LIV TB

Liverpool TB Research Group

*** SPECIAL SESSION ***

Hosted by UoL's Prof Rachel Bearon (R.Bearon@liv.ac.uk)

Dr Ruth Bowness

University of St Andrews

Wed 11th December, 1.00-2.00pm

Rm 103, Maths Building, University of Liverpool

Exploring post-primary infection in Mycobacterium tuberculosis using a hybrid discrete-continuum cellular automaton model

Dr Bowness is a mathematical biologist and MRC research fellow based in the School of Medicine at the University of St Andrews and also working with the Mathematical Biology group in the School of Mathematics. Her research interests lie in developing in host mathematical models for infectious diseases, and this talk will focus on a model related to TB. When Mycobacterium tuberculosis bacteria enter the lungs, a complex immune response ensues and results in the formation of granuloma structures. When these granulomas are unable to contain the bacteria, active disease develops. At different degrees of disease severity, patients seek medical assistance, after which antibiotics are prescribed. The degree of antibiotic penetration into and through the granuloma is uncertain. The outcome of treatment is complicated by dormancy when the bacteria become temporarily resistant to antibiotics. We have developed a hybrid discrete-continuum cellular automaton model to study disease progression and treatment in the lung. The model contains discrete agents, or individuals, which model the spatio-temporal interactions (migration, binding, killing etc.) of bacteria, macrophages and T cells. The spatial movement of cells is governed by biased random walks, while the various cell-cell and cell-bacteria interactions are governed by cellular automaton rules. Chemokine diffusion, oxygen diffusion and a Pharmacokinetic/Pharmacodynamic model is also incorporated in the model via the numerical solution of appropriate PDEs. Several definitions and theories regarding bacterial dormancy exist in the literature. In this work, we use this model to explore several concepts of dormancy and their effect on treatment outcome.