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## "Lung Ultrasound-Based Artificial Intelligence Prediction of Congestive Heart Failure Readmission"

Congestive heart failure (CHF) is a growing cause of healthcare expenditures. Point-of-care lung ultrasound (LUS) has been shown to be a valuable tool to evaluate resolution of CHF related fluid overload during hospitalization for CHF. However, LUS evaluation is dependent on the skill of sonographers and interpreters, leaving room for human error and bias. AI models based on convolutional neural networks have shown promise in analyzing radiologic imaging, and previous studies have shown that that AI may be useful for identifying biomarkers at a single point in time. However, no research has used AI to identify progression of LUS biomarkers and clinical features.

We hypothesized that artificial intelligence (AI) could improve CHF care by being able to detect clinically important changes in LUS biomarkers that predict the course of disease. To test this hypothesis, we studied a convenience sample of 25 adult patients admitted to a university-affiliated hospital between April 2022 and December 2022. Sonographers were trained with directed learning and didactic training. LUS scans were obtained at admission and 24, 48, and 72 hours after admission if a patient was still hospitalized. Patients were scanned using a 13-6 MHz linear array probe and a custom lung present in a sitting or semi-recumbent position. Clinical data was also collected from the electronic health record. Expert annotation of LUS captures was completed by investigators trained on annotation procedures. Video quality, A-line presence, B-line presence, and other relevant biomarkers were noted during the annotation process. Convolutional neural network (CNN)-based models were trained using the LUS scans, annotation data, and clinical data (EHR data) from 17 patients. The eight remaining were used as a test cohort to determine AI's ability to predict readmission within 30 days of study enrollment.

Using either clinical data or an annotation-based multi-layer perceptron (MLP) AI model during training yielded 75% accuracy in predicting 30-day re-admission, whereas combining these methods increased accuracy to 87.5%. The combined feature model achieved 100% recall, implying that it detected all readmission cases, though with false positives.

AI interpretation of LUS and clinical data can identify with high accuracy those CHF patients who are at risk for early readmission. This information may allow for targeted treatment of these patients with the hope of reducing recidivism. Additional studies in larger sample sizes are needed to confirm these results.