

Accepted Manuscript

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PII: S0022-0736(17)30271-6
DOI: doi: [10.1016/j.jelectrocard.2017.08.030](https://doi.org/10.1016/j.jelectrocard.2017.08.030)
Reference: YJELC 52490

To appear in: *Journal of Electrocardiology*



Please cite this article as: Daluwatte Chathuri, Vicente Jose, Galeotti Lorian, Johannesen Lars, Strauss David G., Scully Christopher G., A novel ECG detector performance metric and its relationship with missing and false heart rate limit alarms, *Journal of Electrocardiology* (2017), doi: [10.1016/j.jelectrocard.2017.08.030](https://doi.org/10.1016/j.jelectrocard.2017.08.030)

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A novel ECG detector performance metric and its relationship with missing and false heart rate limit alarms

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Abstract

Purpose: Performance of ECG beat detectors is traditionally assessed on long intervals (e.g.: 30 min), but only incorrect detections within a short interval (e.g.: 10s) may cause incorrect (i.e., missed + false) heart rate limit alarms (tachycardia and bradycardia). We propose a novel performance metric based on distribution of incorrect beat detection over a short interval and assess its relationship with incorrect heart rate limit alarm rates.

Basic procedures: Six ECG beat detectors were assessed using performance metrics over long interval (sensitivity and positive predictive value over 30 min) and short interval (Area Under empirical cumulative distribution function (AUecdf) for short interval (i.e., 10 s) sensitivity and positive predictive value) on two ECG databases. False heart rate limit and asystole alarm rates calculated using a third ECG database were then correlated (Spearman's rank correlation) with each calculated performance metric.

Main findings: False alarm rates correlated with sensitivity calculated on long interval (i.e., 30 min) ($\rho = -0.8$ and $p < 0.05$) and *AUecdf for sensitivity* ($\rho = 0.9$ and $p < 0.05$) in all assessed ECG databases. Sensitivity over 30 min grouped the two detectors with lowest false alarm rates while *AUecdf for sensitivity* provided further information to identify the two beat detectors with highest false alarm rates as well which was inseparable with sensitivity over 30 min.

Principal conclusions: Short interval performance metrics can provide insights on the potential of a beat detector to generate incorrect heart rate limit alarms.

Keywords

ECG beat detectors, heart rate limit alarms, false alarms, performance metrics

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