CANCER RESEARCH UK | CAMBRIDGE CENTRE

# STRUCTURE AND STRATEGY BEYOND 2019


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UNIVERSITY OF CAMBRIDGE

**Royal Papworth Hospital** NHS Foundation Trust

**Cambridge University Hospitals** NHS Foundation Trust

NHS

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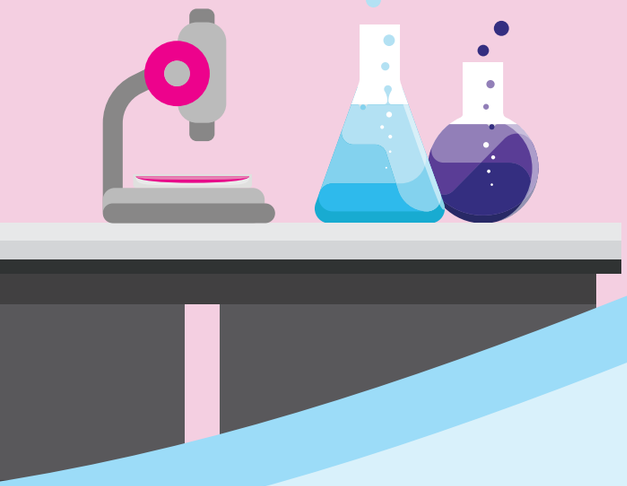
**The Cancer Research UK Cambridge Centre at the University of Cambridge unites more than 700 laboratory and healthcare professionals around a common mission to end death and disease caused by cancer, through research, treatment and education. As a CRUK Major Centre we serve as a national and international resource for patients with cancer and their families, researchers and health care providers, and cancer professionals in training.**

Professor Richard Gilbertson
Li Ka Shing Chair of Oncology
Director, Cancer Research UK Cambridge Centre

# OUR PURPOSE

## MISSION

To end death and disease caused by cancer, through research, treatment and education



## VISION

To be a world leader in the development of ways to detect, monitor, and cure cancer

## CORE VALUES

- We put patients first and foremost
- We respect and value our diverse community of colleagues
- We share selflessly our insights, knowledge, skills and resources
- We teach with passion and commitment

# EMILY'S STORY

I knew nothing about cancer before I was diagnosed; I just knew it was bad. I didn't know what leukaemia was, I didn't even know it was a thing.

The doctors explained to me that they can treat this form of cancer and that, thanks to research, I have a very good chance of being cured.

Emily Cobbald was just 12 years old when she was diagnosed in 2015 with Acute Lymphoblastic Leukaemia, a cancer of the white blood cells. The Sawston Village College student needed to start chemotherapy immediately and spent 12 days in hospital. She is now feeling very well and has no signs of cancer. She is continuing her treatment at Addenbrooke's (Cambridge University Hospitals NHS Foundation Trust).

# WHO WE ARE

## OUR PEOPLE

**180**

PhD students, postdoctoral and clinical fellows

**200**

Allied health and laboratory professionals including research nurses and associate scientists

**131**

Consultant physicians, surgeons and pathologists including Fellows of the Academy of Medical Sciences

**239**

Laboratory based Principal Investigators including Nobel Laureates and Royal Society Fellows

# OUR PROGRAMMES...

Pancreatic Cancer

Urological Malignancies

Early Detection

Paediatric Cancer

Advanced Cancer Imaging

Cell and Molecular Biology

Breast Cancer

Ovarian Cancer

Onco-Innovation

Aerodigestive Cancer

Neuro-Oncology

Haematological Malignancies

## ...THE ENGINES OF OUR RESEARCH

Our members are organised into 12 programmes. Each comprises closely-knit teams of experts in the biological, physical, computational and clinical sciences who meet regularly to design and drive research.

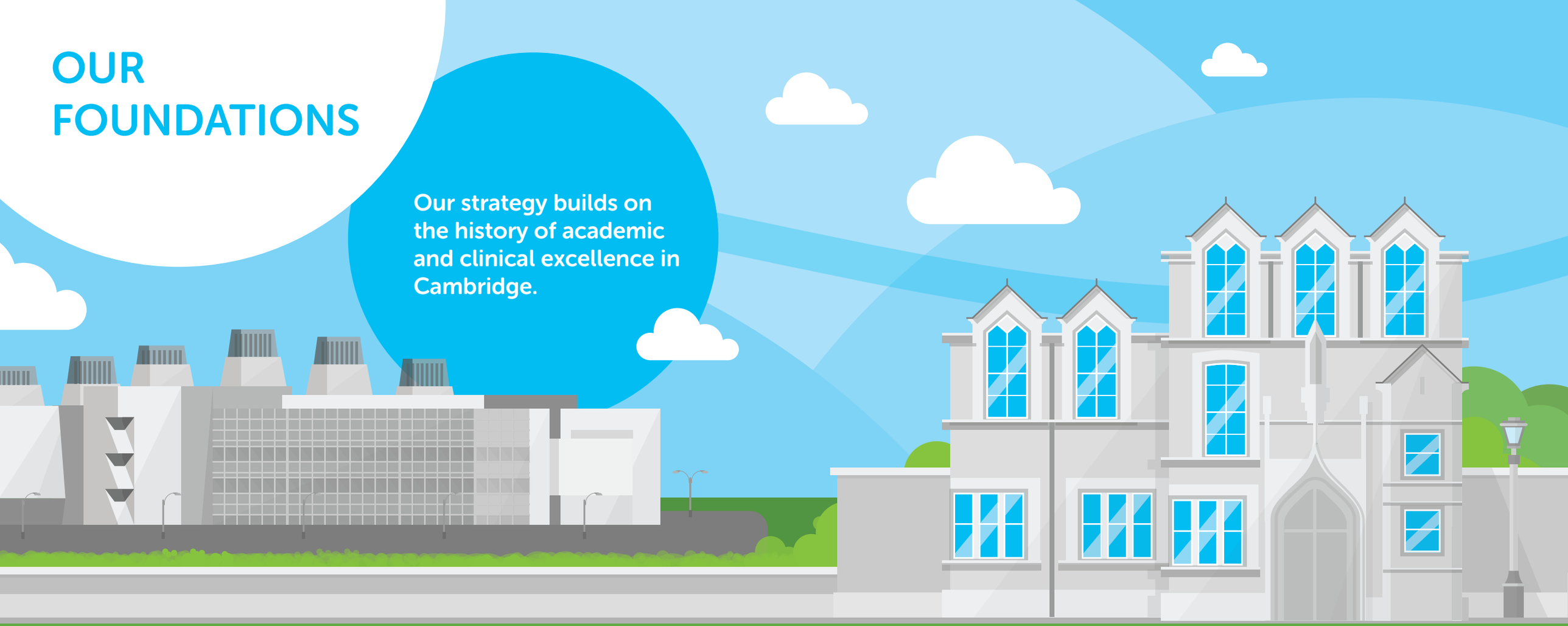
**Eight disease-specific programmes** discover new ways to diagnose, monitor and treat *aerodigestive, breast, haematological, ovarian, *pancreatic and urological cancers: two new programmes study *paediatric and *brain tumours.

**Four discipline-focused programmes** in Advanced Cancer Imaging, Cell and Molecular Biology, Early Detection and Onco-Innovation, make fundamental discoveries in cancer biology and invent new biomarker, clinical device and treatment approaches. The Early Detection Programme also focuses on *oesophageal cancer. The Onco-Innovation Programme includes professionals from the CRUK-MEDI Alliance Laboratory, MedImmune and AstraZeneca, uniting pharmaceutical partners and academics to develop new cancer treatments.

*CRUK designated cancer of unmet need

# OUR FOUNDATIONS

**Our strategy builds on the history of academic and clinical excellence in Cambridge.**



## Our scientific heritage

Across the decades, Cambridge University scholars have made some of the most impactful discoveries in biology, changing the way we understand and treat cancer.

In the 19th Century, Charles Darwin established the theory of evolution by natural selection. This same theory is being used today to explain how cancers progress and resist treatment.

In the 20th Century, James Watson and Francis Crick determined the structure of DNA that codifies the mistakes that drive cancer. The work of Frederick Sanger gave us the technologies necessary to read this code.

In the late 1990s Shankar Balasubramanian and David Klenerman invented Next Generation Sequencing. This has made routine, accurate, low-cost sequencing of the human genome a reality, revolutionising biology and providing unprecedented views of the cancer genome.

In 2017 Cambridge scientists won two of the largest grants ever awarded by Cancer Research UK. Greg Hannon is creating a virtual 3D map of hundreds of breast cancers to improve diagnosis and treatment. Mike Stratton is investigating the patterns of DNA mutations in 5,000 cancer samples from patients across the world to unravel the causes of cancer.

## Making research matter

Cambridge University Hospitals NHS Foundation Trust (Addenbrooke's) serves over five million people across the East of England and treats around 6,000 new cancer patients each year. Our laboratory and clinical research experts work together to bring the latest cancer diagnostics and treatments to our patients.

In 2016–17 Addenbrooke's recruited the second largest number of cancer patients to clinical studies in England (out of 195 nationwide organisations). Between 2012–2017 we enrolled more than 7,800 patients on over 230 clinical studies.

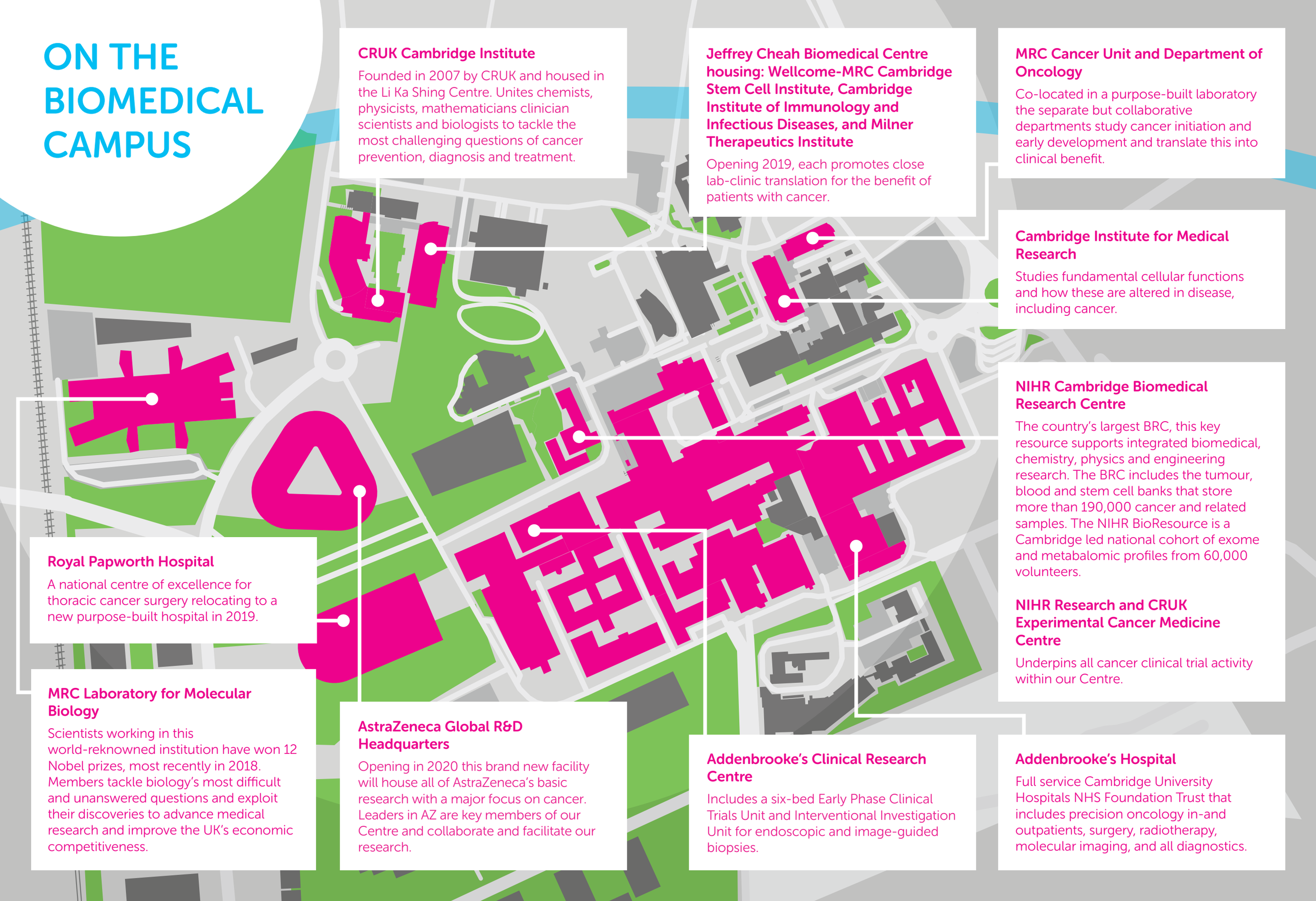
In 2019 the Royal Papworth Hospital – a national centre of excellence for thoracic cancer – will relocate to a brand new purpose-built hospital on the Cambridge Biomedical Campus.

These NHS Trust Hospitals are integral components of our CRUK Major Centre, enabling us to bring innovative treatment approaches to our patients.

This effort is facilitated greatly by:

- England's largest National Institute for Health Research Biomedical Research Centre, which is housed in Cambridge and in which Cancer is the largest theme.
- Separate precision cancer medicine units for the treatment of breast and prostate cancer.
- Modern clinical research facilities for inpatient, outpatient and endoscopy clinical trials.
- One of the UK's most advanced Imaging facilities, including Europe's first clinical hyperpolariser.

# ON THE BIOMEDICAL CAMPUS



### CRUK Cambridge Institute

Founded in 2007 by CRUK and housed in the Li Ka Shing Centre. Unites chemists, physicists, mathematicians clinician scientists and biologists to tackle the most challenging questions of cancer prevention, diagnosis and treatment.

### Jeffrey Cheah Biomedical Centre housing: Wellcome-MRC Cambridge Stem Cell Institute, Cambridge Institute of Immunology and Infectious Diseases, and Milner Therapeutics Institute

Opening 2019, each promotes close lab-clinic translation for the benefit of patients with cancer.

### MRC Cancer Unit and Department of Oncology

Co-located in a purpose-built laboratory the separate but collaborative departments study cancer initiation and early development and translate this into clinical benefit.

### Cambridge Institute for Medical Research

Studies fundamental cellular functions and how these are altered in disease, including cancer.

### NIHR Cambridge Biomedical Research Centre

The country's largest BRC, this key resource supports integrated biomedical, chemistry, physics and engineering research. The BRC includes the tumour, blood and stem cell banks that store more than 190,000 cancer and related samples. The NIHR BioResource is a Cambridge led national cohort of exome and metabalomic profiles from 60,000 volunteers.

### NIHR Research and CRUK Experimental Cancer Medicine Centre

Underpins all cancer clinical trial activity within our Centre.

### Royal Papworth Hospital

A national centre of excellence for thoracic cancer surgery relocating to a new purpose-built hospital in 2019.

### MRC Laboratory for Molecular Biology

Scientists working in this world-reknowned institution have won 12 Nobel prizes, most recently in 2018. Members tackle biology's most difficult and unanswered questions and exploit their discoveries to advance medical research and improve the UK's economic competitiveness.

### AstraZeneca Global R&D Headquarters

Opening in 2020 this brand new facility will house all of AstraZeneca's basic research with a major focus on cancer. Leaders in AZ are key members of our Centre and collaborate and facilitate our research.

### Addenbrooke's Clinical Research Centre

Includes a six-bed Early Phase Clinical Trials Unit and Interventional Investigation Unit for endoscopic and image-guided biopsies.

### Addenbrooke's Hospital

Full service Cambridge University Hospitals NHS Foundation Trust that includes precision oncology in-and outpatients, surgery, radiotherapy, molecular imaging, and all diagnostics.

# BEYOND THE BIOMEDICAL CAMPUS

## Within the City....

### The University of Cambridge

Consistently ranked within the world's top three universities, Cambridge University includes over 100 departments, more than a quarter of which house members of the CRUK Cambridge Centre. Our membership includes 53 University professors and 10 heads of departments.

### Wellcome Trust/CRUK Gurdon Institute

Founded as a joint venture between the Wellcome Trust and CRUK, the Gurdon Institute focuses on the interface between developmental and cancer biology. The Institute is named after current member Prof. Sir John Gurdon who received the 2012 Nobel Prize in Physiology or Medicine for his discovery that mature cells can be reprogrammed to become pluripotent.

### Centre for Cancer Genetic Epidemiology

Housed within Strangeways Research laboratories, this centre studies genetic variants that increase the risk of developing breast, ovarian, prostate and other cancers.

## Research Clusters....

### Babraham Institute and Research Campus

Located just four miles from the Biomedical Campus, the Babraham Institute and Research Campus is considered to be the UK's leading early-stage bioscience enterprise. The campus provides bespoke research and development facilities, scientific support services and bioventures at any stage in the business development cycle supporting the full spectrum of science from R&D to commercial realisation.

### Wellcome Trust Sanger Institute, European Bioinformatics Institute (EMBL-EBI)

The Wellcome Genome Campus on the outskirts of Cambridge is one of the world's largest concentrations of scientific and technical expertise in genomics. With a faculty and staff of around 1,000 the Wellcome Trust Sanger Institute is recognised as a global leader in cancer genomics.



# OUR COLLABORATORS

### Across the UK and beyond...

Over the last five years we have co-published over 2,000 papers with investigators based in 16 CRUK-funded institutions and more than 21 countries.

### Cancer Core Europe

We are a founding member of Cancer Core Europe (CCE). This virtual centre comprises Europe's seven leading cancer centres (CRUK Cambridge Centre, German Cancer Research Centre, Gustave Roussy Institute, Karolinska Institutet, Netherlands Cancer Institute, Vall d'Hebron Institute of Oncology and National Cancer Institute of Milan) that together treat 60,000 new cancer patients every year and are currently conducting 1,500 clinical trials. CCE is developing compatible infrastructures, industry partnerships and clinical trial platforms to advance cancer cures.

### Working with industry

The Cambridge Biomedical and Babraham Campuses host numerous pharmaceutical and biotechnology companies. Of particular note, AstraZeneca has established its new global R&D headquarters on the Biomedical Campus next door to Addenbrooke's (Cambridge University Hospitals NHS Foundation Trust) and other major cancer care and research facilities. The Centre and AstraZeneca leadership have formed a joint strategic executive board that is identifying key areas of mutual interest for co-investment and collaborative research.

# SANDY'S STORY

“

After seven years of chemotherapy, which never actually got rid of the disease, I was lucky enough to be referred to Addenbrooke's. I was placed on a clinical trial which involved taking eight tablets a day. I had scans every two months and each time they did the scan they could see the tumour shrinking until there was only a shadow left and then nothing.

I've had years of clear scans now, with no signs of the cancer at all. I do feel lucky, it's like winning the lottery over and over again.

”

Professor Steve Jackson is an expert on DNA repair whose work in the late 1990s led to the invention of the anticancer drug olaparib. Sandy Tansley began treatment with olaparib in 2009 when her high grade serous ovarian cancer returned. She joined a clinical trial being run at Addenbrookes's (Cambridge University Hospitals NHS Foundation Trust) by Professor Helena Earl and Dr James Brenton.

In the past, this form of ovarian cancer would be fatal but thanks to Steve and the fact that Cambridge researchers were running the clinical trial testing the new drug, Sandy is cancer free.

# WHAT WE HAVE DONE

## CHANGED PATIENTS' LIVES THROUGH IMPACTFUL TREATMENTS

## Embedding CRUK values

Our research strategy is underpinned by Cancer Research UK's four key objectives...

1

### PREVENT

Reduce the risk of developing cancer

2

### DIAGNOSE

Diagnose cancer earlier

3

### TREAT

Develop new cancer treatments

4

### OPTIMISE

Make cancer treatments more effective

CRUK's vision is to bring forward the day when all cancers are cured.

Over the last 40 years, cancer survival rates in the UK have doubled. In the 1970s just a quarter of people survived. Today half of all patients survive cancer and by 2030 CRUK's vision is to increase this to three out of four patients.

Cambridge is one of three Major CRUK Centres leading research and collaborations across the network of CRUK centres in the UK.

Our 12 Research Programmes form the framework of our impactful interdisciplinary cancer research. We are also seeking new ways to deploy Cambridge innovation to better understand the biology and treatment of cancer, especially in relation to the cancers of unmet need, such as lung, pancreatic, paediatric, brain and oesophageal cancer.

We are adopting a proactive approach to the way we treat cancer. Instead of a reactive system that waits for cancer to present, we are developing a proactive personalised strategy for all patients that detects cancer in its earliest form, intervenes precisely, and closely monitors the disease course with non-invasive technologies.

# WE MADE DISCOVERIES TO DEFEAT CANCER

During the last five years, our 12 Programmes made discoveries that are beating cancer every day.

## Early Detection

Discovered the genetic changes that drive early cancers.[17-20]

## Haematological Malignancies

Discovered the mutations and signals that turn normal blood cells into cancer cells.[10-13]

## Advanced Cancer Imaging

Led the development of hyperpolarised MRI and other innovative imaging technologies that are changing the way the world detects and monitors cancer [1-3]

## Paediatric Cancer

Discovered the key processes that drive normal tissue development and childhood lymphoma.[21-23]

## Cell and Molecular Biology

Discovered critical processes that regulate the life cycle of cells and how these are corrupted to make cancer [4-9]

## Onco-Innovation

Discovered critical processes controlling the structure and function of DNA and new drugs to treat leukaemia.[14-16]


1 Rodrigues et al, **Nature Medicine** 2014
2 Schilling et al, **Nature Biotechnology** 2017
3 Xie et al, **Clinical Cancer Research** 2017
4 Balmus et al, **Nature Communications** 2018
5 Rostislavleva et al, **Science** 2015
6 Martincorena et al, **Cell** 2017, **Science** 2018
7 Kerr et al, **Nature** 2016
8 Glodzik et al, **Nature Genetics** 2017
9 Ju et al, **Nature** 2017
10 Grinfeld, Nangalia et al, **NEJM** 2018
11 Lee-Six et al, **Nature** 2018
12 Vassiliou et al, **Nature** 2018
13 Gozdecka et al, **Nature Genetics** 2018
14 Vire et al, **Molecular Cell** 2014
15 Christophorou et al, **Nature** 2014
16 Fong et al, **Nature** 2015
17 Levine et al **Nature Genetics** 2013
18 Weaver et al **Nature Genetics** 2014
19 Blundell et al, **Nature Ecol and Evol** 2018
20 Secrier et al, **Nature Genetics** 2016
21 Malcolm et al, **Nature Communications** 2016
22 Barbieri et al, **Nature** 2017
23 Young et al, **Science** 2018

## Neuro-Oncology

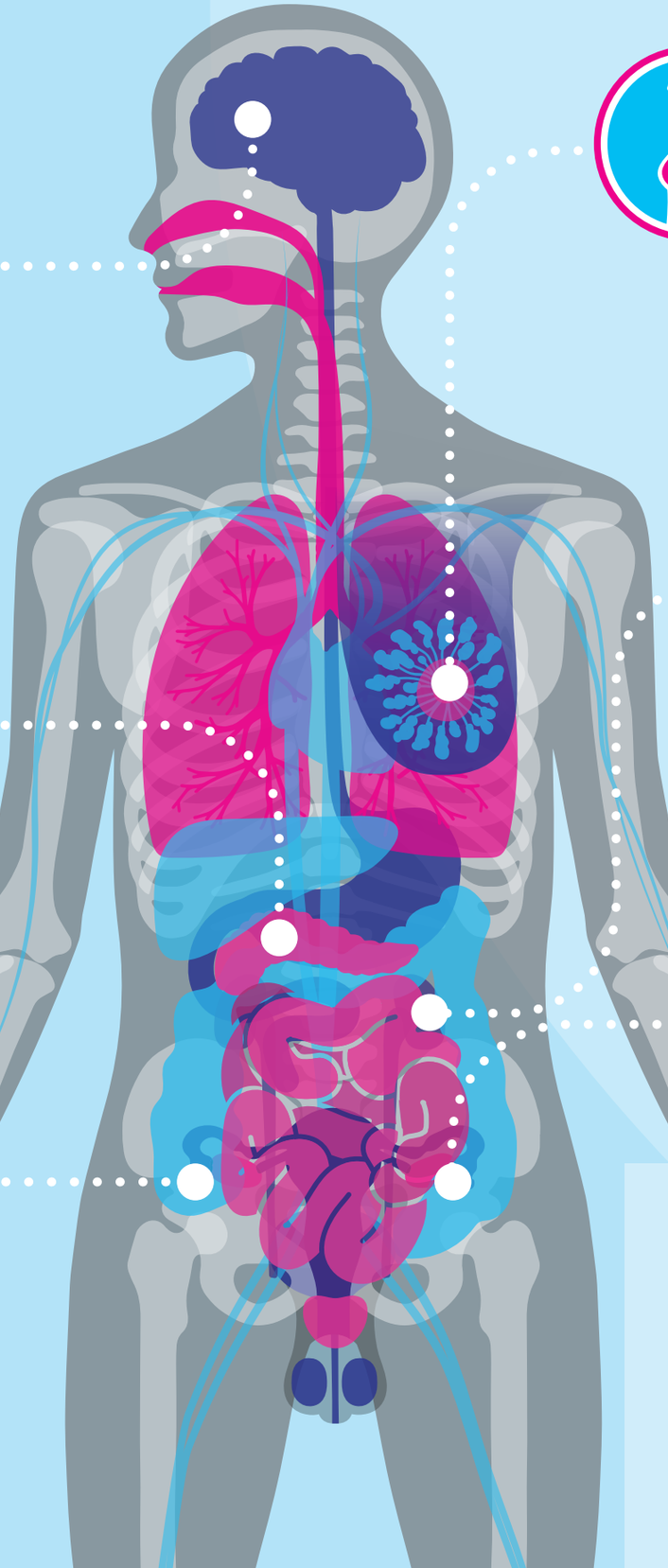
Mapped where common brain tumours are born, and discovered processes regulating normal and malignant brain development.[24-28]

## Pancreatic Cancer

Discovered fundamental cell processes governing DNA repair and cancer predisposition.[29-30]

## Aerodigestive Cancer

Discovered how the intestine is repaired and maintained and how this goes wrong to make bowel cancer.[31-33]



## Breast Cancer

Described the distinct molecular types of breast cancer and created the world's largest collection of breast cancer xenografts.[34-39]

## Urological Malignancies

Described the mutational landscape of renal and prostate cancer and the routes these cancers take to spread around the body [40-44]

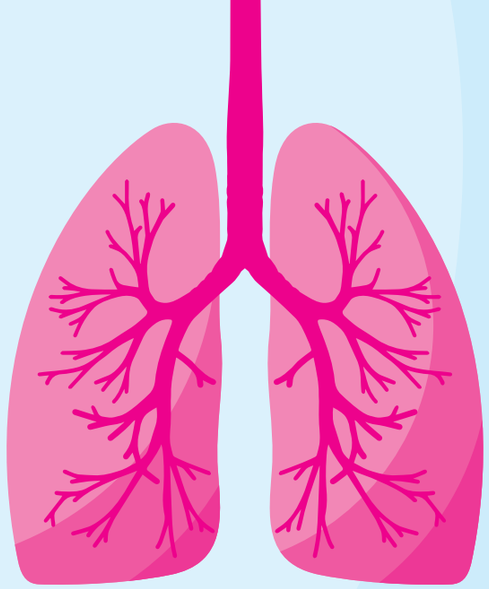
## Ovarian Cancer

Led international efforts to identify genes that regulate the development of ovarian cancer.[45-50]


24 Parker et al, **Nature** 2014
25 Yuen et al, **Cell** 2014
26 Mohankumar et al, **Nature Genetics** 2015
27 Pathania et al, **Cancer Cell** 2018
28 Phoenix et al, **Cancer Cell** 2016
29 Tan et al, **Cell** 2017
30 Wallez et al, **Mol Cancer Ther** 2018
31 Buczacki et al, **Nature** 2013
32 Buczacki et al, **J Exp Med** 2018
33 Davis et al, **Nature Communications** 2016
34 Curtis et al, **Nature** 2012
35 Dvinge et al, **Nature** 2013
36 Nik-Zainal et al, **Nature** 2016
37 Pereira et al, **Nature Communications** 2016
38 Mohammed et al, **Nature** 2015
39 Bruna et al, **Cell** 2016
40 Mitchell et al, **Cell** 2018
41 Assim et al, **JNCI** 2016
42 Wedge et al, **Nature Genetics** 2018
43 Cooper et al, **Nature Genetics** 2015
44 Gundem et al, **Nature** 2015
45 Pharoah et al, **Nature Genetics** 2013
46 Murtaza et al, **Nature** 2013
47 Day et al, **Nature Genetics** 2017
48 Kuchenbaecker et al, **Nature Genetics** 2015
49 Macintyre et al, **Nature Genetics** 2018
50 Song et al, **Journal Clinical Oncology** 2015

# OUR SCIENCE IMPROVED PATIENT CARE

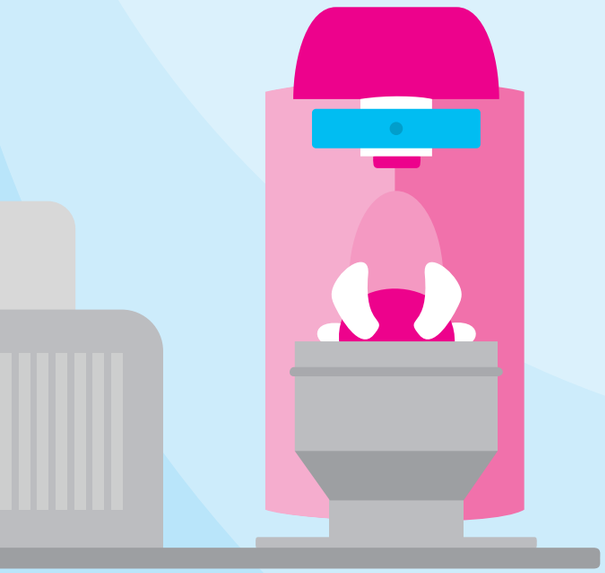
**During the last five years, we brought our science to the patient's bedside, improving the way the world...**



## Stages cancer

We demonstrated that endosonography is the most accurate, safe and inexpensive way to stage lung cancer. Consequently:

- Endosonography has replaced surgery as the first line investigation for mediastinal lung cancer staging (British Thoracic Society and NICE guideline CG121)
- Over 100 UK centres now provide this service
- The rate of surgical staging in the UK has fallen dramatically, from 3,020 per year in 2010 to 1,854 in 2015.[55]



## Images cancer

In close collaboration with GE Healthcare, we developed SPINLab hyperpolarised $^{13}C$ magnetic resonance imaging (MRI). 10,000 times more sensitive than conventional MRI, SPINlab allows real-time visualisation of metabolism and drug response in a patient's tumours. SPINLab is now being used at multiple centres around the world to image cancer. Cambridge founded the first and only GMP-grade pharmacy in Europe for generating hyperpolarised probes for clinical imaging.[53-54]

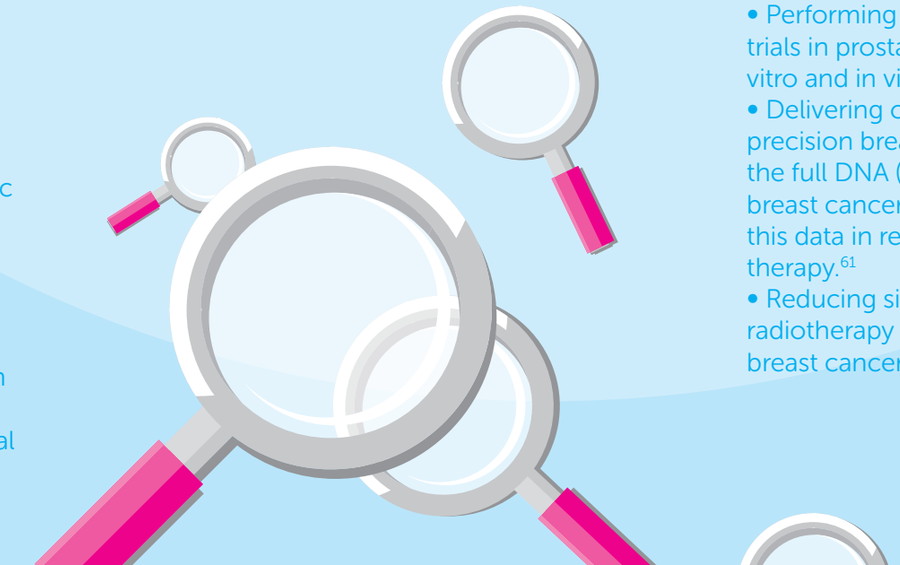
## Treats cancer

We are translating Cambridge discoveries into multiple new cancer therapies, including:

- Inventing new classes of drugs called BET inhibitors that kill leukaemia cells.[56-57]
- Combining molecular targeted drugs to increase the activity of immunotherapy against pancreatic cancer.[58]
- Detecting circulating tumour DNA mutations in the blood to guide randomised, international Phase II trials.[59-60]
- Performing advanced, neo-adjuvant window trials in prostate cancer patients, guided by in vitro and in vivo modelling of drug effects.
- Delivering comprehensive state-of-the-art precision breast cancer medicine by sequencing the full DNA (normal and tumour) and RNA of all breast cancer patients in our clinics and using this data in real time to select and guide therapy.[61]
- Reducing side effects by giving partial breast radiotherapy to women with low-risk early stage breast cancer (NICE guideline NG101).[62]

## Detects early cancers

We invented the Cytosponge™ and lab test, a simple to use, relatively non-invasive diagnostic tool that can rapidly and accurately detect Barrett's oesophagus – the only known precursor of oesophageal cancer – in primary care.[51-52] Awarded the Department of Health Innovation Challenge Prize (2011) and the British Medical Journal Gastroenterology Team of the Year award (2016), the device is now being tested across the world with the potential of saving £1,000s per quality adjusted patient life year.




51 Ross-Innes et al, **Nature Genetics** 2015
52 Ross-Innes et al, **Lancet Gastro Hepat** 2017
53 Serrao et al, **Gut** 2016
54 Wang et al, **Mag Res Med** 2017
55 Rintoul et al, **Thorax** 2014
56 Dawson et al, **Nature** 2011
57 Fong et al, **Nature** 2015
58 Feig et al, **PNAS** 2013
59 Murtaza et al, **Nature** 2013
60 Wan et al, **Nature Rev Cancer** 2017
61 Pereira et al, **Nature Communications** 2016
62 Coles et al, **Lancet** 2017

# WE TRAINED THE NEXT GENERATION

**During the last seven years the CRUK Cambridge Centre trained 28 clinical and 41 non-clinical PhD students. These outstanding scientists now work around the world to advance our understanding of cancer.**


Cambridge University has a long and illustrious history of training PhD students in biomedical research, producing scientists that have made some of the most impactful discoveries in cancer biology and medicine. Our PhD programme is specifically designed to train the next generation of cancer scientists through:

**Mentoring —** each student receives multiple supervision and mentoring experiences within the rich research environment of the Centre and wider University. More than two thirds of our students are co-supervised by two or more leading cancer experts, exposing them to different research and management styles. Each student is also assigned an independent adviser, distant from their day-to-day research and group, and has access to Departmental Directors of Graduate Education and College Tutors.

**Teaching and multi-disciplinary research training —** Centre students have access to numerous training opportunities across the University, including the 35 week lecture series on Cancer Biology and Treatment as well as numerous seminar series, Summer Schools and specific technical training courses.

**Student focused activities —** the Centre organises a number of events throughout the year that bring the entire student body together. The Annual Cancer Centre Graduate Student Symposium and Dinner is a student-led day of workshops, presentations and posters focused on networking between the clinical and non-clinical PhD students and faculty.

# CATHARINE'S STORY

"I had always thought breast cancer was breast cancer. I hadn't realised there were different types. That's why the research into personalised medicine works because they can treat you more precisely. My tumour was triple negative and so I was eligible for the Personalised Breast Cancer study.

My consultant Jean explained how she used precision cancer medicine to guide the use of a special drug that stopped my tumour from repairing its DNA. I didn't know it at the time but they were sure the treatment would be successful because of the type of cancer I had."

Catharine Scott, 51, from Cambridge was diagnosed with breast cancer in September 2016 and was treated by Dr Jean Abraham as part of the Personalised Breast Cancer Programme. This is the world's first study to read all the information contained in each patient's normal and tumour DNA by whole genome sequencing, and to use this to determine their treatment. Over 450 patients have been recruited so far and a further 2,000 will be enrolled.

Catharine's results indicated that she would be eligible for the PARTNER trial. She received a new targeted drug, olaparib, in addition to her chemotherapy. She had an excellent response and no cancer cells were detectable at surgery.


# WHAT WE WILL DO

## OUR STRATEGIC OBJECTIVES

Over the next five years we will leverage the great breadth and depth in biological, physical, computational, and clinical sciences across Cambridge University and allied hospital NHS Trusts, as well as the expertise of our national and international partners, to pursue four strategic objectives.

1

### Conduct impactful interdisciplinary cancer research

We will leverage Cambridge innovation to better understand the biology and treatment of cancer, including cancers of unmet need.

2

### Adopt a proactive approach to cancer

We will change the way we treat cancer; moving from a reactive system that waits for cancer to present, to a proactive, personalised strategy for all patients that detects cancer in its earliest form, intervenes precisely, and closely monitors the disease with non-invasive technologies.

3

### Develop the cancer leaders of tomorrow

We will develop new cancer leaders, trained in early detection and integrated cancer medicine, producing a step change in the way oncology is practised by future generations.

4

### Partner with the public

We will communicate to patients and the public, to better explain the 'how' and 'why' of preventing and detecting cancer early.

# CONDUCT IMPACTFUL INTERDISCIPLINARY CANCER RESEARCH

1

To achieve this we will...

## Deploy Cambridge innovation to better understand the biology and treatment of cancer

The long-term goal of this research will be to develop the expertise, knowledge and innovative technologies needed to establish a personalised, integrated cancer medicine strategy that diagnoses cancer early and individually stratifies, treats, and monitors all patients. Our members will collaborate locally, nationally and internationally to enable an overall strategic direction toward this common mission.
This strategy is aligned closely with Cancer Research UK's priorities to better understand 'what causes and drives cancer', including 'cancers of unmet need', and to 'better treat' cancer by developing effective multimodality therapies.

## The Centre will:

- Invest one third of its budget directly into the work of our Programmes, enabling the memberhip to support key research staff, supplies and capital costs in the pursuit of our mission-centric strategic objectives.
- Invest two thirds of its budget into central research, clinical and training resources accesible to all our membership.
- Pump-prime high priority, on mission, collaborative projects among scientists and physicians inside and outside our Centre.
- Continue to invest in new buildings and capital infrastructure to grow the work of our Centre.

# ADOPT A PROACTIVE APPROACH TO CANCER

2

## To achieve this we will...

Study the earliest stages of cancer and how to detect and treat them. Diagnosing more cancers earlier holds enormous promise to increase survival rates for patients with malignant disease. Around 80% of patients diagnosed with stage I or II cancer survive at least 10 years, compared with only around 25% diagnosed with stage III or IV disease.

We will conduct basic research to better understand the biology of epithelial transformation and biomarkers associated with this process. We will invent and implement devices capable of detecting cancer early within primary and tertiary care settings. We will initiate and support local, national and international early detection collaborative research.

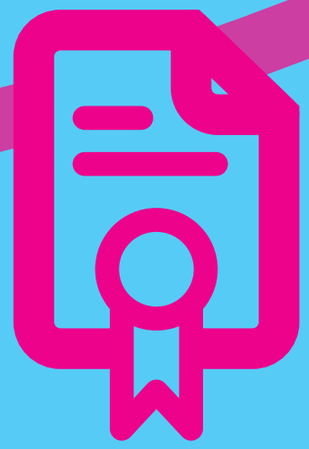
A second key element in our proactive approach to cancer will be the development of molecular diagnostic, advanced imaging and treatment technologies necessary to diagnose cancer precisely, intervene specifically, and track disease behaviour sensitively and accurately. The Centre will collaborate with our industrial partners to conduct prospective clinical trials in the context of an integrated cancer medicine strategy in which all patients undergo comprehensive and prospective data collection including:

- Analysis of their tumour's genome, epigenome, transcriptome, proteome and metabolome.
- Imaging of their tumour's real-time metabolic response to drug treatment.
- Liquid biopsy analysis including circulating tumour cells and DNA.
- Deep clinical phenotyping.

Our strategy will invent and deploy novel mathematical, computational, and visualisation technologies to integrate these individual data streams into a single information flow that travels with the patient through their treatment journey, informing directly all live treatment discussions and management decisions, guiding the patient to the maximum opportunity for cure.

# 3

# DEVELOP THE CANCER LEADERS OF TOMORROW



## To achieve this we will...

Launch a new PhD training scheme specifically designed to produce future generations of cancer leaders, trained in early detection and integrated cancer medicine, effecting a step change in the way oncology is studied and practised.

Fewer than 20% of UK doctoral graduates pursue an academic research career and less than 5% become independent scientists*. To reverse this professional attrition, our new PhD training programme is purposefully designed to:

- Identify candidates best suited to a career in cancer research.
- Deepen understanding of cancer biology and its relationship to the clinic.
- Broaden training experiences in biological, clinical and physical sciences.
- Enhance interactions between clinicians and basic scientists.
- Build collaborations between different disciplines.
- Unify the PhD student body as a scientifically and socially coherent cohort, regardless of background and research discipline.

Our Training Programme will increase the number of clinician scientists by encouraging all our clinical trainees to undertake a period of research training. The new PhD training programme includes three phases:

- Phase 1: Each of our 12 Programmes design three projects of the highest scientific quality and strategic priority that are led by experienced supervisors. These projects will form a portfolio from which PhD applicants will select two projects.
- Phase 2: During the first year, successful applicants will study for a Master of Research (MRes) degree that will include two 14-week lab rotations in the projects selected from Phase 0. This year will also include discipline-specific experiential and taught elements and confer a separate Cambridge University MRes degree. Students wishing to leave the course after the MRes may do so.
- Phase 3: Students progressing from Phase 1 will select one of their two MRes host labs in which to pursue their PhD studies.

*Higher Education Statistics Agency and Royal Society Reports, 2010

# PARTNER WITH THE PUBLIC

4

## To achieve this we will...

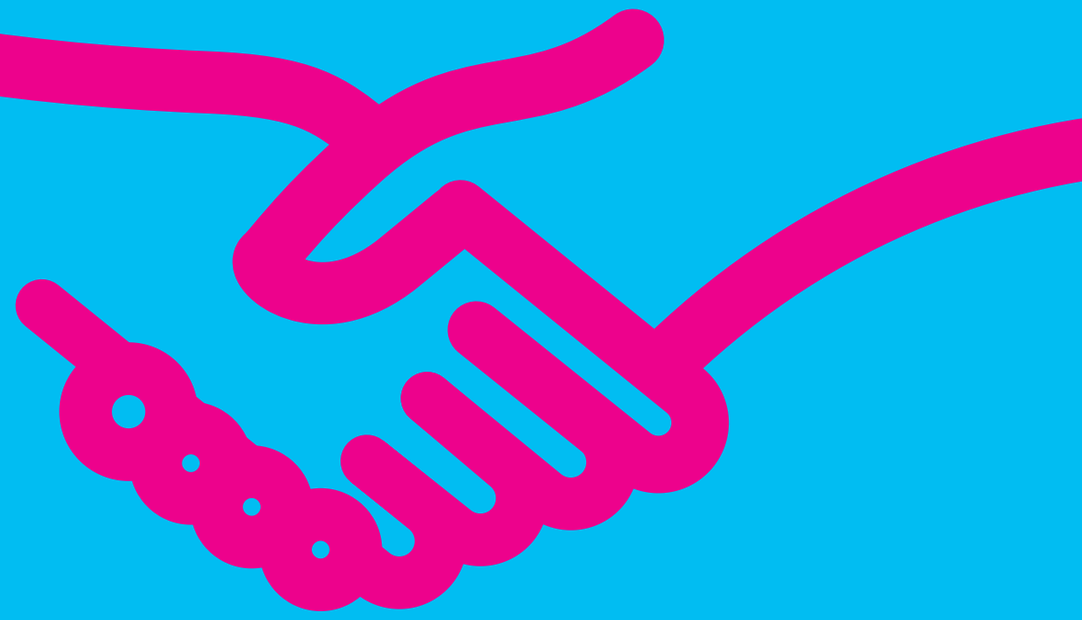
Innovate to communicate the ‘how’ and ‘why’ of preventing, detecting and treating cancer early.

We will engage patients at each stage of the research process, ensuring the maximum possible public engagement in the work of our Centre.

Our Centre has established an Outreach Leadership Team comprising senior leaders who, together with our Programmes, continue to develop an annual programme of exciting and engaging public outreach events across the calendar. Events will be planned in collaboration with Cancer Research UK Head Office and other Centres as well as our aligned NHS Trusts, Cambridge University and local schools.

We will make increasing use of social media platforms in this effort. Patients and advocates will be recruited to all clinical research advisory panels, trial management groups, grant application committees and chair sessions at our scientific meetings.

We will include state-of-the-art patient education facilities within our new Cancer Research Hospital, including virtual reality tools that explain the importance of genomics in precision cancer medicine.



# BUILD FOR THE FUTURE

In addition to critical support from Cancer Research UK and other external funding bodies, the Centre benefits from direct investment by Cambridge University. The University has embarked on a major building programme that is investing in new cancer research and treatment facilities over the next five years.

## Jeffrey Cheah Biomedical Centre

Sited next to the CRUK Cambridge Institute this new 18,000m$^2$ laboratory facility houses the

- Milner Therapeutics Institute for collaborative industry and academic cancer drug development
- Wellcome-MRC Cambridge Stem Cell Institute
- Cambridge Institute of Therapeutic Immunology and Infectious Diseases including cancer immunotherapy

## Mark Foundation Institute for Integrated Cancer Medicine

This major interdisciplinary venture was launched in 2018 with the support of The Mark Foundation for Cancer Research. It unites biological, physical and mathematical scientists to develop novel approaches to diagnose, treat and monitor cancer.

## Royal Papworth Hospital and Heart and Lung Research Institute

Specialist cardiothoracic hospital and research institute supporting lung cancer treatment and research.

## Cambridge Cancer Research Hospital

This major new collaborative initiative between Cambridge University Hospitals NHS Foundation Trust (Addenbrooke's) and the University of Cambridge will build a new Cancer Research Hospital adjacent to the main Addenbrooke's Hospital providing brand new clinical cancer research and care facilities, including:

- The country's first National Institute for the Early Detection of Cancer
- The Institute for Integrated Cancer Medicine housing: innovation physics, engineering, chemistry and genomics laboratories; Cancer Molecular Diagnostics Labs; and the Institute for Precision Breast Cancer Medicine
- Facilities to deliver clinical trials, day chemotherapy suites, offices and support
- An 80 bed inpatient facility for adult, teenage and young adult patients, including bone marrow transplants and immunotherapy

# CHRISTOPHER'S STORY

“

It was a real shock when I was diagnosed. I tried to be positive for my friends and family but it was hard to take it all in. I've been amazed at how quickly I've recovered. I had the operation at 8:30am on the Friday morning and I was back on the ward that afternoon and discharged home two days later.

I'm now back at work and I feel absolutely fine – it's hard to believe there's been anything wrong with me! It's made me think about the research and hope more people will get involved and donate if they can.

”

In July 2016, Christopher Revens, 34, from Bury St Edmunds was diagnosed with astrocytoma, a type of adult brain tumour.

Our team of neurosurgeons were testing a special marker that makes brain cancer cells glow bright pink so that they could see and remove all traces of the tumour. Better surgery helps improve survival so the marker was used in Christopher's operation helping to remove all of the tumour and he has recovered well.

**The CRUK Cambridge Centre is a flagship Major Centre in our national Centres network. Embedded within the world-leading Cambridge University, Biomedical Campus and academic teaching hospital, it is home to some of the world's best cancer scientists and clinicians. The CRUK Cambridge Centre continues to make innovative and highly impactful discoveries that have increased both the quality and quantity of life for patients with cancer across the world. We at Cancer Research UK are delighted to partner in this work and are excited by the future discoveries and treatments that will be made in Cambridge.**

Sir Harpal Kumar
Chief Executive, Cancer Research UK (2007–2018)