Project proposal template
Graduate School studentships
March 2015

Project title	Forecasting Trends in Antibiotic Resistance within Clinically Important Hospital Infections
First Supervisor	Dr ▾ James Denholm-Price
Second Supervisor	Dr Simon Gould
School	Mathematics ▾
Other member of supervisory team *(no more than three KU supervisors in total)*	Professor Mark Fielder
Specific requirements beyond 2:1 degree	Experience in statistical modelling and time series analysis. Familiarity with the issues surrounding antibiotic resistance.

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Project summary

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Forecasting Trends in Antibiotic Resistance within Clinically Important Hospital Infections

Antibiotic resistance is a continuing clinical concern both in the UK and worldwide. Currently in the UK the Heath Protection England (HPE) and the Department of Health carry out both voluntary and mandatory surveillance programmes to monitor the incidence of certain pathogens. These schemes focus predominantly on organisms that have been implicated in surgical site infections and bacteraemia. This type of data can give us a retrospective view of resistance trends, but ideally a system is needed whereby data, as and when it is produced, can be used to monitor and predict how resistance levels will change in the short to medium term [1-3]. Such a system would be a potential benefit for hospital infection control teams in helping to address antibiotic resistance.

The overall aim of this study is to develop a statistical forecasting model which can not only predict antibiotic resistance levels using retrospective data, but would also be able to gather current data and adjust its prediction over time. This study consists of two phases: The first phase is currently underway where antibiotic resistance data has been collected from hospitals around the UK and a retrospective assay has begun to examine a number of parameters. The development of a statistical model is the primary aim of the next phase of the project. To achieve this aim we will start by analysing previous work in the context of our hospital-derived data, such as ARIMA [2], HMMs [4] and other stochastic approaches [5], identifying appropriate statistical approaches before developing and testing a series of models to be evaluated in collaboration with colleagues from the hospitals supplying the data.

Ideally you will have experience in statistical modelling and time series analysis as well as a familiarity with the issues surrounding antibiotic resistance - knowledge in both areas will be important for this multidisciplinary project which provides an excellent opportunity for research and development work in an exciting and rapidly changing field.

[1] Harbarth S, Samore MH, 2008, Interventions to control MRSA: high time for time-series analysis? *J. Antimicrob. Chemother.* **62**(3): 431-433.

[2] Vernaz N., Huttner B., Muscionico d., et al, 2011, Modelling the impact of antibiotic use on antibiotic-resistant Escherichia coli using population-based data from a large hospital and its surrounding community. *J. Antimicrob. Chemother.* **66**(4): 928-35.

[3] Akdeyab M., Kearney M., Scoot M., et al. 2012, An evaluation of the impact of antibiotic stewardship and its effect on the incidence of clostridium difficile infection in hospital settings. *J. Antimicrob. Chemother.* **67**: 2988-2996.

[4] Cooper B & Lipsitch M, 2004, The analysis of hospital infection data using hidden Markov models. *Biostatistics* **5**(2): 223-217.

[5] McBryde ES, Pettitt AN, McElwain DLS, 2007, A stochastic mathematical model of methicillin resistant Staphylococcus aureus transmission in an intensive care unit: Predicting the impact of interventions. *J. Theoretical Biology*, **245**(3): 470-481.