**Title:** Predictive models for serious adverse events in cardiothoracic patients using real-time electrical vital sign monitoring and adverse event data – an exploratory and comparative study.

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Acute deterioration in patients is often preceded by subtle changes in physiological parameter in the hours prior to the occurrence of a serious adverse event (SAE). SAEs for cardiothoracic patients include death, cardiac arrest and/or unanticipated ICU admission. Worldwide Early warning Scores (EWS) systems have been developed with the goal of predicting and preventing many SAEs.

The National Early Warning Scores (NEWS) is the EWS currently recommended by the Royal College of Physicians (RCP) and has been in use for the routine clinical assessment of adults in many UK hospitals since 2012. At present around 70% of acute trusts in England are using NEWS, with other Early Warning Scores in place in other areas. NEWS was built and adjusted based on clinical opinion and preceding additive score system called Vital-Pac early system which utilised real-time vital sign monitoring data recorded in routine practice in hospital. NEWS is an additive scoring system that uses six simple physiological parameters (respiration rate, oxygen saturation, systolic blood pressure, pulse rate, level of consciousness and body temperature) and has shown good predictive performance for the SAE of cardiac arrest, unanticipated ICU admission and death within 24 hours after a vital sign monitoring observation. However, NEWS maybe inadequate in the presence of nonlinear effect of parameters on prediction of SAEs – this may undermine its capacity to predict SAEs for a certain risk groups or for different populations.

This project will study the predictive performance of several more complex methods using data from Papworth Hospital, comparing alternative models to the currently recommended system, i.e., the NEWS additive score. Several potential methods can be applied to this dataset. Generalized linear mixed models, support vector machine and artificial neural networks will be initially considered. These techniques are expected to outperform the simpler additive NEWS because of their better modelling of the complex interrelationship between the different covariates and the outcome. The goal of this project is to verify this conjecture and suggest a potentially improved EWS.

This project contains a large dataset from Papworth Hospital. It is likely to involve a substantial amount of programming and computation, and would suit someone interested in applying and learning predictive analytics and machine learning tools to a specific healthcare problem.