Early Identification Of Gastrointestinal Bleeding Requiring Critical Care Using Machine Learning

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RATIONALE: Gastrointestinal (GI) bleeding is common and easily identified. However, distinguishing which patients will progress to require critical care services is challenging. Among cases that do require critical care, this uncertainty can delay emergent interventions and lead to avoidable morbidity and mortality. We use a machine learning methodology to identify early which patients with GI bleeding were likely to require intensive care unit (ICU) admission.

METHODS: Eight hundred patients admitted from 2013-2015 to a community hospital in Maryland with GI bleed were identified using ICD-9 codes. For each patient, heart rate, systolic and mean blood pressure, platelets count, hemoglobin, hematocrit, and international normalized ratio (INR) were extracted from the electronic health record (EHR). Patients were categorized by initial triage. For each patient, timed serial measures of heart rate, systolic and mean blood pressure, platelets count, hemoglobin, hematocrit, and international normalized ratio (INR) were extracted from the electronic health record (EHR). A machine learning algorithm considers the pattern of prior and new data components in sequence, according to the timeline of each patient's admission, and predicts need for ICU care. A probabilistic approach was used to jointly model the time series and event data (ICU admission). The probabilistic model provides both a prediction score and an associated confidence interval. Alerts are made only on patients whose associated confidence interval is above a desired confidence level to ensure prediction reliability. Using this methodology, at any given time, the model identifies three clinical trajectories: those who should be admitted to the ICU, those who do not require intensive care, and patients for whom the tool chooses to collect more measurements to improve confidence in the predictions.

RESULTS: Data were randomly divided into training (n=600) and validation (n=200) sets. At 75% confidence level, the model identifies patients later admitted to the ICU with an AUC of 0.81. At a specificity of 0.8, the model has a sensitivity of 0.77. Patients progressing to require ICU care were identified a median of 17 hours (IQR: 1 – 47) before ICU admission. The model also identified 130 patients who do not satisfy the 75% confidence level; on these patients more data are required to determine whether critical care services will be necessary.

CONCLUSIONS: Using a novel machine learning tool deployed on routinely collected electronic health data, patients with GI bleeding who will later need critical care services can be identified early in their clinical course.

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