Comparison of Machine Learning Detection of Low Left Ventricular Ejection Fraction Using Individual ECG Leads

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Introduction: Machine learning (ML) techniques have demonstrated the ability to produce automated and robust ECG analysis tools that can predict clinical features not detectable by traditional ECG analysis. Many contemporary ECG-ML studies have focused on the 12 lead ECG. With increased availability of single lead ECG data from wearable devices, there is a clear motivation to explore the development of single lead ECG-ML techniques. **Methods:** We developed and applied a deep learning architecture for the detection of low left ventricular ejection fraction (LVEF), and compared the performance of this architecture when trained individually with the eight unique measured leads of the 12 lead ECG (I, II, V1, V2, V3, V4, V5, V6) to the performance when trained using the entire 12 lead ECG. In addition to measuring AUC, F1 score, sensitivity, and specificity, network outputs were compared across networks via correlation to assess similarity in predictions. ECG and LVEF data was collected from the University of Utah health system, consisting of 24,868 patients, split into a 90% training and 10% test set.

Results: Networks trained with single ECG leads predicted low LVEF with an average AUC over 90% for leads I, V5, and V6 (see Figure 1). We observed high correlation between network outputs for networks trained with leads which were spatially co-located (such as leads V1, and V2).

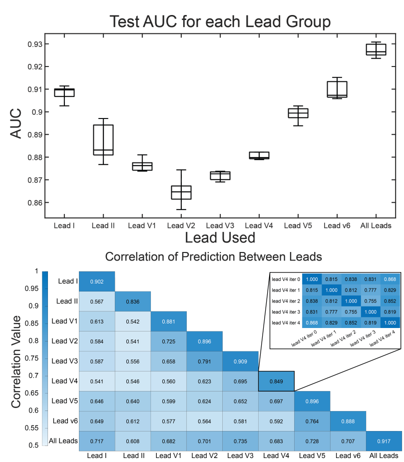

Figure 1. (top) Box plot of area under the reciever operator curve for each lead used in training. (Bottom) average correlation between raw network outputs across leads.

Discussion: Low LVEF detection performance did not drop substantially when using only a single lead as compared to using all available leads for training and inference, with the largest drop in performance observed when using lead V2. We also observed high correlation between network outputs of high performing single leads and the full 12 lead ECG networks. With the rising popularity of wearable ECG devices, these results suggest that emphasis should continue to be on designing ECG-ML tecniques which target these high performing leads.