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Solving Immunological Challenges using Computational and Mathematical Approaches

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Abstract:
In the York Computational Immunology Laboratory we have been combining experimental immunology with computational and mathematical approaches to understand mechanisms driving immunity to pathogens, inflammatory disorders and autoimmune disease. Immune responses occur in specialised microenvironments where stochastic interactions between different cell types and secreted factors can lead to an emergent property, immunity. As an immunologist my research focuses on how immune microenvironments are established, how they can be remodelled and how this can lead to efficient immune responses using a number of different approaches including imaging, genomics, functional assays, mathematical and computation modelling. In this seminar I will discuss how through using a cyclical approach of hypothesis driven modelling and experimentation we have developed new insights into the molecular and cellular mechanisms driving immune development, remodelling and function. I will focus on three different examples, where we have used different modelling approaches; agent based models, multi-scale simulations and mathematical models to address questions that could not be answered by experimentation alone. Finally I will discuss how we are applying critical systems engineering approaches to human disease modelling to accelerate and de-risk the drug development pathway.