

Does a Reduced ECG Lead Set Contain the Full 12-lead ECG information for Interpretation?

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Background: Diagnostic 12-lead ECG analysis is one of the most important clinical cardiology tests. However, one of the challenges with a 12-lead ECG is attaching multiple electrodes to obtain the signals. This study aims to use a deep learning model (DNN)-based approach to directly generate interpretation results from the input waveform for a reduced lead set, without relying on the criteria built for a full 12-lead, and to compare the results with those from a DNN-based full 12-lead ECG.

Methods: A DNN classification model was developed to make determinations for selected morphology classes using 10-second ECG recordings with input lead sets that included the full limb leads and two precordial leads, V2 and V4. A second DNN model was built for the standard 12-lead set [I, II, v1-v6], with signal preprocessing that formed the median beats for all leads. The training dataset consisted of two million 12-lead ECGs from the Mayo Clinic, and the test dataset included 500,000 ECGs, also from the Mayo Clinic. Classification performance was assessed using the Area-Under-the-Curve (AUC) and Precision-Recall (AUCPR) for detecting clinical abnormalities.

Results: The results, as shown in the table, indicated that all reduced lead sets exhibited the same excellent performance on major morphology-related abnormalities, such as bundle branch block (AUC > 0.98), ischemia (AUC > 0.97), and myocardial infarction (old and acute, AUC > 0.98), as the full 12-leads.

Conclusion: Based on the performances of both the reduced lead and full 12-lead classification models, the answer to the question 'Does a Reduced ECG Lead Set Contain Full 12-lead ECG Information for Interpretation?' is 'Yes.'

Table: The Reduce lead set vs 12-lead set for the ECG morphology Interpretations

Morphology classes	Full 12-lead		Reduced lead [I, II, V2, V4]	
	AUC	AUCPR	AUC.	AUCPR
RBBB	1.0	0.96	1.0	0.96
LBBB	1.0	0.93	1.0	0.93
LVH	0.98	0.74	0.97	0.65
Old MI	0.98	0.78	0.98	0.77
Acute MI	0.99	0.45	0.99	0.45
Pace	0.98	0.86	0.98	0.86
Normal	0.96	0.92	0.96	0.91