

PhD projects Greater Manchester Connected Health Cities

PhD studentships available to start from April 2017/September 2017

Greater Manchester Connected Health Cities Programme

Project 5: Predictive methods for learning health systems

Supervisors: Dr Niels Peek; Dr Matt Sperrin

Background

A core element of learning health system is the analysis of healthcare processes and outcomes that are measured downstream to inform decision making that takes place earlier along the same care pathway. In the GM Connected Health City, an example is the Stroke Mimics project which aims to improve decision making by the ambulance staff in the assessment of patients when there is a suspicion stroke. The ambulance staff currently use a simple algorithm, called the FAST test, to determine which patients should be taken directly to a stroke centre. However a recent study in London demonstrated that 37% of FAST+ patients identified by paramedics subsequently had a non-stroke diagnosis (they were "stroke mimics"). The GM-CHC Stroke Mimics project hypothesizes that systematic learning and improvement of this process can be achieved by analysing linked data from the ambulance service and the stroke unit – in particular, the diagnosis that is made at the unit.

Analytically, the key question is whether we can predict the outcome of interest (in this case, the diagnosis) using data that are available at the earlier time point (in this case, at the time of the paramedic assessment). If so, the predictive model/algorithm can be made available to the relevant decision makers (in this case, ambulance personnel) to improve their decision making process. Thus, predictive methods are key to the success of this approach. However, there are important methodological challenges to enable the use predictive methods in the context of a learning health system:

- Data are collected in routine clinical practice and can therefore contain recording errors and missing values, including missing outcomes. This leads to significant risks of bias (and thus, prediction errors) if they are not handled properly.
- For some patients much more data is available than for others – a situation that traditional predictive methods (e.g. based on logistic regression) cannot deal with. For instance for some patients we may have access to a rich, longitudinal health record from primary care, whereas for others hardly any information is available at all.
- As the health system changes over time, the model will need updating to reflect those changes. Some parts of the model must then be discarded while other parts can be retained. If decision makers follow the model's predictions, this will further change the pathway and complicate updating the model. In the Stroke Mimics project, we might increasingly lose sight of potential stroke

mimics. This is an improvement of the service, but it diminishes the opportunities for learning.

PhD project outline

This PhD project investigates predictive methods for learning health systems. Building on existing methods from statistical modelling and machine learning, the project will develop new methods to address the above challenges. The resulting methods will be applied in the Stroke Mimics project and other relevant projects within the GM CHC.

Student background: we require a student with a minimum of an upper second class bachelor's degree in mathematics, statistics or a closely related discipline, with an interest in developing new statistical and machine learning methods that can be applied to challenging data streams. Training will be available in learning health systems and dealing with routinely collected data.