ACRF ACCELERATE
An Impact Philanthropy Initiative

AUSTRALIAN CANCER RESEARCH FOUNDATION

Transforming decades of research into individualised treatment options

Project Title	ACRF Centre for Optimised Cancer Therapy
Lead Institute	QIMR Berghofer Medical Research Institute, Brisbane
Focus Area	Big Data, Precision Oncology
Cancer Types	Melanoma, lung and mesothelioma, blood, colorectal, brain, head and neck and upper gastrointestinal cancers; will be applicable to many other cancers

Challenge and Opportunity

The last two decades have seen major shifts in the understanding of cancer. Rapid developments in sequencing technologies which have enabled the complete genetic make-up of tumours to be characterised, has found changes in cancer cells which have been pivotal to advances in cancer research. This has resulted in an unprecedented level of understanding of cancer risk, cancer evolution and prognosis after treatment for patients[1,2,3]. There is a pressing need and opportunity to use new genomic technologies to optimise the use of existing and novel cancer therapies. This means identifying the best treatment for each individual patient's cancer and working out how the delivery and treatment combinations can be improved to ensure every patient has the best chance of having their cancer cured.

The ACRF Centre for Optimised Cancer Therapy (ACRF COCT) which will be based at QIMR Berghofer Medical Research Institute in Brisbane, is an ambitious and highly translational initiative that seeks to refine the approach to treating patients with cancer. It will integrate the latest advances in genomics and innovative technologies to understand differences among cells within and between tumours and apply deep learning to large data sets to refine the approach to treating patients with cancer.

"ACRF provides funding for new equipment which can dramatically advance the speed and significance of delivering our research findings."

Professor Steven Lane,
Chief Investigator ACRF COCT

Project in Brief

- Technological innovations over the last decade have dramatically increased the understanding of cancer, not least the characterization of genomic changes in cancer cells, which has led to breakthroughs in how cancer is managed and treated.
- International consortia, including members of the ACRF COCT team, have made significant contributions to this knowledge, leading to the generation of large data sets which have informed precision oncology clinical trials.
- The future of cancer medicine relies on the ability to identify and translate research findings in real time for clinicians looking after patients with cancer.
- ACRF COCT will leverage the recent advances in technology and computing to understand in greater depth cancer cells and their environment and to apply deep learning to large data sets, making this information available to clinicians to better inform treatment options.
- ACRF COCT builds on bodies of existing data and brings together an impressive team with an international standing across several areas, including cancer genomics, machine learning and big data studies.

Project Detail

Introduction

The next major breakthroughs in genomic medicine (using a person's genomic information as part of their clinical care) will stem from an integrated approach which understands how patients are selected for treatments, how patients respond to these treatments and how the differences within tumours can inform the optimal choice of drugs to treat cancer.

The research that will be undertaken in the ACRF COCT is based on the principle that an understanding of how cancers respond to therapies will enable the design of better therapeutic approaches and improve outcomes for people with cancer. It will build upon existing data derived from the analytical genomics of cancer cells, to understand the dynamics of tumour responses to treatment – to inform future treatment choices and clinical trials. This will be made possible due to a range of technological and computational advances which will be integral to ACRF COCT.

QIMR Berghofer Media Research Institute in Herston Queensland

The Unique Approach

The technologies within ACRF COCT will significantly improve the tracking and processing of tumour samples and enable single-cell and spatial genomics (to identify molecules and cells in context) to be undertaken. These technologies will be underpinned by expanded data storage and sequencing capacity. Together this will create a pipeline of high-quality samples from patients with more and better features extracted which will be analysed to better understand about patient outcomes and treatments.

The analysis will focus on several cancers including melanoma, lung and mesothelioma, blood cancers, colorectal, brain, head, and neck and upper gastrointestinal, but the findings will be applicable to many other cancers.

Research Program

The ACRF Centre for Optimised Cancer Therapy will leverage a suite of unique resources created by the research team to understand dynamic changes of cancer during chemotherapy, immunotherapy, targeted and cellular therapies.

The program will address four central themes:

1. Expansion of Data Analysis and Storage:

Large public datasets, which include contributions from international consortia and research team members, are rich resources that have already informed several precision medicine clinical trials. The enhanced computing and storage expansion that will be available within ACRF COCT will significantly enhance the capacity to integrate these large datasets and analyse data from additional samples that will be generated from a range of new studies. This analysis will enable the identification of potential drug targets and signatures to track treatment outcomes.

2. Examination of Tumour Heterogeneity:

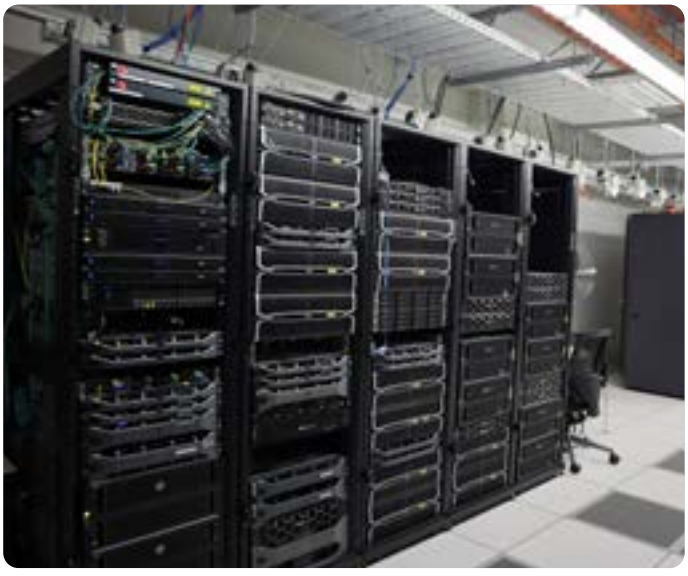
Tumour heterogeneity – the differences that exist between tumours of the same type in different patients or between cancer cells within a single tumour – is one of the challenging aspects of treating cancers. It is dependent on several things including interactions with the ecosystem that surrounds a tumour - the tumour microenvironment, and the spatial localisation of the cancer cell. These factors can influence cellular behaviours and ultimately responses to treatment. The single cell and spatial multi-omics equipment that will be available within ACRF COCT will enable tumour heterogeneity to be examined by creating a “Google Maps” view of a tumour.

3. Machine and Deep Learning:

Cancer is a complex multi-faceted disease so to identify novel features that are linked to treatment response and patient outcomes there is a need to integrate multiple data types. Expertise within the research team will use artificial intelligence and machine learning methods to process and analyse data from multiple sources (i.e. multi-modal deep learning models). Patient clinical data with features extracted from cancer sample characterisation (i.e. genomics, transcriptomics, spatial, single-cell omics) will be used to analyse this ‘big data’ to identify features that predict outcomes such as patient survival and treatment response.

4. Validation of Findings

It is anticipated that several hundred drug targets will be identified from DNA and RNA sequencing studies and that many of the identified genes will operate through the hallmarks of cancer (i.e. a set of traits shared by most cancers). Functional studies will leverage existing resources developed by the research team including established “living biobanks” of patient derived models which retain the structure of the tumour and its genomic features and have been tested for response to chemotherapy and novel targeted therapies[4]. These studies will provide proof of principle for novel treatments and combination therapies that may be rapidly translated into patient care.



Data storage at QIMR Berghofer

The Benefit

ACRF COCT presents an ambitious and highly translational approach that seeks to refine approaches to treating people with cancer and will enhance and extend QIMR Berghofer's capabilities in cancer characterisation and analysis. By using the latest advances in genomics, the latest technology to understand heterogeneity within cancer, and applying deep learning approaches to large data sets including international consortia data ("big data"), cancer treatments will be optimised. This new approach will be applicable across many cancers hence the benefits are wide reaching. Ultimately each individual patient's cancer can be analysed, and the optimal choice of drugs and treatment combinations identified, providing everyone with the best possible outcome. As an academic partner of the future Queensland Cancer Centre and sharing the same campus, the outcomes from ACRF COCT will play an important part in development of the Centre, as precision oncology will be a major focus.

Use of Funds

The $2 million investment will support the development of the ACRF COCT which will integrate the latest advances in genomics, the latest technologies to understand heterogeneity within cancer and apply deep learning approaches to large data sets to refine the approach to treating patients with cancer.

Technology	Cost
EpMotion 5075tc	$180,000
Chromium X (upgrade)	$36,000
Visium + CytAssist	$72,000
Integra WellJet	$39,000
Beckman i7	$490,000
Image Express Pico	$190,000
4 Pb Data storage	$500,000
Laboratory Information Management System	$350,000
Facility Manager	$143,000
Total	$2,000,000

Meet the Team

ACRF COCT will include a team of eight Chief Investigators (listed below) and 18 collaborators. This research team brings together world leading clinicians, cancer biologists and technologists working on cancers including melanoma, lung and mesothelioma, blood cancers, colorectal, brain cancer, head and neck and upper gastrointestinal cancer as well as expertise in bioinformatics, cell biology and immunology.

Chief Investigator Steven Lane
Director, Cancer Research Program, QIMR Berghofer
Group Leader, Gordon & Jessie Gilmour Leukaemia Laboratory,
QIMR Berghofer Senior Clinical Haematologist, Royal Brisbane and Women's Hospital Professor,
University of Queensland

Chief Investigator Nicola Waddell
Group Leader, Medical Genomics Group, QIMR Berghofer

Chief Investigator John Pearson
Bioinformatics Manager, QIMR Berghofer

Chief Investigator Nicholas Hayward
Distinguished Scientist, Oncogenomics Laboratory, QIMR Berghofer

Chief Investigator Stacey Edwards
Group Leader, Functional Cancer Genomics Laboratory,

Chief Investigator Siok Tey
Group Leader, Translational Cancer Immunotherapy Laboratory,
QIMR Berghofer Senior Clinical Haematologist and Clinical Director, Genetically Modified Cellular Therapies, Cancer Care Services, Royal Brisbane and Women's Hospital
Medical Director, Q-Gen Cell Therapeutics, QIMR Berghofer

Chief Investigator Vicki Whitehall
Group Leader, Conjoint Gastroenterology Laboratory, QIMR Berghofer
Senior Scientist, Conjoint Gastroenterology Laboratory, Pathology Queensland

Chief Investigator Lachlan Harris
Team Head, Cancer Neuroscience Laboratory, QIMR Berghofer

ACRF Model for Impact

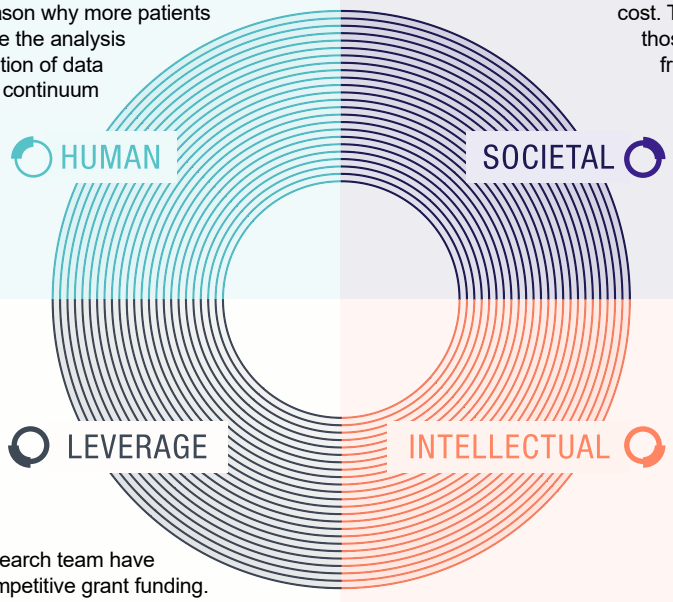
With input from health economic specialists, ACRF has developed a framework to articulate the anticipated future impact of projects that receive ACRF funding. Below is an overview of the outcomes the ACRF COCT has the potential to achieve:

HUMAN

- In 2023 it is estimated that 165,000 Australians will be diagnosed with cancer and 51,000 will die. Precision oncology treatments, such as immunotherapies, have the potential to benefit over 8,000 Australians[5]. Greater accuracy in identifying precision oncology treatments that will benefit patients would greatly increase this number.
- It is estimated that in the US that of the 8% of patients with cancer who qualify for big data–driven targeted therapies, only 5% will benefit. One reason why more patients are not benefitting is because the analysis of data is lagging the generation of data across the discovery to care continuum of cancer[6]. The research undertaken by ACRF COCT will advance the use of big data to help inform treatments.

SOCIETAL

- ACRF COCT has the potential to reduce the burden on caregivers who, when considering time spent caregiving for loved ones, work absenteeism and presenteeism, experience a 23% work productivity loss because of caregiving[8,9]. Based on the average Australian wage, this accounts for an annual productivity loss of $13,916 per caregiver annually.
- A precision oncology approach can deliver health benefits at a potentially affordable cost. The use of a test that can select those patients who can benefit from a particular treatment or monitor the therapeutic response during the early stage of the development of precision oncology drugs has been found to reduce the cost of development by $US1.1Bn[10].



LEVERAGE

- Over the last five years the research team have secured over $21 million in competitive grant funding. The investment in $2M would significantly strengthen future grant applications and secure additional funding.
- Of the $78B net present gains generated by medical research from 1990 to 2004, $52B was in the form of health gains and $26B in wider economic gains[7]. Extrapolating these figures, the $2M invested by the ACRF has a potential return of $5.23M - $7.8M in the form of health gains and $2.57M in the form of wider economic gains.
- A further $300,000 will be provided by Ovarian Cancer Research Foundation to support personel for ovarian cancer research.

INTELLECTUAL

- Jobs in medical research are high value and knowledge-based jobs that contribute substantially to the economy. The core team alone (excluding the CI's) has the potential to generate $603,000 in value added gain[7].
- One of the most important outputs of ACRF COCT will be publications to inform future research. The $2M invested by ACRF alone has a potential return of 23 publications[11].

For references, please visit acrf.com.au/philanthropy-accelerate-references

BACKING BRILLIANT

AUSTRALIAN CANCER RESEARCH FOUNDATION

Contact Information

To find out more about ACRF Accelerate and this exciting project please contact:
info@acrf.com.au 1300 884 988