ACED PhD Training Programme

Course Aims

To provide a solid grounding to the early detection field, this course aims to provide students with the broad spectrum of knowledge and skills across various disciplines relevant to early detection and diagnosis research.

Course Objectives

The course is intended to provide an interactive virtual training programme delivered in 1-hour sessions on an approximately weekly basis across year 1 of the ACED PhD studentship.

1.0	**Introduction / Foundation module**	
1.1	**Cancer epidemiology**	*Global picture of cancer incidence (time, person place), mortality, survival, modifiable risk factors, cancer control continuum (prevention, interception, early detection, early diagnosis, treatment, survivorship*
	Learning outcomes: • Recognise the global burden of cancer. • Discuss the factors contributing to the regional variation in incidence and mortality of cancer. • Summarise the Cancer Control Continuum.	
1.2	**Cancer biology 1**	*Hallmarks of cancer, cancer evolution*
	Learning outcomes: • Describe the hallmarks of cancer and compare these at the cellular and tissue level. • Recognize the process of cancer evolution and tumour progression.	
1.3	**Cancer biology 2**	*Cancer growth and metastasis*
	Learning outcomes: • Contrast the difference between indolent and aggressive/lethal disease and describe potential markers to differentiate indolent from progressive cancers. • Describe the process of metastasis, what it is and how it occurs. • Recognise the role of the tumour microenvironment on tumour growth and metastasis.	
1.4	**Cancer genetics 1**	*Somatic genetics, germline genetics (common variants, pathogenic variants.*
	Learning outcomes: • Define the components of the structure of a gene (e.g. exon, intron, codon) and the "central dogma." • Interpret genetic variant nomenclature and the differences between common and pathogenic genetic variation. • Compare between somatic and germline genetic variation and their role in cancer.	

1.5	**Cancer genetics 2**	*Continued - focus on epigenetics*
	Learning outcomes: • Explain what epigenetics is and distinguish epigenetic modifications from alterations to DNA sequence. • Identify different epigenetic mechanisms relevant to cancer and describe specific examples.	
1.6	**Modes of cancer detection**	*Imaging (CT, MRI, PET scan, US), biomarkers (protein, cell, DNA-based) including examples*
	Learning outcomes: • Identify the different technologies/platforms available for developing clinical tests for early detection. • Contrast between detection methods for imaging and testing biological samples. • Describe specific examples of cancer early detection methods in clinical use.	
1.7	**Precision medicine**	*Principles of cancer treatment and cancer detection and how these could be different in the era of precision medicine*
	Learning outcomes: • Define what precision medicine means and discuss the potential for application to cancer early detection.	
1.8	**Cancer in context**	*Impact of cancer diagnosis on the individual, the family and the healthcare*
	Learning outcomes: • Recognise the impacts of a cancer diagnosis on the patient as an individual and the effect on their family. • Relate to cancer as a disease of a person in contrast to the biology of the disease.	

2.0	**Cancer Metrics**	
2.1	**Classification of cancer**	*Cancer staging (TNM, number staging), grading system, morphology*
	Learning outcomes: • Describe and interpret different tumour classification systems and how they are used clinically with examples.	
2.2	**Introduction to cancer registration**	*Cancer registry data, cancer death registration (issues with death certificates), other routine data sources (HES data, etc).*
	Learning outcomes: • Describe what is cancer registry, the different types and the registration process. • Outline different types of routine population level healthcare data collected. • Recognise the differences between countries in collecting and linking different health data. • Discuss the challenges in accessing and using routine healthcare data. •	

2.3	**Metrics**	*Prevalence, incidence rate, cumulative incidence, age-conditional incidence, lifetime risk, remaining lifetime risk*
	Learning outcomes: • Explain the difference between incidence and prevalence, absolute risk and relative risk, lifetime risk and remaining lifetime risk. • Identify the advantages and disadvantages of using age-conditional absolute risk vs. lifetime risk for risk assessment/.	
2.4	**Survival analysis**	*Different metrics used (e.g. net survival, relative survival, recurrence free survival*
	Learning outcomes: • Define survival analysis and interpret time-to-event data. • Compare and contrast different metrics used for survival analysis (e.g. net survival, relative survival, recurrence free survival).	
2.5	**Cancer risk prediction model**	*What they are, how they are developed, accounting or not for competing risks, how they are validated, their limitations*
	Learning outcomes: • Describe what cancer risk prediction models are, how they are developed and what they are used for. • Discuss how risk prediction models are validated and their limitations.	

3.0	**Cancer Detection Tools**	
3.1	**Biomarker discovery research**	
	Learning outcomes: • Define what a biomarker is and discuss attributes of what makes a good biomarker. • Identify different types of biomarker and methods for biomarker discovery.	
3.2	**Biomarker validation research**	*Analytical validity, clinical validity, different study designs*
	Learning outcomes: • Define the ACCE model framework (analytical validity, clinical validity, clinical utility, ethical legal and social implications) in evaluating emerging tests • Recognise the different stages of biomarker validity and the importance of clinical validation. • Discuss at what stages validation might fail and reasons why. • Compare and contrast different validation study designs and their respective uses and limitations.	

3.3	**Evaluation of biomarkers in clinical application**	*Clinical utility (benefit-harm balance, cost-effectiveness, ethical legal social implications (ELSI), population impact*
	Learning outcomes: • Define clinical utility • Identify the different dimensions of clinical utility • Recognise different considerations of clinical utility of a biomarker for early detection.	
3.4	**Developing detection tools**	*Working with industry, working with healthcare providers, policy makers, legal framework for medical device approval*
	Learning outcomes • Outline the processes and identify relevant stakeholders involved in developing early detection tests/devices to market.	
3.5	**Imaging**	*Breast imaging-reporting and data system (BI-RADS), Prostate imaging-reporting and data system (PI-RADS), role of AI in imaging analysis*

4.0	**Screening – asymptomatic cancer early detection**	
4.1	**Principles of screening**	*Condition, test, treatment, programme, covering sensitivity, specificity, false positives, false negatives, positive predictive value, negative predictive value, sojourn time*
	Learning outcomes • Define what is screening and differentiate screening test from screening programme • Explain the criteria to be considered before setting up a screening programme • Explain what are lead time bias and length time bias • Interpret sensitivity, specificity, positive and negative predictive values	
4.2	**Evaluation of screening strategies**	*Role of modelling in screening – natural history model vs decision analytical models*
	Learning outcomes • Recognise the role of mathematical modelling in understanding natural history of cancer and evaluation of screening programme • Discuss the role of randomised controlled trials of screening and observational studies with routinely collected data in evaluating screening programme. • Discuss the challenges of cancer early detection	
4.3	**Overdiagnosis**	*What it is, how to estimate it, pros/cons of different methods*
	Learning outcomes • Define overdiagnosis in early detection. • Identify different methods to estimate overdiagnosis and compare and contrast the advantages and disadvantages between them	

4.4	**Risk stratified screening**	*What it is, evidence (model vs randomised controlled trial)*
	Learning outcomes • Discuss the rationale for risk-stratification in screening • Describe risk stratified screening • Assess the utility of genetic / epigenetic risk score for risk stratification in risk-stratified screening • Appraise the challenges of implementing risk-stratified screening programme	
4.5	**Implementation frameworks**	*Stakeholder engagement, organisational readiness for change, integrating research and clinical data in learning healthcare*
	Learning outcomes • Explain the difference between implementation science and implementation research • Give examples of implementation frameworks • Explain the factors to be considered and the phases of implementation • Identify relevant stakeholders and recognising the importance of their engagement in implementing a framework. • Recognise the importance of organisational readiness for change for successful implementation	

5.0	**Early Diagnosis – symptomatic cancer early diagnosis**	
5.1	**Early diagnosis**	*Diagnosis intervals, routes of diagnosis, reason for delayed diagnosis (help seeking behavioural factors, healthcare factors, disease factors)*
	Learning outcomes • Describe the routes to diagnosis of symptomatic cancer • Describe the milestones and the time interval in the diagnostic pathway • Recognise different processes in different healthcare systems	
5.2	**Challenges in early diagnosis**	*Disease factors: non-specific symptoms, co-morbidities*
	Learning outcomes • Recognise reasons that may lead to delayed diagnosis from behaviour of the individual, the healthcare system or related to symptoms that may mask diagnosis (co-morbidities, differential diagnosis).	

6.0	Cancer in the wider context	
6.1	**Introduction to health economics applied to early detection**	*Cost effectiveness analysis, discrete choice experiments, budget impact analysis*
	Learning outcomes • Recognise the role of health economics in consideration of early detection programmes in public funded and private healthcare settings. • Explain what economic evaluation and the different types of economic evaluation are (eg cost-effectiveness, cost-utility, cost-benefit, cost-minimisation). • Interpret and discuss the outputs of different types of analysis. • Explain what budget impact analysis is. • Recognise the importance of user preference in early detection programmes/interventions and methods of measuring preferences.	
6.2	**Acceptability of early detection intervention**	*Definition, drivers, research methods, risk communication*
	Learning outcomes • Recognise the importance of acceptability by the public of early detection interventions. • Discuss ways to achieve this and potential hurdles to public acceptance. • Discuss study methods to assess acceptability.	
6.3	**Accessibility**	*Inequity vs inequality, factors contributing to widening the gap and what could be done*
	Learning outcomes • Recognise inequity and inequalities in healthcare and summarise contributory factors. Compare and contrast these across different regions/states, countries and healthcare systems. • Discuss ways to address reducing the gap created by these factors.	
6.4	**Social factors in cancer risk and survival, community engagement**	
	Learning outcomes • Outline the importance of social factors influencing cancer risk and outcomes. Discuss social determinants of health and compare levels of the individual versus healthcare systems. • Explore factors affecting willingness or engagement to participate in clinical trials or novel programmes/interventions.	
6.5	**Ethical and legal frameworks for cancer early detection**	
	Learning outcomes • Recognise the importance of potential legal and ethical requirements and potential limitations governing early detection research and implementation of healthcare programmes/interventions. • Identify legal and ethical differences between countries and legal options of choice between the individual versus population level.	