



IHE ANNUAL REPORT

2018-2019



UCL Institute of
Healthcare Engineering
Transforming lives through digital
& medical technologies

INNOVATE. COLLABORATE. TRANSLATE.



Welcome to our annual report for 2018-2019!

Over the past year, UCL's healthcare engineers have made advances that push at the forefront of what is possible in our field. These advances have spanned foundational engineering that lays the groundwork for the next generation of healthcare technologies, through to realising patient impact in a staggeringly diverse range of areas. This report conveys a snapshot of this activity by celebrating some of the year's highlights and successes.

We also look back at various initiatives that we have led and developed through the Institute of Healthcare Engineering (IHE). We have strengthened and grown our partnerships across UCL and the UCL Partner hospitals, as well as developed new international partnerships, for example around affordable healthcare technologies. We have broadened our focus, and are working to embed students, researchers and staff of all career stages in the IHE. To this end, we have run over 40 events ranging from our IHE Annual Research Symposium, colloquia and research dissemination events, early-career training and engagement, and 13 IHE Workshop Awards to stimulate interdisciplinary research activity.

This interdisciplinarity is at our core and our community spans across multiple UCL Faculties and disciplines. Our heart has sat in the Faculty of Engineering since the Institute's inception in 2012, but our remit continues to broaden and grow. In March this year, we merged with the former Institute of Digital Health (IDH) to unite our focus on transforming lives through digital and medical technologies, and draw together the existing synergies between these communities.

The year ahead sees more plans for growth, continuing to strengthen our partnerships within UCL and with our clinical, patient, industry and global collaborators. Thank you to everyone who has been part of this exciting journey so far and, for those of you reading that are newer to us, we hope to see more of you over the coming year.

Read on for a deeper dive into our activity through chapters that correspond to our six identified priority areas and Delivery Groups; Research, Translation & Industry, Careers, Engagement, Education and Global. We hope you enjoy it!

Best,

Dr Rebecca Shipley,
IHE Director

A handwritten signature in blue ink that reads "RShipley".

ABOUT

TRANSFORMING LIVES THROUGH DIGITAL AND MEDICAL TECHNOLOGIES

The Institute of Healthcare Engineering stimulates and supports interdisciplinary, world-class research and innovation in healthcare engineering.

For us, it's all about overcoming the big challenges – the ones that matter most. They drive our research and, quite frankly, get us into work every morning. We want to help patients with spinal injuries walk again. We want people to avoid stroke and paralysis. We want to hold back the visual deterioration that comes with age. We want to help cure cancer.

Based at University College London, we bring together leading researchers across UCL to deliver transformational research across the health, human, engineering and data sciences.

We have an established research pipeline through which advances in fundamental science and engineering underpin the next generation of healthcare innovations. This is achieved through a unique interdisciplinary network that unites researchers across UCL with our partner hospitals and biomedical research centres.

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Our year in

NUMBERS

#1
 “UCL RANKED
 TOP IN THE UK
 FOR BIOMEDICAL
 ENGINEERING”
 (Source: Shangai
 Rankings 2018)

HOSPITALS

Number of partner hospitals **8**



AWARDS

13 IHE Workshop Awards



RESEARCH

3 Number of biomedical research centres we are linked to

5 Research themes



MEMBERS

58 Delivery group members

11 Management board members

EVENTS

2400 Event attendees over the last year

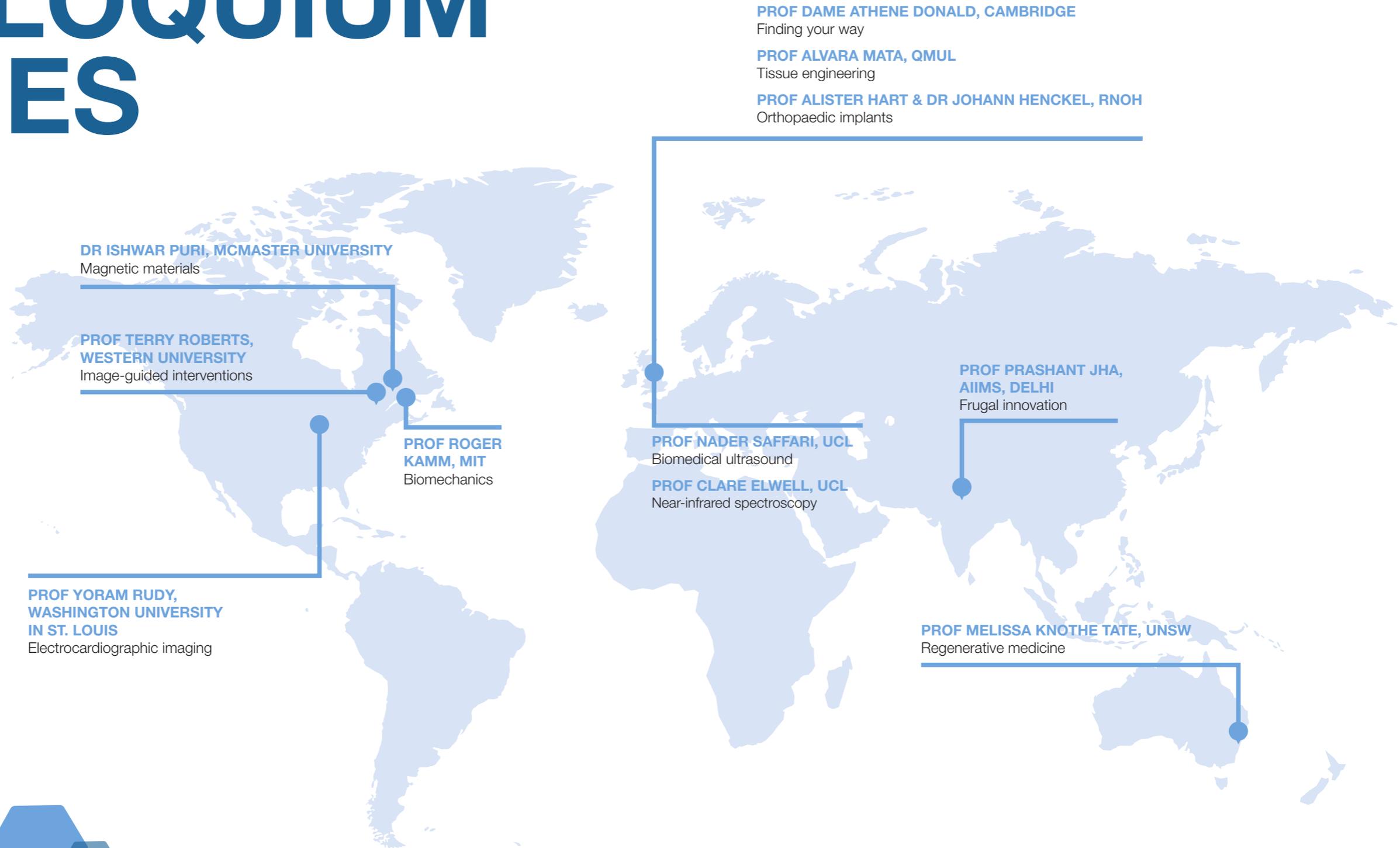



“We focus on the biggest clinical challenges where healthcare engineering can make a measurable positive impact to patients’ lives.”

IHE COLLOQUIUM SERIES

This series of talks shines a light on the latest research developments in healthcare engineering and fosters an engaged community.

This year, we have hosted 11 colloquium talks with guest speakers from across the globe. The series is free to attend and open to all levels and disciplines.



STIMULATING PARTNERSHIPS ACROSS UCL'S INFRASTRUCTURE

Interdisciplinarity is at the core of what we do and our work involves the collaboration of different groups across all the university.

We've worked with the infrastructure in place at UCL to grow connections, support activity and maximise impact. Over the past year, we've been able to co-deliver initiatives in all our priority areas.

Here some of our infrastructural collaborators from this year and the delivery areas that our activity aligns to.

1 RESEARCH

OVPR Research Facilitators (BEAMS/SLMS)
Due Diligence team
Research Impact team

2 TRANSLATION & INDUSTRY

Joint Research Office (JRO)
Translational Research Office (TRO)
UCL Innovation & Enterprise
UCL Consultants
UCL Business
UCL Partners

3 CAREERS

Academic Careers Office, SLMS
UCL Equality, Diversity and Inclusion
UCL Wellbeing

4 ENGAGEMENT

Communications & Marketing (CAM)
UCL Media
UCL Engage
UCL Public Policy

5 EDUCATION

UCL Faculties and Departments
UCL Arena

6 GLOBAL

Global Engagement Office (GEO)



AUTUMN RESEARCH SYMPOSIUM

Our inaugural Autumn Research Symposium in October 2018 showcased the breadth and depth of UCL's healthcare engineering excellence.

The day featured over 30 talks and a poster session from engineers, scientists and clinicians from all career stages. This was followed by networking drinks, research demonstrations and prize-giving to our winning early-career researchers.

Our second Autumn Research Symposium takes place Tuesday 5 November 2019 at the Wellcome Collection. We hope to see you there!



CJ LUO
BEST FLASH TALK



241
ATTENDEES



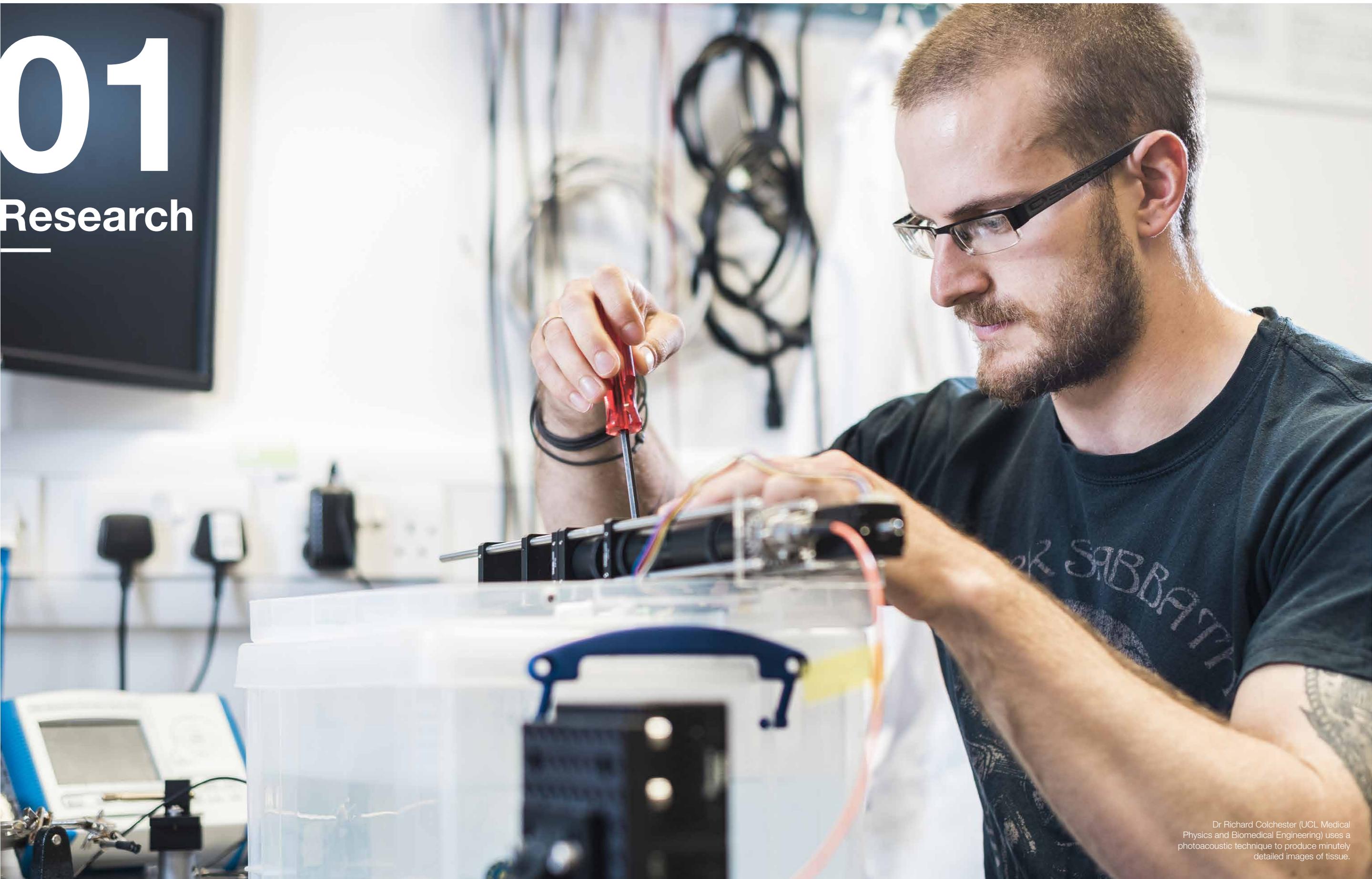
ECR POSTER
SESSION



“The high standard of presentations was a real testament to the strength and diversity of UCL's healthcare engineering research. It was inspiring to hear from such a fascinating range of leading speakers, as well as our flourishing early-career community”
– Dr Rebecca Shipley

01

Research



Dr Richard Colchester (UCL Medical Physics and Biomedical Engineering) uses a photoacoustic technique to produce minutely detailed images of tissue.

OUR RESEARCH THEMES

In 2018, we redefined IHE research themes to span the healthcare pathway. We've focused on integrating activity across these themes to answer unmet clinical needs across a broad scope of diseases and global health challenges.

DIAGNOSTICS

Enabling early and accurate diagnosis of disease is imperative to improve treatments' success rates, and at UCL we conduct research in two main areas: medical imaging, and in vitro diagnostics.

Advancements in medical imaging assist clinicians in gathering information non-invasively, allowing them to diagnose with minimal intervention and with ever increasing accuracy. In vitro diagnostics are tests done on samples such as blood or tissue that have been taken from the human body. They can be used to detect diseases, monitor a person's health, or in precision medicine to identify patients who are likely to benefit from specific therapies.

Researchers at UCL are combining imaging and in vitro systems with machine learning techniques that are able to process vast amounts of data and spot patterns of biomarkers that signify disease. The implications of this are vast – allowing technology to make accurate diagnoses as well as human experts can and, in some cases, spotting new patterns that may enable even earlier diagnosis.

The adaption of portable digital and mobile technologies into diagnostic tools is also having significant global impact, enabling diagnosis of conditions even in low-resource or hard-to-access areas.

PREVENTION

There is increasing recognition of the importance of preventative healthcare that averts the need for emotionally and physically burdensome, costly and sometimes unsuccessful intervention.

Researchers at UCL are engineering technologies to support this shift, ranging from wearable devices that encourage individuals to maintain an active and healthy lifestyle through to bioprocessing and manufacturing methods that enable widespread, affordable vaccination.

At a more fundamental level, scientists are working to understand the precise causes and processes behind diseases in an effort to eventually prevent them. Our improved understanding of people's specific genetic make-up can provide insight into risk of disease and best prevention methods, whilst advanced computational models can be personalised to help predict and prevent disease progression in individuals.

THERAPIES AND INTERVENTIONS

Engineering technologies underpin the development of most healthcare therapies and interventions.

There is an extraordinary breadth and depth of research into this at UCL ranging from regenerative therapies and tissue engineering to simulations that help clinicians prepare for surgical procedures or predict the efficacy of drug delivery.

Our researchers are working at the forefront of advances in surgical intervention, using the latest in medical imaging and augmented reality to help surgeons plan their route pre-surgery and guide them during procedures. Nano-engineers are creating miniaturised imaging and sensing devices capable of fitting on the tip of a needle, and experts in robotics are developing flexible surgical robots able to steady motion and ensure micro-precise manipulation of tissue.

MONITORING

We are developing a range of monitoring tools, from advanced imaging techniques that help clinicians track disease, through to wearable technologies that help patients self-manage conditions.

Advanced imaging techniques provide clinicians with increasingly high-resolution images inside the body, allowing them to monitor patients' progression of disease and response to therapy with greater accuracy than ever before.

Digital technologies are turning common mobile phones and wearable devices into accessible monitoring tools. Advancements in this area promise to revolutionise the care of patients with long-term conditions such as diabetes by allowing them to self-monitor and self-manage their conditions from the comfort of their own home.

REHABILITATION AND ASSISTIVE TECHNOLOGIES

At UCL, we are pioneering advancements in the field of rehabilitative and assistive technologies.

Researchers take a holistic approach to 'whole body' movement rehabilitation following an injury, working to tackle neuro-physiological repair and develop effective assistance that promotes functional independence.

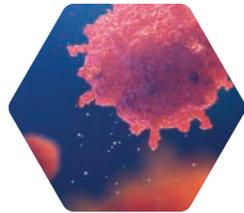
Current research includes the replacement of body parts such as 3D printing personalised hip replacements and developing bionic prosthetics for amputees. Other projects work at the interface of living neural tissue and non-living constructs to repair, replace or enhance patients' nerve tissue. Yet another direction of research targets the brain and nervous system to aid the restoration of lost motor abilities and another area aims to assist individuals with disabilities with their daily living and independence.

Our recent

RESEARCH HIGHLIGHTS

UCL researchers are working at the forefront of advances in healthcare engineering, pushing the boundaries in areas where cutting-edge digital and medical technologies have the potential to transform patient care.

The breadth and depth of activity this year has been staggering. Here are some of our highlights.



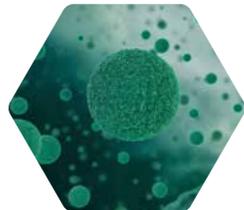
TRACKING VIRUSES THROUGH TIME AND SPACE

The ICONIC project combines genetic data from viruses with electronic health records to visualise, investigate and help control infectious outbreaks.

This pipeline was used to successfully support the control of a major hospital outbreak of influenza. The outputs of this work have been adopted into clinical practice and routine healthcare in numerous NHS settings and through various projects in four different low-and-middle-income country settings.

The project won the prestigious Healthcare Technologies award at this year's IET Awards.

ICONIC (Infection response through virus genomics), was a flagship Wellcome Trust and National Institute for Health Research co-funded project, hosted at the UCL Institute of Health Informatics and now translated into the University College London Hospital (UCLH) Advanced Pathogen Diagnostics Unit.



Moorfields carry out more than 5,000 Optical Coherence Tomography (OCT) scans of patients' retina every week. These scans require highly trained expert analysis in order to interpret the result, which can cause delays in getting to diagnosis and treatment.

ARTIFICIAL INTELLIGENCE EQUAL TO EXPERTS IN DETECTING EYE DISEASES

An artificial intelligence (AI) system, which can recommend the correct referral decision for more than 50 eye diseases – as accurately as experts – has been developed by UCL, DeepMind and Moorfields Eye Hospital. This research was published in *Nature Medicine* last August and attracted widespread press attention.

“*The AI technology we're developing is designed to prioritise patients who need to be seen and treated urgently by a doctor or eye care professional. If we can diagnose and treat eye conditions early, it gives us the best chance of saving people's sight*”

— Dr Pearse Keane, UCL Institute of Ophthalmology

The study was conducted by researchers at the UCL Institute of Ophthalmology, DeepMind, and Moorfields alongside colleagues in the UCL Institute of Epidemiology & Health Care, UCL Medicine and UCL Life Sciences.

VIRTUAL TUMOURS TO AID CANCER DRUG DELIVERY

It is predicted that one in two people in the UK will be diagnosed with cancer in their lifetime.

Our team of scientists at UCL have designed a virtual modelling technique which can create highly detailed 3D models of individual cancerous tumours and simulate the delivery of drugs into them. This helps us to predict the effectiveness of cancer drugs.

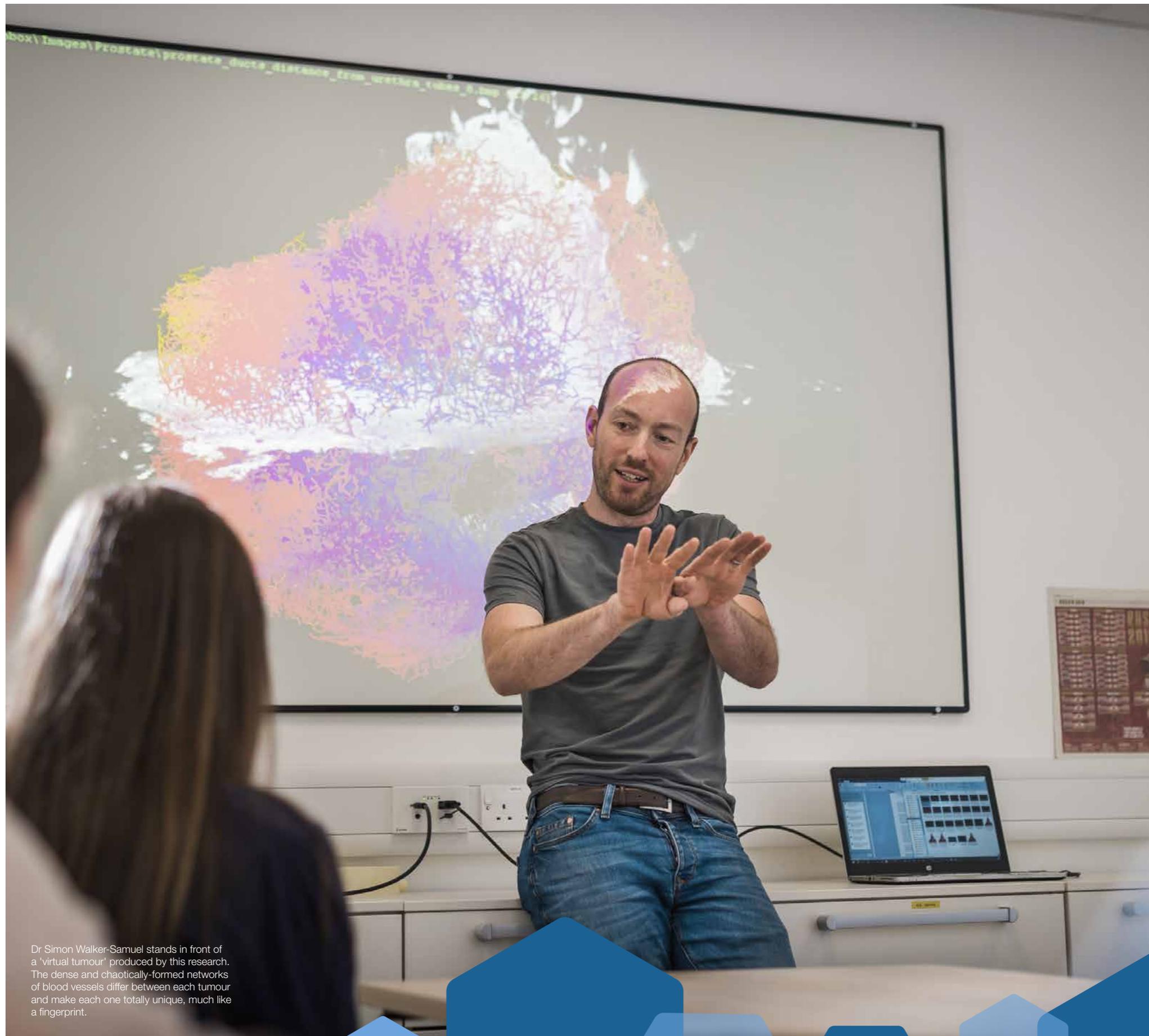
This new framework has a vast potential impact in helping develop new cancer drugs and providing a cost-effective way to test their efficacy before going to human trials. It advances the move towards truly personalised medicine, with the potential that one day clinicians may be able to predetermine the most effective therapeutic plan for each patient's unique tumour make-up.

“*These advances are a truly interdisciplinary effort and would not be possible without the combined input of physicists, mathematicians, cancer biologists, clinicians, imaging specialists and engineers***”**

— Dr Simon Walker-Samuel (Centre for Advanced Biomedical Imaging)

The research was led by Dr Simon Walker-Samuel (UCL Division of Medicine) and Dr Rebecca Shipley (UCL Mechanical Engineering) with support from the Rosetrees Trust and the Wellcome Trust. The study was published in Nature Biomedical Engineering last Autumn.

Dr Simon Walker-Samuel stands in front of a 'virtual tumour' produced by this research. The dense and chaotically-formed networks of blood vessels differ between each tumour and make each one totally unique, much like a fingerprint.



MACHINE LEARNING COULD HELP TO FIND NEW TREATMENTS FOR DEMENTIA

The new machine learning algorithm can automatically disentangle different patterns of progression in patients with a range of different dementias, including Alzheimer's disease. This could enable individuals to be grouped according to what treatments they may respond best to.

“This new algorithm has the unique ability to reveal groups of patients with different variants of disease. One key reason for the failure of drug trials in Alzheimer's disease is the broad mixture of very different patients they test; a treatment with a strong effect on a particular subgroup of patients may show no overall effect on the full population so they fail the drug trial. The algorithm, SuStaln, provides a way to show treatment effects on distinct subgroups, potentially expediting treatments to market.”

— Prof Daniel Alexander, UCL Centre for Medical Image Computing (CMIC)

The research, led by Dr Alexandra Young and Prof Daniel Alexander (CMIC), was published in *Nature Communications* this year. Funding support from the EPSRC, the Horizon 2020 EuroPOND project and others.



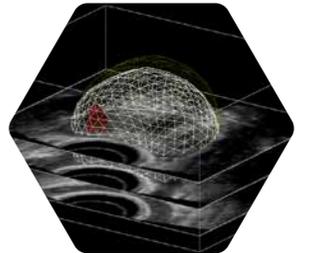
PRECISION TARGETING FOR PROSTATE CANCER

One in eight men in the UK are estimated to have prostate cancer in their lifetime.

Revolutionary technology developed at UCL guides surgeons performing biopsies and improves prostate cancer detection. The software equips surgeons with vital information about the size, shape and location of prostate tumours during a biopsy that is otherwise invisible on ultrasound images.

Results from a recent clinical trial were published this year, showing the software successfully diagnosed more than 90% of prostate cancers in 129 patients at UCLH.

The software is deployed via a UCLB spin-out company, SmartTarget. The study was conducted at UCLH and funded by the UK Department of Health and Social Care and Wellcome Health Innovation Challenge Fund. Research has been carried out through an interdisciplinary team including UCL Medical Physics and Biomedical Engineering, UCL Computer Science and UCL Medical Sciences.



UCLH REPAIR BABIES' SPINAL CORDS IN THE WOMB FOR THE FIRST TIME IN UK

Spina bifida is a condition which arises when the spinal column and spinal cord are not properly formed during early pregnancy. A team of clinicians from University College London Hospital (UCLH) and Great Ormond Street Hospital (GOSH) operated on this in the womb for the first time in the UK, with mums and babies now recovering well.

This pioneering advancement was made possible through the GIFT-Surg project, a seven-year research collaboration between UCL, Kings College London and international clinical partners at KU Leuven.



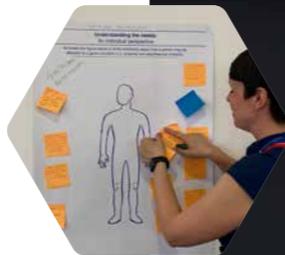
DYNAMIC SEATING FOR CHILDREN WITH SEVERE MOVEMENT DISORDERS

Children learn to move by exploring movement and use movement to help them learn. For children with complex movement disorders like dystonia who can experience powerful involuntary whole-body movements, moving can become something that disrupts every aspect of their lives. They are often constrained into seats designed to provide support and position them safely in an upright sitting position, but their movements are often strong enough to break seats.

Researchers from UCL's Global Disability Innovation Hub (GDI Hub) are evaluating a new kind of seat that moves with the child and enables them to explore movement while they are seated and well supported. Early work has suggested that children can use the freedom afforded to them to learn how to better control their movements and to improve their head and hand control.

The seats and the methods we are using were developed with children with dystonia, their families and clinicians, so we know that we are measuring things that matter to them.

The UCL GDI Hub team, led by Dr Tim Adlam, are working with the Evelina London Children's Hospital, Designability and another local NHS partner, with funding from Sparks Children's Medical Research Charity.



ONLINE PROGRAMME THAT EMPOWERS PATIENTS TO SELF-MANAGE THEIR DIABETES IS ROLLED OUT ACROSS NHS

Diabetes is one of the most common long-term conditions in the UK, affecting about 2 million adults. People with diabetes are more likely to develop heart disease, kidney failure and blindness and to die prematurely.

Many of these problems can be prevented if people with diabetes are given the knowledge and skills to self-manage their condition, unfortunately only a minority of patients receive education on how to do this.

Prof Elizabeth Murray (Primary Care and Population Health) and her colleagues developed an online self-management programme called HeLP-Diabetes (Healthy Living for People with Diabetes). It provides information about the condition as well as treatment advice and emotional support. In May 2019, NHS England announced a national roll-out of the technology in a world-first provision of evidence-based online self-management support.

This research was funded by the National Institute for Research Health (NIHR). The UCL-led research was in collaboration with clinicians at Whittington Health and researchers at the University of Cambridge.



IHE WORKSHOP AWARDS

Our workshop award scheme promotes interdisciplinary collaboration across UCL and our partner hospitals, by bringing together new consortia to develop novel research approaches and technologies. Our award provides up to £1500 funding and full events support including organisation, communications, facilitation and post-event research/grant development.

We provided 13 awards over the last year for an amazingly diverse range of events.

INTERDISCIPLINARY APPROACHES TO FRUGAL INNOVATION WORKSHOP

Date: 3 October 2018

Prof Prashant Jha, lifelong frugal innovator, shared his expertise in developing innovative medical technologies using simple, affordable and efficient methods. The workshop helped attendees replicate this frugal approach in their own research.

UK NERVE ENGINEERING NETWORK MEETING

Date: 5 November 2018

We supported the UCL Centre for Nerve Engineering in hosting the UK Nerve Engineering Network Meeting. Nerve engineers, clinicians and industry representatives from across the UK descended on UCL to learn more about collaborative opportunities in this space.

MAKING RESEARCH INTERACTIVE WORKSHOP

Date: 21 January 2019

Events and festivals are a popular way of opening up research to the public by breaking down research concepts and starting new discussions through engaging methods. However, it can be difficult finding the best activities to convey your research.

We held a hands-on workshop with Dan Plane, a science communicator at the Royal Institution, to help our researchers develop their own interactive public activities.

SPINAL CORD MRI WORKSHOP

Date: 21-22 January 2019

We supported this two-day CMIC workshop where spinal cord MRI researchers and clinicians came together to discuss challenges in the field.

IHE/IPLS WORKSHOP: APPLYING PHYSICS AND ENGINEERING TO FIGHT CANCER

Date: 30 January 2019

Tumours are notoriously heterogenous and therefore difficult to treat.

This workshop set out to establish a community of researchers who are working to map this heterogeneity. Prof Roger Kamm, a world-renowned expert on the mechanics of cancer, joined us from MIT.

We also funded a PhD studentship stemming from this event.

UCL RESPIRATORY WORKSHOP

Date: 13 February 2019

At this CMIC-hosted workshop, our researchers explored the most pressing clinical challenges affecting the lungs and how engineering could provide solutions.

PRECLINICAL FIBROSIS WORKSHOP

Date: 14 February 2019

Lung fibrosis is a deadly disease that occurs when lung tissue becomes damaged and scarred.

We supported this workshop directed at UCL researchers who work with pre-clinical models of lung fibrosis. The group discussed ways of using new imaging and computational techniques to see and quantify microstructural lung damage.

HEALTHY AGEING SYMPOSIUM: LIVING BETTER FOR LONGER

Date: 15 February 2019

Thanks to advances in healthcare, people in the UK are living longer than ever before.

An ageing population brings new challenges. People in later life can struggle with deteriorating health, loneliness and difficulty accessing services. Society needs to adapt to meet older people's needs and provide them with a better quality of life.

This was the premise of our 'Healthy Ageing Symposium' - bringing together around 180 academics, industry leaders and charity representatives, the event aimed to address the challenges of ageing healthily.

The UK Government has made tackling this challenge a priority. They are looking to invest up to £98 million in research for the development of products and services that support people as they get older.

This event provided an opportunity for attendees from different backgrounds to mix and come up with strong ideas to carry forward. Strategic follow-up sessions took place to ensure that connections from the symposium generate real-world impact.



UCL INSTITUTE OF
HEALTHCARE ENGINEERING



STIMULATING
WORLD CLASS **INNOVATION**
& **RESEARCH** HEALTHCARE
ENGINEERING

IDDSI CONGRESS: IMPROVING LIFE FOR DYSPHAGIA PATIENTS

Date: 18 February 2019

Dysphagia – the medical term for swallowing problems – affects almost 600 million people worldwide.

People with dysphagia and their carers need a safe, reliable way to test whether food is safe for them to eat, otherwise they risk choking.

Based on UCL healthcare engineering research, the IDDSI (International Dysphagia Diet Standardisation Initiative) organisation has developed a standardised way of testing and categorising different foods.

“If you have a choice between best guess and evidence, as a healthcare professional, you have to pick evidence. It boils down to safety”

— Alison Smith, British Dietetic Association

We supported the IDDSI Congress – a full-day conference for healthcare professionals, caterers, industry representatives, carers and patients to learn more about the IDDSI framework.

IHE/CVD HUB: CLINICIANS' CHALLENGE TO ENGINEERS IN CARDIOVASCULAR HEALTH

Date: 28 March 2019

This workshop brought together engineers and clinicians in cardiovascular health from QMUL's Cardiovascular Devices Hub (CVD Hub), the IHE and our partner hospitals. The focus was on finding engineering solutions to real clinical challenges.



INNOVATION WORKSHOP: MEASURING OUTCOMES IN CHILDHOOD MOVEMENT DISORDERS

Date: 31 May 2019

Objectively measuring the effectiveness of interventions for children with movement disorders is difficult for many reasons including a lack of useable measures, group diversity, difficulties with communication and complexity in their condition.

This event explored the development of innovative technologies for the management of paediatric movement disorders. The day consisted of short talks from leading experts and interactive sessions. The workshop concluded by developing a joint action plan to advance this field.

The workshop was organised by UCL, the Global Disability Innovation Hub and NIHR Children and Young People's MedTech Co-operative - a national organisation committed to developing paediatric medical technology in health areas with high disease burden and clear unmet needs.



IHE-IOO WORKSHOP: ENGINEERING SOLUTIONS TO OPHTHALMOLOGY'S CLINICAL CHALLENGES

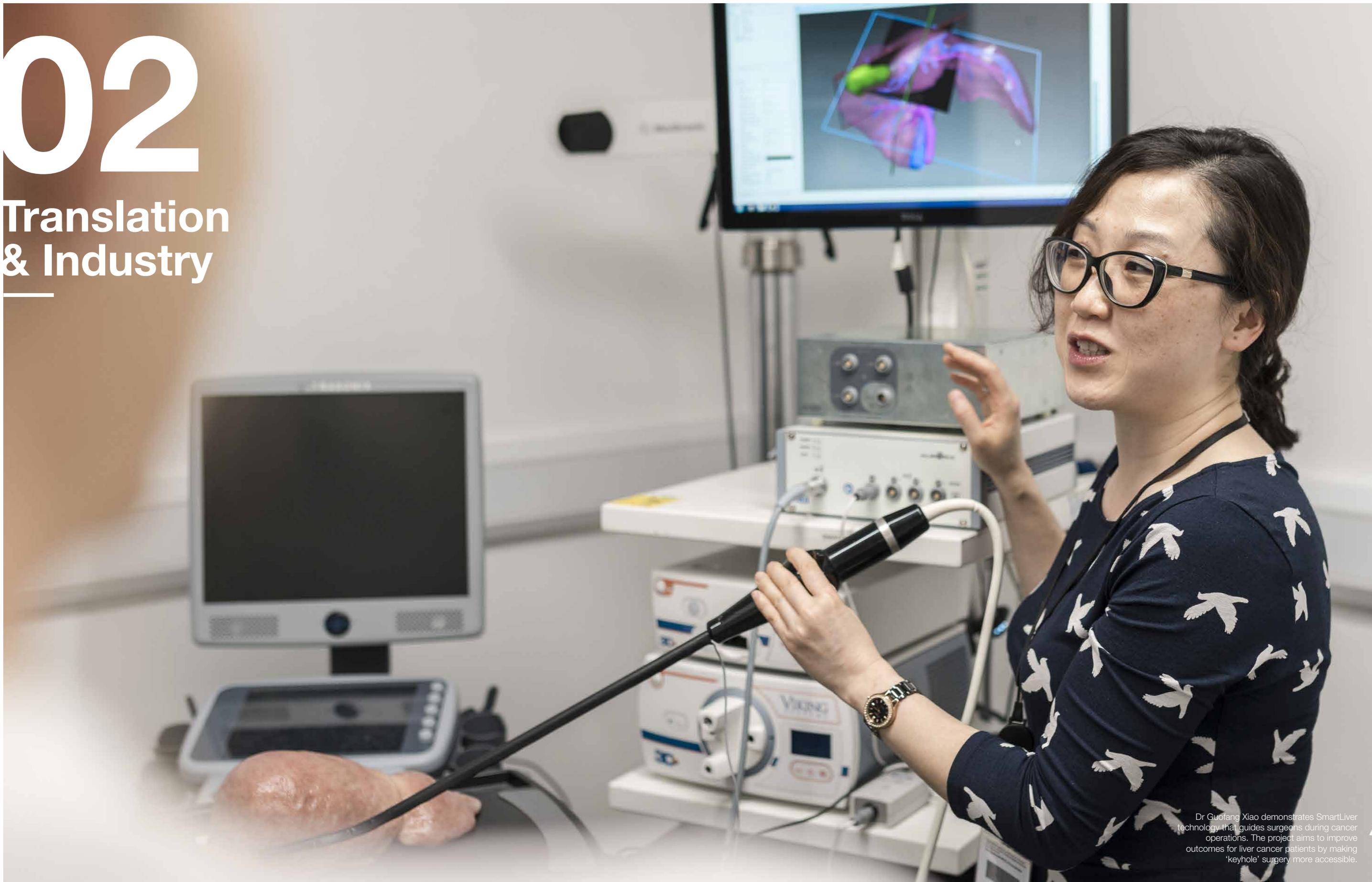
Date: 3 June 2019

Alongside the Institute of Ophthalmology (IoO), we hosted a workshop to bring ophthalmologists, scientists and healthcare engineers together to explore healthcare challenges that could be solved through the application of engineering technologies. We awarded two fully-funded PhD studentships for projects that arose from this workshop.



02

Translation & Industry



Dr Guofang Xiao demonstrates SmartLiver technology that guides surgeons during cancer operations. The project aims to improve outcomes for liver cancer patients by making 'keyhole' surgery more accessible.

SPIN-OUTS ADVANCE OUR TRANSLATIONAL SUCCESS

We work with UCL Innovation & Enterprise and UCL Business (UCLB) to help commercialise research that will have a real and measurable impact on people's lives. Here are some examples of translational activity from within our healthcare engineering community this year.

INVESTMENT ADVANCES NOVEL CELL THERAPY FOR PERIPHERAL NERVE REPAIR

Hundreds of thousands of people every year are affected by severe peripheral nerve damage, resulting in paralysis and loss of sensation, often accompanied by chronic pain. Current therapies are successful in fewer than half of cases and often require grafting of a nerve from another part of the body.

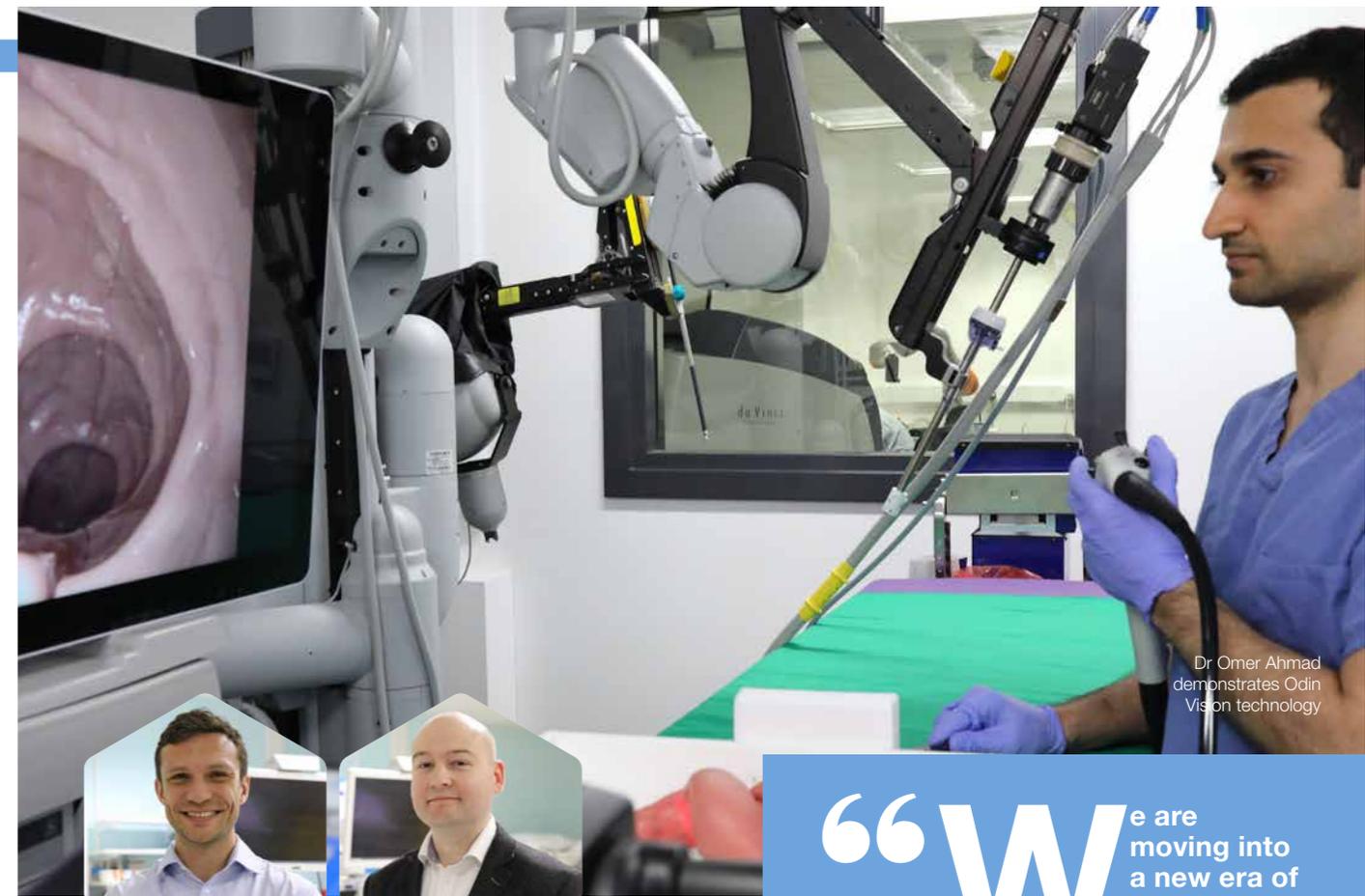
A team from UCL Centre for Nerve Engineering have developed an off-the-shelf cell therapy for the repair of peripheral nerve injury called Engineered Neural Tissue (EngNT). EngNT will provide a living nerve-growth guide that mimics nerve structure, and has the potential to enable both neural regeneration and functional recovery.

UCL spin-out company, Gialign Ltd, was established in 2018 to take this work forward and has received significant investment.

“By controlling the natural ability of cells to organise themselves within soft materials we are able to generate living artificial tissues that can be used to support and guide nerve regeneration. Gialign uses EngNT made with cells developed in collaboration with ReNeuron that are suitable as an off-the-shelf therapy for the immediate treatment of patients with nerve injuries. This overcomes the limitations of nerve grafting where healthy nerves need to be destroyed, and also reduces the delay and variability that would be associated with using a patient's own stem cells.”

— lead researcher Dr James Phillips (UCL School of Pharmacy)

Gialign Ltd is a UCL spin-out company with founders James Phillips and John Sinden. Gialign Ltd has received funding from UCL Technology Fund, UK Innovation and Science: Seed Fund (UKI2S) and Innovate UK. Academic research to develop EngNT has taken place within UCL Centre for Nerve Engineering and UCL School of Pharmacy.



PROF DANAIL
STOYANOV

PETER MOUNTNEY
CEO

Dr Omer Ahmad demonstrates Odin Vision technology

“We are moving into a new era of healthcare where Artificial Intelligence (AI) will support doctors to identify and diagnose cancer faster and more effectively.

— Peter Mountney,
CEO of Odin Vision

SPACE TECHNOLOGY TO FIGHT BOWEL CANCER

UCL spin-out company Odin Vision has received £1 million funding to use space technology to improve the early detection and diagnosis of bowel cancer. The revolutionary artificial intelligence (AI) system identifies and characterises polyps by analysing live colonoscopy video, leading to early treatment and saved lives.

The project will use secure, high-speed satellite communications with bespoke space compression software to create a cloud-based AI system that can support doctors in their decision making. Through the use of space technology, the system can be deployed anywhere on earth enabling patients to receive a consistent, high level of care.

The project is a collaboration between Odin Vision, University College London (UCL) and University College London Hospital (UCLH) with support from Avanti Communications and SEHTA and funding of £1 million from the UK Space Agency. Odin Vision is a UCL spin-out supported through UCLB's Portico Ventures programme. The academic research for the project has taken place at WEISS, UCL.



TWO DEALS SIGNED THIS YEAR HELP COMMERCIALISE BIOACTIVE AEROGELS FOR DENTAL APPLICATIONS

New technology developed at UCL for dental bone grafting and other biomedical applications uses bioactive aerogels. Bioactive aerogels contain calcium and phosphate and, once inside the body, form the mineral phase of bone and teeth.

The technology will offer dental surgeons more options in material properties when performing surgery and could allow for more challenging and significantly improved surgical techniques in dentistry. This has the potential to offer better surgical outcomes for patients, with fewer surgical interventions, improved healing, and greater oral function.

In 2018, the team obtained funding for a study to gain CE mark approval to allow sales in Europe and, crucially, also obtained agreement from a multinational commercial partner to co-develop the technology for regulatory approval.

The technology has also been developed for enamel remineralisation as an additive to toothpaste, helping to treat dentine hypersensitivity which causes painful toothache from certain foods and cold drinks. Bioactive aerogels show much faster action than current competing technologies and are cheaper to produce. The team have also signed a pre-license agreement with a large commercial partner to allow them to evaluate this technology. A potential full license would generate significant revenue for the university, offer considerable improvement in efficacy for users of the toothpaste, and save millions of pounds per year in manufacturing costs, providing further competitive advantage thanks to the UCL technology.

This project is based on technology developed within UCL Chemical Engineering, and as part of the EPSRC "Frontier Engineering" Centre for Nature Inspired Engineering (CNIE), led by Prof Marc-Olivier Coppens and in collaboration with Dr Niall Kent.

Spotlight on GEOFF PARKER

IHE Deputy Director (Translation)

G Geoff Parker joined UCL this year as our new Professor of Healthcare Engineering, Imaging and Enterprise and IHE's Deputy Director (Translation). In this interview, we find out his plans for translational activity and hear his excitement about UCL's unique opportunities for research collaboration.

More generally, I am also keen to help expand translational activity by identifying new clinical challenges and matching those to the excellent healthcare engineering activities and capabilities at UCL. I am a big fan of collaboration between institutions, as these generally benefit everyone involved. Such collaborations are essential for rapid translation of great research ideas, so I will be getting involved in as many of these as I can.

Lastly, I have a strong interest in using commercialisation of research outputs as an effective way to aid translation, so I will be looking out for ideas that have potential in this area and encouraging researchers to take advantage of this route.

HOW IMPORTANT DO YOU THINK THIS KIND OF TRANSLATION IS TO RESEARCH?

My own research is highly translational, so it is of core importance to what I do. Fundamentally, I see areas of clinical adoption as sources of challenges and inspiration. Achieving effective translation is then the natural end point to meeting those challenges.

WHAT DREW YOU TO UCL?

I find the sheer number of talented researchers available to collaborate with very exciting. UCL has a unique breadth and depth in both fundamental imaging methods research and clinical sciences.

YOUR NEW ROLE HERE HAS A TRANSLATIONAL FOCUS, WHAT ARE YOUR HOPES FOR TRANSLATIONAL HEALTHCARE ENGINEERING ACTIVITY AT UCL OVER THE UPCOMING MONTHS?

From a personal perspective, I aim to capitalise on the unique opportunities for research collaborations within UCL. Specific examples include the development of new imaging methods in neuroscience, lung disease and cancer, but there are likely to be more.

YOU'RE COMING TO UCL WITH PREVIOUS EXPERIENCE OF SPINNING OUT YOUR RESEARCH AND FORMING A COMPANY, BIOXYDYN LIMITED. WHAT IS THE MOST VALUABLE LESSON YOU'VE LEARNT FROM THIS?

The most valuable lesson is that commercialisation is one of the few paths to real translation of research into healthcare. If a healthcare technology can survive in a commercial environment then that goes a long way to demonstrating that translation is viable, as it means that what you have is valuable enough for someone to want to pay for it.

TRANSLATION OF INNOVATION

We work closely with established bodies and networks within UCL to accelerate the translation of innovative research into the clinic



Dr Rebecca Shipley (IHE Director) at the TINS launch event

TRANSLATING NOVEL SCIENCE TO PATIENT BENEFIT WITH OUR PARTNERS UCL TRO

We've worked closely with our partners at the Translational Research Office (TRO) this year to bridge the gap between academia and industry, helping Principal Investigators (PIs) to bring their research to fruition.

“The vision of the TRO is to encourage, facilitate and contribute to all aspects of the translation of UCL's and its partner hospitals' life science and biomedical research discoveries along a development pathway towards clinical application and patient benefit.”

— Dr Jane Kinghorn, Director of the TRO

THERAPEUTIC INNOVATION NETWORKS (TINS)

The TINs are multidisciplinary networks hosted by the TRO, connecting research in major therapeutic modalities from across UCL and partner NIHR Biomedical Research Centres. The networks were officially launched in July 2018 and offer an exciting opportunity for engineering innovation.

The TINs:

Cell, Gene and Regenerative Medicines, Biologics, Small Molecule, Repurposing, Devices, Diagnostics

The IHE has been actively engaged with the Devices and Diagnostics TINs and our Director, Dr Rebecca Shipley, leads the Diagnostics TIN. Their purpose is to maximise the translation of disease-related research into high-quality therapeutic interventions quickly and efficiently for the benefit of patients.

SIGNIFICANT INVESTMENT IN HEALTHCARE ENGINEERING AND IMAGING PROJECTS FROM UCLH BRC

The NIHR UCLH Biomedical Research Centre's Healthcare Engineering and Imaging (HE&I) theme aims to improve treatment by developing pioneering technologies to fulfil currently unmet needs.

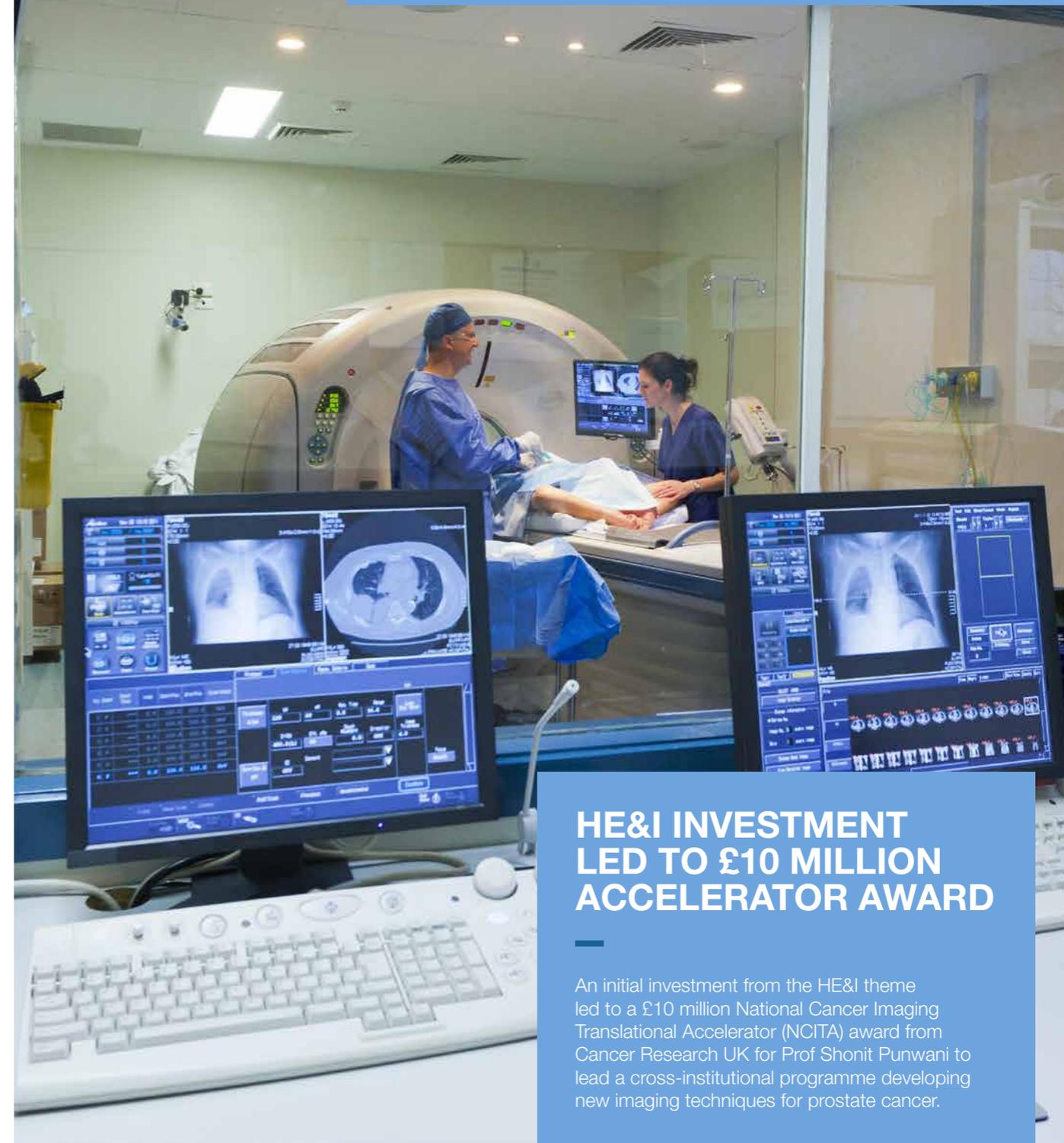
IHE Management Board member Prof Danny Alexander was appointed theme lead this year and we have been working closely with him to open up the routes for translation of UCL engineering innovation into the clinic.

In May 2019, the HE&I theme awarded more than £500,000 to scientists and engineers across 12 research projects:

- 1 **Andreas Demosthenous** – Biosensor for fast point-of-care Blood Analysis of Troponin
- 2 **Paul Beard** – Clinical translation of photoacoustic imaging for the assessment of rheumatoid arthritis
- 3 **Joseph Jacob** – Using Deep Learning of CT Features to Predict Survival and Identify Disease Subtypes in Fibrosing Lung Disease
- 4 **Rui Loureiro** – VR & Robotic Treatment of Neuropathic Pain
- 5 **Geoff Parker** – Tumour mimetic phantoms for diffusion MRI standardisation (TumoMim)
- 6 **Neil Oxtoby** – MC-PMT-D3PM: Memory Clinic Patient Management Tools from Data-Driven Disease Progression Modelling
- 7 **Ryo Torii** – Biomechanical insight into failed coronary arterial bypass grafts in high risk, vulnerable patients with poor ventricles
- 8 **Jamie McLelland** – Image Analysis for Studying Radiotherapy Induced Lung Damage (RILD)
- 9 **Pier Lambiase** – Integration of electrophysiological and structural myocardial mapping to personalise treatment and improve ablation outcomes
- 10 **Stavroula Babalani** – OPTIMAL – Objective, Personalised Treatment of Peripheral Arteriovenous Malformations via a Novel Platform Combining Engineering and Imaging Tools
- 11 **Ivana Drobnyak** – Learning from high-dimensional data to quantify intra-operative risk in frailty and map patient outcome
- 12 **Margaret Hall Craggs** – Optimisation of a multiparametric, quantitative MRI tool for assessment of bone and joint health in inflammatory disease.

“We are very excited by the range of disciplines in these awards. These projects will diversify the HE&I Theme portfolio, ensuring even more patients can benefit from the world-leading engineering and translational research at UCL and the clinical excellence at UCLH.”

– Prof Danny Alexander, HE&I Theme Director



HE&I INVESTMENT LED TO £10 MILLION ACCELERATOR AWARD

An initial investment from the HE&I theme led to a £10 million National Cancer Imaging Translational Accelerator (NCITA) award from Cancer Research UK for Prof Shonit Punwani to lead a cross-institutional programme developing new imaging techniques for prostate cancer.

CLINICAL PARTNERSHIPS HELP ACCELERATE OUR TRANSLATION

We have direct clinical links to eight partner hospitals and three biomedical research centres.

Our strong links to affiliated hospitals and biomedical research centres are integral to our strategy, ensuring that the focus of our research always remains on identifying and solving real clinical problems. The benefits of our cutting-edge engineering innovations can then be taken directly to patients through our partner hospitals, accelerating their impact.



Photos (above) from our #innovate2translate campaign in Summer 2018 which celebrated the NHS' 70th birthday and the importance of continuing innovation.



University College Hospital • Eastman Dental Hospital • Moorfields Eye Hospital
 Royal National Throat, Nose and Ear Hospital • National Hospital for Neurology and Neurosurgery
 Royal National Orthopaedic Hospital • Great Ormond Street Hospital • Royal Free Hospital
 GOSH BRC • UCLH BRC • Moorfields BRC

03

Careers



One of our early-career researchers, Yolanda Ohene (Centre for Advanced Biomedical Imaging) uses advanced MRI techniques to research Alzheimer's disease.

ECR TRAVEL BURSARY

NURTURING AND SUPPORTING RESEARCHERS IN THE EARLY STAGES OF THEIR CAREER

We focus on nurturing and supporting researchers to navigate the early stages of their careers. One of the ways we do this is through an ECR Travel Bursary scheme that helps postgraduate and postdoctoral researchers share their healthcare engineering research across the world.

We awarded 15 travel bursaries between 2018-2019, allowing early-career researchers to attend conferences across the globe – from Delhi to Miami.

NAME	EVENT	CITY	MONTH
Yolanda Ohene	ISMRM	Montréal	May
Phoebe Evans	ISMRM	Montréal	May
Elena Costariol	ISCT Conference	Melbourne	May
Pedro Silva Couto	ISCT Conference	Melbourne	May
Ben Miller	World Congress on Biosensors	Miami	June
Salfarina Saberi	TERMIS World Congress	Kyoto	September
Junjie Zhao	ISACB Biennial Meeting	Bordeaux	September
Michael Ebner	MICCAI	Granada	September
Vasileios Kitsos	IEEE Sensors	Delhi	October
Céline Kayal	SES Technical Meeting	Madrid	October
Pingfan Song	IEEE ICIP	Athens	October
Yu-Jung Tsai	IEEE NSS/MIC	Sydney	November
Ludovica Brusaferrì	IEEE NSS/MIC	Sydney	November
Adeyemi Akintonde	International Conference on the Use of Computers in Radiation Therapy	Montréal	June
Hubin Zhao	EMBC 2019	Berlin	July

SALFARINA SABERI

Salfarina Mohamed Saberi is a PhD student within the UCL Division of Surgery and Interventional Science. In September 2018, she attended the TERMIS World Congress in Kyoto.

“Thanks to this award, I was able to present my research progress and communicate with research scientists. I obtained up-to-date information relevant to my work which will definitely assist with the writing the remainder up of my PhD thesis. I truly appreciate the contribution of this bursary. My attendance of the conference would not have been a success without your support.”

CÉLINE KAYAL

Céline is a PhD student in the UCL Department of Mechanical Engineering. In October 2018, she attended the SES 2018 Technical Meeting in Madrid.

“The presentations helped strengthen my knowledge in mechanobiology, interact with the mechanobiology community and build an international network. My presentation was well received and I benefited significantly from the scientific expertise and feedback. I also contacted potential collaborators. Once again, I would like to thank IHE ECR Travel Bursary for helping me attend this conference.”



NAVIGATING 'FAILURE' WITH

ADAPT TO THRIVE

We've partnered with UCL Academic Careers Office (ACO) to bring our early-career researcher community an event series focused on challenging cultures of perfectionism and demonstrating that failure is an integral and inevitable part of the academic journey.

By sharing other researchers' experiences the event series provides early-career researchers with support and showcases how failure and success walk hand in hand.

During her talk, Dr Ivana Drobnjak told us that she failed her very first exam at university... Then finished in the top 2% of her class. It's important to remember that a moment of failure is just a moment not a mark for life, missteps are all part of the story.

During his early postdoc years Prof David Hawkes came close to leaving academia after four failed grant applications. He spoke at our ADAPT to Thrive event, 22 successful EPSRC grants later!

PROF DAME ATHENE DONALD ON 'FINDING YOUR WAY'

On 1 May, we hosted Prof Dame Athene Donald from Churchill College, University of Cambridge as part of our wider initiative. Throughout the course of her prestigious career, she has been a vocal advocate for women and diversity in science.

Athene presented an 'alternative CV' which served as a refreshing reminder that life is more than a series of academic accomplishments. She spoke about the role that risk and opportunity played throughout her career, telling us that many of the crucial decisions in her life have been somewhat accidental and that is no bad thing. She has been offered lots of opportunities and she has seized them.

She reminded us that everyone feels like a 'failure' or an 'imposter' at some point, pointing out that she spent the first year of her undergraduate degree "feeling like a fool" and the first year of her PhD breaking expensive lab equipment! Finally, Athene left us with her ten golden rules, one of our favourites being "failure in one situation does not mean YOU are a failure".



“Success in academia is showcased and rewarded, but failure is an inevitable feature of academic careers since the odds are stacked against job offers or successful grant applications”

– Dr Julia Bailey blogs about 'failure' for IHE following her ADAPT to Thrive talk



Prof Athene Donald
(Churchill College, University of Cambridge)

AN EXCERPT FROM ATHENE'S BLOG:

“When presenting a 'careers' talk', as I did last week at UCL's Institute for Healthcare Engineering as part of their 'ADAPT to Thrive' series, it seems to me to be helpful to present the passage of my life in a variety of ways to show how different strands weave together to make a whole. There is the 'standard CV' format: the dates I moved from one role to another and where I did them. That is familiar territory to anyone who has ever applied for a job. I overlay on that the times when my research made some (relatively) abrupt change either deliberately or – as often in my case – driven by circumstances. Circumstances which varied from needing a new job to extend my visa in the USA after my first postdoc, to 'inheriting' a grant from my predecessor who'd left the country. I feel this is an important version both because it stresses the importance of luck and chance and because the belief that it is not necessary to go in a straight line with a siloed attitude to research to thrive is also something I feel strongly about. As I tend to put it, seizing opportunities is good, at least most of the time.”



04

Engagement

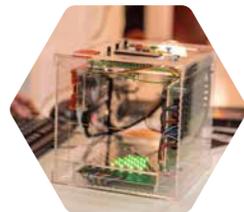


Researchers at WEISS welcomed over 300 members of public to 'Science of Surgery', an interactive afternoon demonstrating how engineering is changing surgery.

PUBLIC ENGAGEMENT

We are committed to establishing a two-way dialogue with the public to provide opportunities for mutual learning, and to ensure that we are tackling the clinical problems that matter the most.

The kinds of open-ended, curiosity-driven conversations that these activities spark help to enrich our own research by challenging our perceived knowledge and contributing new perspectives.



METABOLIGHT: ENGINEERING LIGHT TO MONITOR BRAIN HEALTH IN BABIES

MetaboLight has developed a light-based technique to help diagnose and monitor brain injury when blood supply is cut off to parts of a baby's brain during birth and stop it working properly. Detecting and monitoring damaged brain areas is vital to help doctors treat these babies in the best way.

To communicate their research with the public, the team have developed three main demonstrations, targeting different audiences:

- 'Gummy bear challenge' for KS1 children
- 'Hand scanner' for KS2 children
- 'Brain scanner' for KS3 to adults

They hope to better understand how the public perceives their research and its clinical impact, while also inspiring the next generation of engineers.

This project is a collaboration between UCL Medical Physics and Bioengineering, and UCLH. The project is led by Dr Ilias Tachtsidis and funded by the Wellcome Trust.



“

A highlight was taking part in the 2018 Big Bang Fair, Birmingham. We had thousands of schoolchildren and parents visit our exhibit to learn about our research and what medical engineers and physicists do.

– Dr Ilias Tachtsidis, Wellcome Trust Senior Fellow

SCIENCE OF SURGERY: HOW SCIENCE IS CREATING THE SURGERY OF TOMORROW

In April, the Wellcome/EPSRC Centre for Interventional & Surgical Sciences (WEISS) welcomed over 300 members of the public to 'Science of Surgery' – a fun-filled, interactive afternoon showcasing how science and engineering are changing surgery.

The event featured 17 different activity stations organised across major research areas and covering a wide range of topics, including sensors, imaging, 3D printing and robotics. Activities included magic tricks to demonstrate the tricky nature of selecting and using medical data, give-it-a-go mock robotic surgery, using paints to replicate cell samples and the chance to use a real da Vinci system

The event attracted a wide range of ages, from younger children and teenagers to parents and older people, with many residents from UCL's local Borough of Camden amongst the visitors. In total, around half of the visitors came from the borough and neighbouring areas through the help of local organisations such as Fitzrovia Community Centre and Age UK Camden.

The day was part of a varied public engagement programme at the centre, giving the opportunity for centre staff to develop research communication skills while providing a platform for the centre to reach out to local organisations.

“It's been fantastic to see the enthusiasm and delight on the faces of not just the visitors to Science of Surgery but also our centre staff. This is an important way for the whole centre to explore the work we do with the public and for us to hear their questions and views – hopefully paving the way for further public engagement with research across our work”

— Dan Taylor, Public Engagement Co-ordinator

“I found it really interesting, the passion from engineers and doctors really came across.”

— Visitor feedback

“We didn't only inspire the children but I think they also inspired us and gave us motivation and positive energy to do our research.”

— Bow Chaipanichkul, PhD Student





Our winning team at UCLH
Open Day, July 2018

WEISS TEAM WINS PRIZE FOR 'BEST STAND' AT UCLH RESEARCH OPEN DAY

In July 2018, a team of WEISS researchers took part in the UCLH Open Day to showcase the cutting-edge research and innovation taking place at UCL and its partner hospitals.

Our efforts demonstrating the pioneering research coming out of WEISS earned us the prize for 'best stand'.

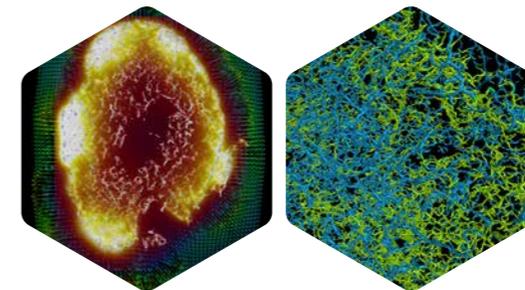
Last year's event was the fifth annual Research Open Day and one of its busiest yet, with hundreds of attendees. It gave members of the public a chance to talk with clinicians and scientists about how they are working to improve healthcare.

ROYAL SOCIETY SUMMER SCIENCE EXHIBITION: TWO UCL STALLS TO EXPLORE HEALTHCARE CHALLENGES

We are delighted to announce that we will be heading to the Royal Society Summer Science festival in July 2019.

UCL's healthcare engineering research will be celebrated in two interactive exhibits, 'The Mathematics of Cancer' and 'Lighting the Way to a Healthier Brain after Birth', alongside 20 other stands from other institutions and a series of talks, workshops and activities.

The free, week-long festival will run from 1-7 July exploring the biggest questions in UK science and technology.



IHE research that uses 'virtual tumours' (pictured above) to simulate the delivery of cancer drugs will be showcased at 'The Mathematics of Cancer' stall at the Royal Society.

PATIENT INVOLVEMENT

Putting patients at the centre of our research

Our research aims to improve healthcare for patients around the world so it is essential that we spend time listening to those who will be impacted.

Public patient involvement (PPI) is an essential component of what we do. It enables us to exchange and broaden our expertise, improve the quality of our research and ensure we focus on the things that matter.

CONTRACEPTION CHOICES WEBSITE HELPS YOUNG WOMEN FIND CONTRACEPTION METHODS WHICH SUIT THEM

Contraception Choices (www.contraceptionchoices.org) provides women with evidence-based information and decision support to make informed choices about contraception. The site provides information on the effectiveness, benefits and side effects of a range of contraceptive methods, and addresses common concerns using clearly presented text, interactive infographics, and videos. The site features the 'What's Right for Me?' interactive tool to help women choose a method of contraception tailored to their preferences.

UCL researchers co-designed Contraception Choices in collaboration with young women, to ensure it met their needs.

The interdisciplinary team was led by Dr Julia Bailey (UCL eHealth Unit, Primary Care and Population Health) and Prof Judith Stephenson (UCL Institute of Women's Health), and colleagues from the UCL Institute of Education, UCLIC and Imperial College Healthcare NHS Trust. Dr Ana Gubijev (UCL Institute of Women's Health) led the user views feedback. The project was funded by the NIHR.

“I feel very well educated thanks to the website - I wish someone had explained about all the different choices years ago.”

— Patient feedback

“It has brought my attention to the copper coil - I didn't know there was a highly effective method that doesn't contain hormones.”

— Patient feedback

“It has made me feel more confident. Prior I didn't really have anyone to speak to about contraception and I didn't feel comfortable discussing it with my doctors so this bridged the gap.”

— Patient feedback

ECLIPSE: PATIENT WORKSHOPS FOR RESEARCH DESIGN

As part of a research project exploring errors and safety in delivering intravenous medication, the ECLIPSE (Exploring the Current Landscape of Intravenous Infusion Practices & Errors) team conducted a patient workshop to inform the planned research and improve patient information.

The two main aims were to establish how to inform and engage potential participants in research and use patients' experiences to shape research questions.

The team recruited nine patient representatives. The workshop started with the patients sharing their experiences as the 'experts' in the room. These conversations were used to improve research design, impact outcomes and public awareness of outputs.

“Our workshop highlighted potential issues and sensitivities we might not have considered, and how to address these. Patients were able to compare and contrast their experiences, as patients with shared stories empathised with one another. This provided common themes as well as a rich source of variability. In return, the researchers became more sensitised to patients' experiences and concerns at an early stage of the study.”

— Dominic Furniss, Research Associate

The project was funded by the National Institute for Health Research (NIHR) Services and Delivery Research programme.



“If this diagnostic software is introduced then families of bowel cancer patients, like my own family, could get reassurance sooner whether everything is okay with their loved one's health.”

— Bowel cancer survivor Lesley Booth on revolutionary artificial intelligence system developed at UCL that identifies polyps on colonoscopy video and supports early detection.

OUTREACH AND ENGAGEMENT TO FOUR TO 19-YEAR-OLDS

In 2018, the UCL Faculty of Engineering school engagement team expanded its reach to 134 programmes across the UK. An extra eight programmes were created specifically for East London schools, as part of our ongoing commitment to the regeneration of the area. We provided engineering activities to over 7,000 four to 19-year-olds. We also increased our number of student and staff STEM Ambassadors to 632 people.

We design engineering engagement programmes that encourage young people from all backgrounds that engineering is for them.

As part of our 50:50 Strategy, we have been able to create a step change in the representation of female students and students from ethnic minorities on our STEM Engagement programmes. Recognising that diversity is intersectional cutting across gender, race, ethnicity, ability and background, our programmes are inclusive both in pupil participation and in the programme design.

For more information on outreach activities, contact Elpida Makrygianni, Engineering Education Developer and Co-ordinator (e.makryannis@ucl.ac.uk)

SCHOOLS OUTREACH



TRAINING OUR RESEARCHERS

We support, train and galvanise our researchers to engage with the public and patients. Throughout this year, we've provided training opportunities for staff and students on public engagement, patient involvement, science communication and media engagement.

MEDIA TRAINING WITH 'THE CONVERSATION'

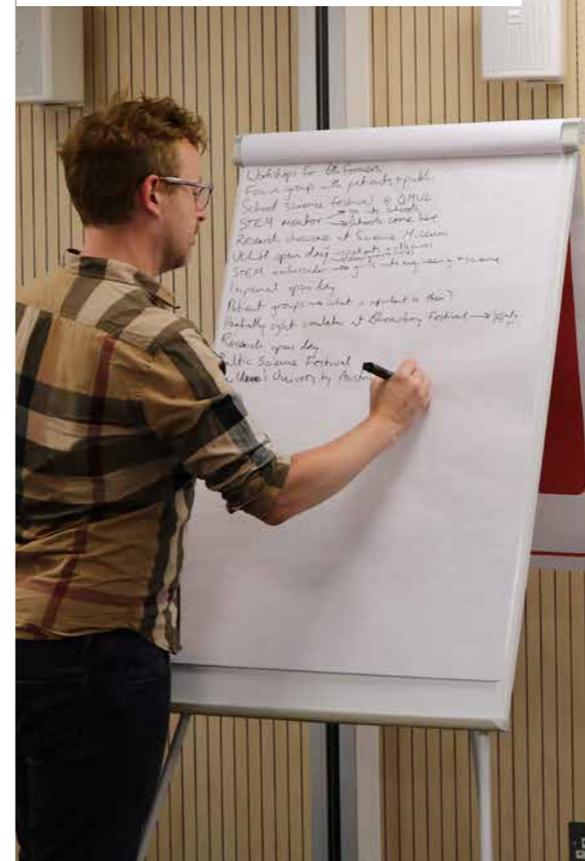
In May 2019, *The Conversation*, UCL Engineering and UCL Media Relations co-hosted a workshop for staff and research students interested in media engagement and thought leadership.

The Conversation is an independent news website that sources its content from the academic and research community.

PUBLIC ENGAGEMENT WORKSHOP: MAKING PUBLIC ENGAGEMENT WORK FOR YOU – GENERATING IDEAS LINKED TO RESEARCH

Last July, researchers and students from IHE and WEISS attended a one-day workshop on public engagement facilitated by Dr Steven Cross (Wellcome Trust Engagement Fellow).

The event aimed to kickstart participants' imagination and turn their ideas into real-life public engagement activities. They split into brainstorming groups and were tasked with generating as many creative ideas as possible – from healthcare hip hop to using Netflix to teach data analysis.



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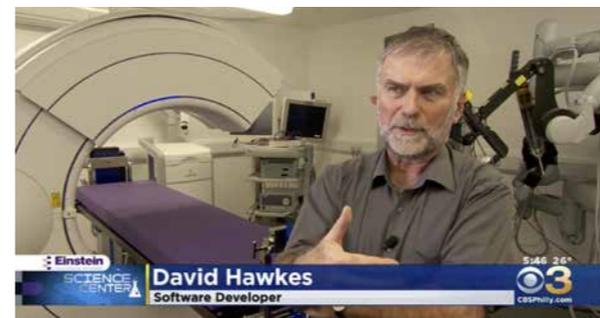
Assume infinite intelligence but zero knowledge in your interactions with the public

– Dan Plane, Science Communicator at the Royal Institution, during a 'Making Research Interactive' workshop we organised this year

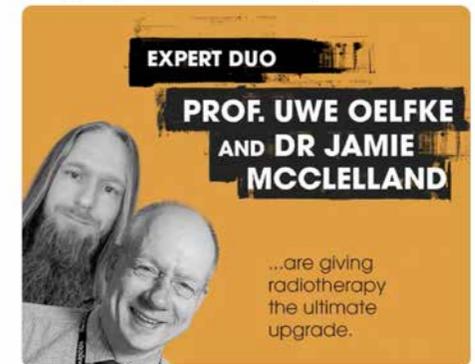
MEDIA ENGAGEMENT



WINTER WARMER RECIPES | ARE YOU SMARTER THAN YOUR KID? TAKE OUR TEST | 7-DAY TV GUIDE
SIMON CALDER | GARDENING - JOBS FOR THE WEEKEND | DAWN OF THE FOOTBALL SUPERLEAGUE



UCL IHE @Health_Eng - 26 Oct 2018
Ahead of tonight's @StandUp2C live show on @Channel4, find out more about Dr Jamie McClelland's cancer-fighting research... @UCLmedphys @UCLEngineering @CR_UK ucl.ac.uk/healthcare-eng...



ENGAGING WITH POLICY

Participating in the policy-making process is crucial in helping UCL maximise our impact and the benefit that our research brings to society. It also connects us to key decision-makers and keeps us focused on solving real-world problems. Here are some examples of policy engagement this year.

ADVISING NATIONAL COMMISSION AND USHERING IN THE 'FUTURE OF SURGERY'

“

We seem to be just at the beginning of a high-tech revolution which will make even Star Trek seem antiquated!

— Prof Laurence Lovat,
Clinical Director of WEISS

Prof David Hawkes, interim Director of the Wellcome / EPSRC Centre for Interventional and Surgical Sciences (WEISS) gave expert evidence to the Royal College of Surgeons' Commission on the Future of Surgery. The report, published December 2018, identifies advances in medicine and technology that are likely to have the greatest impact on surgery over the next 20 years and transform surgical care for millions of patients.

The Commission highlights technologies such as surgical robots, artificial intelligence, 3D printing and new imaging methods that are already changing and will continue to change the way that surgical care is delivered. Through WEISS, UCL is positioned at the forefront of these kind of advancements.

The report also identifies developments in fields such as genomics, regenerative medicine and cell-based therapies that could open new avenues for predicting and treating disease and are actively being pursued by other researchers within the IHE and elsewhere at UCL.

DEFINING NEW INTERNATIONAL STANDARDS AND NHS GUIDELINES

Research into the material properties of foods conducted by Dr Ben Hanson (UCL Mechanical Engineering) has helped to define international standards for classifying food textures, helping people with swallowing disorders.

Swallowing disorders are estimated to affect 600 million people worldwide including premature babies, patients with cerebral palsy, stroke survivors and older residents of care homes. Food wrongly classified for these groups can cause choking deaths.

Ben's work on the mechanics, texture and flow properties of foods forms a key part of the International Dysphagia Diet Standardisation Initiative (IDDSI) which is now being rolled out across the NHS. Ben was the awardee of an IHE Workshop Award this year for a conference on these policy changes.

RETHINKING GLOBAL AND LOCAL HEALTH POLICY RATIONALES

A workshop in January 2019 called for a rethink of policy rationales and models in light of the UN's Sustainable Development Goal 3, which sets out targets for achieving good health and well-being for all by 2030. Discussion focused particularly on how policy at different levels, from the global to the local, can best be aligned to deal with persistent and emerging health issues.

Reflection areas included what the key policy rationales that currently shape health policy at different levels are, what justifies them, what 'rethought' policy models might look like and how local policy-makers could best assume greater responsibility for innovation, risk and uncertainty relating to health security.

The workshop was hosted by the UCL Global Governance Institute's Global Health Thematic Directorate and UCL Science, Technology, Engineering and Public Policy (STeAPP) and formed part of a wider UCL initiative to rethink policy in this area.

OUR YEAR IN SOCIAL MEDIA

Social media provides an invaluable way to keep our followers up to date with the latest research developments and allows for direct interaction with audiences of thousands.

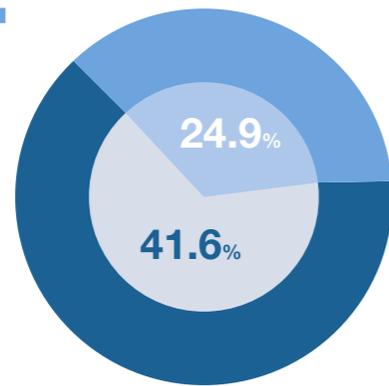
TWITTER FOLLOWERS



TWITTER IMPRESSIONS



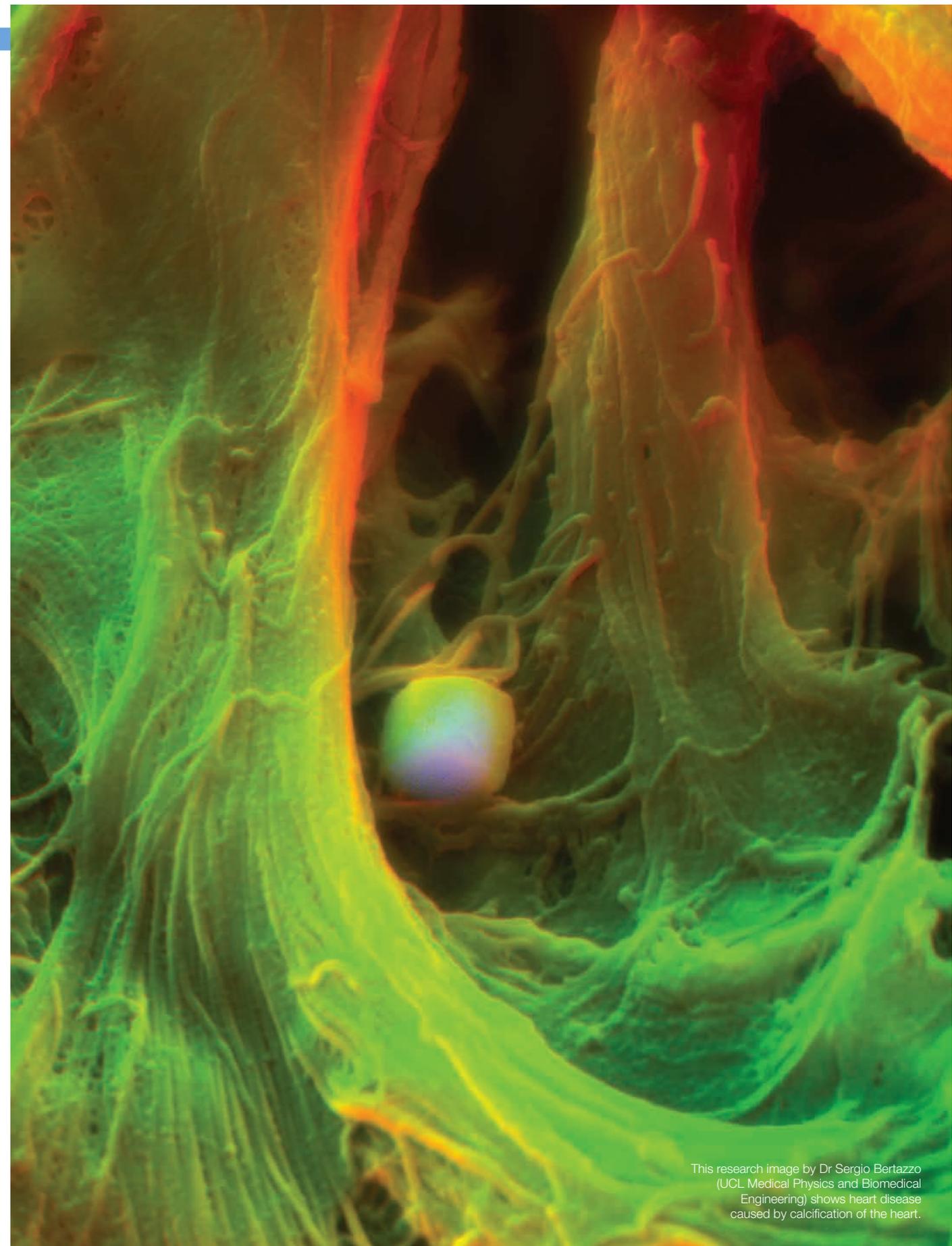
1490
Newsletter Subscribers



AVERAGE NEWSLETTER OPEN RATE

Average open rate in 2017-2018 of **24.9%**

Average open rate in 2018-2019 of **41.6%**



05

Education



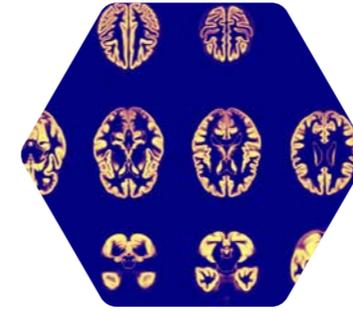
In 2018, the UCL Centre for Nerve Engineering hosted UCL International Summer School students. The three-week programme gave undergraduates studying Neuroscience a deeper understanding of the nervous system.

CDTs

FOUR NEW CENTRES OF DOCTORAL TRAINING (CDTs) FUNDED THIS YEAR WITHIN THE HEALTHCARE ENGINEERING REMIT

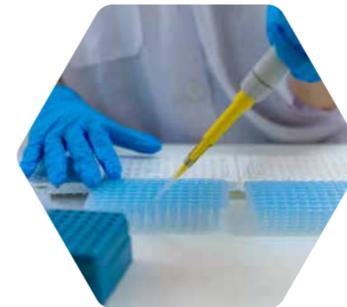
UCL has been awarded funding this year for four Centres of Doctoral Training within the healthcare engineering remit.

Three of these were awarded by EPSRC as part of a wider £40 million investment in CDTs at UCL, the fourth was part of £12.6 million award from UK Research and Innovation (UKRI) to help UCL create a new generation of AI leaders. These centres are training the translational healthcare engineering leaders of the future.



EPSRC Centre for Doctoral Training in Intelligent, Integrated Imaging in Healthcare (i4health)

The new i4health CDT will train the UK's future leaders in next-generation medical imaging research, development and enterprise, to produce intelligent, radical healthcare innovations focused on either imaging or imaging-enabled systems.



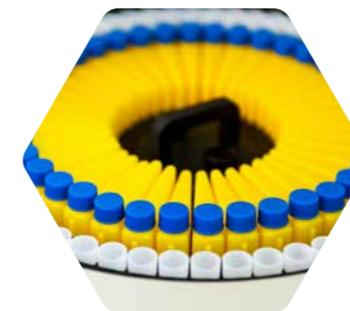
EPSRC Centre for Doctoral Training in Bioprocess Engineering Leadership (Complex Biological Products Manufacture)

This CDT trains the bioprocess engineering research leaders of the future to deliver translation of new scientific advances into safely produced, more selective and affordable therapies.



UKRI Centre for Doctoral Training in AI-Enabled Healthcare

The Centre combines UCL's excellence both in AI and computational science, and in biomedical research. They train future leaders to solve the most pressing healthcare challenges with the most innovative artificial intelligence solutions



EPSRC Centre for Doctoral Training in Transformative Pharmaceutical Technologies

In partnership with the University of Nottingham and the Synthesis & Solid State Pharmaceutical Centre in Ireland, this CDT trains the next generation of leaders for the pharmaceutical and healthcare industries.



GIVING STUDENTS HANDS-ON EXPERIENCE OF HOW ENGINEERING TECHNOLOGIES ARE USED AND NEEDED IN CLINICAL SETTINGS

In summer 2018, five students from the UCL EPSRC Centre in Medical Imaging spent two weeks gaining experience in a clinical setting through a 'Mini MD' course. The course places particular emphasis on interacting with patients and collaborating with clinicians.

“ We immersed ourselves in the clinical needs. We learnt how technology plays a central role, but sometimes we need to take a step back and consider what is the best solution for an individual patient, which isn't always the most technically efficient solution ”

— Maura Bello, second-year PhD student

INDUSTRY EXCHANGE NETWORK (IXN):

HELPING STUDENTS SOLVE REAL-WORLD PROBLEMS

Dr Dean Mohamedally (Principal Teaching Fellow, UCL Department of Computer Science) has been running the IXN initiative for over seven years – a programme which pairs computer science students with industry to solve technological problems.

There is a broad range of industry projects for different levels, with students ranging from BSc first-year students working on app design through to MSc-level students working on more advanced data science projects.

In the last year, Dean created a subset of the programme, 'IXN for the NHS' in collaboration with Microsoft, NHS Digital and the Apperta Foundation.

IXN for the NHS matches clinicians from across the UK with students based on topics from their degree. In 2018, the Department of Computer Science ran 86 projects for the NHS.

Technology arising from the programme is already being used in the NHS. The Topol Review (a government-commissioned report on how to prepare the healthcare workforce for digitalisation) recommended the IXN programme for enhancing state-of-the-art healthcare.

“Via the IXN I have been able to get access to a focused and capable student population to produce clinically-led proof of concepts that solve real needs and improves lives. As a consequence, I am able to provide proof of concepts quickly to clinicians that have no commercial risks and little technical risks. This allows one to help clinicians to be innovative within the boundaries of their technical and operational pathways

– Joseph Connor, NHS Digital



06

Global



A wearable brain scanner is used to image the developing brain of a young infant in Gambia as part of the Brain Imaging for Global Health (BRIGHT) project.

GLOBAL HEALTHCARE ENGINEERING RESEARCH

The below examples are just a glimpse of the diverse global research that is ongoing within UCL's healthcare engineering community.

Growing our collaborations with valued centres of international excellence and local partners over the next year is an exciting step that will allow us to do even more.



SHEDDING LIGHT ON INFANT BRAIN DEVELOPMENT

The Brain Imaging for Global Health (BRIGHT) Project is a longitudinal study following 200 Gambian infants and 60 UK infants from birth to 24 months. The researchers hope to gain insights into the effects that malnutrition, social or environmental difficulties, and increased risk of disease have on infant development.

A large amount of research highlights the detrimental impact that poverty has on child development but not much is known about the neural basis of these consequences. The project hopes to shed light on this by providing the first-ever brain imaging of infants in Africa.

The BRIGHT Project is co-led by Prof Clare Elwell (UCL Medical Physics and Biomedical Engineering) with a team of researchers from UCL, Birkbeck University, Cambridge and the London School of Hygiene and Tropical Medicine. The project is funded by the Bill & Melinda Gates Foundation and the Medical Research Council.





ROBOT-AUTOMATED SYSTEM CAN DIAGNOSE MALARIA

Fast and accurate diagnosis is essential for effective treatment, but access is a challenge faced by developing countries where malaria is endemic.

The FAST-mal (Fast, Accurate and Scalable malaria diagnosis) team is carrying out research to produce a fast robotic-automated computational system capable of reliably diagnosing malaria in sub-Saharan West Africa. The FAST-Mal system uses machine learning to support clinical decision making.

Dr Delmiro Fernandez-Reyes is PI. The project is a collaboration between UCL Computer Science and the College of Medicine of the University of Ibadan. The team were awarded by the £1.5 million EPSRC Global Research Fund.

IMPROVING MATERNAL HEALTH IN NEPAL

Perinatal women and their newborns are amongst the most vulnerable in disasters when access to healthcare advice and services may be reduced or non-existent.

Working in partnership with local rural communities in Nepal, the MANTRA project investigated hazard and risk perception, and building women's resilience by improving access to information and communications before, during and after disasters arising from geo-hazards.

The group co-designed an app through focus group discussions with local women. It has three modules: maternal health, neonatal health and geo-hazards. Women, including those who had never used a smartphone before, reported they enjoyed using the app and learned from it.

This project was led by Prof Maureen Fordham and an interdisciplinary team from the UCL Institute for Risk and Disaster Reduction and the UCL Institute for Global Health and external colleagues.





USING MOBILE TECHNOLOGIES TO TEST AND TREAT HIV

Mobile phone-connected HIV tests, which link to treatment, prevention and medical care are being developed for use in South African communities affected by HIV.

The mobile phone-connected diagnostic tools aim to widen access to testing in GP surgeries, in the community throughout developing countries, and in the home. The capability to detect infections and then wirelessly connect test results through a mobile phone app to healthcare systems will help patients gain faster access to treatment and support public health efforts to map indicators of emerging infections in real-time.

To help develop this app, the m-Africa project has initially focused on building a library of images of HIV point-of-care tests to train a machine learning model, being developed by the i-sense project at UCL. The model will automatically read the test results from a photo taken on a mobile device. The image library now has approximately 20,000 images being used for training models.

In parallel, a smartphone app has been developed and a prototype is currently being piloted to investigate participant feelings about self-testing using an app, as well as participant reactions to being told their test results by a device (rather than by a healthcare professional), and the phone counselling and support that follows.

Led by Prof Rachel McKendry, Dr Valérian Turbé, Dr Maryam Shahmanesh, the i-sense EPSRC IRC in Early Warning Sensing Systems for Infectious Diseases team and other colleagues from across UCL, Imperial College London and at the Africa Health Research Institute in KwaZulu Natal. The project is funded by the Medical Research Council GCRF Global Infections Foundation Award (MR/P024378/1) and is part of the EDCTP2 programme supported by the European Union.

DEVELOPING WHEELCHAIR-ACCESSIBLE MAPS OF DELHI

Researchers from the Global Disability Innovation Hub (GDI Hub) are working with the Indian Institute of Technology Delhi (IIT-Delhi) to create wheelchair friendly maps of the city.

The team are using low-cost sensors that can identify pavement features and determine the force wheelchair-users need to propel themselves. These sensors connect to the user's smartphone. Users can add geotagged photos and voice notes.

“Infrastructure in India can often make pushing a wheelchair or tricycle difficult. We're trying to identify how people are currently getting around in Delhi, to find new ways of facilitating rehabilitation and identifying ways to improve infrastructure.”

— Dr Catherine Holloway (UCL Interaction Centre) and Academic Director of the GDI Hub

mHEALTH INTERVENTION AND COMMUNITY MOBILISATION HELP BANGLADESH BATTLE DIABETES

Bangladesh has one of the highest growth rates of diabetes in the world, with approximately seven million cases in 2017. Rural communities are particularly vulnerable due to limited access to diagnostic tools or health information.

UCL researchers are targeting the problem by combining community outreach projects with the use of mobile phone technology to spread health information designed to prevent or manage the disease. The D-Magic project published results in the Lancet Diabetes and Endocrinology earlier this year, showing how community groups can cut diabetes risk by almost two-thirds.

“By the end of the project villagers had a much better understanding of how to prevent and control diabetes, many had started exercise clubs and even lobbied local markets to sell healthier foods.”

— Project lead and principal investigator, Dr Ed Fottrell.

The team of researchers from UCL Institute for Global Health and the Diabetic Association of Bangladesh was led by Dr Edward Fottrell (Director, UCL Centre of Non-Communicable Diseases). The Bangladesh D-Magic trial was fully funded by the Medical Research Council under the Global Alliance for Chronic Diseases (GACD).



Dr Patty Kostkova visiting partners at the University of Lagos, Nigeria

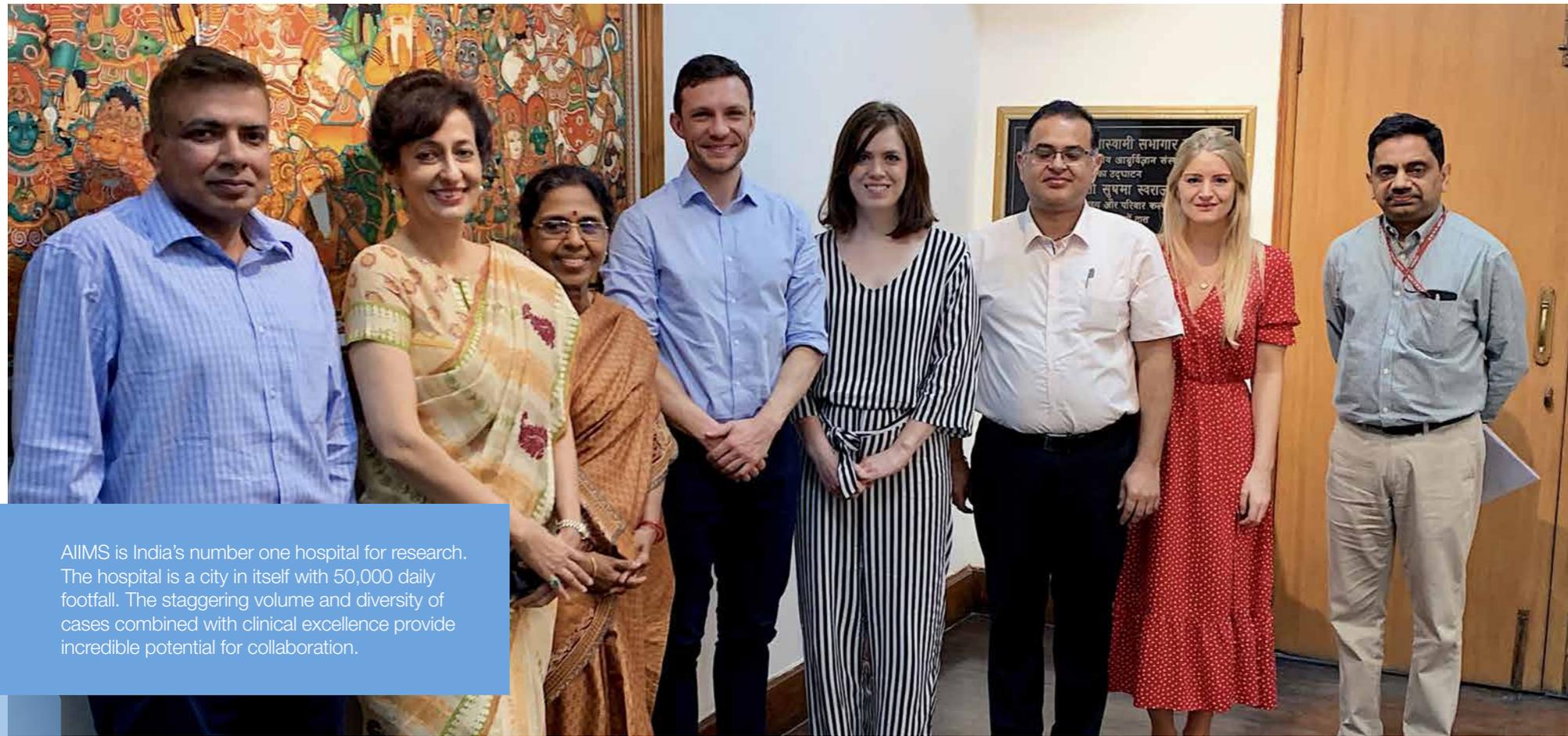
ENCOURAGING BETTER USE OF ANTIBIOTICS IN NIGERIA

Misuse and overuse of antibiotics contribute to the global issue of antimicrobial resistance. 20-50% of surgical antibiotic prescription in Nigeria is thought to be non-compliant with prescribing guidance published by the World Health Organisation.

Working in partnership with three hospitals in Nigeria, the GADSA (Gamified Antimicrobial Stewardship Mobile Decision Support App) project explored barriers to compliant prescribing for elective surgeries and the preliminary impact of a gamified smartphone app on prescribing behaviour change and compliance with guidance.

The group co-designed the app through focus group discussions with local surgeons. In-app feedback on prescription decisions is provided by an interactive 'mentor' and badges are awarded for compliant decisions and interaction with the app. The app is currently being piloted across the three sites but early data shows a positive impact.

The project was led by Dr Patty Kostkova with an interdisciplinary team from the UCL Institute for Risk and Disaster Reduction, the UCL Institute for Health Informatics, Public Health England and colleagues at Lagos University.



AIIMS is India's number one hospital for research. The hospital is a city in itself with 50,000 daily footfall. The staggering volume and diversity of cases combined with clinical excellence provide incredible potential for collaboration.

ADVANCING PARTNERSHIPS IN AFFORDABLE TECHNOLOGIES

IHE-India: case-study of international collaboration

In April 2019, IHE and WEISS visited Delhi, India to advance partnerships around affordable technologies. We visited the All India Institute of Medical Sciences (AIIMS) and the Indian Institute of Technology (IIT-Delhi), both world-renowned centres of excellence in frugal innovation for healthcare.

Our trip built on previous visits from UCL representatives, including the UCL President and Provost Prof Michael Arthur, and collaborations being led by our Pro Vice Provost South Asia, Prof Monica Lakhanpaul.

We are continuing to grow this partnership and will be welcoming a delegation from India to our Global Healthcare Engineering Symposium in July. We have also begun an undergraduate exchange programme that sees the first five students from AIIMS attending a summer school with us next month.

APPLYING ENGINEERING TECHNOLOGIES TO TACKLE THE GLOBE'S BIGGEST HEALTHCARE CHALLENGES

Developing innovative technologies that are also affordable is a necessity in the healthcare landscape of emerging economies like India, as medical practitioners often have to deliver services where infrastructure is limited. Within India a significant proportion of its 1.4 billion citizens live near or below the poverty line and medical care is generally paid for out of their own pockets, meaning that product development must be inexpensive in order for it to be adopted.

What is significant, is that this low-cost constraint has not compromised the quality of the healthcare innovations coming out of India. Affordable, effective and accessible alternative solutions are being created for patients with regularity.

Collaboration with our Indian partners offers exciting potential for bidirectional learning. It is a chance to explore how the kind of digital and engineering technologies that we are developing at UCL could be applied to effectively work in low-resource settings. By working with partners on the ground we can get a better sense of what the real challenges are and what is needed to make technologies translatable and usable.

There is also a lot to be learnt from India's approach to affordable innovation. As the NHS faces its own resource constraints, this need has become particularly pertinent. Reversing a frugal mindset back into our own UK-based research offers the potential to save the NHS significant resources, which could then be directed toward patient care instead.



PARTNERSHIPS OF EQUIVALENCE & BUILDING A DISABILITY MOVEMENT

Blog by Dr Cathy Holloway, Director of the Global Disability Innovation Hub (GDI Hub)



Partnerships of equivalence was a term I first heard in Delhi. It was used by UCL's Vice-Provost International, Dame Nicola Brewer to explain the types of relationship UCL enters into as part of its Global Engagement Strategy. Such partnerships of equivalence – reciprocal relationships of mutual respect – depend on commitment to build trust and to engage for the long term. They are relationships to which both parties have something significant to offer. Subsequent learnings will naturally flow in both directions. Critically, they allow for more than the sum of just combined individual activities. They lead to significant, sustained change.

I was reminded of partnerships of equivalence during a recent workshop in South Africa to develop a Pan-Africa network to advance disability research. The workshop was held in the University of Kwazulu Natal in Durban, South Africa. It had two broad aims. First, to establish a sustainable partnership between Global North and Sub-Saharan Africa disability researchers, which would serve as a foundation for knowledge sharing and skill transfer to advance excellence in disability research. Second, to develop a strategy to build disability research hubs with African researchers to improve research and training capacity in Africa and in the field of disability more generally. Funding for the workshop was awarded through a GCRF bid to Paul Lynch at the University of Birmingham and developed with Jill Hanans-Hancock (MRC, South Africa) and Hannah Kuper (LSHTM).

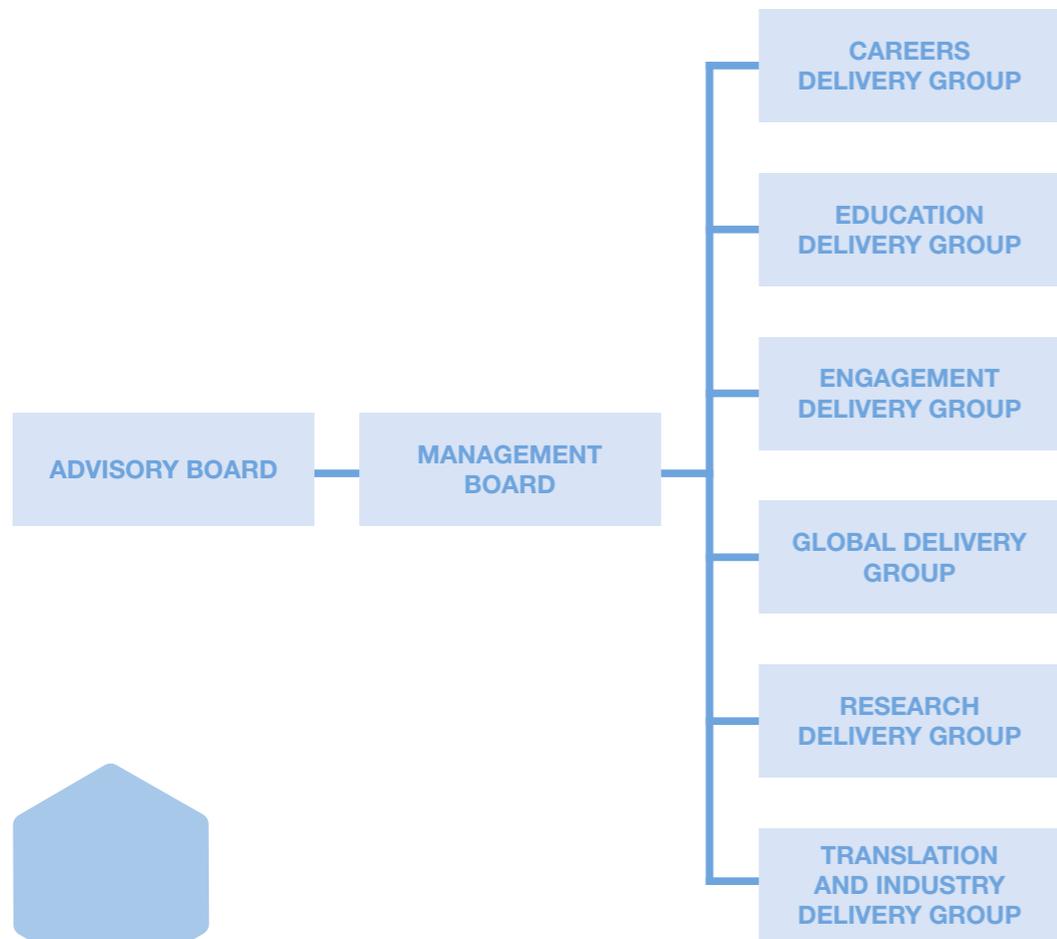
The workshop represented the opportunity to develop partnerships of equivalence between Sub-Saharan African institutions, within these institutions and with partners from the Global North. There was a rich discussion about power dynamics within these relationships. Noting the much-tainted past of colonialism which still lingers in South Africa in particular. The relationships between scientists and disabled people and disabled peoples' organisations was also richly explored. Unpicking the complementarities between, for example AFRINEAD and the new network. In all cases what emerged was a need for collaboration, joint exploration and bold vision.

One discussion in particular stands out as it reminded me of our initial work to establish GDI Hub. Jacques Lloyd who is an expert in both rehabilitation and advocacy described the work he is doing to establish community-level disability sports days across South Africa. With minimal funding, a lot of hard work, and crucially through partnerships with local people and agencies, Jacques has successfully developed a recipe of sporting events to improve health and wellbeing. Pairing sporting events open to all levels of ability with critical healthcare interventions such as connection to assistive technology services and HIV screening. The photos reminded me of National Paralympic Day in London and Motivate East. Things I had not heard of before we began the journey of GDI Hub; but essential building blocks of the disability innovation foundations.

On leaving the workshop I felt the same excitement I had once felt when setting up the GDI Hub – the tingling feeling you get when you know that people are coming together to do something new and extraordinary.

The workshop has laid the foundation for a co-developed new agenda for disability research in Africa. GDI Hub is humbled, privileged and excited to have a role in shaping this exciting, timely and ambitious endeavour. Watch this space!

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New advancements in robotic technology are transforming the way that surgery is performed. Claudia D'Ettoire and George Dwyer demonstrate this potential using a KUKA robot arm.

THANK YOU

We have done our best to acknowledge those involved throughout this report, but know that our thanks extend far beyond those named. In science we stand on the shoulders of giants that have gone before, but also owe it to the invaluable support of the teams that surround us. All our efforts are a truly interdisciplinary endeavour and would not be possible without the combined input of our researchers, professional staff, external partners, funders and the public.

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We're always interested to hear from potential collaborators, curious members of the public or interested others.

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