

Project title: Explainable Multi-Modal AI for Precision Checkpoint Inhibition Immunotherapy in Non-Small Cell Lung Cancer

Project Summary:

Precision oncology has transformed the way cancer is treated, moving from “one-size-fits-all” protocols toward individualised strategies. Non-small cell lung cancer (NSCLC) is the most common cause of cancer-related mortality worldwide. While checkpoint blockade immunotherapy (CBI) has significantly improved survival in a subset of its patients, identifying such patients remains difficult due to the imperfect PD-L1 immunohistochemistry method currently in use. Despite efforts to use AI on imaging data to find an alternative non-invasive solution, most computational tools developed for NSCLC CBI do not integrate biological data, and are thus limited in their explainability, hindering their clinical acceptance and translation.

To address this gap, we propose to develop a novel multi-modal biomarker for NSCLC that integrates biological data (transcriptomics, histology +/- blood biomarkers) with imaging features (hand-crafted radiomics and deep learning features) to construct a shared latent space that captures complementary disease information as embeddings. These representations will be reinforced with causal modelling, enabling the disentanglement of mechanistic relationships between tumour biology, CBI response, treatment adverse events, and patient prognosis. By adding biological information and a causal basis to an imaging-derived model, we aim to improve its predictive performance and explainability, providing clinicians with an interpretable non-invasive tool for patient stratification and therapeutic decision-making in NSCLC CBI.

The project aim is to develop an encoder-latent space pipeline that enables multiple modal data integration, including genomic, histopathologic, imaging, and clinical data, for guiding precision CBI for NSCLC, with direct applications in patient stratification, treatment planning, and prognostic counselling.

Multi-centre study data will be drawn from ethically approved clinical studies at Imperial (IMPACT) and collaborating sites in the UK and internationally, as well as from the public domain (e.g. TCIA & TCGA).

Supervisory Team: Dr Mitchell Chen, MRC Clinician Scientist & Consultant Radiologist, Surgery and Cancer, ICL

Professor Eric Aboagye, Director of the CRUK-EPSRC-MRC-NIHR Comprehensive Cancer Imaging Centre, Surgery and Cancer, ICL

Clinical Specialities: Clinical Radiology, Medical Oncology, Respiratory Medicine, Clinical Oncology, Histopathology, Clinical Immunology