Predicting Clinical Deteriorations using Wearable Sensors

Peter H Charlton 12, T Bonnici 1, L Tarassenko 2, PJ Watkinson 3, DA Clifton 2, R Beale 1, J Alastruey 1

1 Faculty of Life Sciences and Medicine, King’s College London, UK; 2 Department of Engineering Science, University of Oxford, UK; 3 Oxford University Hospitals NHS Foundation Trust, UK

Clinical Problem

Hospital patients are at risk of clinical deteriorations such as heart attacks and strokes. Early signs of deteriorations can be identified from clinical measurements such as heart rate and blood pressure. These are measured by hand every 4-6 hours. It may be possible to monitor patients continuously using wearable sensors. Breathing rate is a key marker of deteriorations, but it is difficult to measure electronically.

Aims

1. To develop a technique for monitoring breathing rate unobtrusively using wearable sensors.
2. To assess whether wearable sensors can be used to reliably predict deteriorations using this technique.

Monitoring breathing rate unobtrusively

Many wearable sensors monitor the heart using the ECG signal, which is influenced by breathing. A novel technique was developed to estimate breathing rate from the ECG. Laboratory tests showed that it was at least as precise as existing methods.

Predicting deteriorations using wearable sensors

A system was designed to predict deteriorations from wearable sensor data. Its performance was assessed in a clinical trial of 184 patients. Its predictions were of similar accuracy to those made in routine practice.

Next Steps

Smart watches routinely measure a signal which is influenced by both the heart and blood vessels. The signal is indicative of cardiovascular health, providing opportunity to predict deteriorations in the wider population.

Acknowledgments

This work is supported by the EPSRC, the NIHR, the Wellcome Trust and EPSRC under grant no. WT88877/Z/09/Z and grant no. WT088641/Z/09/Z, a Royal Academy of Engineering (RAEng) and King’s College London Centres of Excellence in Medical Engineering funded by the EPSRC, NIHR and Wellcome Trust and EPSRC under grant no. WT88877/Z/09/Z and grant no. WT088641/Z/09/Z. This work was supported by the UK EPSRC (Grant EP/H019944/1), the NIHR Biomedical Research Centre at Guy’s and St Thomas’ NHS Foundation Trust and EPSRC under grant no. WT88877/Z/09/Z and grant no. WT088641/Z/09/Z.

Peter.Charlton@kcl.ac.uk