



UNLEASHING INNOVATION

**London's Life Sciences Sector:
The Fight Against COVID-19**



INTRODUCTION

– Neelam Patel, CEO, MedCity



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CEO, MedCity

COVID-19 has thrown us into unprecedented times in every aspect of life. The global impact has been profound and the life sciences sector worldwide has refocused efforts and resources to tackle a pandemic which has already claimed too many lives.

The health and life sciences ecosystem has been rapid in its response - fighting COVID-19 through research, innovation and collaboration. The extent of the region's reply exemplifies the cluster's strength in the co-location of the clinical, academic and industry; cross-institutional collaboration; world-class universities, our three Academic Health Science Centres and big data assets.

Together our ecosystem has also made insightful contributions to the national effort, with 41 members consulted as part of the Scientific Advisory Group for Emergencies (SAGE), 1,125 staff members (from clinical academics to technical staff) seconded

to the NHS, and 37 high priority Public Health England clinical trials carried out.

A clear example of this is the London COVID-19 Alliance, set up by MedCity. Through the Alliance, world-leading universities, institutions and partners, including King's College London, Imperial College London, UCL and Queen Mary University of London, have worked closely with Government and agencies across London, offering expertise and innovation, joining in the national effort to tackle the pandemic.

Unleashing Innovation shares some key examples of the world-leading science taking place across London in: vaccine development; diagnostics and testing; treatment; data, disease modelling and genomics. Collaboration, innovation and excellence are at the heart of what has been achieved and we must harness this as a legacy that lives on through life sciences research in London post-pandemic.

To date we have gathered over 350 examples of ground-breaking projects across the ecosystem. You can visit our interactive COVID-19 Unleashing Innovation Map to discover more examples and themes: for example, the ground-breaking work tackling the issue of mental health during the pandemic.

At MedCity we are extremely proud, and, privileged, to play a role in forging collaborations and developing networks that enable London and the greater south east's life sciences ecosystem to unleash innovation through research for the benefit of the UK and beyond. Never has this been more critical than now as we unite globally to overcome COVID-19.

THE CENTRE OF A GLOBAL RESPONSE...

London's life sciences ecosystem has been strong nationally and internationally, in the fight against COVID-19....

37



HIGH PRIORITY PUBLIC HEALTH ENGLAND STUDIES ACROSS LONDON



2

VACCINE TRIALS IN PROGRESS

14+



ANTIBODY AND ANTIGEN TESTS DEVELOPED OR BEING DEVELOPED

400



MEDICAL STUDENT VOLUNTEERS WORKING EACH WEEK IN THE NHS

50,000+



ITEMS OF PPE DONATED TO THE NHS

1,125



STAFF SECONDED TO THE NHS

41



EXPERT MEMBERS OF SAGE AND ITS SUB-COMMITTEES

* Data from the National Institute of Health Research

VACCINES

- ▶ A team at **Imperial College London (Imperial)**, led by Professor Robin Shattock, has a promising world-leading new COVID-19 vaccine in clinical trials. A self-amplifying RNA vaccine has been developed that, when injected, delivers genetic instructions to muscle cells to make the 'spike' protein on the surface of the coronavirus. This provokes an immune response which in turn creates immunity to COVID-19. Human trials are underway having been tested on animals since early February.
- ▶ The Future Vaccine Manufacturing Research Hub (Vax-Hub), co-led by **University College London (UCL)** and **University of Oxford**, has collaborated on the adenovirus manufacturing platform that is now being used to make the Oxford vaccine for clinical trials. VaxHub is working closely with **UCL's** Future Targeted Healthcare Manufacturing Hub, which has been awarded £10.3m to enable the UK manufacturing industry to deliver advanced medical precision and patient screening.
- ▶ **Imperial, King's Health Partners (KHP)** and **UCL** are supporting the **University of Oxford** vaccine trials, another world leading vaccine candidate. **Imperial College NHS Trust** and **University College London Hospital (UCLH)** recruited healthy volunteers to take part, with a focus on healthcare workers who have had a higher chance of exposure to the SARS-CoV-2 virus.

"Scientists across the globe share a common goal right now – to create a vaccine that means we can live in a COVID-19 free world. World-leading science, research and innovation institutions across our cluster are major players in the development of potential vaccines".

Professor Robin Shattock
Imperial College London



* Photo by Thomas Angus, Imperial College London

* Supplied by Imperial College London

DIAGNOSTICS INNOVATION

▶ **OpenCell.bio, King's College London (King's) and Opentrons Labworks** have collaborated to develop a low-cost, rapidly deployable COVID-19 testing lab inside a shipping container, that can process 2,400 tests per day, using low-cost liquid-handling robots that perform a qPCR test to detect the presence of the SARS-CoV-2 virus. This is the first fully functional lab that can be immediately deployed anywhere in the world for COVID-19 testing. This system design is open-source and the test relies on reagents and consumables that are free from the supply chain restrictions faced by other COVID-19 testing labs that require reagents from the same few suppliers.



▶ **i-Sense, a collaboration between UCL, Imperial, London School of Hygiene and Tropical Medicine (LSHTM), University of Surrey and Newcastle University**, in partnership with Public Health England, has been at the forefront of research to harness digital and diagnostic technologies for COVID-19. i-sense aims to build a new generation of digital sensing systems to identify and prevent outbreaks of infectious disease and antimicrobial resistance, much earlier than ever before. Led by Prof Rachel McKendry at **UCL**, the team is addressing key challenges associated with tracking and testing the COVID-19 pandemic; namely early

identification of infection in the community through online data sources, and development of point-of-care diagnostic tests linked to national health systems.

▶ **Autolus Therapeutics**, a CAR T-cell company developing therapies in oncology, spun-out of UCL in 2014, used its in-house protein engineering group, highly experienced in the rapid development of antibody based therapeutic moieties. This group allocated available resource to develop novel recombinant protein therapeutic drugs which interfere with the viral entry and propagation of COVID-19, drawing on its experience of



"We have spent years researching T-Cell assets for oncology but COVID-19 required fast thinking outside the box. We knew the advanced therapy innovations we had already produced could be part of the solution. We are proud to have identified the potential for our cancer-focused technology, know-how and expertise benefit COVID-19 patients and help tackle the challenge that lies ahead."

Dr Martin Pule
Autolus



* Photo @opencell.bio

rapidly progressing clinical translation to clinical testing in critically ill patients.

▶ **Imperial's** Regius Professor of Engineering, Chris Toumazou, has developed a ground-breaking COVID-19 test solution to transform the care and safety of patients and staff. DnaNudge's rapid, lab-free COVID-19 test achieves accuracy with sensitivity of 98% and specificity of 100% and results in around an hour. Approved for clinical use by the Medicines and Healthcare Products Regulatory Agency (MHRA) following successful patient trials, it is now being rolled out in urgent patient care settings. As the only non-lab, non-human interaction Point-of-Care solution, it is rapidly being adopted by senior clinicians.

▶ The **ARCTEC (Arthropod Control Product Test Centre) at LSHTM** is working in partnership with the University of Durham and Medical Detection Dogs. Led by Professor James Logan, the team are investigating the role that dogs could play in detecting and diagnosing COVID-19, after work has shown dogs are capable of detecting malaria with high accuracy.

▶ **Queen Mary University of London (Queen Mary)** has adapted an antibody test used in multiple sclerosis treatment, which can precisely determine how much COVID-19 antibody is present and if the antibodies can block re-infection, which will be necessary when assessing potential vaccines. In just a few days, the team produced sufficient amounts of the COVID-19 antibody test to potentially test 1.6 million people, which can be quickly adapted if the virus mutates.



DATA & DISEASE MODELLING

“COVID-19 has prompted data-driven collaborations across the globe. Insight drawn from population health data and mathematic modelling of the pandemic is enabling us to best understand it, and from there advise the UK and international governments, and ultimately develop the most effective treatments and care for patients.”

Professor Neil Ferguson
Imperial College London



* Photo by Thomas Angus, Imperial College London

▶ The **Abdul Latif Jameel Institute for Disease and Emergency Analytics at Imperial**, was set up last year to rapidly respond to emergencies such as pandemics, extreme climate events, and natural and humanitarian disasters. The Centre – led by Professors Neil Ferguson, Azra Ghani and Christl Donnelly – is at the forefront of mathematical modelling of the COVID-19 epidemic and has been closely involved with policy advice to the UK Government and internationally.

▶ Professor Andrew Hayward from **UCL** is leading the national ‘Virus Watch’ study to investigate the extent of the spread of coronavirus within communities and how social distancing affects the risk of infection. The study has received £3.2m funding to collect data on a cohort of 42,500 people across the country from April 2020 to March 2021. Postcards have been sent out to

households inviting them to take part. The results generated will be vital in informing measures to ease lockdown and prepare for the future. Latest data on the study will also be provided on the Virus Watch website.

▶ A major programme of home testing for COVID-19 is tracking the progress of the infection across England and leading national research. Commissioned by the Department of Health and Social Care, it is being led by Lord Ara Darzi, Professor Paul Elliot and Professor Helen Ward, along with a world-class team of **Imperial** scientists, clinicians and researchers, and colleagues at the **Imperial College Healthcare NHS Trust**. This work could also indicate how many have been infected and recovered since the COVID-19 outbreak began by looking for markers – virus antibodies – of previous infection.

▶ **LSHTM**, with the **World Health Organisation (WHO)**, is generating a global dataset of all interventions related to COVID-19 that harmonises existing datasets into one central global dataset. LSHTM has also developed an online interactive tool to map COVID-19 prevalence, deaths and recoveries globally, updated daily. Similarly, an online tracker developed by the LSHTM Vaccine Centre follows COVID-19 vaccine candidates as they progress through the development pipeline and is updated weekly.

▶ The DECOVID project, a collaboration between **UCLH, NHS Foundation Trust, UCL, The Alan Turing Institute, University Hospitals Birmingham NHS Foundation Trust**, and the **University of Birmingham**, will apply cutting-edge data science and artificial intelligence to map COVID-19 data. It will store detailed and frequently updated health data from hospitals as the COVID-19 pandemic unfolds, to allow clinicians and researchers to generate rapid and robust insights and support more effective clinical treatment strategies, helping patients, healthcare professionals and



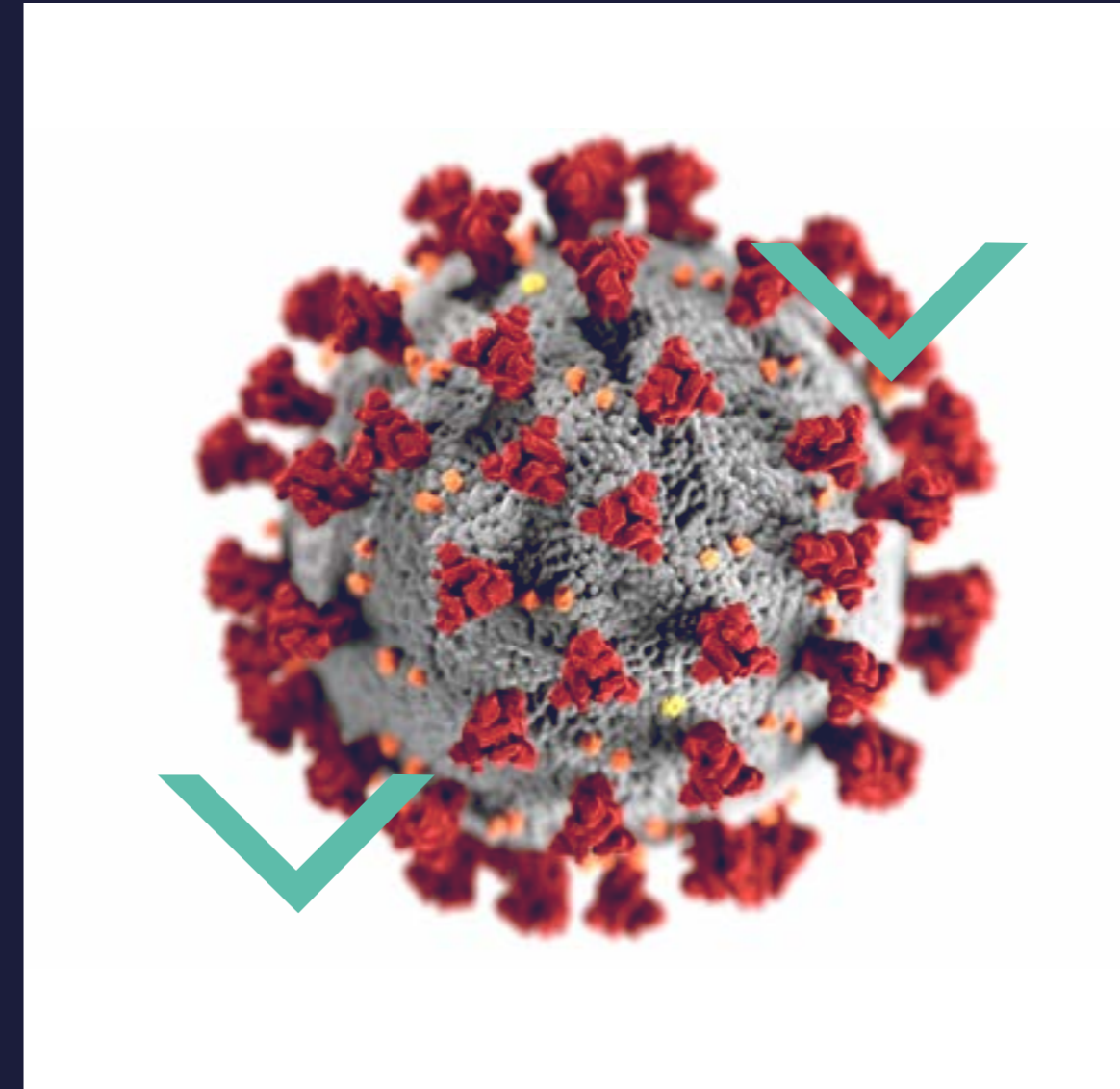
* Photo by Anna Shvets

society.

- ▶ A COVID-19 Symptom Tracker App, developed by **King's**, that has recruited over 3.6 million people across the UK, aims to identify how fast the virus is spreading in each area, the highest-risk areas in the country, and who is most at risk, by better understanding symptoms linked to underlying health conditions. This has already generated major insights, including the identification of loss of smell/taste as a significant symptom of COVID-19; discovery that symptoms including fever, fatigue and anosmia, have genetic influences (genetics 50% responsible for the presentation of key symptoms of COVID-19); and development of AI diagnostic to predict COVID-19 without testing, based on symptoms.
- ▶ The COVIDENCE study, led by **Queen Mary**, will recruit 12,000 people from diverse groups across the UK. By including a mixture of people with and without conditions such as diabetes, lung disease and heart disease, and with a range of ethnicities, the team will determine why certain people appear to be at greater risk of COVID-19, including those from black, Asian and minority ethnic backgrounds.
- ▶ **Queen Mary** is also working with partners to leverage the power of the real time Discovery Data Service. This provides information for integrated primary and secondary health care at the point of care and anticipates and supports population health management and health system responses to the COVID 19 emergency.

GENOMICS

- ▶ Professor Judith Breuer leads the London sequencing initiative at UCL for the COVID-19 Genomics UK (COG-UK) Consortium, which is delivering large scale, rapid sequencing to better understand the spread of COVID-19 and share this intelligence with hospitals, regional NHS centres and the Government. The virus genome data is combined with clinical and epidemiological datasets from other centres across the UK to help guide public health interventions and policies. **UCL** and **Imperial** are also leading the COG-UK Hospital-Onset COVID-19 Infections (HOI) Study, a phase III prospective, interventional, cohort, superiority study to evaluate the benefit of rapid COVID-19 genomic sequencing on infection control in preventing the spread of the virus in NHS hospitals across the UK.
- ▶ Our genetic make-up and its links to our reaction to the virus is the focus of global biobank work at **Queen Mary**. Data is being drawn from volunteers from the **East London Genes and Health Study** who have been admitted to **Barts Health NHS Trust** with confirmed severe COVID-19. Overall, the Global Biobanks expect to be able to identify or exclude genes of large effect and identify those of lesser effect.
- ▶ Data from COVID-19 patients is also being used in biomarker modelling research that uses a novel high-throughput mass spectrometry platform to identify blood biomarker signatures for predicting the severity of COVID-19. This research is being conducted through a global collaboration across the **Institute of Biochemistry, Charité University Medicine, Berlin, The Francis Crick Institute, Imperial** and **UCL**.



* Photo @ CDC

“COVID-19 is major threat to London and the entire world. We at UCL are incredibly proud to be part of the national rapid response efforts to contain the virus. The COVID-19 Genomics UK Consortium will provide important data to Public Health England about how the virus is spreading”

Professor Judith Breuer
UCL



TREATMENTS

Pharmacological Interventions

▶ A landmark trial is being co-led by Dr Manu Shankar-Hari, a consultant in intensive care medicine at **Guy's and St Thomas' NHS Foundation Trust**, along with experts from **NHS Blood and Transplant** and the **University of Cambridge** on a promising new blood plasma treatment for COVID-19. Known as 'convalescent plasma', the treatment is for patients who are severely ill with COVID-19 and involves blood plasma donations from patients who have recovered from COVID-19. This plasma is transfused into COVID-19 patients whose bodies are not producing enough of their own antibodies against the virus, to support the patients fighting the disease. The research lab run by Dr Shankar-Hari within **King's School of Immunology and Microbial Sciences**, is coordinating the underpinning science behind the convalescent plasma treatment.

▶ Patients who are the most seriously ill with COVID-19 are also the focus of scientists from the **Francis Crick Institute**, **King's**, and **Guy's and St Thomas' Hospital** who are conducting a trial

"Convalescent plasma is a promising treatment that could help patients who aren't producing enough antibodies to curb the disease. This trial will help us understand whether the treatment should be used more widely to treat COVID-19."

Professor Sir Robert Lechler
Executive Director of King's Health Partners AHSC &
Senior Vice President of Kings College London



▶ to evaluate if a drug called interleukin 7, known to boost T-cell numbers, can aid patients' recovery. The trial of this drug was prompted by the finding that those with the most severe form of COVID-19 have extremely low numbers of immune cells called T-cells, which clear infection from the body.

▶ The first large-scale international trial to report on the use of the drug remdesivir to treat patients hospitalised with COVID-19 was co-led by **UCL**, **KHP** and the **Medical Research Council (MRC)**. The Adaptive COVID-19 Treatment Trial (ACTT-

EU/UK), is taking place in around 75 hospitals globally, with the MRC Clinical Trials Unit at UCL leading the UK and EU study. Other sites in the EU (Spain, Denmark and Germany) were co-ordinated by the **University of Copenhagen**. The randomised controlled trial, which has recruited more than 1,000 patients globally, aims to evaluate the safety and efficacy of the anti-viral drug remdesivir as a treatment for COVID-19.

▶ A new drug to prevent lung damage and blood clots in people with COVID-19 is set to be trialled in UK hospitals with support from researchers at the **British Heart Foundation Centre of Excellence at Imperial**. The drug, a molecule known as TRV027, aims to restore the balance between two hormones, angiotensin II and angiotensin 1-7, which control blood pressure and affect blood vessels, and could put a brake on many of the dangerous processes which occur in COVID-19, such as lung damage and blood clots.

▶ **Queen Mary** is studying the COVID-19 antibody response to produce artificial antibodies for treating severely ill patients. By collecting B cells from volunteers and amplifying their antibody genes, the team aims to build an antibody immune library which will act as a platform for an unlimited source of SARS-COV-2 specific antibodies.



* Photo @ThisIsEngineering

Device Studies

▶ **UCL, UCLH** and **Formula One** collaborated to create the UCL-Ventura Continuous Positive Airway Pressure (CPAP) breathing aid. Developed by engineers at **UCL** and clinicians at **UCLH** working with **Mercedes-AMG High Performance Powertrains**, it underwent patient evaluations at **UCLH** and partner hospitals in London. The devices have been delivered to over 60 NHS hospitals across England, the devolved nations and crown dependencies in line with demand, and NHS staff can request the devices for their hospitals at no cost to assist management of patients during possible future surges. The designs of UCL-Ventura have been made freely available to support the global response to COVID-19. The CPAP design licence has been downloaded by more than 1,800 teams in over 105 countries around the world, and 22 teams have begun the manufacture and hospital testing of the devices.

▶ The **OxVent group**, comprising scientists, clinicians, engineers and medical technology manufacturers from **King's, University of Oxford** and **Smith+Nephew** mobilised quickly to respond to COVID-19 and the anticipated needs of the NHS in treating it. The team developed the OxVent ventilator

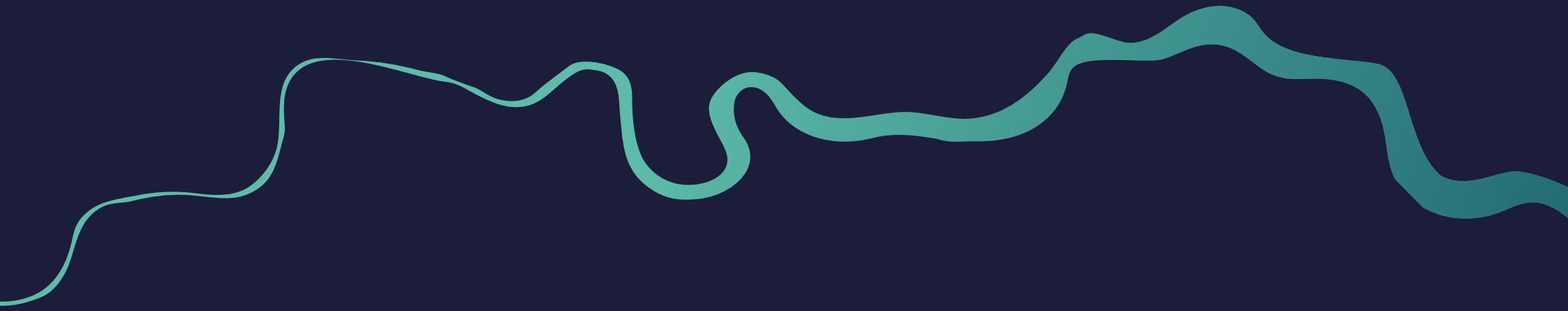
to be produced at speed and scale and at significantly lower cost than alternatives. This was conceived as an open source not-for profit project.

▶ Innovation has also seen the development of mechanical ventilation using AI to support patients with severe symptoms of COVID-19 through the DeVENT trial which is being co-led by Dr Brijesh Patel, Clinical Senior Lecturer at **Imperial** and Honorary Consultant at **Royal Brompton & Harefield NHS Foundation Trust**. Those who are most severely affected by the virus may develop a life-threatening condition, known as Acute Respiratory Distress Syndrome (ARDS), where the lungs cannot provide the body's vital organs with enough oxygen and require mechanical ventilation. The DeVENT trial is testing a new AI device called the **Beacon Care system** which is connected to a ventilator to help monitor the effect mechanical ventilation is having on a patient's lungs.



* Supplied by UCL

For more information on London's innovative response to the pandemic please visit www.medcityhq.com or email medcity@ovidhealth.co.uk



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MedCity is incredibly grateful to the following institutions for their contributions and input into Unleashing Innovation:

