding AUPRs were 0.597, 0.680, and 0.456. The workflow protocol developed is outlined below.

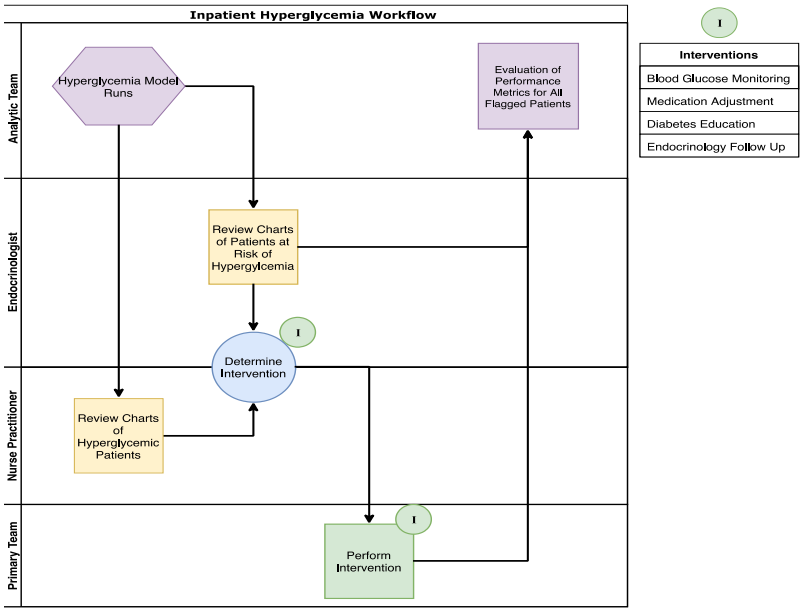

Figure 1: Interdisciplinary Team Workflow

Conclusions. The decision support tool and interdisciplinary team workflow created in this protocol align with clinical needs to identify and screen patients at risk of corticosteroid induced hyperglycemia. This effort is being piloted in coordination with the Bone Marrow Transplant Unit at DUH. In the future, we hope to deploy a reinforcement learning model to provide clinicians with intervention recommendations in this workflow.