Passive Smartphone Actigraphy Data Predicts Heart Failure Decompensation

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Introduction: Heart failure (HF) is a major cause of morbidity and mortality, and one of the leading causes of hospitalization. Early detection of HF symptoms and pro-active management may reduce adverse events. Passive accelerometer data from smartphones may reflect behavioral and physiologic changes due to HF and thus could enable prediction of HF decompensation.

Hypothesis: In a group of veterans with HF, features of actigraphy data passively collected from smartphones can be used to differentiate decompensation events from control (euvolemic) periods.

Methods: Veterans with HF at the Atlanta VA Medical Center were equipped with a smartphone app, "Automated Monitoring of Symptom Severity" (AMoSS), which passively collected three-dimensional accelerometer data for up to one year. HF decompensation was based on inpatient and outpatient encounters in which diuretic levels were increased. Control visits were also assessed based on outpatient visits in which the subject was determined to be euvolemic. Actigraphy data from two weeks preceding the control and decompensation events were evaluated. We mathematically derived 17 features from actigraphy data that assessed the regularity of physical activity, amount of peak activity, and mean levels of activity over varying time scales. We randomly chose 70% of the data for the training set, and 30% for the test set. A support vector machine (SVM) was trained to predict the event type, and performance was assessed on the test set.

Results: We followed 20 veterans for a mean (SD) of 256 (192) days, and observed 19 decompensation events and 39 control events during this time. The mean (SD) age was 66 (7) years and 95% were male. The SVM achieved an accuracy of 0.88 on the training set. On the test set (32 events), the SVM achieved an AUC of 0.76, accuracy of 0.72, positive predictive value of 0.83, and negative predictive value of 0.69.

Conclusions: Actigraphy data passively collected from smartphones can help differentiate decompensated from euvolemic states in veterans with HF with minimal cost and no user input. More research is needed to understand its potential clinical implications.