



## Personalisation of glycaemic regimes to reduce in-hospital hypoglycaemia

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### Background

The prevalence of diabetes (type 1 and 2) in patients in hospital in England and Wales is 16.8% reflecting over ~15,000 patients per year (National Diabetes Inpatient Audit 2015). A total of 22.5% of those patients suffer errors of insulin prescription or management resulting in 23.5% having a minor hypoglycaemic episode (Capillary Blood Glucose (CBG) 3.0-3.9mmol/L) and 11.5% having a severe hypoglycaemic episode (CBG less than 3.0mmol/L) (NaDIA 2015). Just under 1/5 of those with a severe hypoglycaemic episode required resuscitation with injectable treatment. The long term consequences of this are severe: in-patient hypoglycaemia is associated with increased mortality (odds ratio 1.62) and also an economic burden with an increase in length of stay (1.51 fold increase) compared to patients without hypoglycaemia (Nirantharakumar K et al, 2012).

### Hypothesis

In-patient hypoglycaemia can be predicted and thereby prevented. We will use large-scale data from regional and national hospital data sets (including collaboration with the MaGIC study group of 11 acute hospitals in the UK – representing over 30,000 hypoglycaemic episodes in 1 year) to identify underlying factors for in-hospital hypoglycaemia. We will then use mathematical modelling for risk stratification of patients and for prediction of blood glucose enabling us to trial prevention strategies.

### Aims

1. To formulate personalised algorithms for risk prediction of hypoglycaemic episodes in hospital based patients that can be widely used (nationally, internationally).
2. To provide individualised blood glucose optimising regimes that are safe for patients in hospital.
3. To perform a cost-benefit analysis of the implemented programme.

### Work packages

1. To use the large datasets of networked blood glucose values in OUH to develop and pilot a prediction model of inpatient hypoglycaemia for patients with diabetes. This would include

phenotyping patients to determine individualised risk and predict treatment effect. Adaptive and proactive monitoring of patients would be implemented to determine how often different patients should be monitored.

2. To test this prediction model in a network of hospitals using the same networked blood glucose meters across the UK.
3. To develop a preventative strategy which could be automated to reduce the risk of inpatient hypoglycaemia without excess hyperglycaemia.
4. To test this preventative intervention in a national and international randomised controlled trial to include patient and professional experience, length of stay and mortality and health economic analysis.

The Oxford NIHR BRC Clinical Informatics team will help to establish data flows of relevant data (and metadata) from a range of clinical and laboratory information systems – including medication, comorbidities, pathology and vital signs data – and also to establish a secure, managed environment for data linkage and analysis. Strategies to prevent initial and recurrent hypoglycaemia would be developed in collaboration with OCDEM.

We are working closely with centres across Europe (including Prof Pieber in Graz, Austria) to improve inpatient glycaemic control and would envisage utilising this collaboration to test the hypoglycaemia model and intervention.

We would welcome applicants with an aptitude for working with large datasets and testing clinical hypotheses. Researchers competent in Diabetes health care clinical trial methodology and evaluation are few and far between and the clinical and scientific teams are committed to training up new researchers in this crucial area.

#### **Supervisor's recent relevant publications**

1. [National Diabetes Inpatient Audit \(NaDIA\) 2015 National Report](#). HSCIC March 2016. Advisory Group includes **A Lumb, R Rea, G Tan**.
2. J Yoon, AM Alaa, S Hu, **M van der Schaar** (2016) [ForecastICU: A Prognostic Decision Support System for Timely Prediction of Intensive Care Unit Admission](#). *Volume 48: Proceedings of The 33rd International Conference on Machine Learning*.
3. A Alaa, J Yoon, S Hu and **M van der Schaar** (2016) [Personalized Risk Scoring for Critical Care Prognosis using Mixtures of Gaussian Processes](#). *IEEE Transactions on Biomedical Engineering*.
4. AM Alaa and **M van der Schaar** (2016) [Balancing Suspense and Surprise: Timely Decision Making with Endogenous Information Acquisition](#). *29th Conference on Neural Information Processing Systems*.
5. W Hoiles and **M van der Schaar** (2016) [A Non-parametric Learning Method for Confidently Estimating Patient's Clinical State and Dynamics](#). *30th Conference on Neural Information Processing Systems*.