When does an ECG become abnormal? Determine the optimal transition between normal and abnormal ECG waveforms

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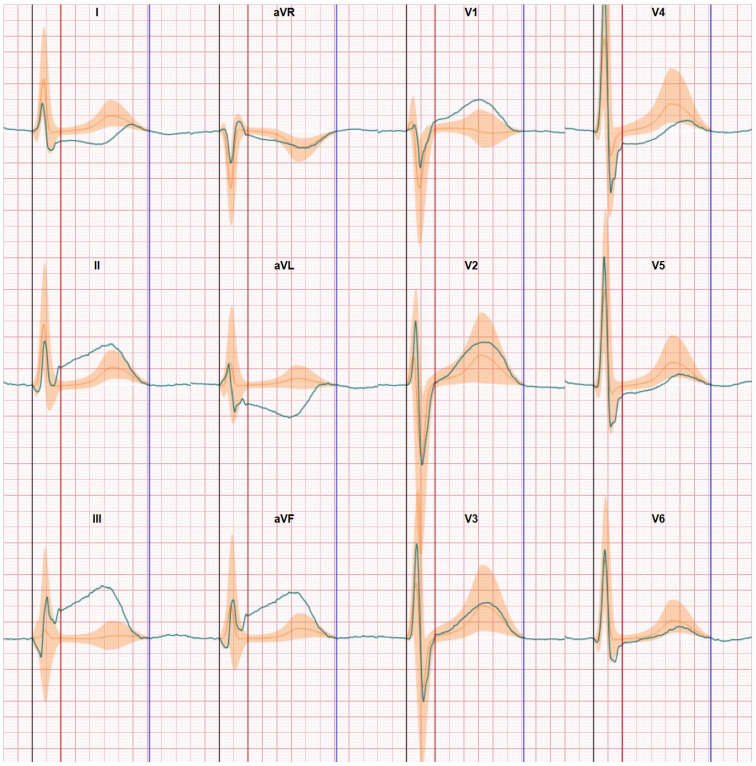
ECG has tremendous diagnostic capabilities, that includes novel, fully interpretable approach that compares investigated ECG to the distribution of thousands of normal ECGs in terms of QRS, ST and T-wave in order to determine if the ECG is normal or abnormal. The exact shape of the normal ECG distribution is not known and research suggested that clipping it from both sides can increase the diagnostic performance of described approach. In this research we investigated how removing asymmetrically from 0% to 7.5% of outliers from both sides of the normal ECG distribution affects mentioned diagnostic performance.

We have revealed that asymmetric outlier removal is the one that increases the performance the most, especially for T-wave resulting in AUC of 81.5% in detection of abnormal ECG. The biggest asymmetry was observed for path-ST and increased AUC from 55% to 69%. We have observed the further removing outlier observations from normal ECG distribution can further increase abnormal ECG detection performance of decision-making based on comparison of investigated ECG to the mentioned distribution in terms of QRS, ST and T-wave (PathECG and WaveECG).

The constructed distribution of ECG signals, with outlier removal, offers an easy way to visual compare an ECG with the normal distribution, taking the outlier removal into account. This can significantly increase the diagnostic value of the standard 12 lead ECG.



Example of an ECG of a patient with a Proximal Right coronary artery occlusion (in green). In orange the distribution of normal controls derived from the PTB-XL database (see methods). A clear gap between ECG and distribution is visible in leads I, II, III, aVL, aVF, V1, and V4. This visual check can increase the clinical diagnostic value of the standard 12 lead ECG.