Teesside University

Unlocking capacity through automation

Multimodal AI applications in cancer research

Presenter:

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Group PIs:

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- **Prof Claudio Angione**

About me

Le Minh Thao Doan
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AI in computational biology – Teesside University

My research:

- AI for biomedical data
- Multi-modal AI integrating different data types (clinical, omics, and imaging)
- Explainable AI and identifying potential new biomarkers of cancer
- Mechanistic insights into cancer diagnosis and subtypes

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The **AI Revolution:** Giving Medicine Superpowers

Artificial intelligence has moved beyond theory into a clinical reality that 'gives doctors superpowers.' By analyzing massive datasets—from DNA sequences to retinal scans—AI identifies patterns invisible to the human eye, accelerating drug discovery and enabling early disease detection years before symptoms appear.

PRECISION DIAGNOSTICS & EARLY DETECTION

Predicting Cancer 5 Years in Advance

MIT-developed AI recognizes subtle patterns to predict breust cancer years before symptonis appear.

85% Increase in Diagnostic Accuracy

Ai-assisted pathology significantly improves the identification of cancer cells in tissue slides.

Real-Time Emergency Flags

AI tools scan radiology images in seconds to alert specialists to strokes or bleeding.

ACCELERATED RESEARCH & TREATMENT

Drug Design in Just 46 Days

AI compresses years of traditional molocular research into weaks to find new disease treatments.

The 'Digital Biopsy'

AI analyzes cell ecosustems to predict how a specific patient will respond to treatment.

Superhuman Surgical Precision

Robotic systems learn from millions of procedures to eliminate tremors during delicate surgeries.

COMPARISON OF AI EFFICIENCY VS. TRADITIONAL MEDICAL TIMELINES & ACCURACY

Traditional Method			AI-Enhanced Method		
Several Years	Human Radiologist Review	Minutes to Hours	46 Days	5-Year Predictive Analysis	Seconds
Drug Candidate Discovery	Breast Cancer Screening	Emergency Scan Triage	Drug Candidate Discovery	Breast Cancer Screening	Emergency Scan Triage

[15 Most Important AI Breakthroughs in Medicine]

Examples in Early detection: AI for breast screening

MIRAI

Robust AI tools to predict future cancer

The MIT-developed AI system, known as **MIRAI**, has been validated to predict breast cancer risk up to five years in advance. This system analyzes mammograms to produce a personalized risk score, allowing for early detection and intervention. MIRAI has been tested on over 1.7 million mammograms and has shown superior performance compared to traditional risk stratification methods. It is designed to be inclusive across diverse populations and can be integrated into clinical workflows to enhance breast cancer screening and prevention efforts.

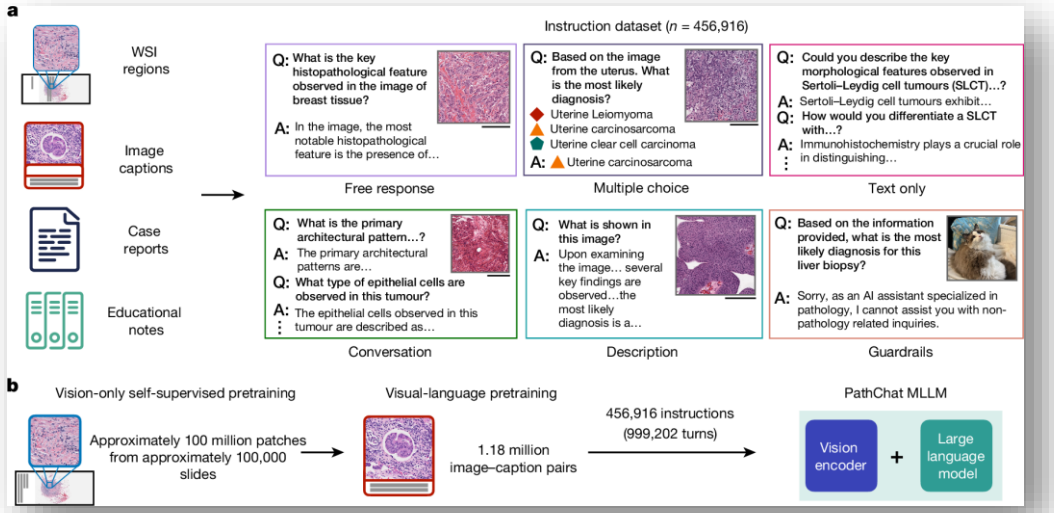
AI in Mammography Screening (AIMS)

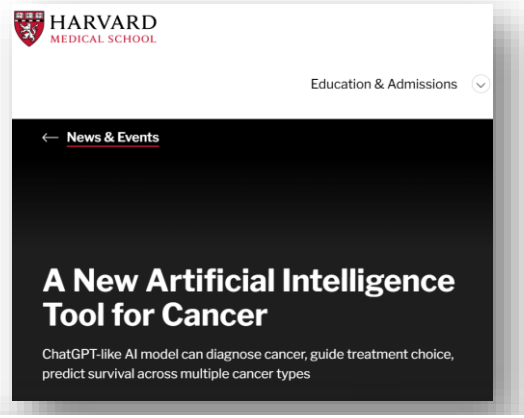
What is AIMS?

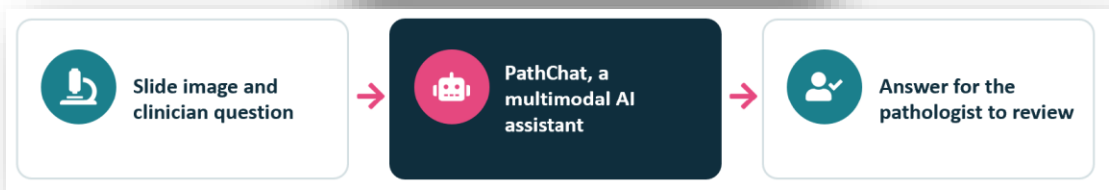
This is the Artificial Intelligence (AI) in Mammography Screening study. AIMS is an implementation study designed to appraise the benefits of a Deep Learning AI tool in breast cancer screening mammography. It is run though a clinical-academic-industrial partnership between Imperial College London, St George's University Hospital London, OPTIMAM (OMI-DB) - Royal Surrey NHS Foundation Trust, and Google Health, having received funding from NIHR-NHSx-AAC in 2021.

Find out more about how we are using artificial intelligence to help detect breast cancer with Google Health.

And histopathology...







Source: Lu et al., A multimodal generative AI copilot for human pathology. Nature, 2024.

However, several challenges are still there...

Challenges

Limited specialist time

Image review, reporting, and multidisciplinary preparation are largely manual.

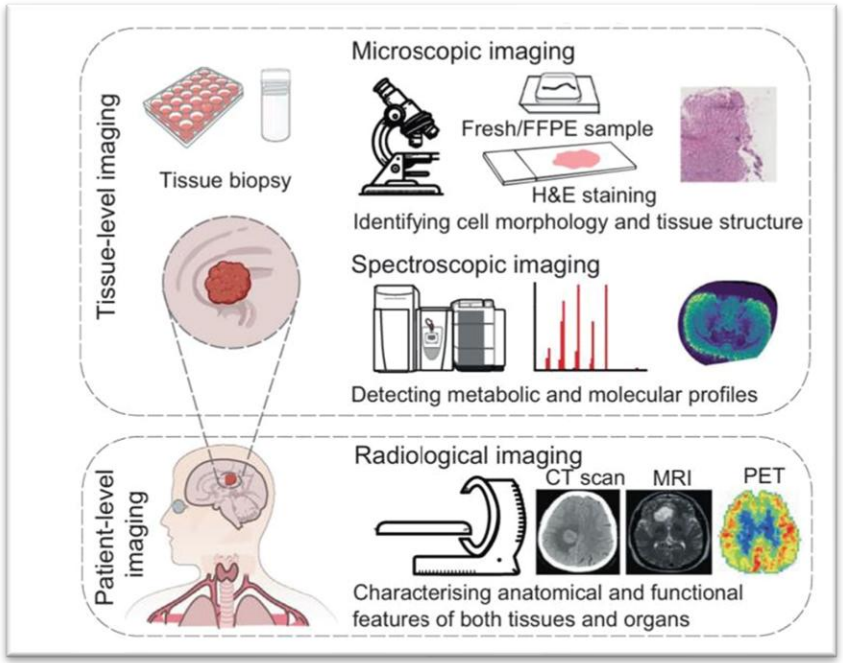
Long waiting times

Delays accumulate between diagnosis, prognosis, and treatment planning.

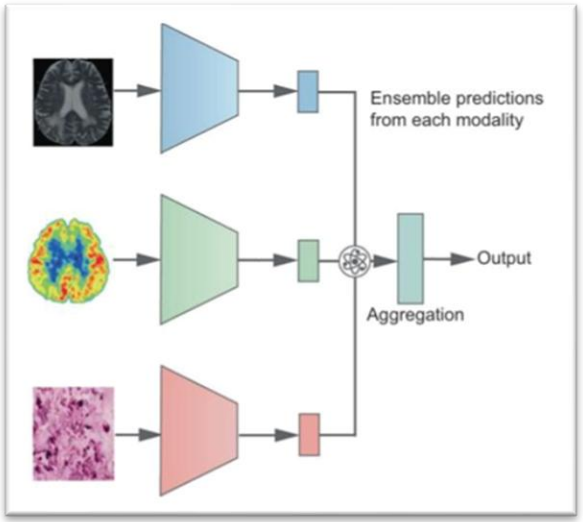
More data types per patient, in many formats (multimodal data)

A Viable pathway: Multimodal AI

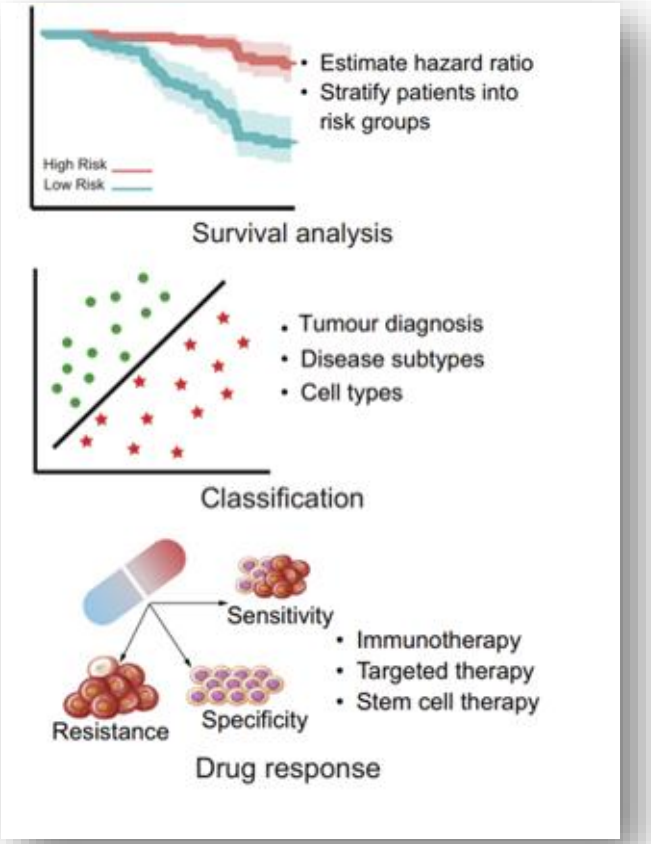
Input: multiple data sources
From imaging to omics



Multimodal AI model
Integrating multiple data sources



Output: multiple tasks

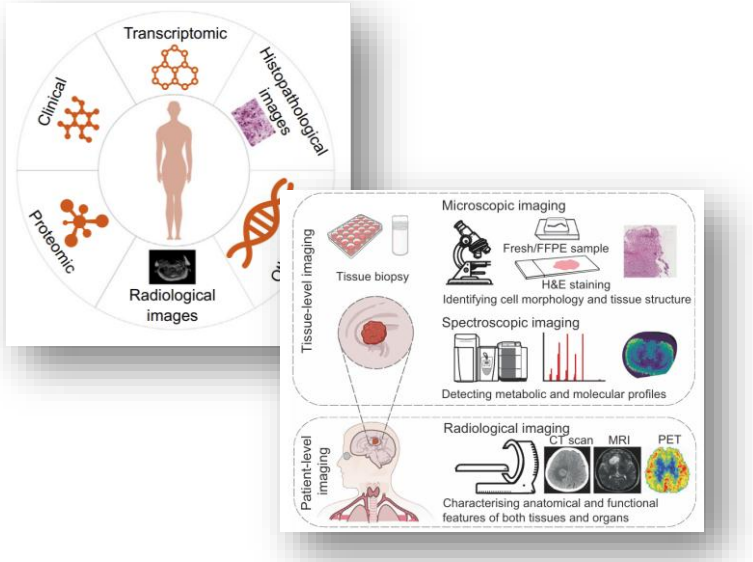


How to integrate clinical expertise?

Interpretability?

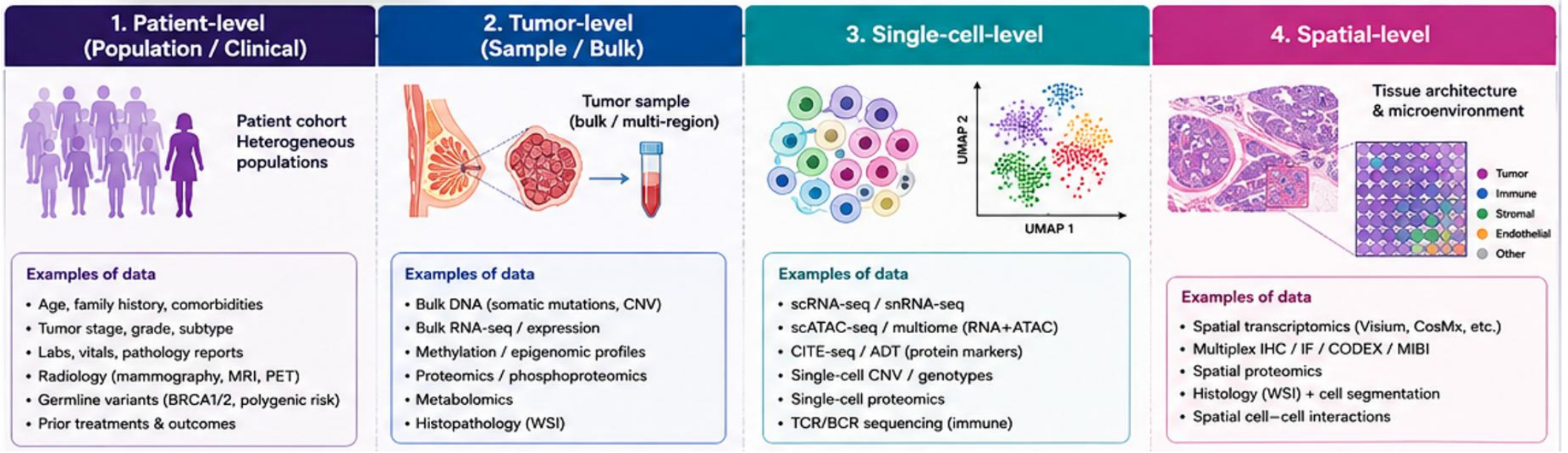
Doan, L.M.T., Shahhosseini, K., Verma, S., Marefat, A., Locicero, G., Verma, S., Angione, C. and Occhipinti, A., 2026. Bridging modalities with AI: a review of AI advances in multimodal biomedical imaging. *Communications Engineering*, *5*(1), p.30.

How multimodal AI can improve cancer patient outcomes?

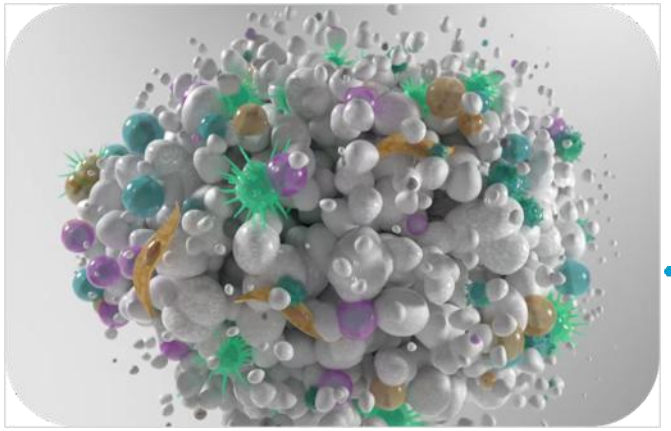


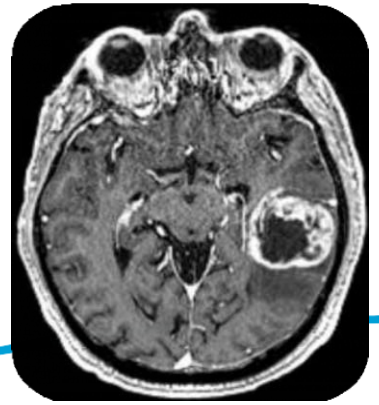
Diagnosis → Prognosis → Response to treatment

Characterise TME

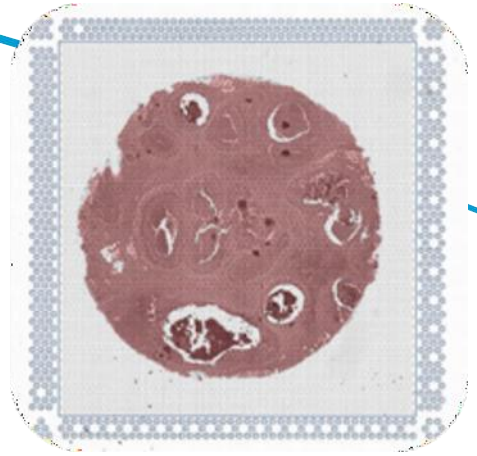


Complexity across Scales

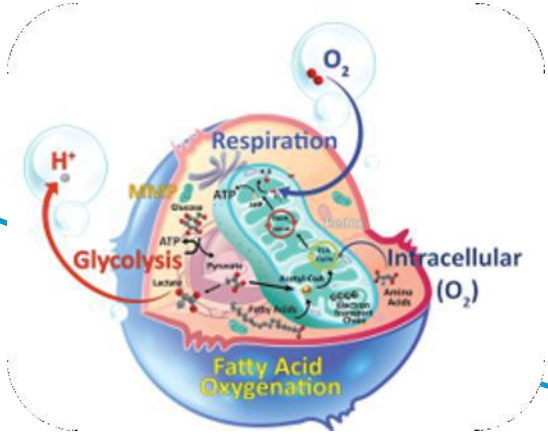




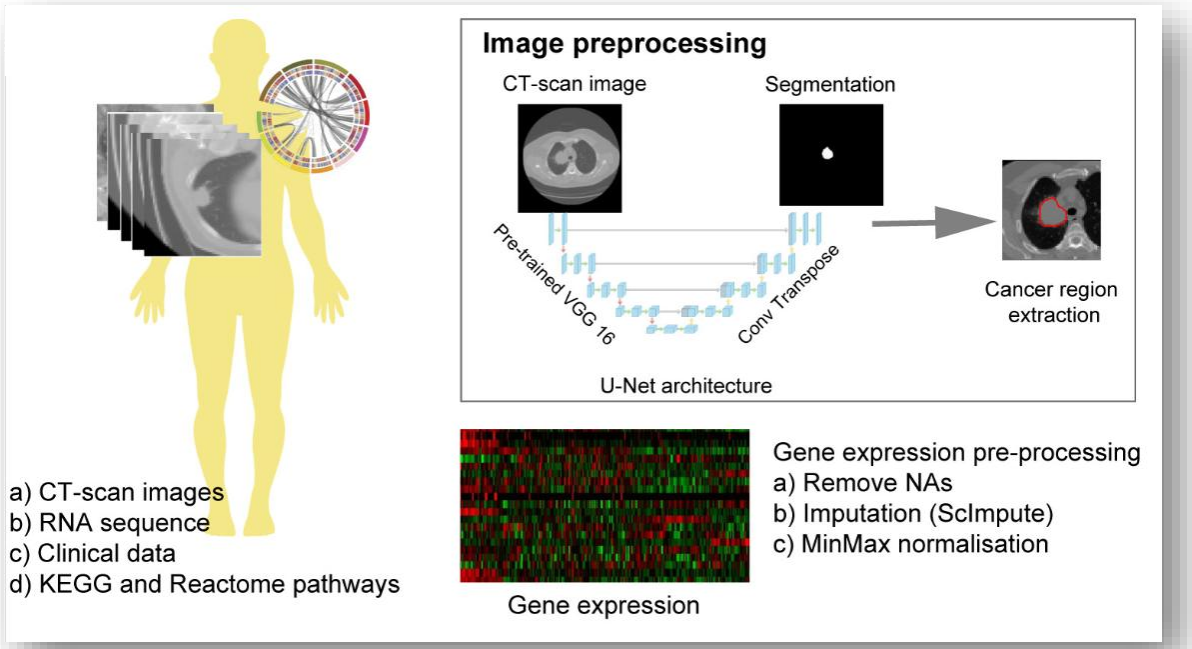
Patient level

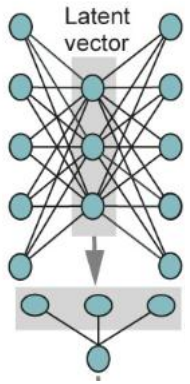


Tissue level

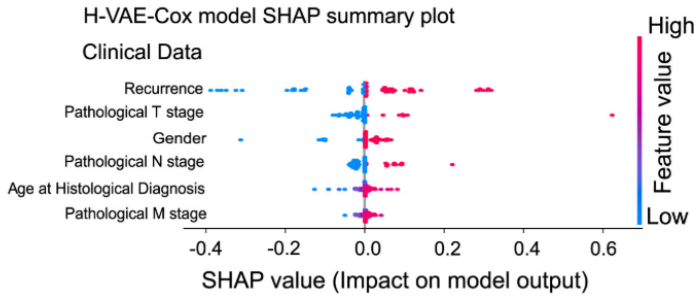


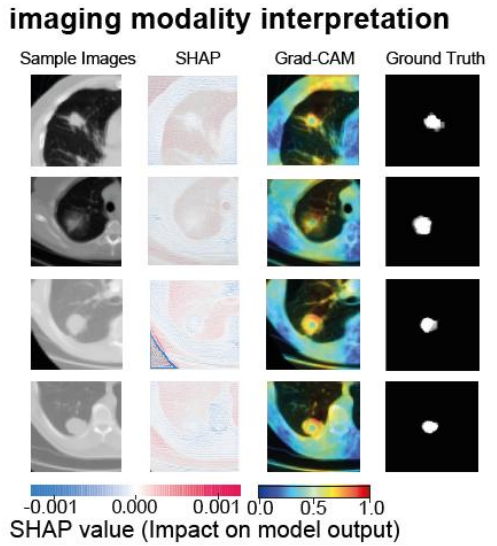
Integrating radiological imaging with clinical and transcriptomic for survival prediction in NSCLC





AI model

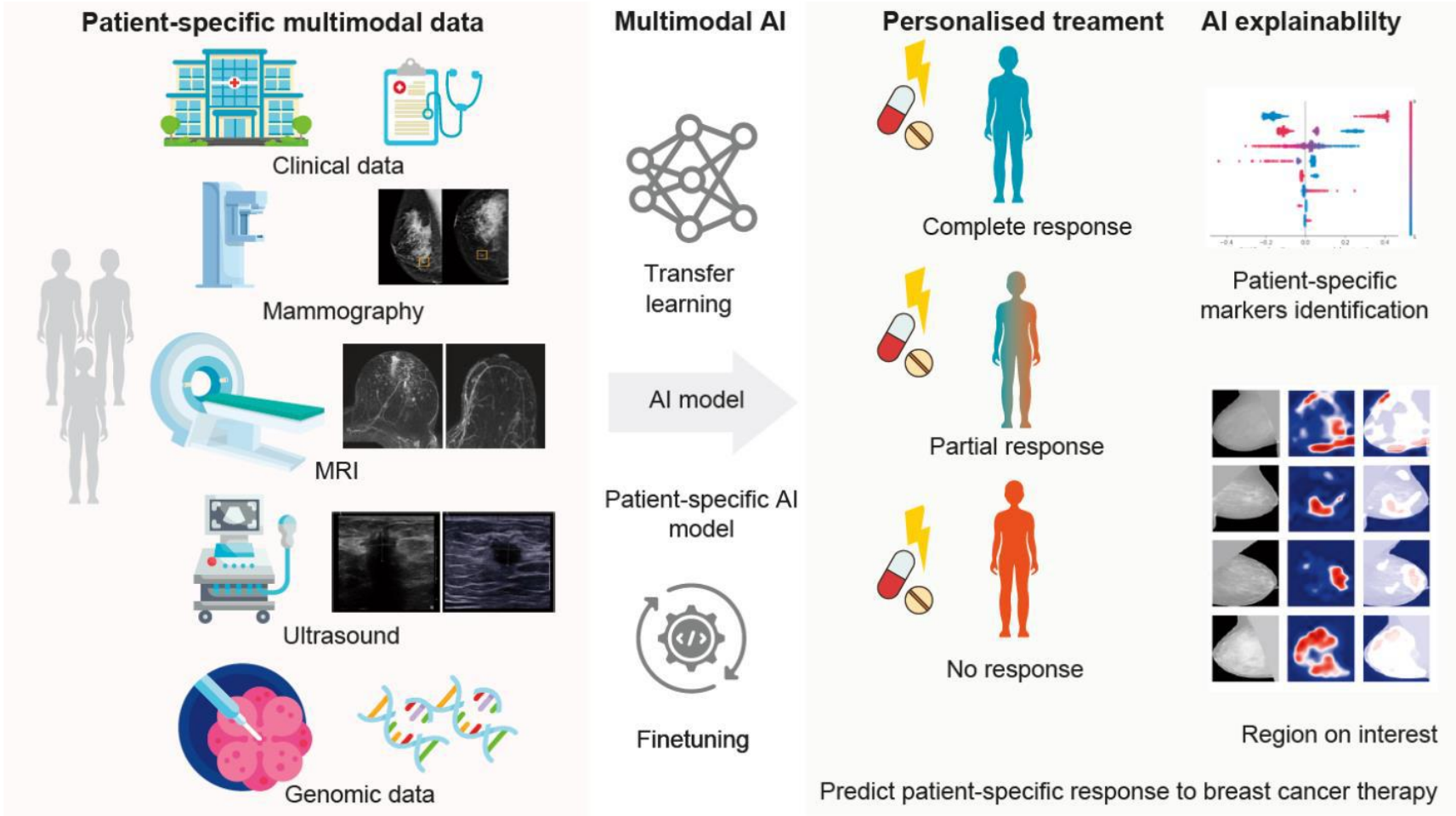




Sample Grad-CAM-highlighted images, scored by radiologists

Verma, S., Magazzu, G., Eftekhari, N., Lou, T., Gilhespy, A., Occhipinti, A., & Angione, C. (2024). Cross-attention enables deep learning on limited omics-imaging-clinical data of 130 lung cancer patients. Cell reports methods, 4(7).

Integrating radiological imaging with molecular and clinical info to predict breast cancer treatment response



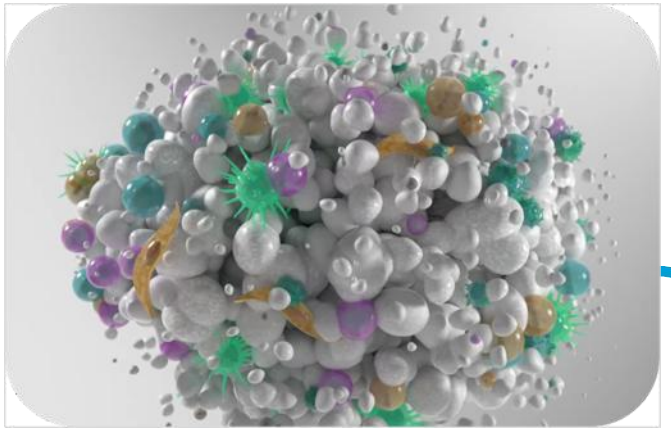
Northern Centre for Breast Research

NHS Gateshead Health NHS Foundation Trust

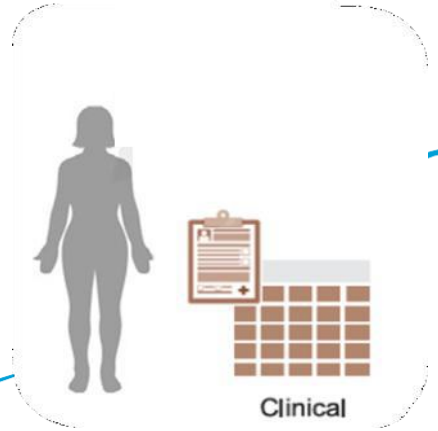
NHS

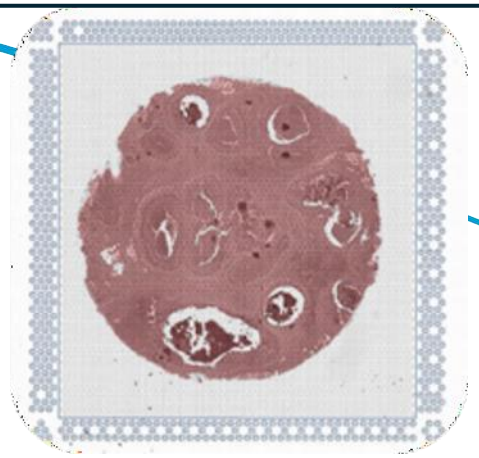
British Society of Breast Radiology

Complexity across Scales

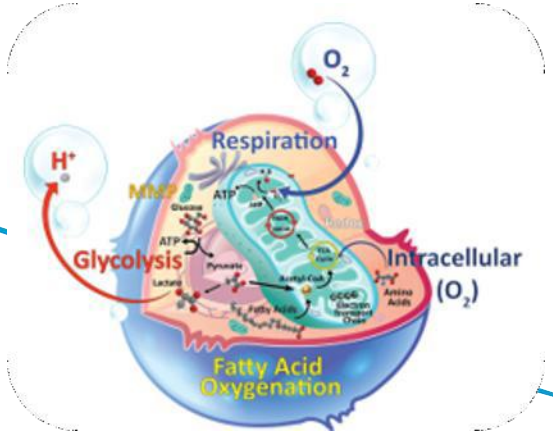


Patient level

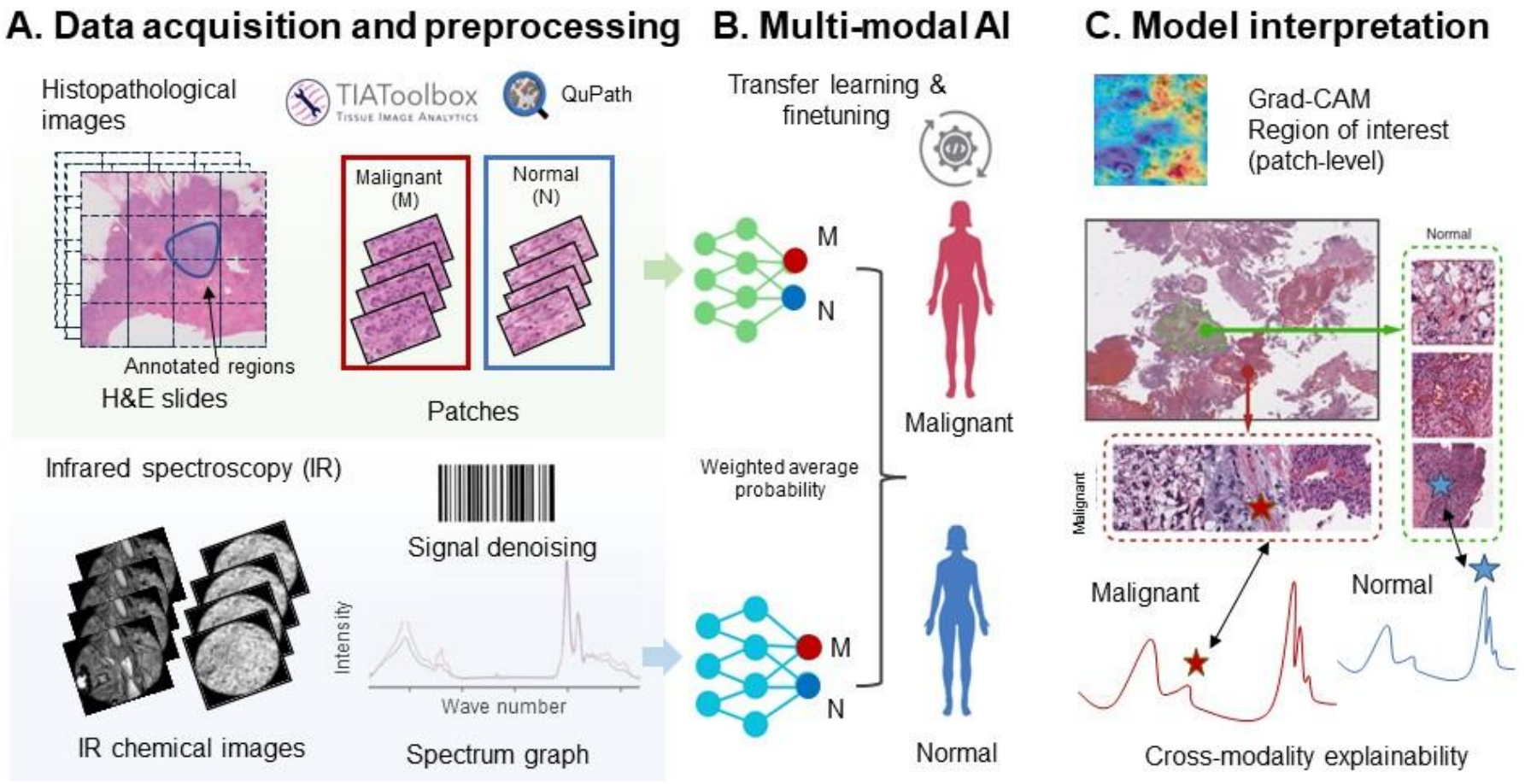




Tissue level



Integrating infrared spectroscopy and digital pathology: an explainable AI multi-modal framework for breast cancer diagnosis



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The University of Manchester

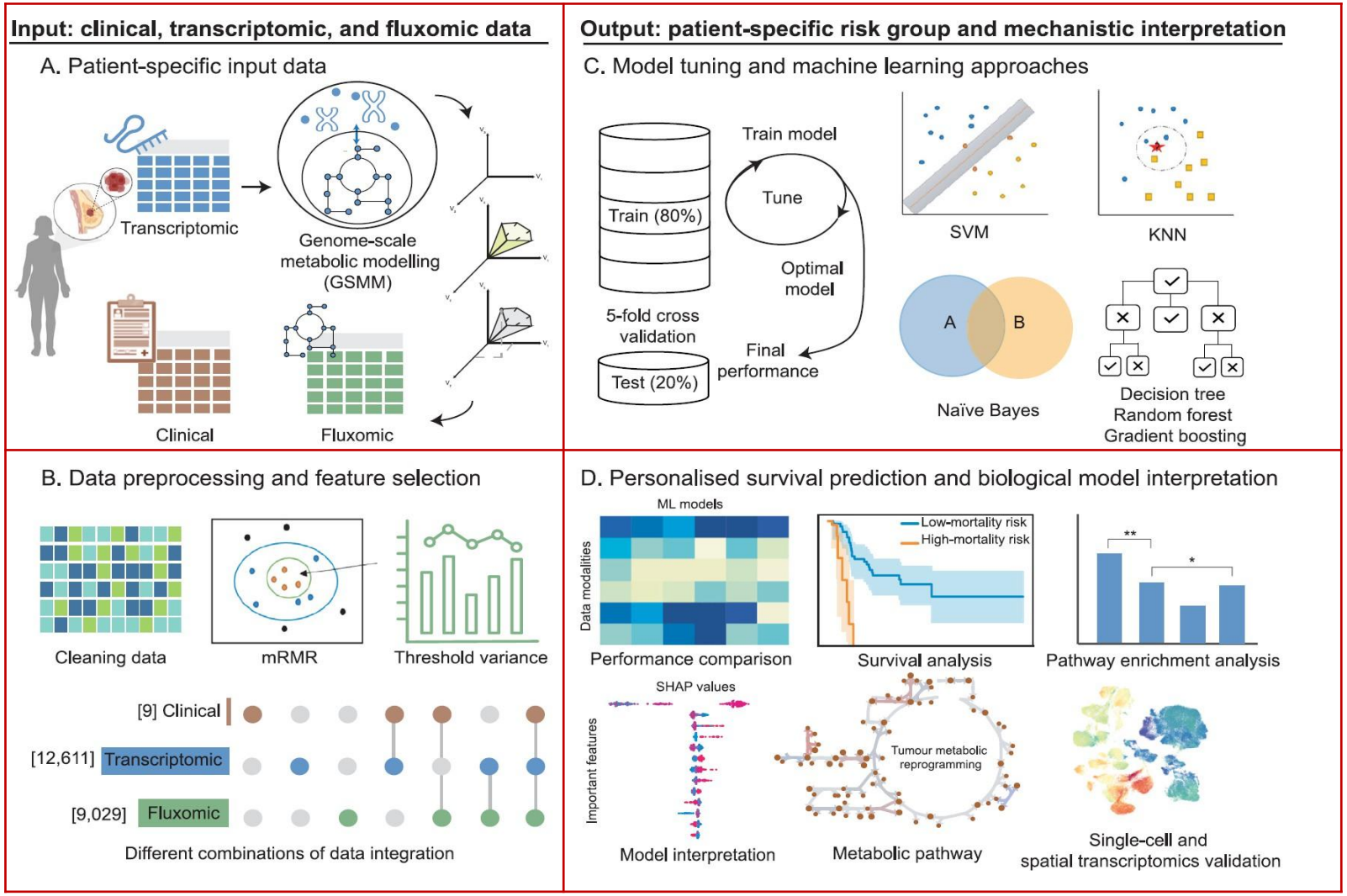
University of Cambridge

NHS

UKRI Engineering and Physical Sciences Research Council

CLIRPath-AI

An AI framework to characterise breast cancer metabolic dysregulations across data modalities



Insight into tumour metabolism

Pathways that help sustain the energy demands of rapidly dividing cancer cells

- Beta-oxidation of polyunsaturated fatty acids
- Glycolysis

L. Doan,S. Verma,N. Eftekhari,C. Angione, A.Occhipinti. From bulk to single-cell and spatial data: An AI framework to characterise breast cancer metabolic dysregulations across modalities. *Computers in Biology and Medicine*. 2025.

Application in a pre-clinical study shows novel reprogramming mechanisms in breast cancer immunotherapy

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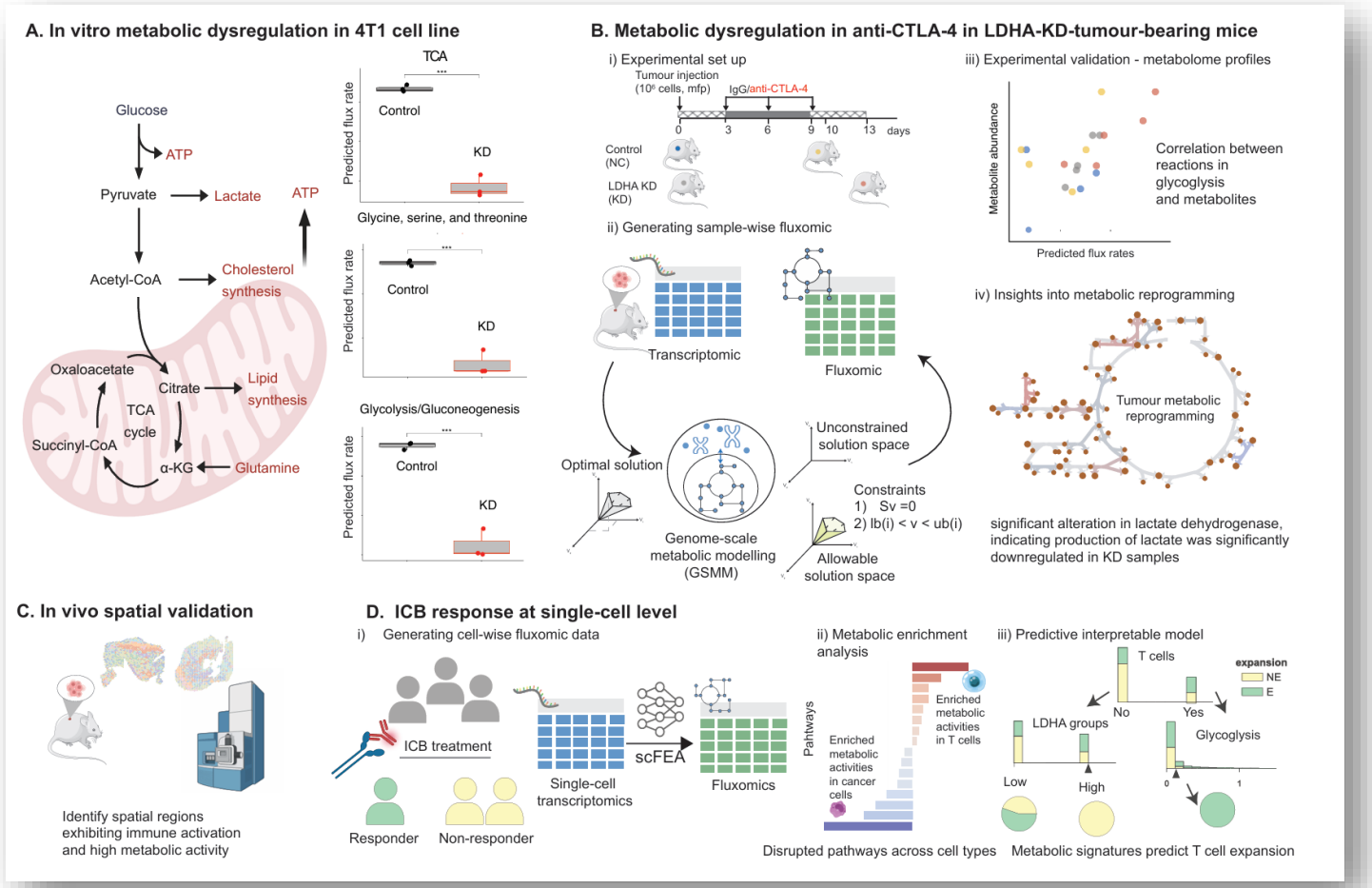
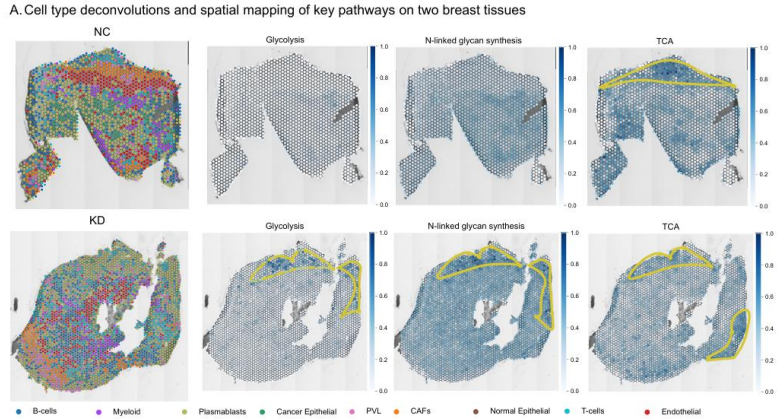
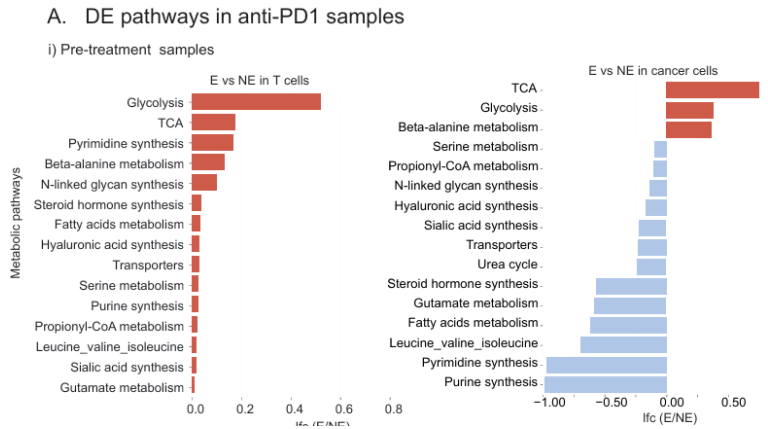
Weill Cornell Medicine







Thank you!

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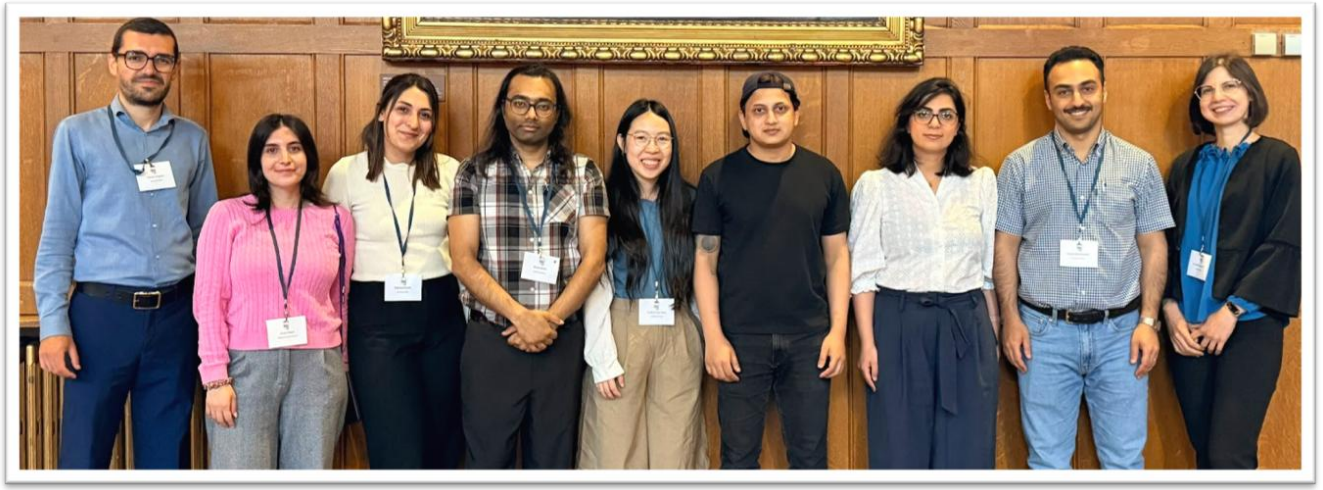

PI: Prof Annalisa Occhipinti
A.Occhipinti@tees.ac.uk

Networking Event – MRC Funding

If you'd like to know more about AI applications and how to get involved, don't forget to register for our **networking event on the 21st October, 1- 4 pm at Teesside University**

Scan the QR code on the left or get in touch with Annalisa (A.Occhipinti@tees.ac.uk)