



## An equitable lung cancer screening program to tackle Australia's deadliest cancer

Project Title	ACRF Lung Cancer Screening Centre of Excellence
Lead Institute	The University of Queensland Thoracic Research Centre
Focus Area	Cancer screening/detection
Cancer Types	Lung cancer

# Lung cancer is the leading cause of cancer death in Australia

Despite being the 5th most diagnosed cancer, lung cancer has the highest mortality rate of all cancers, accounting for one in five deaths from cancer in Australia<sup>(1)</sup>. According to the Australian Institute of Health and Welfare, it is estimated that 14,529 Australians will be diagnosed and 9,193 will die from lung cancer in 2022<sup>(1)</sup>. The prognosis for lung cancer is poor, with a 5-year survival rate of only 21%, compared to 70.1% in all cancers combined<sup>(1)</sup>. This is because lung cancer is typically diagnosed at an advanced stage after it has spread to other parts of the body.

While lung cancer has a high potential cure rate if detected at an early stage, lung cancer screening is not accessible to people living in regional and remote areas, including Aboriginal and Torres Strait Islander people, who are statistically more likely that to be diagnosed with, and die from the disease. Health disparities are evidenced in lung cancer outcomes.

42.2% of all lung cancer cases are Stage IV at diagnosis with a five-year relative survival of only 3.2% compared to 67.7% if diagnosed at Stage I <sup>(1)</sup>.



## An equitable lung cancer screening program for all Australians

The ACRF Lung Cancer Screening Centre of Excellence (LUSCE) will be a mobile multi-platform lung cancer research facility focused on the early detection of lung cancer. The ambitious project aims to determine the most effective ways to detect lung cancer early, determine when and how it can be treated, and avoid where possible late-stage, incurable cancer.

National screening programs have proven to be effective for breast, bowel and cervical cancers. This pilot project, conducted in Queensland, will provide data requested by government health agencies to support the potential establishment of a national lung cancer screening program, which in-turn would provide equitable access to lung cancer screening services for all Australians.

ACRF LUSCE will engage key stakeholders including consumers, health professionals and policy makers to identify key factors to support the success of the project and help co-design its implementation.

## A world-first integrated mobile lung cancer screening platform

Mobile cancer screening services in Australia are highly successful, with programs like BreastScreen Australia being testament to their value in the early detection of cancer. When BreastScreen was introduced in 1991, the breast cancer survival rate was 68%, by 2018 the survival rate had increased to 91%.

The current model of lung cancer detection relies on CT scans, which are not readily available in rural areas. To combat this issue, ACRF LUSCE will take lung cancer screening equipment on the road using a fit-forpurpose trailer. A prime mover will be used to transport the heavy-duty scanning and biomarker collection laboratory required to undertake the state-wide lung cancer screening program.



## ACRF LUSCE has three key interrelated research themes:

## 1. Telehealth screening

ACRF LUSCE will be equipped with a state-of-the-art low dose computerised tomography scanner (LDCT). The LDCT scanner combines x-ray equipment with sophisticated computers to produce multiple, crosssectional scans of the inside of the body. Using up to 90% less radiation than a traditional CT scanner, the LDCT scanner produces high quality images that will be able to detect lung abnormalities.

## Results from two international clinical trials have demonstrated that LDCT imaging has the potential to reduce lung-cancer specific mortality by a projected minimum of 20% in Australia <sup>(2,3,4)</sup>.

### 2. Computer-aided analytics

High quality screening requires a comprehensive approach to nodule management. In an Australian-first, ACRF LUSCE will test 3D volumetry and evaluate its effectiveness in identifying and evaluating the size of tumours as compared to using electronic calipers. While an incredibly useful tool in cancer diagnosis, in approximately 1.2% of cases 2D volumetric assessment leads to a false positive result. A false positive result can cause significant harm to the patient, including further and unnecessary invasive procedures, biopsies and surgery. 3D volumetry technology will build on the effectiveness of 2D volumetry, to assess the volume of tumour masses with precision and accuracy, reducing false positive scans.

Artificial intelligence (AI) algorithms play a vital role in the automated detection, segmentation, and computer-aided diagnosis of malignant lesions; with radiomics and deep-learning-based types showing much promise. Radiomics is a growing field related to the extraction of a set of features from an image, which allows for automated classification of medical images into a predefined group to assist patient diagnosis and treatment.

For the first time in Australia, ACRF LUSCE will prospectively test a promising Radiomics tool developed by collaborators from the Mayo Clinic and Vanderbilt University (USA).

### 3. Integrating biomarkers

Using biomarkers to select people for lung cancer screening is a key research gap because of its possibility to identify those at high risk who are not eligible for screening by conventional criteria, while avoiding further investigation in those who do not have malignant disease. ACRF LUSCE will research the applicability of the most promising screening biomarkers, which indicate the presence of cancer cells in the body, including blood tumour markers, blood genomic liquid biopsies and exhaled breath biomarkers including end-products of metabolic process such as Volatile Organic Compounds (VOCs).

ACRF LUSCE will contain essential equipment for the mobile breath collection and preanalytical processing and these, together with blood samples will be stored, for biomarker testing to take place at a centralised laboratory located at The Prince Charles Hospital in Brisbane.

ACRF LUSCE will be a world first mobile lung screening service to test the feasibility of integrating biomarker testing in regional locations while addressing the logistical challenges posed relating to sample collection, storage and transportation for processing at a centralized laboratory. 

 Our goal is to prevent and

 Cure lung cancer, to fulfil our

 vision of making lung cancer

 a rare disease. With a network

cure lung cancer, to fulfil our vision of making lung cancer a rare disease. With a network of national and international researchers, we will reimagine the digital integration with our communities, processes, information and technology to help control the huge burden of lung cancer."

Professor Kwun Fong, Chief Investigator

## How ACRF LUSCE will come to life

ACRF LUSCE will invite and enrol people aged 55 - 74 with a high lung cancer risk for a low dose computerized tomography (LDCT) scan and an annual Health Status follow-up. Each scan will be read providing a comprehensive radiological report categorising each patient as positive (abnormality), negative or indeterminate.

Mobile low dose computerized tomography (LDCT) screening will be supported by the ACRF LUSCE Virtual Hub. This digital health enabled diagnostic and assessment platform will operationalise the remote screening by coordinating screenings, enabling reading and reporting of LDCT scans, and advising local health care providers of detected abnormalities. Scans and results will be provided to the participant and their local health service provider.

Suspicious lung nodules requiring specialist consultation will be enabled by the development of fit for purpose telemedicine with the Hub specialists to deliver ready, timely and efficient assessment and management of the suspected lung cancers, including access to Thoracic Medicine, Thoracic Surgery, Radiation and Medical Oncology.

By retaining the scientific design and methodological rigor of the International Lung Screening Trial (clinicaltrials.gov 1) conducted in 6 hospitals in 4 capital cities, ACRF LUSCE findings will enable comparison between mobile and metropolitan sites to ensure uniform Quality Assured screening across Australia.

## Closing the gap on lung cancer screening services

Despite the statistically higher rates of smoking in regional and remote communities, lung cancer screening services are concentrated in metropolitan areas, with people living in rural and remote areas having to travel great distances to access services. Smoking is one if the leading risk factors in the development of lung cancer with 19.6% of people smoke in regional and remote communities, compared to 12.8% in major cities <sup>(5)</sup>.

The mobile nature of ACRF LUSCE will allow it to reach pockets of rural and remote Queensland, including Aboriginal and Torres Strait Islander communities, where lung cancer rates are disproportionately high.

Aboriginal and Torres Strait Islander people are also statistically more likely to smoke than non-Indigenous Australians. Lung cancer, like all health disparities in Aboriginal and Torres Strait Islander communities needs to be addressed, and early screening will be one activity to assist in reducing this inequality of health outcomes.

Aboriginal and Torres Strait Islander people are statistically twice as likely to be diagnosed with lung cancer and one and a half times more likely to die from the disease than non-Indigenous Australians <sup>(5,6)</sup>. Indigenous research leaders Associate Professor Maree Toombs and Professor Gail Garvey will co-design a research approach in partnership with Aboriginal and Torres Strait Islander communities. Using community-based participatory research they will create a framework to implement a culturally competent lung cancer screening service. Their extensive expertise, across several research initiatives, includes. the Carbal Medical Service Mob Van, a mobile caravan providing primary health care to Aboriginal communities around Toowoomba, Queensland. Maree has dedicated her career to serving the community and, as such, is guided by the community in which areas are important for research. She will bring her extensive experience working with Indigenous Australian communities to this project.

Associate Professor Maree Toombs, Associate Dean, Indigenous Engagement Faculty of Medicine at the University of Queensland.

## Where will ACRF LUSCE stop off?

ACRF LUSCE will spend an estimated 70% of time on the road, stopping over in locations across rural and remote Queensland. The routes will be designed taking to account information from Queensland's B-Triple Network and existing Queensland mobile health services.

Below are some of the destinations that the truck is planning to visit. Detailed map and locations are yet to be confirmed.



## ACRF Model for Impact

With input from health economics 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 ACRF LUSCE has the potential to achieve. Being a pilot project, the potential outcomes of ACRF LUSCE have been extrapolated to a national screening program.

### HUMAN

- By offering a comprehensive lung cancer screening service, ACRF LUSCE has the potential to prevent the deaths of 4,246 Australians per year and reduce lung cancer mortality by 20% <sup>(1,2,3,7)</sup>.
- It is estimated that in the first 10 years of a lung cancer screening program in Australia, approximately 70% of all screen-detected lung cancer will be diagnosed at an early stage <sup>(7)</sup>.
- ACRF LUSCE has the potential to reduce annual cancer costs by \$9M for the 4,246 patients who could be diagnosed at an early stage of lung cancer in Australia each year <sup>(8,9)</sup>.

**HUMAN** 

LEVERAGE

#### SOCIETAL

- The project could reduce costs associated with premature mortality due to lung cancer by 20%, resulting in approximately \$1.38B in savings annually <sup>(10)</sup>.
- ACRF LUSCE has the potential to reduce the burden on caregivers who, when taking into account time spent caregiving for loved ones, work absenteeism and presenteeism, experience a 23% work productivity loss as a result of caregiving.
   Based on the average Australian wage, this accounts for an annual productivity loss of \$12,784 per caregiver <sup>(11,12)</sup>.

SOCIETAL 🔿

#### LEVERAGE

- The University of Queensland has leveraged an additional \$120,000 funding per year for 5 years to support ACRF LUSCE operating costs.
- Future potential investments from Cancer Australia and the Australian Government, which has recently invested \$6.9M for 5 lung cancer nurses and to implement modelling for a National Lung Cancer Screening Program.
- 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 <sup>(13)</sup>. Extrapolating these figures, the \$2M invested by ACRF alone has a potential return of \$7.81M, with \$5.1M in the form of health gains and \$2.71M in wider economic gains.

### INTELLECTUAL

INTELLECTUAL

- Jobs in medical research are high value and knowledge-based that contribute substantially to the economy. A core team of 17 Chief Investigators, 24 scientists and researchers has the potential to generate \$164,150 in value added <sup>(13)</sup>.
- One of the most important outputs of ACRF LUSCE will be publications to inform future research. ACRF LUSCE will return an estimated 23 publications <sup>(14)</sup>.



The \$2M grant will be used to purchase the technology and equipment to enable the early detection of lung cancer including:

Technology/equipment	
Fit for purpose CT scanner in a Siemens SOMATOM go.Up Trailer with mobile Integrated Injector Arm and trailer mounted portable generator	
Telemedicine: Virtual Hub Radiology Workstation	\$18,000
CAD volumetrics and BRODERS Radiomics tool	\$212,000
Sequencing instrument and dedicated workstation	\$300,000
Breath Sampler	\$25,000
Exhaled breath condensate unit, lung function and smoking quantification, DLCO System and gas-powered freezer for sample storage	
Total	\$2M

Note: Funds will be sought for the Prime Mover, failing which hire costs will be covered by the project operating costs.

## Meet the team

ACRF LUSCE will include a team of 17 Chief Investigators (listed below) and 24 scientists and researchers who are respected professionals in their field. Together, they bring national and international expertise in lung cancer screening:

#### Chief Investigator Kwun Fong

Director, University of Queensland Thoracic Research Centre Thoracic Physician, The Prince Charles Hospital

### **Chief Investigator Ian Yang**

Thoracic Physician, The Prince Charles Hospital Professor of Medicine & Head University of Queensland Northside Clinical School, University of Queensland Thoracic Research Centre

#### **Chief Investigator Henry Marshall**

Thoracic Physician, The Prince Charles Hospital Associate Professor, Faculty of Medicine, University of Queensland Thoracic Research Centre

### **Chief Investigator Rayleen Bowman**

Thoracic Physician, The Prince Charles Hospital, Associate Professor, Faculty of Medicine, University of Queensland Thoracic Research Centre

Chief Investigator Rachael O'Rourke Director of Medical Imaging, The Prince Charles Hospital

**Chief Investigator Patricia Valery** Epidemiologist at QIMR Berghofer, The University of Queensland

**Chief Investigator Emily Stone** Respiratory Physician St Vincent's Hospital, University of NSW

**Chief Investigator Renee Manser** Respiratory Physician, Royal Melbourne Hospital, Peter MacCallum Cancer Centre, The University of Melbourne

**Chief Investigator Karen Canfell** Director of Cancer Research, The Daffodil Centre NSW

**Chief Investigator Marianne Weber** Psychology Senior Research Fellow, Cancer Council NSW

**Chief Investigator Gail Garvey** Deputy Division Leader Health Services Research, Menzies University

**Chief Investigator Stephen Lam** Professor of Medicine, University of British Columbia, Leon Judah Blackmore Chair in Lung Cancer Research, Chair Provincial Lung Tumour Group, Canada

Chief Investigator Martin Tammemagi Professor Emeritus Epidemiology, Health Sciences, Brock University, Ontario, Canada

Chief Investigator Sabe Sabesan Medical Oncologist Townsville University Hospital, James Cook University

**Chief Investigator Zulfiquer Otty** Medical Oncologist, Townsville University Hospital, James Cook University

**Chief Investigator Fraser Brims** Respiratory Physician, Sir Charles Gairdner Hospital, Professor, Curtin University Medical School; WA

Chief Investigator Annette McWilliams Respiratory Physician, Fiona Stanley Hospital, The University of Western Australia



## **Collaborative partners**

ACRF LUSCE will be based at the University of Queensland Thoracic Research Centre at the Prince Charles Hospital in Brisbane as part of the Metro North Hospital and Health Service.

ACRF LUSCE will also leverage collaborative relationships with health partners for additional resources including:

- The University of Queensland salaried academic leads, project and operating facilities
- Metro North Health Hospital and Health Service telemedicine personnel, Clinical ICT and data warehouse, project and operating facilities
- In kind contributions have been secured from Medical Research Future Fund, NHMRC International Lung Screen Trial (ILST), The Daffodil Centre and NHMRC Centre of Research Excellence in Cervical Cancer Control
- Siemens Healthineers education and training, promotion and marketing
- Lung Foundation Australia Provision of personnel, cross-promotion of the project, dissemination of study findings and evidence-based advocacy and government relation activities

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

