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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.



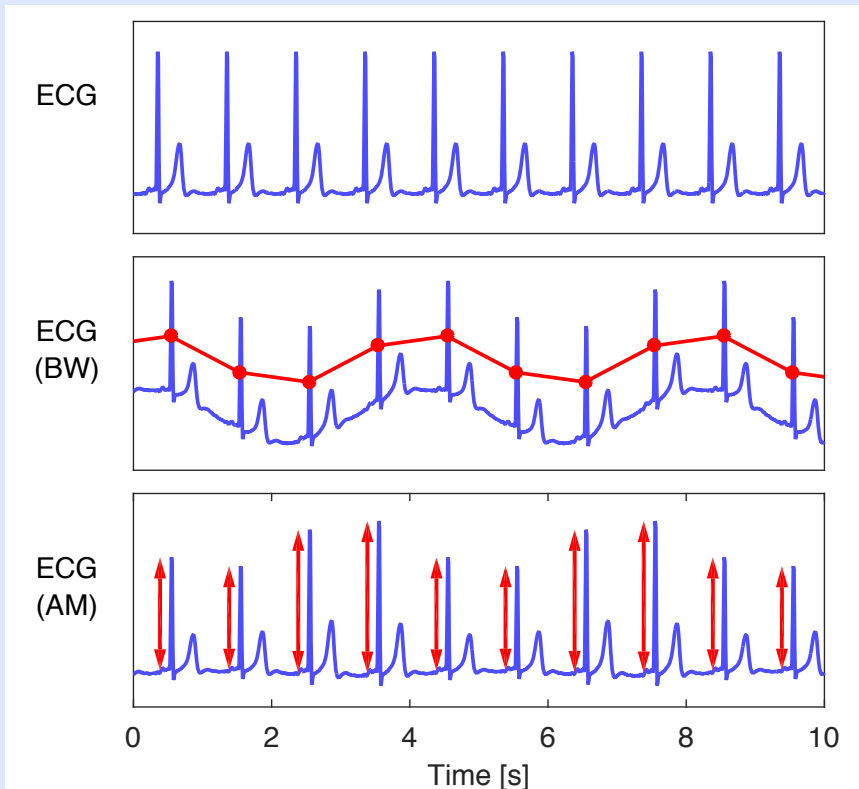
Breathing rate is a key marker of deteriorations, but it is difficult to measure electronically.

Aims

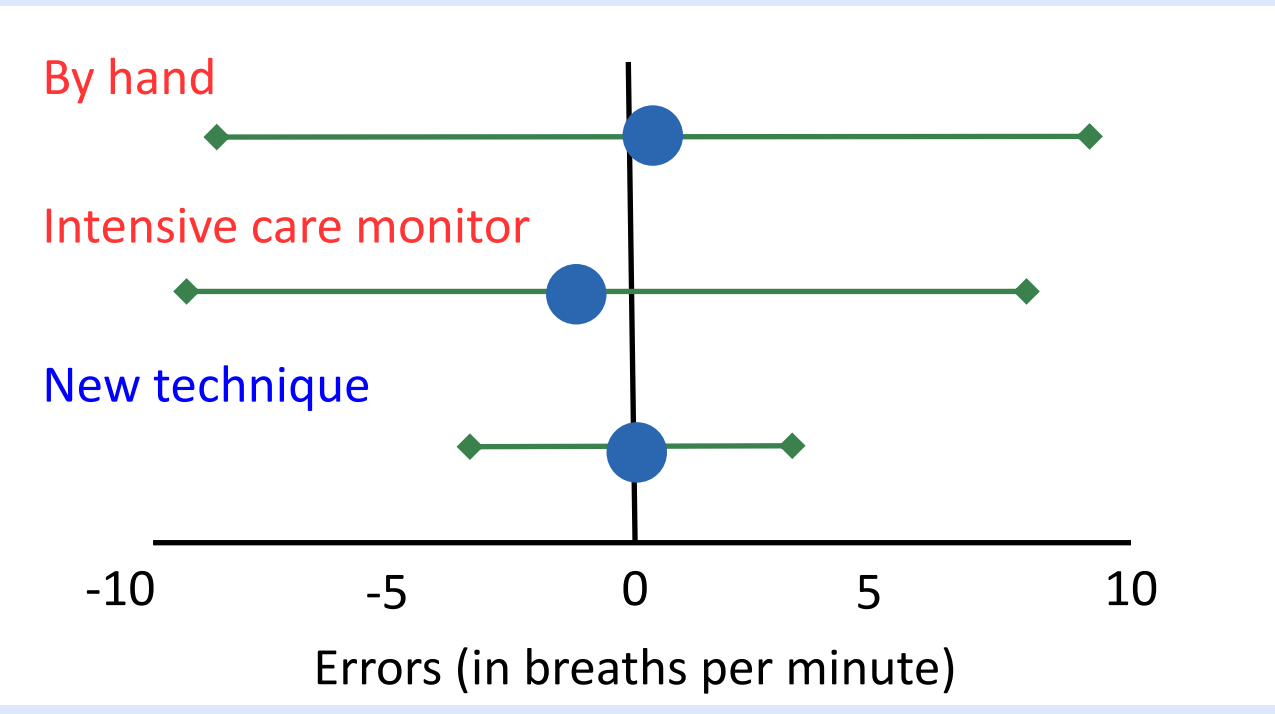
1. To develop a technique for monitoring breathing rate unobtrusively using wearable sensors.
2. To assess whether wearable sensors can be used to reliably predict deteriorations using this technique.

Monitoring breathing rate unobtrusively

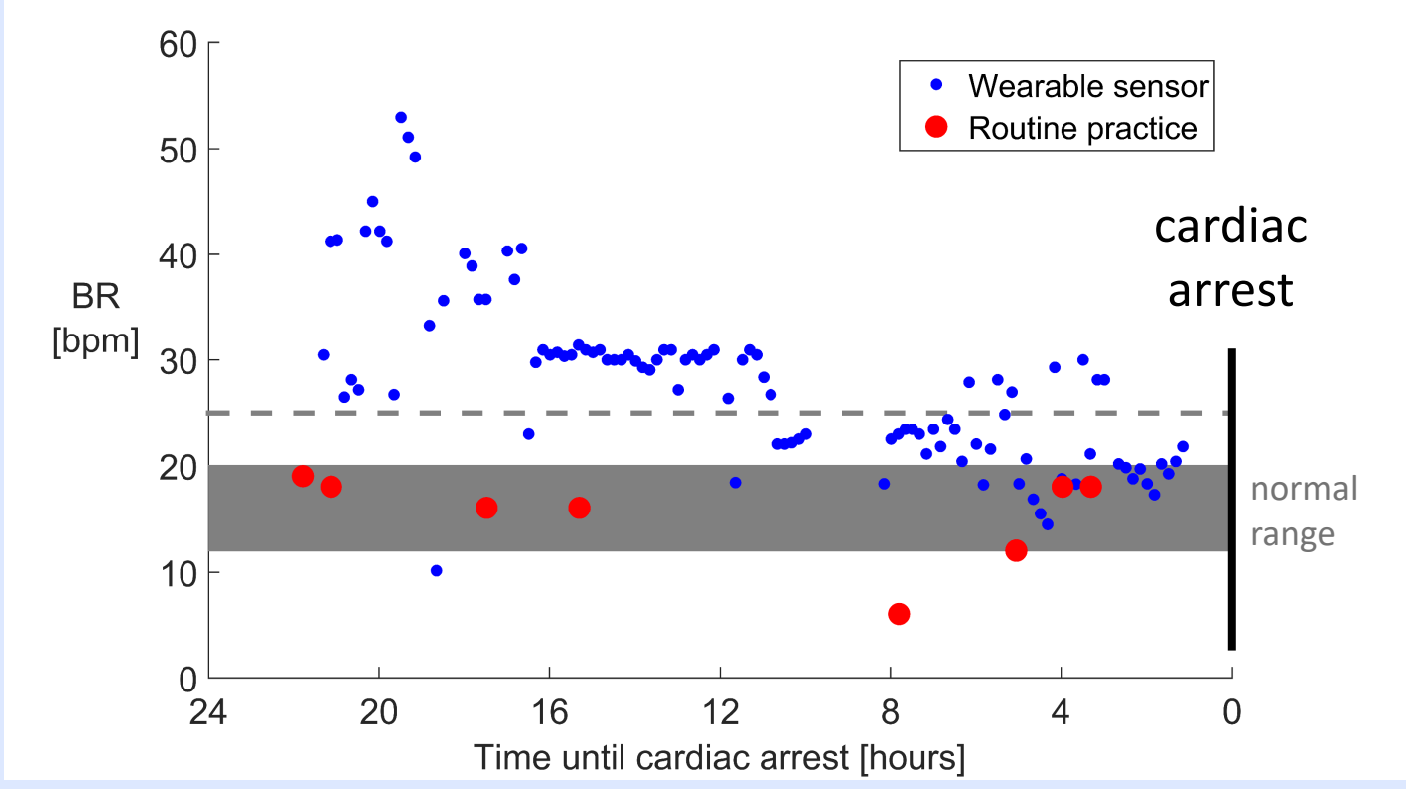
Many wearable sensors monitor the heart using the **ECG signal**, which is influenced by **breathing**.



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**.



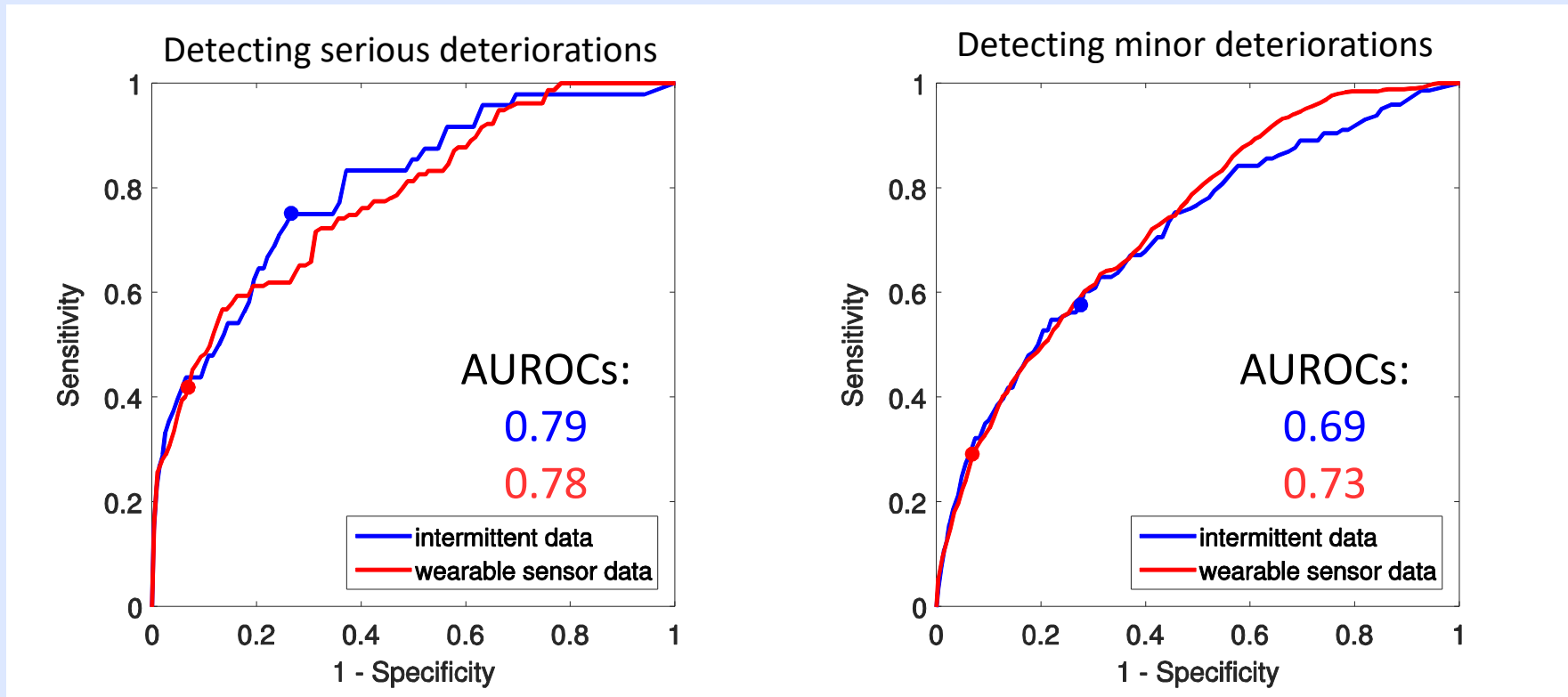
The **novel technique** was able to identify elevated breathing rates (BRs) in the hours preceding a cardiac arrest, when **routine practice** did not.



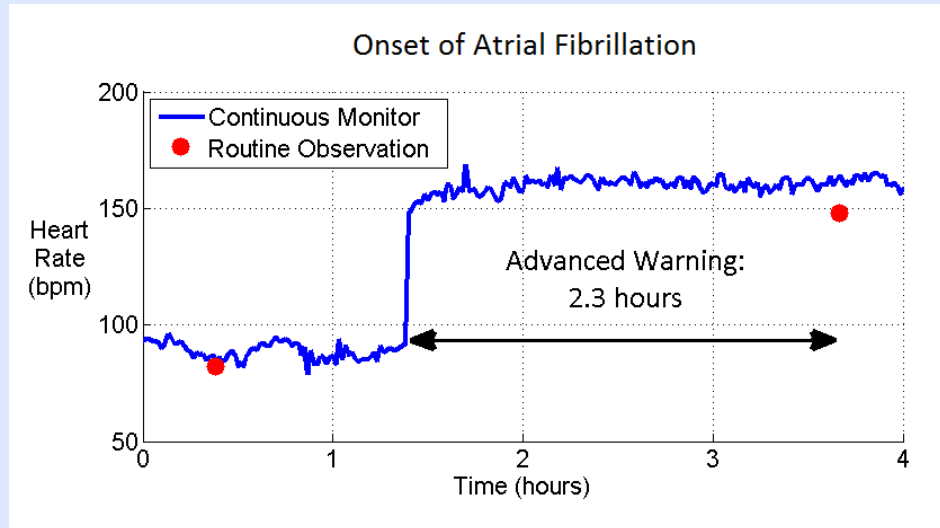
Predicting deteriorations using wearable sensors

Wearable sensors predicted deteriorations with **similar accuracy** to routine practice

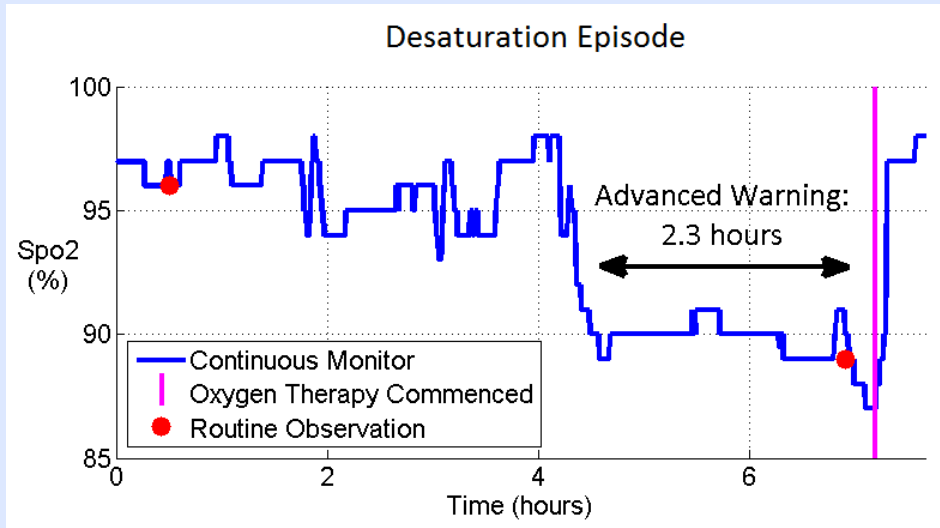
A system was designed to predict deteriorations from wearable sensor data. Its performance was assessed in a clinical trial of 184 patients. Its predictions were of similar accuracy to those made in routine practice.



Wearable sensors gave **advanced warning** of physiological changes hours before routine practice

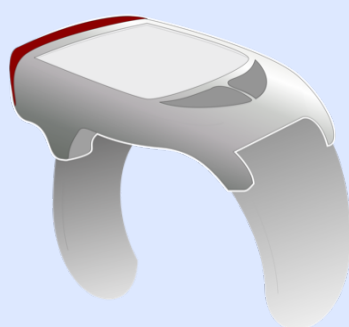


Atrial fibrillation is an arrhythmia affecting 25% of patients after heart surgery. Here, the wearable sensor identified an increase in heart rate, indicating atrial fibrillation, prompting treatment.

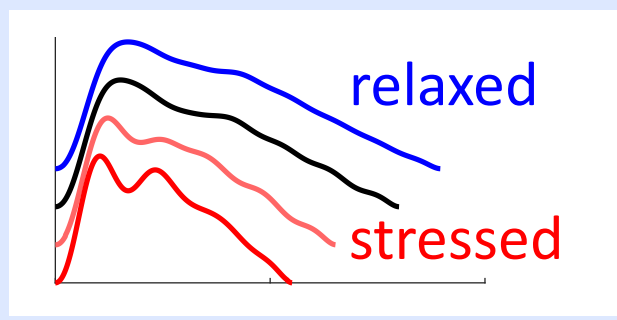
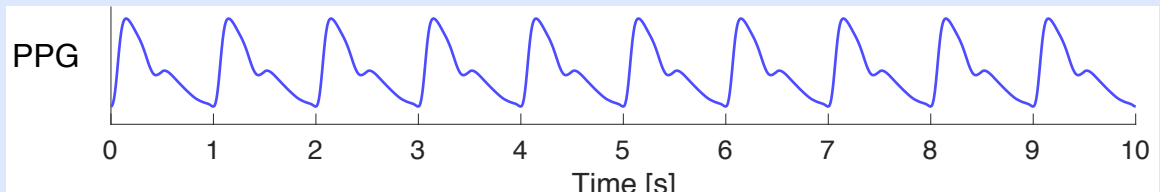


Here, the wearable sensor detected a drop in oxygen levels hours before routine practice, prompting earlier initiation of oxygen therapy to maintain healthy oxygen levels.

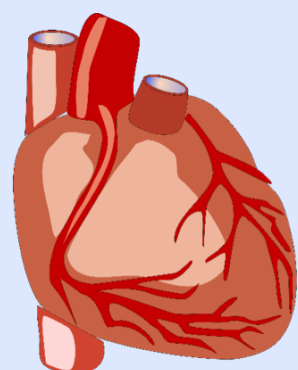
Next Steps



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

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