Accurate Identification of Actionable Single-Lead ECG Data Using a Signal Quality Assessment Algorithm

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Background: Noise originating from non-cardiac sources can obscure ECG morphology, leading to potential misinterpretation by automated ECG analysis software and healthcare professionals. By identifying noise-corrupted segments, signal quality (SQ) assessment algorithms enable clinicians to prioritize ECGs that possess sufficient quality for informed clinical decision-making.

Methods: We evaluated the performance of the HeartKey SQ algorithm in appraising individual ECG lead quality relative to manual quality assessment. The algorithm assesses each 2-second segment for signal amplitude, noise features, and lead errors, providing a binary classification of ‘low’ or ‘high’ signal quality. Performance was evaluated using sensitivity (Se) and specificity (Sp) metrics on three diverse datasets: i) leads I-III of the PhysioNet CinC 2011 Challenge database (2994 x 10 s files), ii) a proprietary database of continuous Holter (lead III) recordings with known periods of leads ON and OFF (30 files, 372 min total), and iii) a database of modified lead III (MLIII) and sternum-lead recordings (80 x 10-min files) collected at the Beacon Hospital (Dublin, Ireland). Reference quality annotations were manually generated by two ECG data analysts; any discrepancies were resolved by a third, more experienced analyst.

Results: The algorithm achieved a 'high' signal quality duration Se of 97% and Sp of 80% over leads I, II, and III of the PhysioNet CinC database. Periods of leads ON and OFF were accurately identified as 'high' and 'low' signal quality, respectively, with a 'high' signal quality duration Se of 98% and Sp of 97% on the Holter database. The MLIII and sternum-lead database, which featured a variety of sinus and non-sinus rhythms, was similarly classified with high fidelity, achieving a 'high' signal quality duration Se of 99% and Sp of 75%.

Conclusion: The SQ algorithm effectively distinguished between low- and high-quality ECG segments, aligning strongly with visual assessment by ECG interpreters.