Scottish Government Health Directorates Chief Scientist Office

CHIEF SCIENTIST OFFICE

FOCUS ON RESEARCH

# Improving Decision Support for Treating Arterial Hypotension in Adult Patients During their Management in Intensive Care

**Researchers** Prof C K I Williams (PI), Dr I Piper, Prof J Kinsella, Prof P Andrews, Mr L Dunn

**Aim** The presence of artifact (abnormal data not caused by a patient's physiology such as noise due to patient handling) in intensive care unit (ICU) monitoring data is a major problem, as it means that the recorded data is not an accurate reflection of the patient's state of health. This is a problem for real-time monitoring, and for the proper audit or trail of therapies.
The original project aim was: Can application of the Factorial Switching Linear Dynamical System (FSLDS) model automatically detect artifact in the blood pressure (BP) signal, as the basis for a "data quality engine" in support of decision support systems to improve the detection and management of intensive care patients? This led to two research questions 1) Can the model be adapted to automatically detect artifact in the blood pressure (BP) signal? 2) What is the sensitivity/specificity and potential clinical utility of the model applied to live data from intensive care patients?

**Project Outline/Methodology** The project collected and annotated data from 27 patients in the neurological intensive care unit (Neuro-ICU) at the Southern General Hospital, Glasgow. It developed and trained the FSLDS model and a new DSLDS model using this data to detect various artifactual events in the data.

**Key Results** The overall FSLDS performance for the detection of blood sample, damped trace and suction artifactual events was 0.86, 0.77 and 0.60 as measured by the area under the ROC curve. Combining the DSLDS with the FSLDS gave results of 0.95, 0.79 and 0.64 respectively.

**Conclusions** We have successfully shown that the FSLDS/DSLDS can be adapted to the Neuro-ICU data, with the performance given above. We have also shown that the system can run in real-time on an ICU server.

**What does this study add to the field?** We have presented for the first time results of the FSLDS/DSLDS on adult Neuro-ICU data. The annotated dataset will also be very valuable for future research. The methodology can also be extended to detect changes in patient state, e.g. development of severe infection.

**Implications for Practice or Policy:** The Healthcare Quality Strategy for Scotland recognised that "developments in technology and in information and communications technology in particular, will give us tools to fundamentally reshape how healthcare is delivered." This project has shown that the FSLDS technology can be implemented in real-time, and the level of performance obtained. The longer-term aim is to use this technology for decision support to guide patient management.

**Where to next?** Accurate BP monitoring underpins all forms of patient management in intensive care. We plan to assess the robustness of these models for detecting artifact in other intensive care domains including general intensive care and in a specialist burns unit. Furthermore, advanced statistical models such as these can also help predict optimal doses of drugs for improving BP should it become critically low. Towards this end, pilot work is in progress on modelling drug infusion effects on blood pressure.

**Further details from:**
http://homepages.inf.ed.ac.uk/ckiw/projects/adult_icu/