A Prediction Model of In-Patient Deteriorations Based on Passive Vital Signs Monitoring Technology

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Background: Over the past year, many health systems accelerated their initiatives of advanced remote monitoring systems at patients' homes. Moving to an unattended environment requires overcoming patients' compliance issues and demonstrating the effectiveness of remote monitoring technology.

In this study we analyzed data of 38,502 patient encounters, collected over a period of 3.5 years in acute settings at Newton Wellesley Hospital. Patients were monitored with a contact-free EarlySense monitoring system, passively and continuously tracking patients' Respiratory Rate (RR) and Heart Rate (HR). A Machine Learning (ML) model is presented for timely indication of deteriorating patients without a need for human compliance.

Table1: Study Datasets

Dataset	Encounters (Deterioration %)
Training	17,091 (2.9%)
Validation/tuning	8,549 (2.7%)
Testing	12,862 (2.9%)
COVID-19	131 (18.3%)

Methods: The datasets in Table 1 were used to derive, tune, and test a collection of Gradient Boosting classifiers. A combination of time series features, such as trends and vitals' variability were used in conjunction with demographic & comorbidity data in the development of this model.

Results: An evaluation of the model for hourly predictions of patients' deterioration (patient expired or transferred to ICU) yielded an Area Under the Curve (AUC) of 0.81.

This is comparable to an AUC of 0.78 reported in the literature for an Electronic Medical Records (EMR) based ML model with a similar population and deterioration criteria.

Additionally, when evaluated on a set of 131 COVID-19 patients at Sheba Medical Center, the suggested model achieved an AUC of 0.88.

Conclusions: The suggested model, developed on data from acute settings, solely based on passive measurement technology, performs equally as well as models developed on EMR systems that include nurse inputs. Applying the model on other acute settings (COVID-19 unit) showed similar performance, providing confidence that the model is robust and can be used at home settings.