

## **Pilot Study: Feasibility of Predictive Analytics for the Early Detection of Hypotensive Events**

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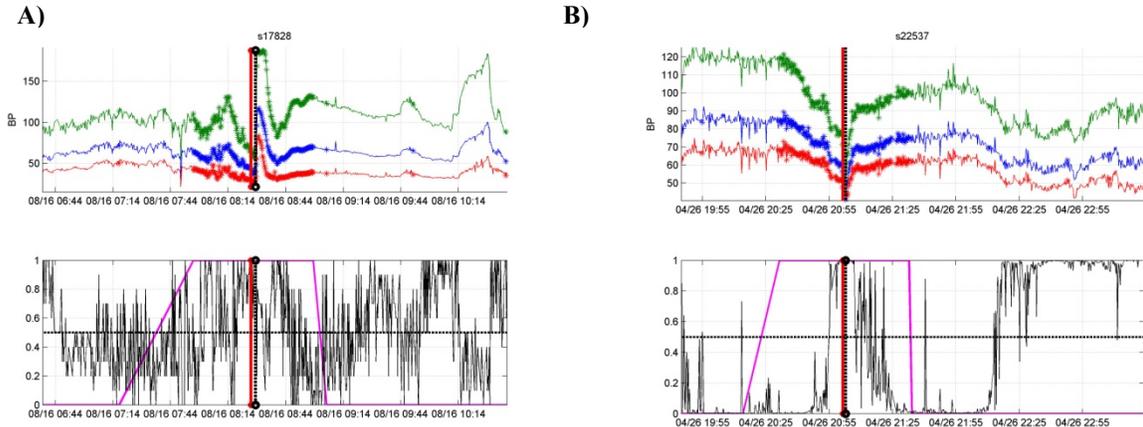
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**Background:** Patients in high risk settings are often at risk of developing hemodynamic instability. Current methods of identifying such instability rely on the monitoring of invasive and noninvasive hemodynamic parameters that exhibit pronounced changes only when a critical event is already occurring. However, a number of published studies have recently demonstrated that hemodynamic instability can be detected earlier by analyzing the subtle complex changes in multiple hemodynamic variables and their relationships.

**Methods:** The main objective of this preliminary study was to evaluate the feasibility of the early detection of hypotensive events in patients admitted to the ICU. Data used in this study came from the MIMIC II Research Database. From this database, we looked at the arterial pressure waveforms of 14 patients with hypotensive events, and extracted 161 waveform features (Edwards). Hypotensive events were defined as any time periods where 1) SBP < 50 mmHg, and/or 2) MAP drop by 40% from median MAP for at least 10 minutes. This extreme definition was used for training the models with the expectation that all other less extreme hypotensive events would also be detected. After identifying these hypotensive events, each patient's data was then categorized as hypotensive and nonhypotensive. Hypotensive data was defined as 30 minutes before/after and including a defined hypotensive event. Nonhypotensive data was defined as all remaining data, but resampled to equal the length of hypotensive data. Presented in this abstract are two model building methods: 1) Sequential feature selection and model building using k-nearest neighbors (k=10), and 2) lasso regularization for a generalized linear model using binomial distribution to select significant ( $p < 0.05$ ) features and model building using logistic regression. Leave-one-out cross validation was performed on all the data of each patient to validate the model. Misclassification rates were defined as the misclassification of defined hypotensive and nonhypotensive data per patient as described above.

**Results and Conclusion:** The overall misclassification rate was 0.38 for the k-nearest neighbors model (38 features) and 0.37 for the logistic regression model (76 features). In Figure 1, we can see that the two models are very sensitive to all drops in blood pressure. Further analysis will need to be performed using other statistical methods, and the definition

of hypotensive events for validation may need to be re-evaluated. In conclusion, these preliminary pilot results show that prediction and detection of hypotensive events is feasible.



**Figure 1.** Examples of model results. A) k-nearest neighbor B) Logistic regression model. Thick Red/Black lines = start/end event, Red/Blue/Green lines = SBP/MAP/DBP, Thin Black line = posterior probability of hypotensive event (Fig1A) and predicted response (Fig1B). Pink line = True category (0 = nonhypotensive, 1 = hypotensive).