# Artificial Intelligence for radiomic prediction of radiotherapy side effects

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# Radiotherapy is very effective, but can result in side-effects in some patients

## Breast
- Erythema (short term)
- Atrophy
- Pain
- ...

## Lung
- Cardiotoxicity
- Breathing problems
- Lung fibrosis
- ...

## Prostate
- Incontinence
- Rectal bleeding
- Sexual dysfunction

## Patient factors
- Demographics
- BMI
- Age
- Comorbidities
- ...

## Treatment factors
- Medication
- Surgery
- Hormone therapy
- ...

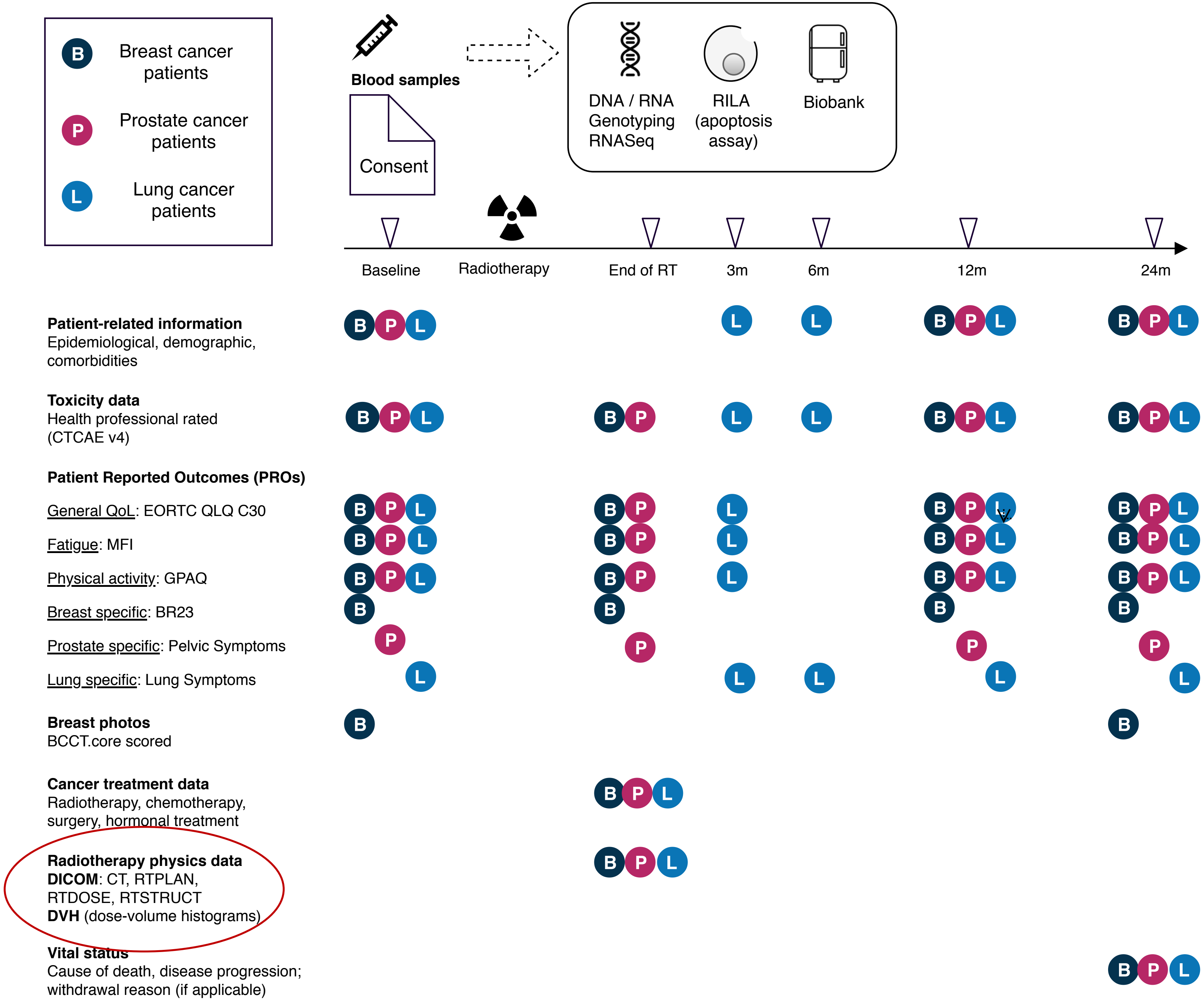
## Genetics
- Genome-wide SNP data

## RT treatment
- Dose
- Fractions
- Time of day?
- **RT technology**

# The REQUITE project

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 601826

- Multi-national observational study
- Breast, lung and prostate cancer patients
- ~ 4500 patients from 26 recruitment sites in 8 countries
- Cohort to validate existing predictive models and biomarkers of radiotoxicity


B Breast cancer patients
P Prostate cancer patients
L Lung cancer patients
Blood samples
Consent
DNA / RNA Genotyping RNASeq
RILA (apoptosis assay)
Biobank
Baseline
Radiotherapy
End of RT
3m
6m
12m
24m
Patient-related information
Epidemiological, demographic, comorbidities
Toxicity data
Health professional rated (CTCAE v4)
Patient Reported Outcomes (PROs)
General QoL: EORTC QLQ C30
Fatigue: MFI
Physical activity: GPAQ
Breast specific: BR23
Prostate specific: Pelvic Symptoms
Lung specific: Lung Symptoms
Breast photos
BCCT.core scored
Cancer treatment data
Radiotherapy, chemotherapy, surgery, hormonal treatment
Radiotherapy physics data
DICOM: CT, RTPLAN, RTDOSE, RTSTRUCT
DVH (dose-volume histograms)
Vital status
Cause of death, disease progression; withdrawal reason (if applicable)

# REQUITE: Big(ish) data

**CRFs & PROs**

> 100,000 forms

**Photos**

> 5,400 photos scored

**Genomics**

> 12 m SNPS
4,223 subjects

**CT Images**

> 569,000 files

### Patient factors

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- BMI
- Age
- …

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- …

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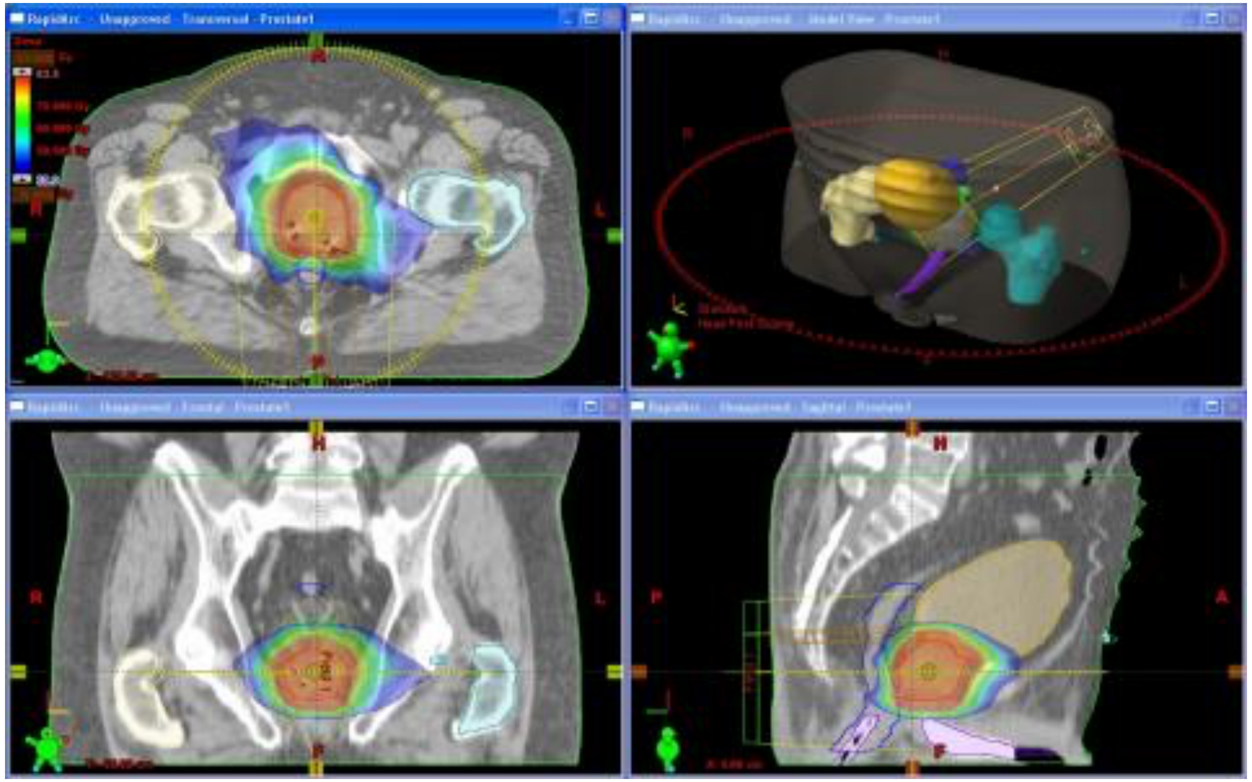
# Physics Data – radiotherapy planning



- Manual or semi-manual delineation of tumour and organ structures
- RT plan to maximise tumour dose while sparing surrounding tissues
- Can we use AI approaches to predict which plans are more likely to result in radiotoxicity?
- Deep learning imaging approaches : Axial3D

# IAX Involvement

- IAX provided travel funds to meet with Axial3D and develop a Wellcome Trust Innovator Award application

**Academic perspective**

- Axial3D's expertise in machine learning image analysis will allow us to fully exploit radiotherapy dose data with greater precision
- Machine learning outcomes will enhance our radiotoxicity prediction models

**Axial3D perspective**

- Being part of an active research community
- Develop new products that can improve the healthcare and medical institutions

# Acknowledgements

**Leicester**

- Chris Talbot
- Tim Rattay
- Dusan Milanovic
- Paul Symonds

**IAX**

**Axial3D, Belfast**

- Niall Haslam

**North West Cancer Centre, Londonderry**

- Wendy Hyland