Inferring Laboratory Values from Electrocardiogram Signals - An Exploratory Study

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Introduction: Laboratory value represents a cornerstone of medical diagnostics, but suffers from slow turnaround times, and high costs and only provides information about a single point in time. The continuous estimation of laboratory values from waveform data such as electrocardiogram (ECG) signals would therefore mark a significant frontier in healthcare monitoring. Despite its transformative potential, this domain remains relatively underexplored within the medical community.

Methods: In this preliminary study, we used a publicly available dataset (MIMIC-IV-ECG) to investigate the feasibility of inferring laboratory values from ECG features using tree-based models (XGBoost). We define the prediction task as a binary prediction problem of predicting whether the lab value falls into patient-specific norm values specific to each lab value. The model performance can then be assessed using AUROC.

Results: Our findings demonstrate promising results in the estimation of laboratory values related to different organ systems (cardiac, liver, kidney, respiratory, coagulation) based on a small yet comprehensive set of ECG features. While further research and validation are warranted to fully assess the clinical utility and generalizability of ECG-based estimation in healthcare monitoring, our findings lay the groundwork for future investigations into approaches to laboratory value estimation using ECG signals. Promising future research directions include the inclusion of patient metadata such as intoxications, diagnostics, and diverse clinical features. Such advancements hold promise for revolutionizing predictive healthcare applications, offering faster, non-invasive, and more affordable means of patient monitoring.

Selected results from ECG-based laboratory value estimation method

Laboratory value	Performance
NTproBNP	0.8477
Bilirubin, Direct	0.7719
Urea Nitrogen	0.7402
Creatinine	0.7201
Hemoglobin	0.7144
INR(PT)	0.7105

Tab. 1: AUROC scores for the estimation of laboratory values on the MIMIC-IV-ECG dataset demonstrating the feasibility of inferring laboratory values from ECG features and demographics alone.