Derivation of a Multivariable Model to Assist Emergency Department Triage of Heart Failure Patients by Their Diuretic Treatment Needs

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Background
Emergency medicine physicians (EMP) treat 1 million patients with acute decompensated heart failure (ADHF) annually. After emergency department (ED) treatment, EMPs must determine the need for further intravenous loop diuretic (IVLD) therapy in dispositioning patients to home (no further IVLD treatment), short stay observation (≤24hrs treatment), or inpatient hospitalization (>48 hours treatment). We hypothesized that EMPs overestimate IVLD needs, resulting in unnecessary admission, and derived a multivariable prediction model to aid EMP decision-making.

Methods
We prospectively enrolled 63 patients with ADHF. The primary predicted outcome was the number of guideline-based doses of IVLD (1 dose = 1x home furosemide dose) received during the total acute care encounter. Variables available prior to ED disposition (labs, imaging, risk-scores, structured physical exam {edema, JVP, orthopnea grade, hepatojuglar reflux}, patient symptom scores) were used to derive a multivariable prediction model with linear regression. Control predictor models included A) ED physical exam + symptom score + natriuretic peptide (NP) and B) EMP disposition decision adjusted for risk of 30-day serious adverse events. Models were compared by adjusted R^2.

Results
EMPs admitted 57 patients for full hospitalization, 5 for observation, and did not discharge any patients directly after ED IVLD treatment. Total-encounter IVLD requirements were median 2.5 guideline-standardized doses (IQR:0.8-4.5). ED disposition was poorly correlated with post-ED treatment needs, explaining only 2.1% of variance in IVLD requirements (i.e. R^2=0.021). Physical exam, symptom score, and NP explained 24.7% of IVLD requirements. The new model (predictors: NP, BUN, sodium, troponin, heart rate, blood pressure, chest x-ray, medication adherence, edema severity) explained 54.7% of IVLD requirements.

Conclusion
EMPs may increase unnecessary hospitalizations by overestimating post-ED IVLD treatment needs. Our novel model, pending external validation in a new >5000 patient sample, was 26 times more accurate than risk-adjusted ED disposition and twice as accurate as physical exam/symptom score/NPs.