



*SoMS Honours Project Opportunity 2022*

*Mapping cancer cell signalling through single-cell quantitative imaging and machine learning*

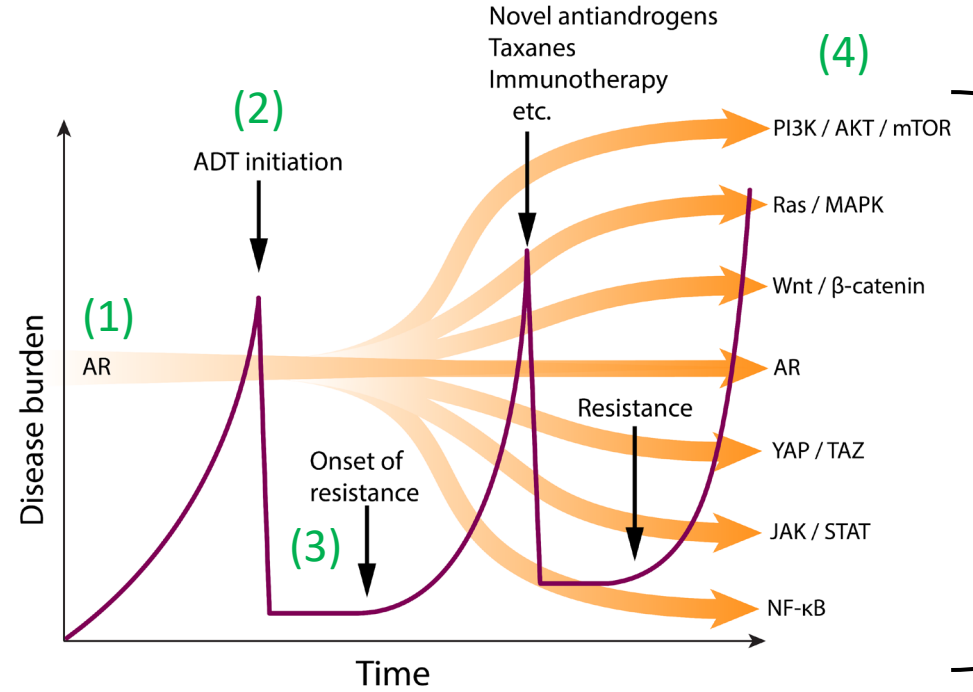
*John Lock; Cancer Systems Microscopy Lab (SoMS, UNSW & Ingham Institute)*

*Website: <https://www.cancersystemsmicroscopylab.com>*

*Email: [john.lock@unsw.edu.au](mailto:john.lock@unsw.edu.au)*

# Question: *Why we need a better diagnostic in advanced Prostate Cancer*

- Prostate cancer (PC) is the second-most common cancer in men and a leading cause of cancer deaths globally
- PC is *initially* driven in by Androgen Receptor (AR) signalling (1), meaning it is sensitive to Androgen Deprivation Therapies (ADT) (2)
- **BUT** resistance to ADT arises in almost all patients (3)
- Resistance can be driven by various alternate molecular signalling pathways that promote cancer cell survival, proliferation and metastasis (4)



(5) **?**  
Which resistance signalling pathway is active in each individual patient?

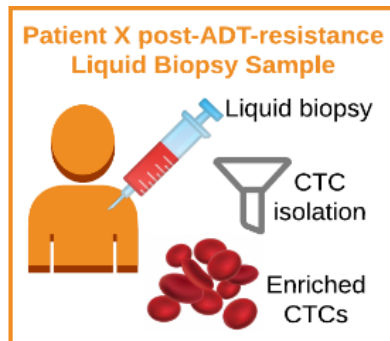
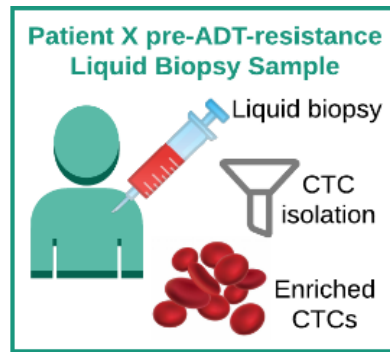
(6) Knowing resistance signalling pathways per patient will allow treatment with targeted therapies

- Because solid tumour biopsies cannot be regularly repeated to track changes in molecular signalling in each patient, *we need a new diagnostic method to detect which signalling pathway is active in each advanced prostate cancer patient* (5) to eventually guide selection of an optimal targeted treatment (6)

# Our Approach: *Liquid Biopsy, Proteomic Microscopy & Machine Learning*

You will access 3 cutting-edge methodologies to measure which signals are driving prostate cancer in individual patients

**1. 'Liquid Biopsy'**  
analysis of Circulating Tumour Cells (CTCs) isolated from PC patient blood samples

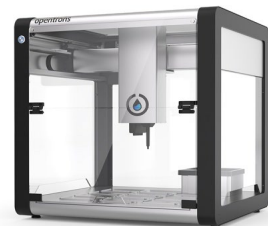


**2. 'Proteomic Microscopy'** involves sequential cycles of molecular labelling & imaging to detect multiplexed signalling pathway activities (and other cancer markers) in each and every patient CTC

**2a.** CTC samples



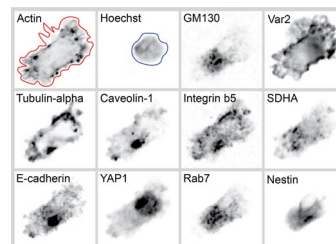
**2b.** Automated Molecular Labelling with Liquid Handling Robotics



**2c.** Automated Imaging with Confocal Microscopy

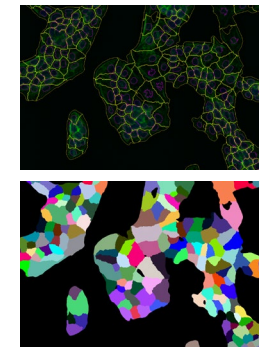


**2d.** Multiplexed CTC Data

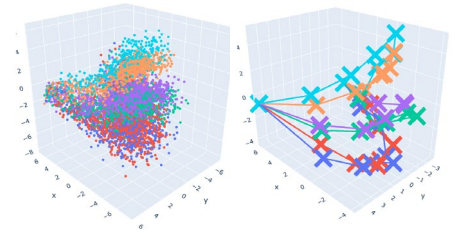


**3. 'Machine Learning'** for CTC detection, signalling activity mapping and signatures definition to guide targeted therapy selection. VR analytics support data analysis

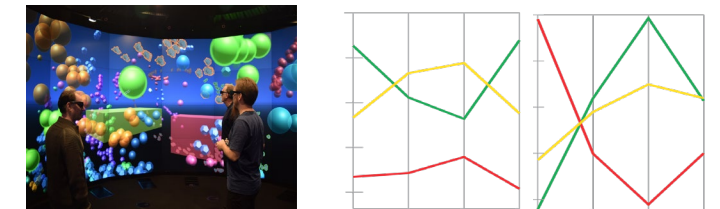
**3a.** Image Analysis



**3b.** Signal activity mapping via Deep Learning variational autoencoder



**3c.** VR analytics & signalling signature definition



Medical Oncologists treating PC patients provide blood samples

# Your Role: *Tune the project to focus on your strongest interests*

- The Cancer Systems Microscopy lab uses advanced automated labelling and imaging of cultured cells and patient-derived cells (such as CTCs) from liquid biopsies **(1)**
- We develop and use automated image analysis and statistical analysis methods to extract insights from image data spanning 1000s of cells **(2)**
- We also develop and use machine learning and AI tools to link quantitative data analyses to patient outcome prediction **(3)**
- You can focus across all or some of these areas, depending on what you are most excited about.

