

Towards Personalised Healthcare Engineering: A new paradigm in blood disorder treatment

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Abstract:

Personalized medicine is a medical model that proposes the customization of healthcare, with decisions and practices being tailored to the individual patient by use of patient-specific information (initially genetics information) and/or the application of patient-specific cell-based therapies. The BioBlood project aims to deliver personalised healthcare through a “step change” in the clinical field of haemato-oncology. BioBlood represents an engineered bio-inspired integrated experimental/modelling platform for normal and abnormal haematopoiesis that receives disease & patient input (patient primary cells & patient/disease-specific data) and will produce cellular (red blood cell product) and drug (optimal drug treatment) therapies as its output. Herein, we will present the experimental platform, which is a novel three-dimensional hollow fibre bioreactor capable of culturing normal and abnormal haematopoietic cells in the absence of exogenous growth factors by mimicking the structure and function of the bone marrow, alongside a population balance model (PBM) that is able to capture cellular heterogeneity and in particular leukaemia heterogeneity. The PBM, which is able to extract patient- and disease-specific information is linked to a pharmacokinetic/pharmacodynamic (PK/PD) model, which is used to optimise chemotherapy treatment in a personalised manner.