Project title: Digital Twins for Personalised Breast Cancer Treatment and Clinical Trial Design

Project reference: DT4H_16_2023

1st supervisor: Dr Heba Sailem – Institute of Pharmaceutical Science

2nd supervisor: Mr Stephan Greiner – Roche Diagnostics

Aim of the project

This project offers an exciting opportunity to work between King's College and Roche to develop impactful digital twins models for breast cancer patient therapy. The primary objective is to create a digital tumour twins model toward predicting breast cancer patient trajectory. The digital tumour twins model will not only consider the patient's medical history and individual characteristics but also incorporate microscopic tumour characteristics derived from histopathological images. Importantly, these models will be validated using orthogonal data generated as a part of clinical trial. The digital tumour model presents several unique opportunities, including personalized treatment recommendations based on patient-specific data and the identification of tumours with similar characteristics. This project will benefit from unique datasets generated in collaboration with the University of Oxford and Roche.

Project description

This project complements another project advertised by Dr Sailem, "Digital twins for histopathology toward personalised cancer treatment". The focus here is on clinical trials enabled by collaboration with Roche and would be of interest to students considering working at the interface between academia and industry.

Histopathology remains the cornerstone of cancer diagnosis, carrying profound implications for patient prognosis. Pathologists carefully evaluate tissue samples, relying on their expertise to discern changes in cell morphology, cellular organization, and mitotic events while considering the underlying tissue anatomy. While histopathological assessment is generally robust for many cancer types, it can be subjective and susceptible to human error. Moreover, human perception is limited as it only can compare a handful of parameters at a time. However, within a single histopathological image, there can exist thousands to millions of cells within tumour sections, which can result in large number of potential features.

This is where artificial intelligence (AI) can have huge potential. AI systems have the exceptional capability to systematically identify and extract relevant features from thousands of histopathological images, unveiling clinically significant patterns that might not be apparent to the naked eye. This not only promises a more objective evaluation of existing pathological criteria but also offers the prospect of uncovering novel predictive biomarkers that were previously inconceivable.

Our Digital twins project aims to provide an invaluable tool for advancing cancer therapy. We plan to harness AI-driven insights derived from histopathological images and integration with other omics data. Thus, our digital twins project can offer a wealth of data that can inform tailored treatment strategies and predict disease trajectories with a level of precision and comprehensiveness that was previously unattainable. The resulting technology would not only reduce the need for animal testing but could also outperform it as it is based on a comprehensive analysis of patient and tumour characteristics with response data from clinical trials.