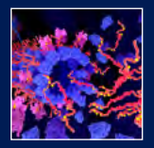
INNOVATION insights

THE LATEST INNOVATIONS, COLLABORATIONS AND TECHNOLOGY TRANSFER
FROM THE UNIVERSITY OF OXFORD

ISSUE 13 OCTOBER 2019

CAN AI IMPROVE HEALTHCARE?

The challenges and opportunities for World-leading AI researchers



Targeted drug delivery for brain diseases ▶

A catalyst for sustainable fuels ▶

A novel surgical tool for an orthopaedic hip replacement ▶

Increased channel capacity in telecommunication networks ▶

OXFORD UNIVERSITY INNOVATION

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INNOVATION insights

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A world-leading innovation ecosystem…

…with Oxford University at its heart.

It takes time to build an ecosystem – and whilst the University is over 900 years old, OUI has 'only' been in existence for just over 30 years. But there's no doubt that the ecosystem is developing both in the breadth of support it offers and its reach across the globe. Three completely separate developments over the past few months illustrate this well.

Firstly the "AI@Oxford" conference in September demonstrated how Oxford is a magnet, not just to leading academics, but also to businesses and policy makers keen to be at the forefront of technology that is already changing the world we live in. With more than 250 organisations and 700 delegates involved, the conference drew international attention, including from the Wall Street Journal.

Many of the new ventures created by OUI differentiate themselves by applying machine learning and AI to challenges from medical diagnoses to extracting meaning from large datasets.

A number of our partners in the Oxford Cluster participated in the conference. The cluster itself became easier to visualise with the launch of our Cluster Map illustrating the vitality of the region – more details are in a news item in this issue.

And finally we welcomed a new partner from across the pond to join our pool of investors. Osage University Partners, a seasoned US-based investor in university startups, has selected Oxford as its first UK institutional partner and is now evaluating investment opportunities within the Oxford University spinout community.

The ecosystem is thriving – read more in this edition, and please do send your feedback.

News

Mapping entrepreneurial success
OUI have launched an interactive map showcasing all the tech, media, investment, and corporate companies in the Oxford cluster.

FULL ARTICLE ▶

GitHub secures code analysis platform
Semmle, an Oxford-based spinout developing a code analysis tool, has been acquired by Microsoft-owned GitHub.

FULL ARTICLE ▶

Oxford leads commercial innovation
Oxford's innovation output and the surrounding Oxford Cluster take centre stage in the Wall Street Journal feature on European university innovation.

FULL ARTICLE ▶

Oxford spinout discovers next generation herbicide chemistries
Founded in 2018 from Oxford University's Plant Sciences Department, MoA Technology has secured £6.3M Series A funding with an aim to combat a global herbicide resistance crisis.

FULL ARTICLE ▶

Smart water technology
Mixergy, an Oxford spinout developing smart hot water solutions around the home, has partnered with Centrica on the latter's expansion into smart home technologies.

FULL ARTICLE ▶

Targeted drug delivery for brain diseases

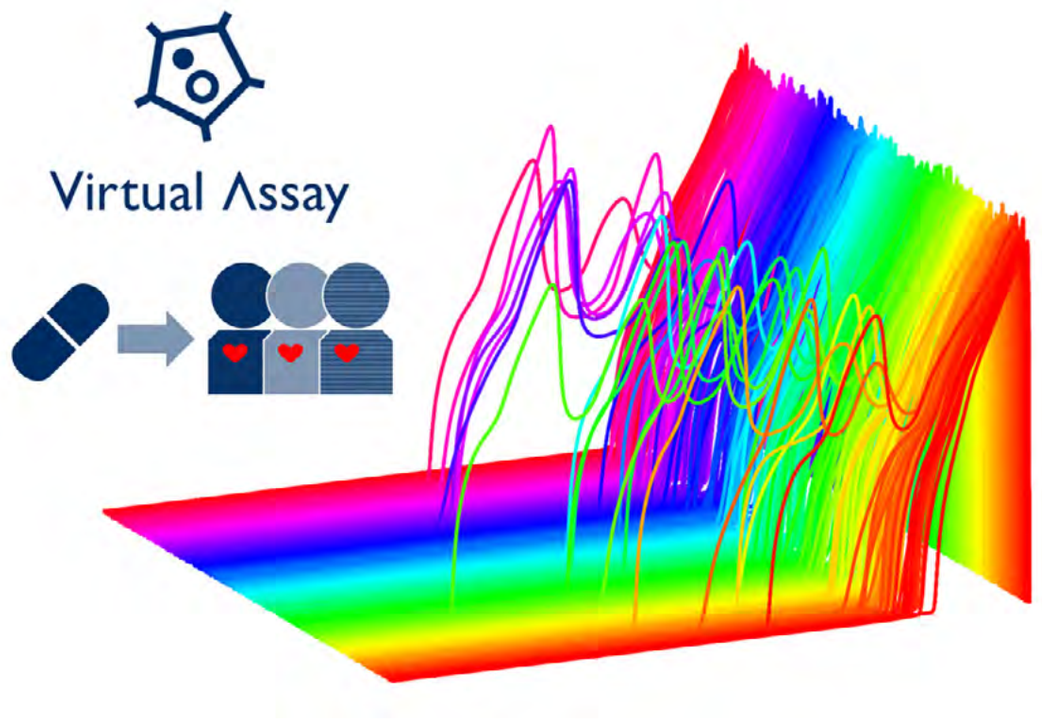
Tauopathies are a class of neurodegenerative diseases characterised by abnormal tau proteins, abundant neural proteins which are thought to play a role in a number of diseases by aggregating within cells, leading to cell death and cognitive decline. Alzheimer's disease is the most prevalent tauopathy and the leading cause of dementia, which affects around 850,000 people across the UK.

Researchers at the University of Oxford have identified a novel method for selective drug delivery by targeting liposomes, a spherical lipid vesicle containing the active agents, to molecules that are able to cross the blood brain barrier, thus enabling drug to accumulate at sites of interest within the brain.

FULL WEB PROFILE ▶

Virtual Assay drug screening software V.3.0

Virtual Assay, user-friendly and easy to use, offers a quick and economical methodology for *in silico* drug trials, with the potential of replacing *in vitro* animal experiments in the pre-clinical phase of drug development.



Virtual Assay starts with well-understood and biophysically detailed cellular cardiac models and modulates the parameters to generate a range or population of models, accounting for inter-cellular variability. These populations are then calibrated against experimental data, retaining only those models in range with experimental observations.

Once calibrated, these populations can be used to analyse the effects of different pharmaceutical agents on cardiac cellular responses. Models in the population will respond differently to the same input, thus giving a qualitative and quantitative evaluation of drug-induced changes at the population level and allowing for predictions of risk of adverse cardiac events following drug application.

FULL WEB PROFILE ▶

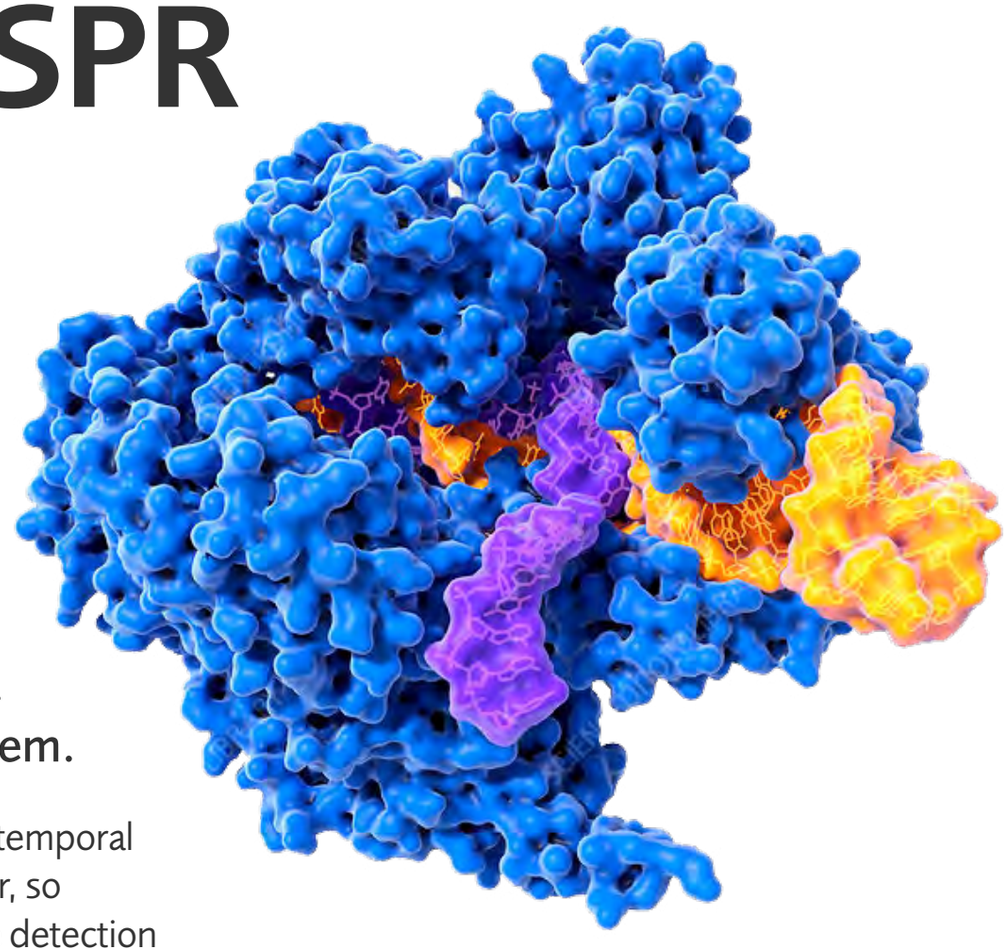
Single cell analysis technology

Single cell isolation is a core part of many biologically important workflows where it is essential to confirm that a selected colony derives from a single cell. This is important in a research context to provide high quality data and, in a commercial environment, to meet regulatory requirements.

Researchers at the University of Oxford have developed a new technique for ensuring monoclonality which relies on fluid walls, interfaces and the ability to "flatten" droplets to enhance optical clarity. This new method enhances optical clarity by replacing standard well plates with fluid wall arrangements (i.e. the liquid/fluid interface of a droplet becomes the bounding fluid wall), thereby eliminating the "edge effect" problems that occur with well plate walls.

FULL WEB PROFILE ▶

Logical control of CRISPR gene editing system

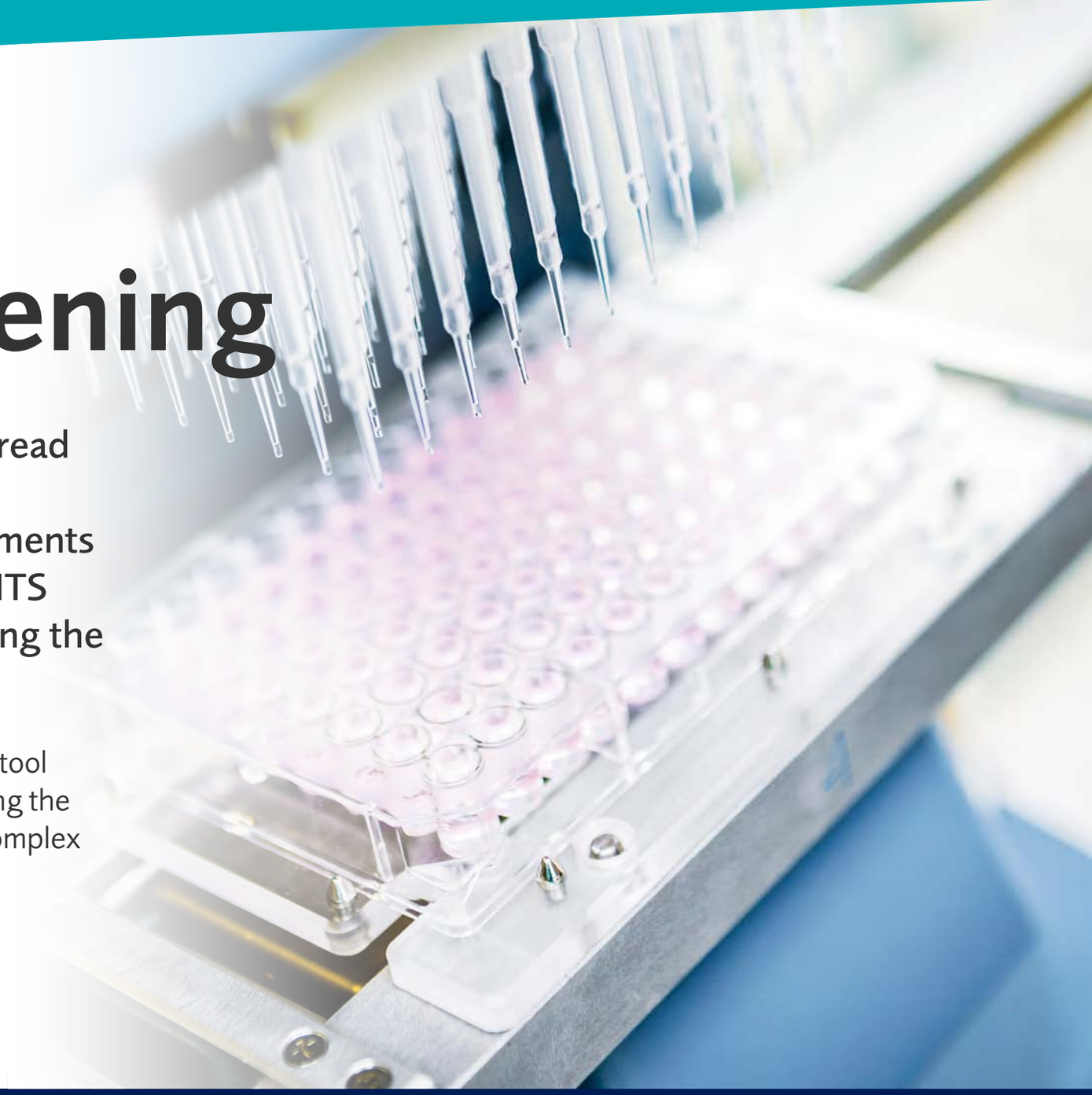


The recent development of gene editing using biological system CRISPR, creates the prospect of dramatic developments in medicine for gene repair and cancer therapy. The CRISPR/Cas9 system allows targeted DNA cleavage and hence editing of the human genome. However, unwanted DNA cuts, resulting from non-specific delivery to off-target cells, could promote tumorigenesis. Cell-specific activation of CRISPR/Cas9 is essential to avoid this problem.

Researchers at the University of Oxford have developed a control system that allows spatio-temporal activation of CRISPR, based on an engineered RNA guide strand. This technology is modular, so both targeting and sensing can be adapted to allow new genes to be targeted, subject to the detection of new biomolecular triggers. It also provides a platform technology that can be applied to any gene therapy based on

FULL WEB PROFILE ▶

Simplifying high throughput screening



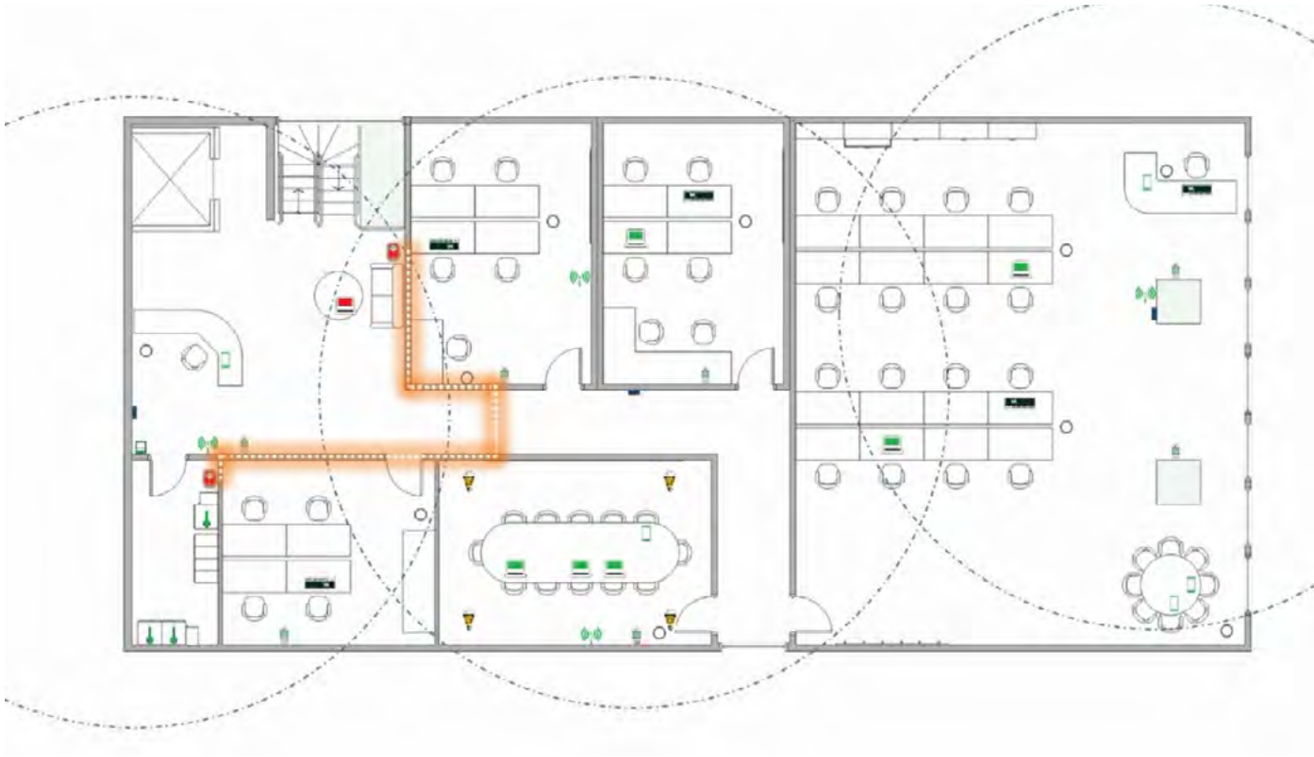
High throughput screening (HTS) has found widespread use in the field of drug discovery, allowing users to conduct hundreds or thousands of biological experiments simultaneously. Despite the rapid advancement of HTS methods, there are very few tools capable of analysing the complex and varied data produced.

Researchers at the University of Oxford have developed HTScape, a tool that can analyse data from a range of HTS experiments. By normalising the HTS data, HTScape can offer a truly flexible method for visualising complex datasets and designing validation studies.

FULL WEB PROFILE ▶

A method for detecting power line communication

Power line communication occurs where electrical wiring is used to carry data in addition to electrical power. This enables a network that already distributes electrical power, such as in a building, to also distribute data signals, essentially creating a local area network without having to install dedicated wiring. Power line communication also offers a viable alternative for data transmission in industrial control, embedded sensing and automotive applications.



Researchers at the University of Oxford have recognised the need for improved power line security and have developed a solution in the form of a novel electromagnetic receiver for the wireless detection of unauthorised power line networks and users.

FULL WEB PROFILE ▶

Deep vein thrombosis diagnostic device

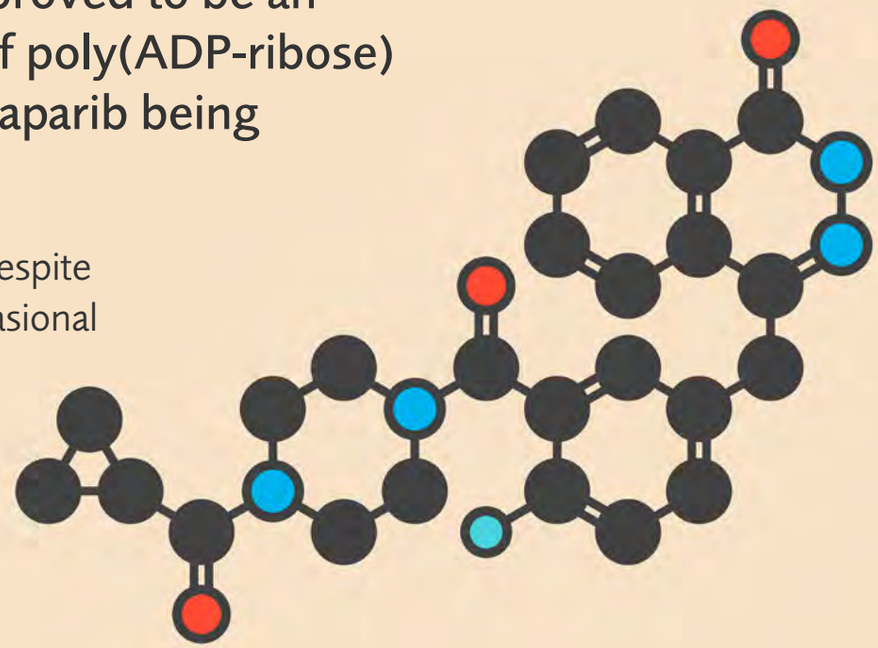
Deep vein thrombosis (DVT) is a blood clot that forms within the deep veins of the limbs. If left untreated, half of these blood clots will travel to the lungs, forming a pulmonary embolism, which is a leading cause of death. There are 104,000 annual cases of DVT in the UK, costing the NHS £640 million. A 2016 survey of over 1,000 UK GPs indicated that a more accurate DVT diagnosis is the top need to reduce referrals.

Researchers at the University of Oxford have developed an easy-to-use point-of-care solution that can help to screen DVT patients in primary care, avoiding the need for unnecessary referrals and treatments.

FULL WEB PROFILE ▶

Non-invasive PET imaging of PARP expression

The manipulation of the genomic instability of tumorous tissues have proved to be an efficient anticancer therapeutic method. More specifically, inhibitors of poly(ADP-ribose) polymerases (PARP) enzymes have been a popular subject of study, olaparib being (Lymparza®) the first PARP inhibitor to be clinically approved.



A number of clinical trials currently study the use of olaparib in diverse therapies, however, despite the considerable successes, resistance to PARP inhibition often occurs in patients due to occasional low PARP enzyme expression in tumours. Positron emission tomography (PET) has emerged as a popular non-invasive evaluation method to reveal the PARP expression in tumours. Several radiolabelled olaparib analogues have been used in PET studies, however, their structural deviation from olaparib makes them incompatible for further development.

Researchers at Oxford have tackled this limitation and developed the first 18F-labelled olaparib, thus allowing in-vitro and in-vivo monitoring of olaparib accumulation in tumours.

FULL WEB PROFILE ▶

A novel surgical tool for an orthopaedic hip replacement

Total hip replacement is one of the most frequently performed surgeries in the UK and around the world. In 2017 there were a total of 94,184 procedures performed in England and Wales. (NIHR, 2019)*

Due to wear and tear, a hip implant can become uncomfortable and painful for the patient, resulting in further surgery, which can occur 1 in every 10 patients. It is often difficult for the surgeon to separate the hip replacement components during the revision surgery, with no specific tool currently available.

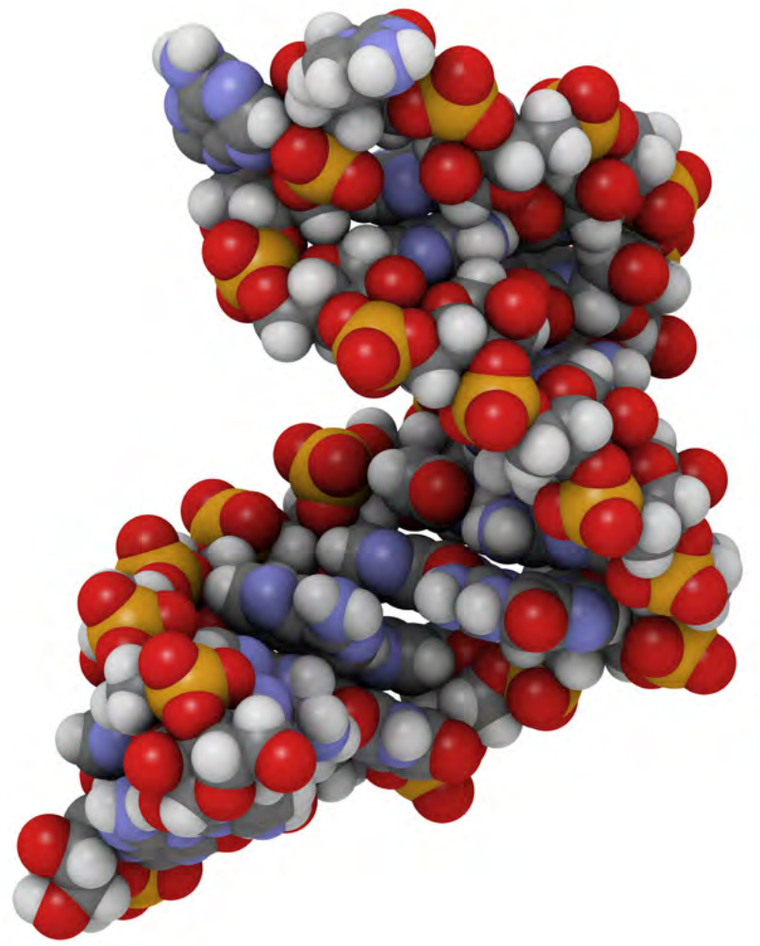
Engineers at Oxford University and orthopaedic surgeons at West Middlesex University Hospital have designed and prototyped a novel surgical tool which allows the easy extraction of the head component, without applying undue force to any other parts of the orthopaedic implant. This tool has been optimised to provide the correct forces and displacements for a wide range of head-stem combinations.

* doi: 10.3310/signal-000771

FULL WEB PROFILE ▶

Manipulating gene expression in mammalian cells

Precise regulation of gene expression is critical for development, homeostasis and regeneration in mammals. Perturbations in gene regulatory programs that lead to aberrant protein production can have profound developmental consequences and underpin the aetiology of many human diseases, including cancer. In contrast, commonly used experimental and therapeutic approaches such as knock-in/out strategies are more suitable for binary control of gene activity.



Oxford researchers have developed a method for analogue control of gene expression levels in mammalian cells using engineered, synthetic microRNA response elements (MREs). In-depth studies in a variety of cell types revealed that the system has the capacity to achieve control of gene expression output to within 1% of any desired level. This innovative platform opens new possibilities of intervention in human genetic diseases where controlling the levels and/or spatial-temporal activity of endogenous genes or therapeutic transgenes could provide a curative strategy.

FULL WEB PROFILE ▶

A new method to predict the growth in abdominal aortic aneurysms

Predicting the future rate of abdominal aortic aneurysm growth is a particularly useful tool in guiding the management of abdominal aortic aneurysm (AAA). Slow growing aneurysms will require less frequent monitoring, whereas as fast-growing aneurysms would benefit from early intervention. Currently the threshold for AAA repair is defined by the size of the AAA and not the biological behaviour of the AAA within the affected individual.

The ability to predict the rate at which an aneurysm will progress will enable us to stratify the clinical need in terms of monitoring and intervention.

Researchers at the University of Oxford have devised a method for predicting the rate of growth of abdominal aortic aneurysms in humans using the pulsation characteristics of an artery during ultrasound imaging, such as the brachial artery of the arm.

FULL WEB PROFILE ▶

Targeting different activation states of Ras to treat cancers

In the UK, over 350,000 people are diagnosed with cancer each year. Approximately 20% of these tumours are caused by genetic mutations that permanently activate Ras proteins, making it a key drug target in oncology. Ras proteins are a family of proteins involved in the activation of cell growth and cell survival genes. Activated Ras proteins lead to multiple downstream protein-protein interactions that ultimately result in the transcription of a number of genes that promote cell growth and survival.

Researchers at the University of Oxford have devised a method of obtaining small molecules that have the same properties as larger, validated Ras inhibitors that are unable to access the intracellular targets. These small molecules can bind to Ras proteins and prevent further protein-protein interactions, inhibiting the activation of oncogenic genes commonly associated with cancer proliferation.

FULL WEB PROFILE ▶

A catalyst for sustainable fuels

Jet fuels are a type of aviation fuel consisting of a mixture of different hydrocarbons with carbon chain lengths that vary from C8-C16 and C5-C15. In recent years, demand for synthetic jet fuels has increased due to the reduction of pollutants and carbon emissions associated to their use compared with conventional jet fuels.

Despite the benefits associated with the use of synthetic jet fuels, their formation through Fischer-Tropsch synthesis (FTS) typically involves additional emission processes and energy costs.

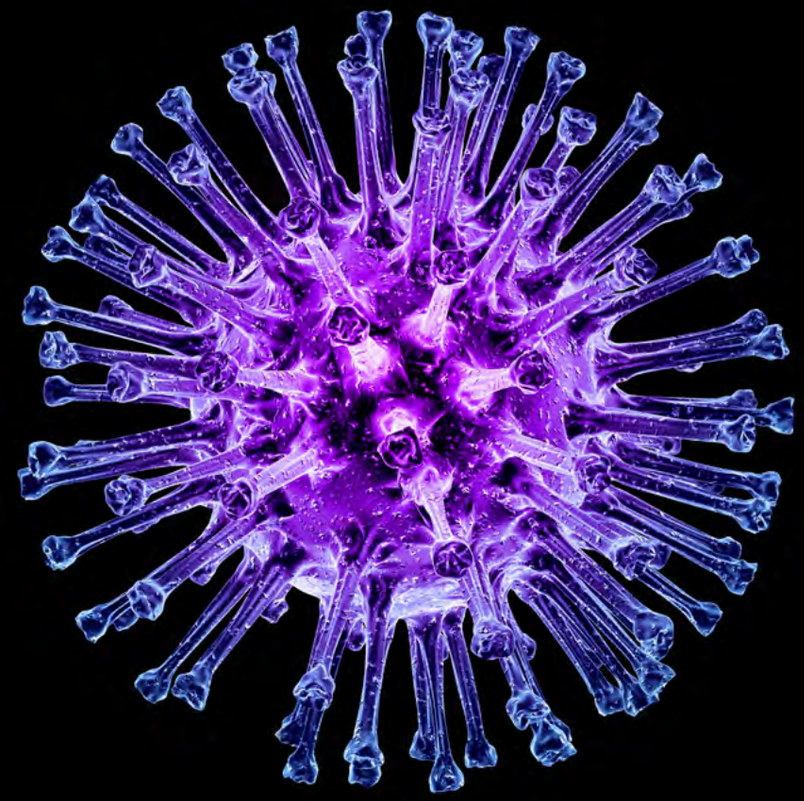
Researchers at Oxford have tackled this issue and developed a novel and sustainably formed catalytic system for the hydrogenation of CO_2 and/or CO to form the desired jet fuels.

FULL WEB PROFILE ▶

Broad-based flu vaccine with superior safety and delivery profile

Researchers at Oxford have developed S-FLU, a novel live attenuated influenza virus vaccine that could be used safely in the face of a new pandemic strain of influenza, and for seasonal strains.

S-FLU has been uniquely engineered with the ability to provide broad T cell-based protection across type-A viruses, the constantly changing form of influenza responsible for both seasonal flu and the vast majority of epidemics. Furthermore, risks associated with genetic transmission from the vaccine virus into seasonal flu has been eliminated, and efficacy is comparable to FluMist®, the best-in-class licensed live attenuated influenza vaccine.



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Chemical recycling of plastic waste

Plastic materials are widely used throughout the world, and many forms of plastic materials will be more extensively used in the future. However, it is well known that many plastic materials, due to their stability in use, are not bio-degradable and that significant problems exist in the disposal of such materials.

Pyrolysis for the conversion of waste plastics into synthetic crude oil mixture and mixed distillates has drawn great commercial interest due to increasing oil prices. However, the stability and quality of these oil products is low and thus subsequent treatment is required to obtain valuable products.

Researchers at Oxford have developed a novel and sustainable catalytic system and process for the depolymerisation of waste plastics to produce very high value constituent monomers of thermoplastic polymers. Consequently, this could achieve a truly circular economy of plastic usage.

FULL WEB PROFILE ▶

Increased channel capacity in telecommunication networks

Devices using high capacity telecommunications consists of multiple links, connected by electronic processing nodes, switches or cross-connects. In order to increase the data transfer rate for the available bandwidth, telecommunication signals are transmitted as encoded signals, with two or more modes of electromagnetic radiation typically encoded and transmitted together.

Dividing the capacity of the data transfer medium into multiple modes may be achieved by using intensity orthogonal states. Conventional detectors can separate multiple modes of electromagnetic radiation that have been multiplexed and transmitted in this way.

Researchers at the University of Oxford have developed novel devices and methods for de-multiplexing two modes of co-propagating electromagnetic radiation, wherein the two modes of electromagnetic radiation are orthogonal to each other.

FULL WEB PROFILE ▶

Powerful targeted proteomics technology

The Advanced Proteomics Facility (APF) at the University of Oxford has a long-standing reputation for providing service work to external organisations. The facility has recently been working with Sharp Life Sciences (EU) Ltd. (SLS), providing protein identification services to demonstrate the advantages of SLS's innovative solution for automating the preparation of proteins for mass spectrometry analysis.

The product is built on SLS's aQdrop microfluidic lab-on-a-chip technology (https://www.aqdrop.com/) and enables users to prepare consistently high quality samples with minimal hands-on time and up-front cost. SLS knew of the APF's reputation as an excellent research facility and provided feedback that "the staff at Oxford APF have always been extremely helpful and flexible, and the data we have received has been excellent."

A number of other facilities at the University make their equipment and services available to external organisations. Please see the link below for more examples and click 'Contact Us' if you would like to find out more about what is available.

FURTHER INFORMATION ▶

Optical computing based on phase change materials

New and exciting approaches and architecture designs are transforming the world of computing. Photonic computing represents a solution with many advantages over traditional semiconductor systems, including higher transmission speeds, lower energy consumption and systems miniaturisation. Widespread implementation of photonic computing requires the development of efficient optical transistors and non-volatile optical memory.

Based on previously developed micro optical switches and all-photonic memory based on phase change materials (PCM), a collaboration of researchers at the University of Oxford has developed systems and techniques to utilise these components effectively in future optical processing and memory units. These developments help pave the way towards optical memcomputing devices (devices that carry out both data processing and storage) and creating "photonic synapses" and "optical neurons".

FULL WEB PROFILE ▶

AI@Oxford showcase the future of AI research

There's few technologies that have captured the human imagination like artificial intelligence (AI). Sci-fi authors have long drawn on the concept, with artificial antagonists enslaving humanity, while more modern thinkers point out that we're already ruled by algorithms. From startups looking at machine learning and data modelling that make sense of a world addicted to data to imaging diagnostics revolutionising software to the evolution of supply chain and manufacturing to journalism and social media, there's few areas of human civilisation yet to be touched by AI, which has rapidly become one of the biggest and most influential technological advancements of recent years.

Unsurprisingly, Oxford University has not escaped AI's rise. Home to one of the top computer science departments on the world and awash with departments, institutes and academics researching into AI across the institution, the University has become a global powerhouse in AI. Further afield in the Oxford Cluster, the ecosystem has seen an avalanche in spinouts either developing AI or utilising AI in recent years.

To showcase this strength, Oxford University Innovation led on hosting AI@Oxford, the University's biggest ever tech conference, this past September at Said Business School.

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INNOVATION insights

FEATURED ARTICLE

A two-day event, AI@Oxford drew 700 delegates across all disciplines and walks of life. Split over three streams, tech, healthcare and society, the event aimed to bring together our AI academics with spinouts active in this space and players from tech, pharma, media, the investor community, government and more to inspire interdisciplinary thinking on AI.

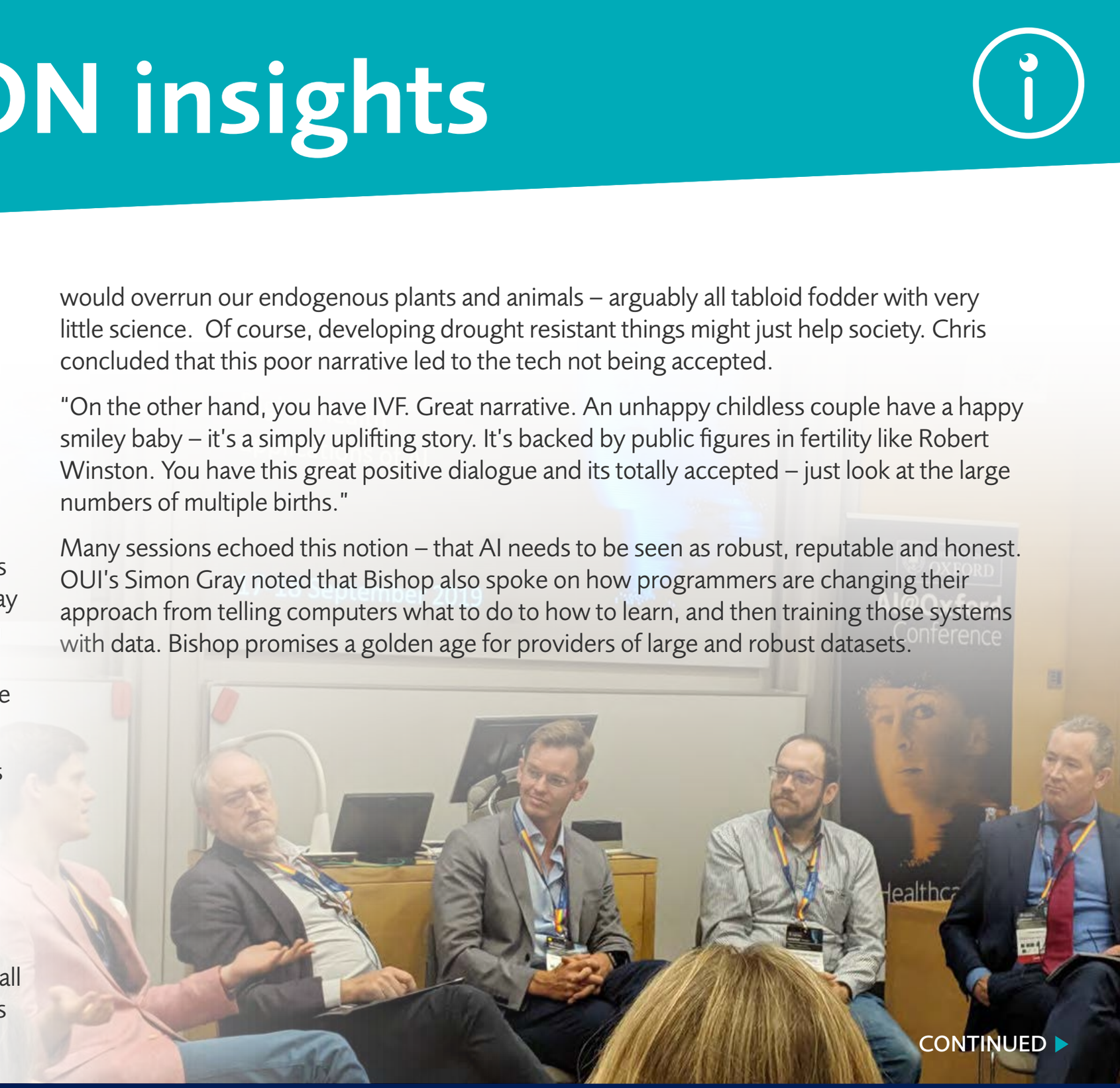
The communications surrounding AI developments has increasingly been seen as by insiders as runaway publicity with little substance as eager startups spin narratives lacking in evidence to journalists hungry for the next AI headline. Consequently, much of the conference looked to cut through the hype of AI.

The topic was central to a keynote from Microsoft's Chris Bishop, who discussed hype vs reality in relation to AI.

"He spoke about adoption of technology with reference to AI," reported OUI's Jamie Ferguson. "Take GMO crops for example. They have really never been accepted in Britain as the narrative has all been about Frankenstein foods and how the GMOs would overrun our endogenous plants and animals – arguably all tabloid fodder with very little science. Of course, developing drought resistant things might just help society. Chris concluded that this poor narrative led to the tech not being accepted.

"On the other hand, you have IVF. Great narrative. An unhappy childless couple have a happy smiley baby – it's a simply uplifting story. It's backed by public figures in fertility like Robert Winston. You have this great positive dialogue and its totally accepted – just look at the large numbers of multiple births."

Many sessions echoed this notion – that AI needs to be seen as robust, reputable and honest. OUI's Simon Gray noted that Bishop also spoke on how programmers are changing their approach from telling computers what to do to how to learn, and then training those systems with data. Bishop promises a golden age for providers of large and robust datasets.



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"However, later on in the day, the dangers of systems being trained with biased datasets was explored," added Gray. "AI-based systems, with so much potential to benefit society, may reinforce and embed historical biases and prejudices, without any prospect of 'correction'.

How willing are we, individually and as a society, to put our lives in the hands of 'black box' systems, operating not as designed by a programmer, but according to inferred rules from historic data?"

Oxford, with its multi-disciplinary expertise, and pre-eminence in fields from new technologies to societal development, is ideally placed to answer these sorts of questions – as demonstrated by the strong debate around ethics in AI throughout the conference.

Devoting a large chunk of the second day to the £150m donation to Humanities Division underwriting a new centre for Ethics in AI at Oxford, Sir Nigel Shadbolt kicked off a series of discussions on the topic.

"We had sessions highlighting how AI can be used for political means, how there is a shortage of people who really understand AI, and how it should be people that don't understand the technology that need to be involved in how it is being misused and contesting it so that mistrust in society can be addressed with mistakes being made public and transparent," reports OUI's Emilie Syed.

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INNOVATION insights

"There was a consensus that ethics needs to be integrated as early as possible, right from the mathematical point of view with fair algorithms and unbiased data. This should be done in a practical way because while it is quite easy to agree on high principles like fairness, it is quite a different matter when one gets into the nitty-gritty of how to implement it. Most interesting and compelling was the idea that Ethics in AI should be akin to Medical Ethics, which everyone takes for granted and has existed since the very beginning of medicine. This has enable medical establishments to deal with difficult issues such as informed consent, equitable access, and brain death. Thus software developers should be held accountable just as doctors are with the Hippocratic oath."

Paul Ashley, OUI's Head of Life Sciences, noted a similar theme in the healthcare stream.

"Here at OUI, we know better than most that exciting and innovative things happen when smart people from different disciplines get together. It was great to see leaders in ethics brought into a future healthcare discussion. The Ethics in Healthcare AI provided session of fascinating insights and I could tell from the eyebrows in the audience that many had not realised the strong need for ethical consideration alongside the drive for healthcare benefits."

Alongside the sessions, AI@Oxford also saw fringe events at the Jam Factory on AI in art and at the Foundry on AI in tackling climate change, a potential theme for a future conference of similar scale. For readers looking to find out more about what was said at AI@Oxford, be sure to follow OUI's Twitter where videos will be made available over the coming weeks.

FULL WEB PROFILE ▶

A space for innovation

Agile Lab – a shared space to develop and commercialise scientific research

Housed within the centre for Innovation and Enterprise at Oxford University's Science Park in Begbroke, the Agile Lab gives pre- and early stage startup companies the space for proof of concept and prototype studies. The space comprises a large laboratory with shared equipment and dedicated laboratory technician, and an adjoining office.

Low rental cost: £400/month allows the tenant a 1.8m bench space, access to lab equipment and write-up space.

Flexible tenancy: 6 month minimum.

Be part of the CIE community

For more information contact: **agilelab@begbroke.ox.ac.uk**

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OXFORD INNOVATION SOCIETY 2020

The Oxford Innovation Society (OIS) is an open innovation network for industry, academia, and investors. The next meeting will be held on:

- Thursday 26 March

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner.

Membership details on www.innovation.ox.ac.uk/ois

INNOVATION insights

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