THE COVID-19 CHALLENGE

MOVING FORWARD TOGETHER

norwich research park

FROM THE SOIL TO OUR HEALTH; NORWICH RESEARCH PARK'S VISION IS TO CHANGE LIVES AND RETHINK SOCIETY THROUGH PIONEERING RESEARCH AND INNOVATION, REFRAMING THE FUTURE OF RESEARCH AND DELIVERING REGIONAL GROWTH.

Norwich Research Park is a thriving business and research community of around 30,000 talented people, including 17,000 students, 3,000 researchers and clinicians, and personnel at over 150 companies, and we are continuing to expand.

One of the largest single-site concentrations of research in food, genomics and health in Europe, the Park has world-leading credentials. We bring together four independent internationally-renowned research institutes: John Innes Centre, Quadram Institute, Earlham Institute and The Sainsbury Laboratory; with University of East Anglia (UEA) and Norfolk and Norwich University Hospitals NHS Foundation Trust (NNUH), supported and funded by The John Innes Foundation and Biotechnology and Biological Sciences Research Council (BBSRC).

Together we create a community of people, place and resources that stimulates ideas and delivers innovation to change lives and rethink society.

Earlham Institute
Decoding Living Systems

John Innes Centre
Unlocking Nature's Diversity

NHS
Norfolk and Norwich University Hospitals
NHS Foundation Trust

Quadram Institute
Science Health Food Innovation

The Sainsbury Laboratory
TSL

UEA
University of East Anglia

FOREWORD

CHRISTIE WATSON, AUTHOR & PROFESSOR OF MEDICAL AND HEALTH HUMANITIES

Image: Cheryl George

Professor Christie Watson graduated from Creative Writing MA (prose) at UEA in 2009 and in 2020 was appointed Professor of Medical and Health Humanities. She has published two works of fiction, including the Costa First Novel Award-winning Tiny Sunbirds, Far Away, and two non-fiction works: The Language of Kindness: A Nurse's Story and The Courage to Care: A Call for Compassion. Christie was a registered nurse for 20 years and this year re-registered as a nurse, joining the Emergency COVID-19 nursing register.

The COVID-19 crisis has taught us the true meaning of caring for one another. My experience of returning to clinical nursing at this time showed me the incredible courage of individuals in the face of this unknown and terrifying illness. Perhaps the most distressing thing of all this year is the idea that we may not be able to be with loved ones if they are sick or dying, and yet nurses will always be there holding the hand of our relatives when we can't. Nurses remind us that we are never alone, not even now.

During this time of great suffering I've witnessed many acts of compassion. Communities have come together and people are thinking of other families, as well as their own. We must hold onto that, the importance of reaching out and of working together.

That is what we have seen from the people working across Norwich Research Park. Individuals and organisations looking to themselves and what they each can do to help, and then coordinating, coming together with compassion and the conviction that they can make a difference.

When people unite from diverse backgrounds to face a common challenge, there is a real opportunity to gain deeper understanding and new ways of looking at things.

I have often advocated for an interdisciplinary approach to healthcare and the need to treat the whole person. This pandemic has been a stark reminder that human health occurs within society, that health issues have dramatic consequences for our cultural, economic and emotional wellbeing.

Across the Park community, institutes, organisations and researchers have been employing their expertise to help us to really understand COVID-19. Researchers are responding to the disease itself – looking at how it affects the body, how we can test for and treat its physical effects – but also the impacts on our whole selves, our work and our relationships.

A holistic understanding will be vital as we continue to deal with the pandemic and look to the long-term consequences for our health and wellbeing, for our economy and society. Our best tools for moving forward together from this crisis will be collaboration and kindness.

MEETING THE COVID-19 CHALLENGE: AT A GLANCE

LEADERSHIP

14

"History will record the personal tragedy, the terrible fear, and the economic shock. But, history will also examine what we did and what we learned."

DAVID PARFREY,
NORWICH RESEARCH PARK

"Our staff and students were willing to adapt quickly and flexibly to help where they could and to re-position their research to answer newly emerging questions raised by the pandemic."

PROF FIONA LETTICE,
PROF DYLAN EDWARDS
UNIVERSITY OF EAST ANGLIA

15

16

"The crisis has undeniably inspired innovation, fostered new collaborations and forged a collective will to achieve common goals."

PROF NEIL HALL,
EARLHAM INSTITUTE

17

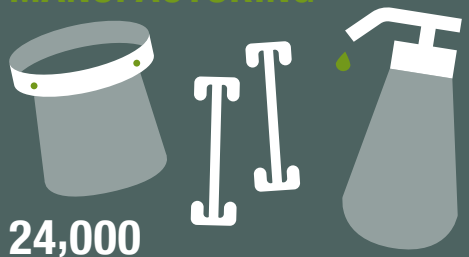
"The remarkable relationships we have with the scientific institutes on the Park are now even closer."

PROF KRISTIAN BOWLES,
NORFOLK AND NORWICH UNIVERSITY
HOSPITALS NHS FOUNDATION TRUST

FIRST RESPONSES

At the onset of the COVID-19 crisis, our Park united to support NHS staff to continue to care for our community safely and with confidence. **06-09**

MANUFACTURING

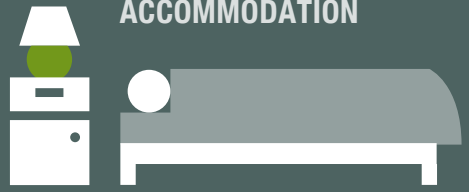


24,000
FACE SHIELDS & EAR COMFORT BANDS

4,000L
HAND SANITIZER

SUPPORTING KEY WORKERS

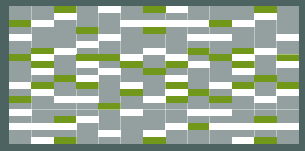
FREE
DAY CARE & ACCOMMODATION



GETTING TO GRIPS

Biochemists across the Park are developing deep insights into how the virus behaves and how it affects our health and wellbeing. **10-13**

SEQUENCING



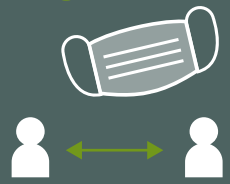
1,600
GENOMES SEQUENCED

LOSS OF SMELL

CONFIRMING AS SYMPTOM AND ASSESSING TREATMENTS

LEAVING LOCKDOWN

EVALUATING MASKS AND COMMUNITY INTERVENTIONS



DEVELOPING TESTING

Our Park is leading the way in creating cutting-edge tests and innovative solutions for testing populations.

18-21

TESTING IN OUR COMMUNITY

VOLUNTEER TASKFORCE

BUILDING A PLATFORM FOR COMMUNITY TESTING

INNOVATIVE SOLUTIONS

£50,000
TECHNOLOGY GRANT FOR RAPID GLYCON TEST

LIFE UNDER LOCKDOWN

Our researchers are examing the wide-ranging impacts of COVID-19 and identifying those in society who will need the most help to recover.

22-25

IMPACT ON CLIMATE CHANGE

17%
REDUCTION IN CO_2 EMISSIONS DURING LOCKDOWN

TRACKING HEALTH AND WELLBEING

1,000 people reporting on lifestyle choices

CHANGING WORK AND RELATIONSHIPS

norwich research park

OUR COMMUNITY

30,000 people

3,000 researchers and clinicians

17,000 students

150 companies

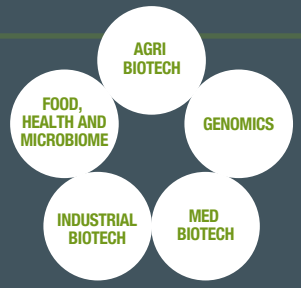
NATIONAL AND INTERNATIONAL EXCELLENCE

10 of the Park's scientists in the **top 1%** of the "most highly cited"in the world

Norwich ranked in the **top 10** of UK cities for quality of research

PARK EXPERTISE

An unbroken chain of research excellence in food, genomics and health.



FIRST RESPONSES

Our institutes and organisations responded rapidly to the immediate demands of the onset of COVID-19, and in particular, to the needs of frontline medical staff at the hospital and throughout the region.

Volunteers from across the Park came together to create vital supplies of PPE and sanitiser to reduce the risk of infection, and to establish support systems, such as childcare, to ensure NHS staff could continue their work

PROTECTING THE PROTECTORS

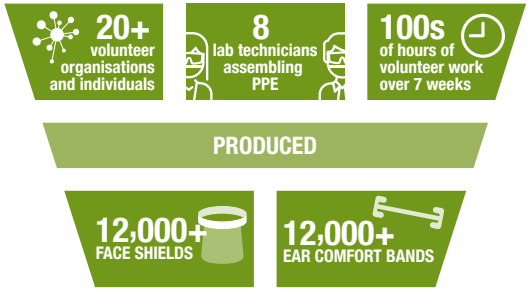
One of the most crucial aspects of the COVID-19 crisis has been the unprecedented need for personal protective equipment (PPE) for frontline health and social care workers. Facilitated by Research and Innovation Services at the University of East Anglia (UEA), a team of scientists, local businesses and individuals came together to produce a contingency supply of thousands of clinically approved face shields for health trusts throughout Norfolk, and a number of pharmacies, community hospitals, hospices and care homes across Norfolk and Suffolk.

The project began with Dr Aram Saeed, Associate Professor in Healthcare Technologies (School of Pharmacy), and science engagement specialist Prof Ben Garrod (School of Biological Sciences) approaching the local tech community for assistance in providing access to 3D printers and sharing software and skills. Over 750 businesses and individuals responded and UEA's Research and Innovation Services rapidly assessed their capacity and resources to meet the urgent need for PPE.

At the same time, UEA Health and Social Care Partners worked closely with the Norfolk and Norwich University Hospital (NNUH) to determine the clinical specification required and to test prototype face shields produced by Professor Sheng Qi and Dr Mahmoud Abdelhamid from UEA's School of Pharmacy. Following this testing and evaluation, NNUH approved the use of 3DVerkstan and Prusa face shield designs and full production, incorporating quality control checks and quarantine, started in early April.

"I am truly humbled by the overwhelming support we have received from local people and would like to thank everyone who was involved in making the visors which are so vital to us. We have felt the love from the community every step of the way as we have tackled the challenges posed by the pandemic."

– PROF NANCY FONTAINE, CHIEF NURSE, NORFOLK AND NORWICH UNIVERSITY HOSPITAL



The face shields – consisting of a 3D-printed headband, a sheet of clear plastic and buttonhole elastic – were assembled by a team of eight science technicians, led by Paul Disdle, along with two academics in the University's New Science Building.

At the height of the seven-week programme, UEA processed around 200 face shields every day and delivered 1,200 to NNUH each week, who then in turn distributed them to the James Paget University Hospital, Great Yarmouth and Queen Elizabeth Hospital, King's Lynn. The remainder were shared with other health and care organisations.

Dr Abdelhamid also developed a design for 3D-printed ear comfort bands to hold face masks off the ears, preventing them from becoming sore and painful when worn for hours at a time.

Project collaborators included: Altair Astro UK; Birds of Dereham; Bosch (Suffolk); CF Tech; Copyshop (Great Yarmouth); DMP 3D; Drone Training Ltd; Greg Rowe Ltd; Haas; Hexatomic; John Mayes Engineering Ltd; Knit Wit; Littlewood Lodge; LSI Architects; Norwich Print Solutions; Norwich University of the Arts; Notre Dame High School; Paper Story; Perdix Design Ltd; Pixel Spark; Redpack; S-Can; SyncNorwich; The Norfolk Truffle Company; Waitrose (Eaton); Yare Valley Technical Services.

Image: Dr Mahmoud Abdelhamid

SOURCING SOUGHT-AFTER SANITISER

From the outset of the COVID-19 crisis our NHS partners and local charities urgently needed supplies of ethanol/hand sanitiser. Working together over a period of 12 weeks, a team of 14 technicians from the Faculty of Science at the University of East Anglia (UEA), led by Laboratory Manager Judith Mayne, produced close to 4,000 litres of hand sanitiser which was distributed to hospitals and key workers across the region.

The initiative was led by UEA Health and Social Care Partners, the research partnership hosted by UEA whose main function is to increase collaboration between health and social care organisations in Norfolk, Suffolk and North East Essex.

A number of local businesses contributed to the project with supplies of vital resources for the production process, including ethanol, plastic bottles and packaging materials for distribution.

"It's important that we all do what we can to help one another. We looked into the best way to make hand sanitiser, working with the great team at UEA was the quickest and simplest way we could help."

– **FERGUS FITZGERALD, HEAD BREWER, ADNAMS**

12 WEEKS

14 TECHNICIANS

4,000L HAND SANITISER

2.6M CLEAN HANDS

Technicians from the Faculty of Science utilised their chemical expertise to create a production line in UEA's new teaching laboratories and, following World Health Organisation guidance, rapidly used up local supplies of isopropanol and ethanol to produce a sanitiser solution. Donations of spray bottles and ethanol from local community members enabled the team to continue to supply hand sanitiser for several weeks.

"It is a great credit to our technicians that they worked throughout the initial lockdown to generate much needed local supplies."

– **PROF MARK SEARCEY, PRO-VICE-CHANCELLOR, FACULTY OF SCIENCE, UEA**

In total, the sanitiser was distributed to 15 health and social care facilities, NHS trusts and community organisations in the East of England and used by thousands of key workers, health and social care professionals and volunteers.

Companies who donated to the project include: Adnams, BreakFree Retail; M & H Plastics, OakVilla Distillery; PCE Automation; ROMIL Pure Chemistry; Simon Long Removals and Wild Knight Distillery.

Image: Dr Aram Saeed

DOORMATE TACKLES CONTACT TRANSMISSION

A team of researchers, technicians and students from University of East Anglia (UEA), led by Dr Aram Saeed, Associate Professor in Healthcare Technologies (School of Pharmacy), developed the DoorMate™ a device that enables healthcare staff to get through doors and carry out other tasks without having to touch surfaces that could be contaminated.

The DoorMate™ has various facets which enable the user to easily open different door handles and push buttons, and can also be used to type on keypads and keyboards. It includes an ergonomically shaped handle for comfort and a loop for attaching it to a lanyard.

The device was created in response to a World Health Organisation (WHO) report which suggested that there may be indirect contact transmission of the virus with the surfaces or objects in infectious environments, such as hospitals.

Following testing of a prototype by the Norfolk and Norwich University Hospital, the device has been approved for clinical use. UEA is offering a free licence to access design of the DoorMate™ to governments, research institutions and manufacturers to produce and supply the device to health and social care organisations.

The link to access licencing and manufacturing specifications can be found on page 26.

TECHNICIANS PROVIDE CRITICAL SUPPORT

When the country went into lockdown and organisations on the Park had to close their research labs and move to remote working, a group of critical workers stayed on site to keep the labs and greenhouses running, preserving years' of research and enabling scientists to return to the workplace with as little disruption as possible.

During the closure, specialist technicians in the John Innes Centre (JIC) Horticultural Team carried out vital, time-sensitive work including processing recently harvested plants, regeneration of unique cereal and pea stock and planting 3,000 ash trees.

John Lord, Head of Horticultural Services, JIC said: "It was hugely rewarding to see the team responding so positively to the situation. And working so closely with the team gave me clearer insight into how we can improve our service to science."

Following health and safety guidance from the Park's Business Continuity Group, teams of technicians developed systems for safe working, enabling the Park's research laboratories to reopen, and research to resume, in mid-May.

The changes implemented at JIC became a model of best practice in creating COVID-secure labs. At the request of the Institute of Science and Technology (IST), Clare Stevenson, Programme Manager at JIC and Technician Commitment Lead, produced a walkthrough video highlighting the changes made, providing institutes around the country with the guidance needed to get scientists back at work safely.

"Science needs a team and everybody has their part to play, from the most junior to the most senior. When it comes to getting the labs open, the people who understand the technology – the technicians – are the people that can get it up and running."

– CLARE STEVENSON

MEDICAL FACULTY AIDS NHS

Since the onset of COVID-19 there has been critical demand for skilled medical staff and the Faculty of Medicine and Health Sciences at the University of East Anglia (UEA) responded with both personnel and training facilities.

To address staff shortages, the Faculty arranged for:

- Training of final year medical students to be completed earlier so they could provide frontline care
- Paid placements for student nurses, midwives and allied health professionals
- Clinically-trained academic staff to return to NHS

To facilitate training of former medical staff returning to frontline care, UEA provided the NHS with access to labs, teaching rooms and model hospitals bays in their Edith Cavell and Bob Champion Research & Education Buildings.

"Our skilled staff and students have worked closely with our colleagues in the NHS and made vital contributions to the medical care offered to the people in our region."

– PROF DYLAN EDWARDS, PRO-VICE-CHANCELLOR, FACULTY OF MEDICINE AND HEALTH SCIENCES, UEA

TREATMENT AND TESTING AT THE HOSPITAL

Teams at the Norfolk and Norwich University Hospital (NNUH) responded quickly and effectively to the onset of the COVID-19 pandemic. Within a few weeks, the hospital opened a second emergency department, created two separate intensive care units and trained more than 1,600 staff in intensive care skills.

During this time, offers of support flooded in from colleagues throughout the Park with health care professionals and scientists volunteering across the hospital.

"We are hugely grateful for the support we received from across the Park. Everyone went the extra mile, enabling us to focus on the essential work of protecting patient lives. This collaboration is an example of what we can achieve together and how everyone rose to the challenge presented by COVID-19."

– PROF ERIKA DENTON, MEDICAL DIRECTOR, NNUH

The hospital's Microbiology Department continue to carry out analysis of nose and throat swabs for current infections of COVID-19 in staff, patients and the public, as well as antibody testing for NHS staff and other key workers.

NNUH is also contributing to 16 coronavirus clinical trials and research studies, several of which involve collaboration with colleagues from across the Park. The largest of the projects is RECOVERY (Randomised Evaluation of COVID-19 Therapy), a nationwide clinical trial to assess the benefits of existing medications in treating patients with COVID-19. The RECOVERY project was able to show that the use of the low-cost steroid dexamethasone reduced by up to one third the number of deaths among patients in hospital suffering severe respiratory illness.

DAY CARE FOR KEY WORKERS' CHILDREN

Key workers at the region's NHS Trusts were able to access free day care for their children provided by medical student volunteers and the University of East Anglia's (UEA) Sportspark, enabling more staff to stay in work and support the fight against COVID-19.

In March, students from the Faculty of Medicine and Health Sciences at UEA established Helping Hands, a National Health Supporters initiative to provide babysitting for NHS staff during the COVID-19 pandemic by matching them to medical student volunteers. UEA's students assisted many local families, particularly at evenings and weekends when suitable care could be difficult to find.

From early April, the Sportspark offered a free activity programme for children of NHS staff. Children were able to use the award-winning facilities and enjoy a range of creative activities devised by volunteers. They also received a healthy packed lunch and were given information about minimising the risk of spreading coronavirus.

The initiative was set up by UEA Health and Social Care Partners (UEAHSCP) utilising COVID-19 emergency funds so that parents could use the service free of charge. Further funding from Santander Universities ensured the service continued until early July.

"I cannot express how valuable the Sportspark has been. Not only has it allowed me to come to work, it has meant I can feel happy that my children are experiencing fun and normality during this strange time. It has been the saving grace for our family."

– LOUISE COOPER, RADIOGRAPHER, NORFOLK AND NORWICH UNIVERSITY HOSPITAL

ACCOMMODATION FOR NHS STAFF

Empty student accommodation at the University of East Anglia (UEA) campus was made available to NHS staff so they could safely continue their work during the COVID-19 pandemic. The self-catering, ensuite rooms, which also offered free WiFi, provided comfortable and convenient accommodation for staff who were isolating from at-risk family members, or would usually have commuted via public transport.

TRAINING TO SUPPORT YOUTH WELLBEING

University of East Anglia Health and Social Care Partners (UEAHSCP) launched the free FutureLearn course 'Anxiety in Children and Young People during COVID-19' which helps parents, carers and teachers to understand and identify common stressors and symptoms and provides advice on how to assist a young person experiencing anxiety. The course, led by Dr Paul Linsley, Associate Professor in Mental Health Nursing, has so far been accessed by over 17,000 participants from across 136 countries.

"The content was very informative and helpful. I thoroughly enjoyed participating and learned so much from the course. Would recommend to others."

– PARTICIPANT FEEDBACK

COMPUTER POWER TO BATTLE COVID-19

University of East Anglia (UEA) donated four of its graphics processing units (GPUs), servers which contain high powered graphics cards, to the Folding@home (FAH) project following a call out in response to COVID-19.

FAH was created by Stanford University, California in 2000, and uses idle computer power to simulate how proteins fold in the human body, providing vital information for researchers seeking cures to the world's most significant illnesses. The GPU servers work on the 'folding' jobs around 30 times faster than a regular computer system would manage. These results then automatically start reporting back to FAH with their findings.

VITAL VALVE PROTOTYPED

Dr Aram Saeed, Associate Professor in Healthcare Technologies (School of Pharmacy, University of East Anglia) is working with Norfolk and Norwich University Hospital (NNUH) and Lotus Cars to develop PEEP valves – a critical component used within certain types of mechanical ventilators for patients in intensive care.

Restricted availability of the valve was identified as a key risk factor at an early stage in the pandemic, and Dr Saeed and the NNUH team worked together to explore alternatives and devise a rapid manufacturing process. Dr Saeed identified Lotus as being able to supply vital support to the engineering of the new valves and together they have prototyped several different designs. The prototyped valves show promising results and with further development could prove useful in the event of increased ventilator demand within hospitals in the coming months.

"We were delighted to be asked to help. In typical Lotus fashion our team of volunteers quickly came up with a modified solution that needed few parts, was lighter and easier to manufacture, yet worked just as efficiently."

– MATT WINDLE, EXECUTIVE DIRECTOR OF ENGINEERING, LOTUS

GETTING TO GRIPS WITH COVID-19

By investigating the virus at a genetic level, examining how it affects the human body, and revealing it's symptoms the Park's scientists have contributed to global understanding of the physical effects of COVID-19.

Collaboration means these discoveries are shared, creating rapid real-world impact in improving care and resource management as we get to grips with the pandemic.

SEQUENCING THE VIRUS

In March, the Government announced an initiative to map the spread and behaviours of COVID-19 in the UK using genome sequencing. The COVID-19 Genomics UK Consortium is made up of health agencies and research institutes at 16 sites across the UK, including the Quadram Institute on the Park.

The consortium aims to help the UK respond to this and future pandemics by delivering large scale, rapid sequencing of the cause of the disease, and the ability to identify different variants of the virus which have unique genome mutations. The best way to do that is using viral genome sequencing. The genetic code aims to provide public health agencies and clinicians with a cutting-edge tool to combat COVID-19.

QUADRAM INSTITUTE HAS SEQUENCED MORE THAN 1,600 GENOMES

Dr Justin O'Grady, Group leader at the Quadram Institute and Associate Professor at the University of East Anglia (UEA), typically works on serious diseases like pneumonia and sepsis. He is an expert in developing new ways of diagnosing diseases using cutting-edge genomic techniques. Dr O'Grady led the coronavirus genomes sequencing team on the Park, which has sequenced more than 1,600 genomes to date. This is more than most countries have achieved and demonstrates the world-leading expertise on the Park.

COVID-19 GENOMICS UK CONSORTIUM

5 MONTHS

40K GENOMES

~50% GLOBAL SEQUENCING

Source: COVID-19 Genomics UK Consortium Report 11 August 2020

Dr O'Grady explains: "We aim to sequence the code of as many genomes as possible to identify the different types of the virus and build the family tree. Then when a number of coronavirus cases are detected in a factory, for example, we can tell if the staff have passed it on to one another or not. We can then work with public health experts in the Test and Trace programme to intervene and stop transmission in the most effective way."

"We welcome this vital work to understand how COVID-19 spreads and behaves by using whole genome sequencing. It's a testimony to the excellence of the scientific expertise we have here at Norwich Research Park that we are contributing to this national, collaborative effort."

– **PROF IAN CHARLES, DIRECTOR, QUADRAM INSTITUTE**

INFECTIOUS-DISEASE EXPERTISE

Infectious disease expert Prof Paul Hunter, from Norwich Medical School, University of East Anglia (UEA) has been a leading voice throughout the coronavirus pandemic, researching and developing our understanding of how the country can best manage our response to COVID-19 and appearing as a frequent expert media commentator.

TACKLING FAKE NEWS

As early as February, Prof Hunter and his colleague Dr Julii Brainard warned that their research demonstrated that fake news could worsen the effects of a disease outbreak and this was highly likely to apply to COVID-19.

The research set out to test the effect of sharing dangerously wrong information on human health during a disease outbreak. The research was part-funded by the National Institute for Health Research (NIHR) Health Protection Research Units in Emergency Preparedness and Response and Gastrointestinal Infections, in partnership with Public Health England.

"Misinformation means that bad advice can circulate very quickly – and it can change human behaviour to take greater risks."

– **PROF PAUL HUNTER**

USE OF FACE MASKS

In early April, while the country was still under lockdown, Prof Hunter and Dr Brainard advised that the use of face masks on public transport and in enclosed spaces such as shops could help reduce the spread of COVID-19 while increasing freedom of movement.

They analysed research into the use of face masks to limit the spread of illnesses with similar symptoms to COVID-19 or other respiratory infections. They found that masks had a consistent protective effect, and that the most impact was gained when masks were worn by both ill and healthy people in close proximity.

BLUEPRINT TO EXIT LOCKDOWN

To provide policymakers with meaningful information for managing the country's exit from lockdown, Prof Hunter and his team undertook one of the first studies in Europe to examine what have been the most effective community interventions in the battle against the spread of COVID-19.

The team found that banning mass gatherings, closing some non-essential businesses and closing educational facilities are most strongly associated with a reduced incidence after a certain lag period.

The research was carried out in collaboration with the University of Newcastle, the London School of Hygiene and Tropical Medicine and Tshwane University of Technology in South Africa.

EXAMINING COVID-19 IN CARE HOMES

Prof Hunter and Dr Brainard examined how COVID-19 entered and spread within care homes – the first research project of this kind.

40% OF COVID-19 DEATHS IN UK IN CARE HOMES

The research team looked at staffing levels and PPE availability in 248 care homes across Norfolk. Their investigation revealed that the risk of COVID-19 being introduced to the home increased with the number of non-care staff employed and found that the subsequent spread of the virus was largely associated with inadequate access to PPE, particularly facemasks and eye protection.

SMELL LOSS CONFIRMED AS KEY SYMPTOM

Prof Carl Philpott from Norwich Medical School, University of East Anglia (UEA) is part of an international research team that was able to demonstrate that loss of smell or taste are key indicative symptoms of COVID-19.

The Global Consortium for Chemosensory Research (GCCR) survey was launched in response to anecdotal reports of smell and taste loss in people who tested positive for COVID-19 and in May, Public Health England joined the World Health Organisation in adding a new loss of taste or smell (anosmia) to the list of symptoms for COVID-19.

The international group of researchers united to study how, when and why people were experiencing the symptom, and to establish what this reveals about coronavirus.

COLLECTED DATA FROM 50 COUNTRIES

Researchers were able to confirm that loss of smell is a symptom of COVID-19, and found that it particularly affects some demographics, such as women in their 30s and 40s. This is notably different to other illnesses as it is more commonly older people who present with anosmia following a virus.

The study also revealed that in some people loss of smell or taste was the only or the first symptom they experienced. Recognition of the importance of this symptom has meant affected people are able to access testing and take measures to prevent the spread of the coronavirus when they might not previously have done so.

COMPARING COLDS AND COVID-19

Further research by the European Clinical Olfactory Working Group, which includes Prof Philpott, revealed how smell loss associated with COVID-19 is different from that associated with a cold.

The team carried out smell and taste tests on 10 COVID-19 patients, 10 people with bad colds and a control group of 10 healthy people, matched for age and sex.

The researchers found that smell loss was much more profound in the COVID-19 patients. They were less able to identify smells, and they were not able to identify bitter or sweet tastes, which distinguished the people with COVID-19 from those with colds.

The research team hope that these findings could be used to develop alternative testing when formal diagnostic tools are not available or when rapid screening is needed, particularly at the level of primary care, in emergency departments or at airports.

TREATING COVID-19 ANOSMIA

Prof Philpott, along with other UK experts, has worked with the British Rhinological Society to develop guidelines to treat patients experiencing COVID-19 related loss of smell and taste.

HOW WERE THE GUIDELINES CREATED?

15 strong expert panel gathered

Literature review summary provided

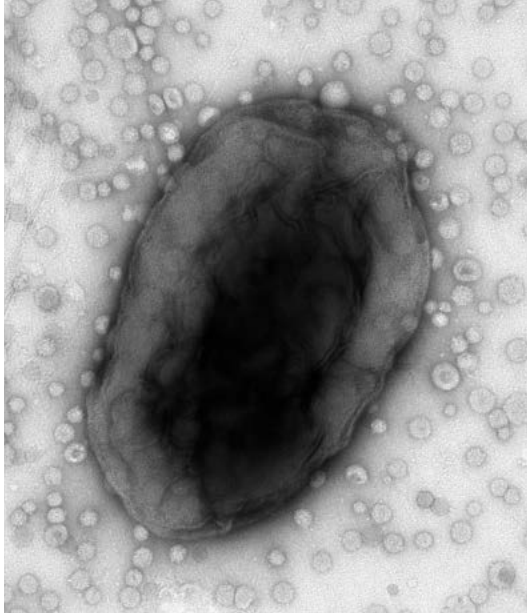
Treatments ranked

WHAT TREATMENTS HAVE BEEN RECOMMENDED?

Smell training – regular sniffing (usually of essential oils) to stimulate olfactory nerves – recommended for all patients. Oral steroids, steroid rinses and omega 3 supplements may be considered on an individual basis.

"Although many patients will recover their senses of smell and taste, there will also be a minority in whom these sensory losses persist, and they will need additional support. Given the UK rates of infection, this means that about 20,000 people may be left with smell and taste disturbances due to COVID-19."

– PROF CARL PHILPOTT



UEA EXPERT DEVELOPING VACCINE DELIVERY JOINED WHO

Prof Simon Carding, from Norwich Medical School, University of East Anglia (UEA) and the Quadram Institute, working in collaboration with Prof Mark Smales (University of Kent) and Prof James Stewart (University of Liverpool), is developing a new drug delivery method for COVID-19 vaccines which utilises new approaches created by researchers at Quadram Institute Bioscience working with gut bacteria.

Bacteria in the gut has a natural ability to generate nanoparticle-size Outer Membrane Vesicles (OMVs) – tiny sacs that transport material inside and between cells. OMVs can be engineered to deliver vaccine to the body. This OMV-based approach is already used for meningococcal vaccines and has excellent safety records.

Further advantages include needle-free vaccination, easier administration (oral or nasal), rapid cost-effective production, and a stable product that can be stored for months without cold storage.

In May, Prof Carding was invited to join the World Health Organisation's COVID-19 Expert Advisory Group on vaccine prioritisation.

COORDINATING THE COUNTY'S CARE

Health Economics Consulting (HEC), a consulting academic group at Norwich Medical School, University of East Anglia (UEA), has been coordinating efforts and contributing to planning the region's response to COVID-19.

The team produce a weekly forecast of expected bed demand, working with NHS and County Council analysts, and report to executive teams in NHS acute, community and mental health trusts across the region. This enables resources like staffing, personal protective equipment (PPE) and beds to be allocated effectively.

The team of 12 academics led by Prof Ric Fordham, brings together the group's expertise in health economics, modelling, public health and data, with researchers from the Quadram Institute, consisting of statisticians and infection control experts.

UEA experts are also working closely with doctors and nurses at the Norfolk and Norwich University Hospital (NNUH), gaining insight from their frontline experience, and providing practitioners with research evidence currently available from around the world to enable them to make decisions.

MAPPING THE BODY'S RESPONSE

Researchers from the Earlham Institute (EI) are collaborating with international partners to model the effect COVID-19 has on the body in order to understand how the sickest patients are being affected.

Dr Tamas Korcsmaros and his group at EI are experts in developing bioinformatics tools and techniques which bring together wide-ranging data to inform our understanding of complex diseases. The team have utilised this experience to collaborate with Dr Julio Saez-Rodriguez from the University of Heidelberg as part of the international COVID-19 Disease Map effort.

"Our main goal is to understand the systemic effect the virus has on our body, and in particular, why in some patients the infection leads to severe inflammation and a life-threatening over-activation of the immune system. To achieve this, primarily, we create computational models and then we will test some of the predictions in-house or with expert collaborators."

– **DR TAMAS KORCSMAROS**

THE IMPORTANCE OF SCIENCE

DAVID PARFREY, EXECUTIVE CHAIR, NORWICH RESEARCH PARK

There is no doubting that the COVID-19 pandemic has been a moment in our history, a moment which will be remembered and will be analysed by future generations. History will record the personal tragedy, the terrible fear, and the economic shock. But, history will also examine what we did and what we learned.

Around us we have all seen acts of humanity and great innovation, and we have rightly demonstrated our pride in, and appreciation for, those who contributed to the nation's response. Here at Norwich Research Park our people certainly played their part, we cared for the sick at the Norfolk and Norwich University Hospital (NNUH), we assisted in protecting people through the manufacture of sanitiser and PPE, we developed diagnostic tools and tested people, we volunteered, we supported and we collaborated for the common good.

We are a place of science, education and patient care but crucially we are a connected community. We are a set of jigsaw pieces capable of being joined quickly to make many different pictures. Our response to the pandemic was swift and well-informed

CRUCIALLY WE ARE A CONNECTED COMMUNITY

Our science focuses on some of the greatest challenges facing humankind: feeding a growing population, bringing our climate back from the brink and issues of human health - 21st century challenges that are growing in their risk to society. We owe it to those who follow us to find answers.

Our knowledge and our capabilities, but above all our people did what is normal to them - they joined together as a connected community to change lives.

We are a place of learning too: we have learned more about ourselves and what is possible, we learned that our people and their knowledge are the components, and the power of collaboration are the connecting bolts, but our passion is the energy that fuels our achievements.

Science is in everything we touch, everything we see and hear and everything we consume. Science is not new; it was present at the beginning of time and as long as our world lives, science will be there. Our job at Norwich Research Park is to work with science, to use it for the benefit of life itself.

COVID-19 has been, and still is, an experience we will not forget. We have used our science to help with the care of people in our wider community, to provide solutions to short term needs and to contribute to the longer-term answer. Long terms answers, not just to COVID-19, but to future pandemic threats, feeding the world's growing population, climate change, enabling people to grow old with good health and so many other things, all depend on science and its application. At Norwich Research Park this was our job before COVID-19, it has been our job through COVID-19, and it will be our job after COVID-19.

Science has shown the vital part it plays in our lives, it has shown that it is truly mainstream. The UK has a rich history in science, and we at Norwich Research Park have proved our contribution. We stand ready to continue playing our part for the future of this world, its people and the UK economy.

At Norwich Research Park we will continue to deliver great patient care, great education and great scientific research and outcomes. We will continue to engage with society to create better understanding and greater opportunities.

We will continue our part in changing lives and rethinking society.

WHAT HAPPENS NEXT?

PROF FIONA LETTICE, PRO-VICE-CHANCELLOR, RESEARCH AND INNOVATION, UEA
PROF DYLAN EDWARDS, PRO-VICE-CHANCELLOR, FACULTY OF MEDICINE AND HEALTH SCIENCES, UEA

As can be seen from the examples in this publication, the University of East Anglia (UEA) was quick to respond to regional needs as the pandemic hit the UK, using our skills and expertise to work on practical projects like making face visors and sanitiser to more complex research issues around developing COVID-19 testing and understanding the impacts of the pandemic on the elderly and lockdown on general behaviour, health and CO_2 emissions.

What did we learn from these projects and our response?

We learnt that universities in general, and UEA in particular, have a wealth of expertise and skills that can be adapted to meet a unique and fast moving challenge.

We learnt that our staff and students were willing to adapt quickly and flexibly to help where they could and to re-position their research to answer newly emerging questions raised by the pandemic.

We learnt that we have a great network of partners and collaborators and that they were willing to work together with us on the new challenges we faced – well we already knew that, but the crisis really brought this into sharp focus. We also developed and formed new relationships and partnerships to fill gaps in our expertise and skills.

WE WILL PRIORITISE THE SAFETY OF OUR STAFF, STUDENTS AND THE COMMUNITY

But what happens next and how do we ensure that we use the lessons learned to move forward positively?

We will prioritise the safety of our staff, students and the community – working on a COVID-19 testing programme that builds on the successful pilot project that the Earlham Institute and UEA jointly led during the summer. UEA has pledged to develop a Civic University Agreement, which will be a formal agreement developed in close collaboration with regional partners to identify and prioritise ways to work together to help the region economically, socially and culturally. This will include building back better from the COVID-19 pandemic and consequences of lockdown.

We will continue to invest in projects that bring the university closer to the broader community through focused partnerships, such as UEA Health and Social Care Partners (UEAHSCP). The shared purpose and trust underpinning UEAHSCP was particularly important in helping us understand the needs of health and social care organisations and how best the university could support their vital work.

We will draw closer to businesses with the help of UEA's team of relationship managers and specific initiatives such as Gateway to Growth, Productivity East and the EIRA project.

We will continue to invest in interdisciplinary research themes, launching the first two in 2020 – ClimateUEA and CreativeUEA, bringing together a wide range of disciplines and expertise to address key local, national and global challenges.

Last but not least, we will continue to invest in our amazing staff and students, enabling them to live UEA's values of Collaboration, Empowerment, Respect and Ambition.

STANDING THE TEST OF TIME

PROF NEIL HALL, DIRECTOR, EARLHAM INSTITUTE

At some point in the future, there will be a post-mortem of the UK's response to the coronavirus pandemic. Whatever your views, the crisis has undeniably inspired innovation, fostered new collaborations and forged a collective will to achieve common goals.

From the outset, COVID-19 testing capacity has been vital in the national response. Given the life science expertise and infrastructure on Norwich Research Park, it didn't take long for us to realise we could make a significant contribution.

We quickly coordinated a volunteer drive across the Park to help the Norfolk and Norwich University Hospital increase COVID-19 testing capacity for key workers. Soon after, the Earlham Institute scientists applied their expertise in automation to scale up a new testing facility in the University of East Anglia's (UEA) Bob Champion Building. These inter-organisational efforts undoubtedly made an impact on the local picture.

With limited information and capacity at the outset of the pandemic, it made sense to focus testing towards people with symptoms and those working in high-risk environments, such as our frontline NHS staff. But one of the most important things we've learnt about SARS-CoV-2 is how easily it spreads while moving under the radar. The Office for National Statistics suggest around 70-80 per cent of people who are infected with coronavirus will have no symptoms at all.

Waiting for symptoms to appear before testing meant we were missing 'silent spreaders' - people who are infectious before the onset of symptoms, those with atypical symptoms, and those who never develop symptoms at all. We saw an opportunity to trial regular community testing to see if we could spot these asymptomatic cases.

The project was managed by an incredibly talented and hard-working group from across the Park. All partners lent their time and support, and – most importantly – the participants were 800 of our own staff and students. In a truly collaborative project, we analysed over 3,000 samples and established a platform for regular testing.

IT DIDN'T TAKE LONG FOR US TO REALISE WE COULD MAKE A SIGNIFICANT CONTRIBUTION

It now seems a second wave is being driven by transmission among young, mostly asymptomatic carriers. As universities open across the UK there's a real concern that campuses will be hotspots for outbreaks. Our feasibility study has enabled UEA to take a lead nationally by offering testing to its student population.

Testing has been radically scaled up, cheaper and quicker tests are being developed, and labs across the country are in a position to contribute to the national effort. The institutes on Norwich Research Park are leading the way and providing a template for others to follow.

We have some of the brightest and best minds tackling global issues every day; from food security and climate change to human health and disease. But the threat posed by a global pandemic demands an urgency and clarity of action that few people will experience in their research career.

We all hope an effective vaccine is on the horizon. Until then, I'm confident the Park will rise to the challenge and continue to help save lives and protect livelihoods.

CRUCIAL COLLABORATION

PROF KRISTIAN BOWLES, CONSULTANT HAEMATOLOGIST AND ASSOCIATE MEDICAL DIRECTOR, NORFOLK AND NORWICH UNIVERSITY HOSPITALS NHS FOUNDATION TRUST

Norfolk and Norwich University Hospitals NHS Foundation Trust (NNUH) recognised that the COVID-19 pandemic presented us with an extraordinary challenge in looking after our community, and we realised early on that testing was going to be key. Our hospital's approach was developed on the back of clinical and operational leadership, and in collaboration with our Norwich Research Park partners, which was crucial. Our service was delivered by a dedicated, highly skilled and hard-working team of staff, working in extraordinary conditions.

The necessary rapid expansion of COVID-19 diagnostic testing for the Trust was made possible through Herculean efforts by a large number of hospital staff and vital support from colleagues across the Park.

COMMUNITY AND COLLABORATION ARE CENTRAL TO THE PARK

We developed three COVID-19 diagnostic tests. Our NNUH Virology lab provided expert clinical leadership and set up our first COVID-19 diagnostic test. Our team in the NNUH Histopathology lab repurposed their virus testing capacity and set up a second COVID-19 diagnostic test. Finally, in work led by the University of East Anglia (UEA) team in the Bob Champion Research and Education Building (BCRE), a third type of COVID-19 diagnostic test was developed. All this was supported by UEA and Earlham Institute (EI) staff and with essential equipment supplied by Park partners. We were we able to triple our hospital testing capacity, and by using three different platforms we felt this would help to build in resilience as we moved through the first wave.

We knew we needed to act quickly to develop testing, and when we asked our Park colleagues for support, within a few days over 100 trained molecular biologists volunteered to work with us to keep the tests and machines running. None of this could have been done without this team of highly specialist skilled volunteer scientific staff and their equipment which was leant to the testing effort.

Our ability to test for COVID-19 helped our clinical staff to identify people with the infection and then care for our patients (with or without the infection) in appropriately designated areas of our hospital. Working together in this way also supported clinical and scientific COVID-19 research projects, which will contribute to the overall understanding of the virus.

It was amazing to see how everyone responded with compassion and professionalism to the unprecedented demands. I witnessed first-hand how our community and collaboration are central to work on the Park. There are few comparable places where a major regional hospital is located and operates alongside world-leading research institutes in bioscience. We have known the benefits of proximity and working together for years, and during the pandemic we picked up the phone to the UEA, EI and the Park management team and everyone we spoke with just said yes, what could they do to help. The remarkable relationships we have had for years with the scientific institutes on the Park are now even closer.

There's no doubt in my mind that without increased testing capacity delivered by the pathology teams and the Park, our challenge at NNUH and the risk to our patients and staff would have been even greater.

We are now at the next stage of the pandemic and our collaborative working across the Park will continue to be an important part of how the hospital and the wider community responds to this ongoing challenge.

DEVELOPING TESTING

Testing has been critical to the global response to COVID-19, and the Park has the expertise, infrastructure and determination to create real solutions.

Researchers are developing cutting-edging tools and investigating the most effective methods of implementing testing, while across the Park, community testing is driving an innovative approach to managing the pandemic.

VOLUNTEER TASKFORCE INCREASES TESTING CAPACITY

Volunteers from all research organisations on the Park, led by the Earlham Institute's Sarah Cossey (Director of Operations) and Dr Karim Gharbi (Head of Genomics Pipelines), worked with staff at the Norfolk and Norwich University Hospital (NNUH) to increase the number of tests carried out and enable frontline staff to continue their vital work in caring for patients.

Scientists from the Earlham Institute, John Innes Centre, The Sainsbury Laboratory, Quadram Institute Bioscience, University of East Anglia (UEA), Eastern Pathology Alliance and the Cotman Centre came together to employ their expertise by helping with the isolation and detection of viral RNA, part of the vital testing process.

Dr Rose Davidson and Dr Stuart Rushworth from UEA's Norwich Medical School established a dedicated lab in the Bob Champion Research and Education Building (BCRE) where microbiologists from the University support the work of staff at NNUH. The lab at BCRE continues to operate as a key facility for the ongoing testing of NHS staff.

"We needed skilled molecular biologists who were already familiar working with dangerous samples like COVID-19. In late March, we put out a call for volunteers on a Friday and by Sunday we had an army of volunteers ready to go. It was really humbling to see, and very much a team effort."

– **DR KARIM GHARBI**

The expert taskforce led to a significant increase in testing capacity while still delivering results within 24 hours.

Frontline NHS staff in key roles, such as critical care workers, paramedics, emergency department staff, and primary care staff can access testing if they or a member of their household develop symptoms of COVID-19. By confirming negative results and substantially reducing the self-isolation period, NHS staff can return to work more quickly.

DRIVE THROUGH TESTING

To facilitate the process of testing, the Park also created a dedicated drive-through facility.

The Park management team and a team from the NNUH worked quickly to cordon off the car park, erect gazebos, set up testing equipment and employ a traffic management system.

NHS staff operate the drive-through and collect swab samples safely, before they are sent to the labs for testing.

Image: Earlham Institute

PILOT PROVES COMMUNITY TESTING POTENTIAL

Researchers at the Park completed a successful pilot of a ground-breaking project to identify and track COVID-19 within a community – tackling the growing issue of 'silent spreaders', asymptomatic people who unknowingly spread the virus.

The pilot was a cross-Park collaborative project, managed by University of East Anglia Health and Social Care Partners (UEAHSCP), utilising expertise from the Earlham Institute (EI), University of East Anglia (UEA), the Norfolk and Norwich University Hospital (NNUH), the John Innes Centre, the Quadram Institute and The Sainsbury Laboratory.

Over 800 staff and students, either working on the Park or within easy reach of the site, signed up to a two-week testing period. Participants were asked to self-administer nose and throat swabs twice a week from home, completing four tests in total. Samples were dropped off at collection points on the Park and analysed in EI. The majority were processed within 24 hours, with the fastest results returned nine hours after samples had been delivered.

No positive samples were detected, but the pilot demonstrated that regular, routine testing is achievable, and has the support of the community.

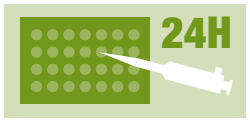
Researchers at EI and UEA are now looking to work with public health leads and other lab sites to share knowledge and prepare for the rapid implementation of Government-backed community testing.

"During this pilot, regular testing has helped protect a small community and reassured them they're not unknowingly spreading the virus. It's now time to introduce a programme of mass population testing so we can see exactly where the virus is, how it's spreading and act rapidly to disrupt the chain of transmission."

– PROF DYLAN EDWARDS, PRO-VICE-CHANCELLOR, FACULTY OF MEDICINE AND HEALTH SCIENCES, UEA

KEY FINDINGS

3,046 results were delivered to participants



Most samples were processed within 24 hours

85% of participants returned all four swabs

Optimised process could deliver same day results

PARTICIPANT FEEDBACK

98% of respondents would take part in regular testing if offered

57% said their experience was "excellent" with 94% rating it 4 or 5 out of 5

UNIVERSAL TESTING AT UNIVERSITY

Building on the successful community testing pilot, the University of East Anglia (UEA) offered COVID-19 testing to all of its staff and students.

At the start of term, students and staff who regularly work on campus were offered an asymptomatic test. The test was voluntary, with staff and students strongly encouraged to take up the opportunity, alongside preventative measures such as frequent hand washing and social distancing.

The testing campaign, project managed by UEA Health and Social Care Partners (UEAHSCP), aimed to identify cases of the virus early, prevent its spread and protect the wider UEA community and people of Norwich. This was particularly important with young people coming together from different parts of the country.

The University plans to increase the testing capacity and regularity in the coming months. Approaches being explored include pool testing – group samples from one household – and sentinel testing – where two or three individual samples from a large household are tested separately as representatives.

ANTIGEN PRODUCED TO AID RESEARCH

Leaf Expression Systems (Leaf), a spin-out company from the John Innes Centre which specialises in the production of proteins and complex natural products, has successfully produced an antigen – recombinant SARS-CoV-2 N-protein – and is developing further antigens to contribute to research into the COVID-19 virus.

The N-protein antigen plays a key replication role in the assembly of the SARS-CoV-2 virus which causes COVID-19. Supply of the antigen will help scientists to develop SARS-CoV-2 vaccines and diagnostic testing kits.

Leaf developed the antigen using Hypertrans® its proprietary plant-based expression technology. The technology expresses proteins in the leaves of plants, which is a much quicker alternative to other established systems used for producing proteins. This means that Leaf can quickly scale up production of vaccines and antigens to respond to outbreaks of disease and support diagnostic and immunisation programmes.

"Hypertrans® is well suited to rapid response delivery of vaccines and other biologics, and we are delighted to play our part in delivering solutions to not only SARS-CoV-2 but other diseases for which biologic treatments can have significant positive impact."

– SIMON SAXBY, CEO, LEAF EXPRESSION SYSTEMS

FUNDING FOR RAPID DIAGNOSTIC TEST

Iceni Diagnostics – established by Prof Rob Field (formerly of the John Innes Centre) and Prof David Russell (School of Chemistry, University of East Anglia) – has been awarded a £50,000 grant by Innovate UK to accelerate development of its test for COVID-19. The grant is part of a £20 million government fund to support ambitious technologies that will build UK resilience against the long-term impact of the outbreak.

The Iceni Diagnostics test is designed to be used for triage, to enable large numbers of people to be quickly tested on the spot, with minimal training required to implement the test. People with a positive response can be rapidly identified, quarantined and subjected to further testing, while negative-response individuals are able to return to their normal work-life activities.

ICENI AWARDED £50,000 GRANT BY INNOVATE UK

The traditional method of identifying a virus is from its genetic material. The Iceni Diagnostics device uses a different tactic, by creating a sugar trap for the virus. Viruses recognise their host using chains of sugars known as glycans on the surface of the human cell. Iceni Diagnostics exploits this virus-glycan interaction within its novel diagnostics approach.

Iceni Diagnostics has already applied its platform technology to the influenza virus, and has demonstrated that by modifying the glycans the test could be adapted to identify different strains of the disease – human influenza, avian flu and equine flu. These insights have enabled the company to modify its technique for the new strain of coronavirus.

The design means that a low-cost device can be mass-produced to meet the substantial demands for immediate and recurrent coronavirus testing in the weeks and months ahead.

ANALYSIS REVEALS ATYPICAL SYMPTOMS IN CARE HOME CASES

Many care home residents who have COVID-19 are either asymptomatic or experience atypical symptoms according to a study by University of East Anglia (UEA) and North Norfolk Primary Care, supported by UEA Health and Social Care Partners (UEAHSCP).

Enhanced care home teams (ECHT) with Norfolk general practitioners carried out the testing service in care homes in North Norfolk. The service recorded symptoms amongst residents and revealed that around half of those who tested positive for COVID-19 were asymptomatic, although some went on to develop symptoms.

Researchers, led by Dr Paul Everden (Norwich Medical School, UEA and Innovation Lead for North Norfolk Primary Care), also found that in many cases symptoms were not typical and did not include a high temperature, cough or loss of smell. Instead, residents who tested positive for COVID-19 often presented as 'generally unwell'.

The findings demonstrate that effective testing and screening of residents and staff in care homes is vital for identifying cases and controlling the spread of the virus.

EXPLORING HIGH-THROUGHPUT TESTING METHODS

At the start of lockdown, two groups were set up in The Sainsbury Laboratory (TSL) and the 2Blades Foundation to explore alternative, high-throughput methods for COVID-19 diagnostics. Once optimised, these methods have the potential to expand and speed up local testing.

"We are very proud of the enormous effort our staff and students have made since the start of the pandemic in developing better tests and in helping with the local response – all on a voluntary basis. We are grateful to the Gatsby Charitable Foundation for supporting these activities throughout."

– PROF NICK TALBOT FRS, EXECUTIVE DIRECTOR, THE SAINSBURY LABORATORY

One research group used open-access protocols from the Broad Institute to investigate the use of CRISPR-based SHERLOCK technology (specific high sensitivity enzymatic reporter unlocking). A kit from Sherlock Biosciences and Integrated DNA Technologies has recently been FDA-authorised and made available in the US. The TSL/2Blades group has produced the active enzyme, guide RNAs specific to COVID-19 and control target RNA sequences. They are currently adapting the open-access protocols to equipment available on Norwich Research Park.

The second group designed a test based on a published toehold switch protocol for Ebola. Toehold switches can provide diagnosis through the use of a non-invasive oral swab or sputum sample in a simple two-step test that gives a clear blue/white, positive/negative result. The group have designed COVID-19-specific trigger RNA sequences and toehold switch regulators. Their current aim is to minimise the time from sample to diagnosis.

INNOVATIVE TESTING OF PNEUMONIA PATIENTS

The INHALE trial, led by University College London (UCL) in collaboration with University of East Anglia (UEA) and the Norwich Clinical Trials Unit, has been analysing a cutting-edge test to treat pneumonia patients suffering a secondary bacterial infection. In March 2020, in response to the COVID-19 pandemic, the study was temporarily refocused to guide treatment of COVID-19 patients.

Pneumonia is one of the main symptoms of severe COVID-19 disease and because many critically ill COVID-19 patients can no longer breathe by themselves they are put onto mechanical ventilators. The ventilators pump air through a tube into the lungs, helping the patient to survive. However, the ventilation also increases the risk of bacteria entering the lungs, establishing a further infection known as 'secondary pneumonia'.

Previous analysis by the INHALE trial assessed that the most succesful test for the rapid identification of bacteria in pneumonia patients was the BioFire FilmArray Pneumonia Panel.

During the pandemic, the INHALE team carried out clinical trials of the FilmArray test on COVID-19 patients. The results of the trial showed that the FilmArray revealed more types of bacteria than a traditional culture test, pinpointing 26 pneumonia pathogens and detecting whether any have critical antibiotic resistances. The test also provides results more quickly – in around one hour compared to 72 hours for a culture – enabling clinicians to begin focussed treatment much sooner.

The test has been used to treat COVID-19 patients at hospitals including UCL, the Royal Free, Watford General, Chelsea and Westminster and Liverpool University hospitals.

"COVID-19 created a vital medical need: to test if real-time information on secondary bacterial pneumonias improves treatment of the sickest, ventilated COVID-19 patients. And we've quickly refocused INHALE to do exactly that."

– PROF DAVID LIVERMORE, NORWICH MEDICAL SCHOOL, CO-CHIEF INVESTIGATOR

MODELLING CONTACT TRACING

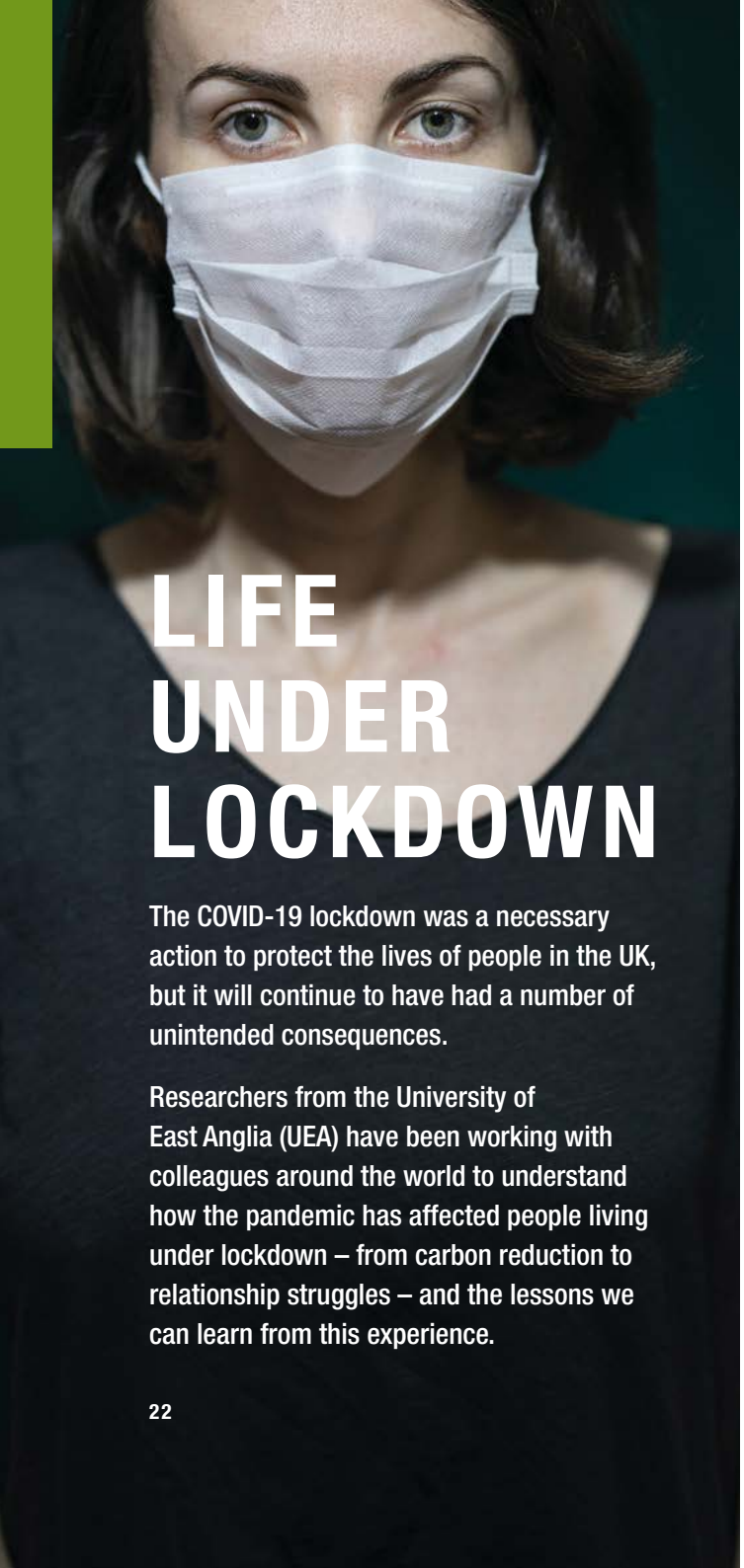
Researchers from University of East Anglia (UEA), working with Oxford University and the London School of Hygiene and Tropical Medicine, utilised data from a BBC citizen science experiment to help predict how different strategies could control the spread of COVID-19.

Contagion: The BBC Four Pandemic was a citizen science experiment, carried out in 2018, in which social contact and movement data was collected using a custom-made phone app – in order to see how a future pandemic could spread across the UK.

Researchers re-purposed the BBC data to simulate outbreaks of COVID-19, combining data from the real-world interactions with mathematical models to provide a uniquely informed insight into the likely impact of different social interventions.

The team, led by Dr Lewis Spurgin (School of Biological Sciences, UEA), aimed to find out how contact tracing can be used most effectively to create a sustainable method of preventing the spread of COVID-19 and avoid disruptive community interventions such as lockdowns.

The study found that contact tracing reduces outbreak size, but can result in large numbers of people being quarantined as the outbreak grows. However, social distancing, along with large-scale testing and releasing of non-infectious people, would reduce the number of those in quarantine without significant increases in the size of the outbreak.



LIFE UNDER LOCKDOWN

The COVID-19 lockdown was a necessary action to protect the lives of people in the UK, but it will continue to have had a number of unintended consequences.

Researchers from the University of East Anglia (UEA) have been working with colleagues around the world to understand how the pandemic has affected people living under lockdown – from carbon reduction to relationship struggles – and the lessons we can learn from this experience.

CRISIS CAUSES CRASH IN CARBON EMISSIONS

The COVID-19 global lockdown had an "extreme" effect on daily carbon emissions, but it is unlikely to last according to analysis by an international team of scientists, led by Prof Corinne Le Quéré (Tyndall Centre for Climate Change Research and University of East Anglia).

The study published in the journal Nature Climate Change shows that daily emissions decreased by 17% – or 17 million tonnes of carbon dioxide – globally during the peak of the confinement measures in early April compared to mean daily levels in 2019.

TOTAL REDUCTION IN CO_2 EMISSIONS JAN-APR 2020

↓1048 MEGATONNES GLOBALLY

↓18 MEGATONNES IN THE UK

The team analysed government policies on confinement for 69 countries responsible for 97% of global CO_2 emissions. At the peak of the confinement, regions responsible for 89% of global CO_2 emissions were under some level of restriction. Data on activities indicating how much each economic sector was affected by the pandemic were then used to estimate the change in fossil CO_2 emissions for each day and country from January to April 2020.

GLOBAL REDUCTION IN EMISSIONS BY SECTOR:

↓43% SURFACE TRANSPORT

↓43% INDUSTRY & POWER

↓10% AVIATION

"Opportunities exist to make real, durable changes and be more resilient to future crises, by implementing economic stimulus packages that also help meet climate targets. For example, in cities and suburbs, supporting walking and cycling and the uptake of electric bikes, is far cheaper and better for wellbeing and air quality than building roads, and it preserves social distancing."

– PROF CORINNE LE QUÉRÉ

ANNUAL EMISSIONS

The impact of COVID-19 on emissions for the full year 2020 is expected to be a global reduction of 4%-7% depending on the duration of travel restrictions and community interventions, and the extent of the recovery. This annual drop is comparable to the amount of annual emission reductions needed year-on-year across decades to achieve the climate objectives of the UN Paris Agreement.

TRACKING OUR HEALTH AND WELLBEING

In early April, a multi-disciplinary research team from the University of East Anglia (UEA), supported by UEA Health and Social Care Partnerships (UEAHSCP), launched the C-19 health and wellbeing daily tracker study to monitor people's health behaviours and mental health during the COVID-19 lockdown. The study focuses mainly on diet, physical activity, smoking and drinking, which together account for one-third of the total disease burden in the UK.

"In order to develop strategies and treatments to help support people going through an unprecedented time of restricted movement and contact, we have to have solid, empirical evidence on which to base decisions."

– **PROF CAITLIN NOTLEY**

Just over 1,000 participants completed the daily surveys for 12 weeks during lockdown and will be followed up 6 and 12 months later. The findings generated will enable researchers to draw robust conclusions about how people's health behaviours varied during lockdown and, importantly, whether any changes were sustained and turned into habits, which would affect their long-term risk of disease. The data will also show which groups are at greatest risk of facing difficulties in recovering from any negative changes made to their lifestyle due to COVID-19.

OVER 1,000 PARTICIPANTS TOOK PART IN THE TEST

The research findings will provide meaningful information to support people living through another lockdown – and also help people who experience conditions which routinely confine them to their homes such as long-term illnesses or injuries, immobilisation or agoraphobia.

The study is being co-led by addiction specialist Prof Caitlin Notley (Norwich Medical School) and Dr Felix Naughton (School of Health Sciences), a senior lecturer in health psychology, and they plan to start publishing the findings of the study in Autumn 2020.

Preliminary findings on the effect of lockdown on changes in nutrition and dietary behaviour have contributed to Defra's National Food Strategy: Part One, which contains urgent recommendations to support the country through COVID-19.

PARTICIPANTS RECORDED LIFESTYLE CHOICES INCLUDING:

PHYSICAL ACTIVITY | **DIET** | **SLEEP**

SMOKING AND ALCOHOL CONSUMPTION | **DRUG AND SUBSTANCE USE** | **WELLBEING**

REVEALING RELATIONSHIPS AND ROUTINES

Social researchers from the School of Environmental Sciences, University of East Anglia (UEA), working with the University of Manchester, University of Nottingham, and London Metropolitan University, launched a nationwide questionnaire to explore how personal relationships have changed during lockdown. As restrictions ease in some areas and are enforced in others, the research findings about personal experiences and changes in social relationships during lockdown will provide crucial evidence about people's priorities and the challenges some may face in their journeys to social recovery.

The UK survey is based on a French study which received 16,000 responses. Researchers hope to compare findings across the two countries which went through different forms of lockdown restrictions.

"Exploring how UK citizens faced the threat of COVID-19 is essential to understand the short and long-term impacts of the lockdown, and to provide evidence on how people may have been affected by factors such as their living conditions, levels of isolation, income security and access to technology."

– **DR EMILIE VRAIN, SCHOOL OF ENVIRONMENTAL SCIENCES, UEA**

CARING FOR YOUNG CARERS

The pressures facing young carers during the COVID-19 pandemic were examined in research by Dr Kate Blake-Holmes (Centre for Research on Children and Families, University of East Anglia). As well as identifying the range of issues facing young carers, the research findings highlight the importance of identifying carers at the earliest opportunity to ensure they receive the help they need, including support to return to education safely.

Restrictions due to lockdown and anxiety regarding the risks associated with COVID-19 have been central to young carers' difficulties, increasing their caring load and preventing them from accessing their usual coping strategies such as going to school, hobbies or time with friends.

THERE ARE 800,000 YOUNG CARERS IN THE UK

Additionally, the care and education systems that would usually support young carers and their families have had to make radical changes during the pandemic, potentially drawing their focus away from the often unheard voices of young carers.

THE STUDY FOUND THE KEY ISSUES EXPERIENCED BY YOUNG CARERS DURING LOCKDOWN INCLUDE:

NOT BEING ALLOWED INTO SHOPS | **LACK OF ACCESS TO PUBLIC TRANSPORT** | **LOSS OF ROUTINE** | **INABILITY TO ENGAGE WITH LEARNING**

The research report calls for any child under the age of 18 living with a parent or sibling with substantial disability, physical health needs or mental ill health to be automatically regarded as a young carer during the on-going pandemic and supported accordingly. Also, that during this health crisis, additional emphasis must be given to the stipulation in both the Care Act 2014 and the Children and Families Act 2014 that no child should undertake inappropriate and/or excessive care.

The work involved support organisation Caring Together and their Norfolk Young Carers Forum.

"Young carers' voices are central to understanding the impact of these responsibilities and they should be involved in all aspects of research, as well as policy and service development."

– **DR KATE BLAKE-HOLMES**

KEEPING CHILDREN IN CARE CONNECTED

Almost 200 children's social care professionals, carers, adoptive parents and birth relatives responded to a survey into their experiences of contact since the onset of lockdown which revealed that video calls have been used widely to replace face-to-face contact, alongside text messaging and phone calls.

The survey, carried out by Prof Elsbeth Neil (Centre for Research on Children and Families,University of East Anglia), also showed that both carers and families have experienced barriers due to lack of access to computers or internet services, or unfamiliarity with new technologies.

Older children were more likely to feel comfortable using digital technology, and for some it was preferable to professionally supervised in-person contact. Though positive experiences were reported, both parents and children also expressed sadness at the loss of physical closeness.

There were significant challenges to using video calls with babies and young children as well as some older children with disabilities, or where children had difficult relationships with their parents and disliked having this contact take place within their 'safe space'. Parents also expressed concerns that this could reduce the chances of a child returning home, with the absence of physical contact seen as detrimental to developing or sustaining a relationship.

"The challenges have been greatest for the youngest children as it is harder for them to connect with parents just on a screen. But this has been a time of rapid learning. Carers, professionals and parents have all been finding creative ways to make calls more child-friendly and have a family-like feeling, for example by including games, songs and stories."

– **PROF ELSBETH NEIL**

GUIDANCE TO HELP INFORMAL CARERS

Prof Morag Farquhar (School of Health Sciences, University of East Anglia) leads a research programme on improving support for patients living with advanced disease and their carers – often unpaid family and friends. Prof Farquhar considered how these informal carers have been affected by increased uncertainty during the pandemic, and need additional support to access help and deal with the possibility of sudden changes, including becoming ill themselves and experiencing bereavement.

"A carer's greatest source of anxiety and distress is not knowing what to expect and who they should contact for help. Carers are used to putting the person they support first, but they need to take care of themselves as well – for their own health and in order to continue caring."

– PROF MORAG FARQUHAR

Working with colleagues at the University of Manchester, Prof Farquhar published guidance for clinicians on topics that should be considered with the carers of very ill patients during COVID-19.

IDENTIFYING MOST AT RISK GLOBALLY

Writing in the British Medical Journal, Prof Peter Lloyd-Sherlock (School of International Development, University of East Anglia) along with other international experts, reported on the high risk presented by COVID-19 to older people living in low and middle-income countries (LMICs).

The report recommended that a global expert group on older people be formed to identify and evaluate cost-effective interventions that respond to the needs of older people in LMICs living in challenging settings, where formal health service infrastructure is limited.

SUCCESS OF WORKING FROM HOME

The first international empirical study of working from home shows there were both positive and negative experiences for workers, but the benefits could be maintained after the pandemic.

Researchers at the University of East Anglia (UEA), working with the University of Greenwich, Auckland University of Technology and the Phone Free Day campaign, found that people used collaboration technologies to improve the work produced and to maintain relationships with colleagues. Difficulties reported by workers included lack of boundaries between work and home and the loss of spontaneous, creative discussions.

Overall, this way of working had a near-equal mix of positive and negative implications for team collaboration. Lessons from the research could be used to improve working from home and flexible working in the future.

"Employees proved they can be trusted in this kind of environment, so that will influence how we work now and going forward."

– DR BRAD MCKENNA, NORWICH BUSINESS SCHOOL, UEA

TRAUMA OF DOMESTIC ABUSE SUPPORT WORKERS

The lockdown increased the risks to domestic abuse victims and survivors – and put additional strain on those trying to help.

Prof Eylem Atakav (School of Art, Media and American Studies, University of East Anglia) has recorded interviews with people working in domestic abuse services, many of whom emphasised how difficult it was to adapt to a completely different way of working. This was compounded for support workers who were themselves domestic abuse survivors and were dealing with traumatic cases from their own homes.

Challenges included increased case loads, reduced availability of support workers and restrictions on the help they were able to offer.

Prof Atakav also found that lockdown had created new opportunities for collaboration. Regular online meetings empowered frontline workers to share their experiences with policymakers, politicians and academics and to come together to address issues surrounding domestic abuse and COVID-19.

COPING WITH PAIN IN LOCKDOWN

University of East Anglia's Dr Toby Smith (School of Health Sciences) and Prof Alex MacGregor (Norwich Medical School) have conducted a 12-week online survey to see how people with joint and muscle pain were affected during the COVID-19 lockdown. Their previous research has revealed the challenges and poor health outcomes caused by social isolation and loneliness for people with conditions like osteoarthritis, rheumatoid arthritis, and fibromyalgia.

This work will identify who is most at risk of poor health and wellbeing due to self-isolation so health services can better support these people during the COVID-19 pandemic and beyond.

FURTHER READING

FIRST RESPONSES

Page 7 – DoorMate™ tackles contact transmission

Licensing and manufacturing specifications: https://www.uea.ac.uk/business/access-entrepreneurship-and-innovation/licensing/doormate

Page 8 – Technicians provide critical support

Clare Stevenson's COVID-secure lab video: https://www.youtube.com/watch?v=Z-r40NDDmfU

Page 8 – Treatment and testing at the hospital

RECOVERY project: https://www.recoverytrial.net

Page 9 – Day care for key workers' children

Helping Hands relief childcare: https://www.facebook.com/groups/846306199170453/

Page 9 – Training to support youth wellbeing

FutureLearn course: https://www.futurelearn.com/courses/youth-mental-health-during-covid-19

GETTING TO GRIPS WITH COVID-19

Page 10 – Sequencing the virus

COVID-19 Genomics UK Consortium: https://www.cogconsortium.uk/

Page 11 – Infectious-disease expertise

An agent-based model about the effects of fake news on a norovirus outbreak: https://www.sciencedirect.com/science/article/abs/pii/S0398762020301474

Community use of facemasks and similar barriers to prevent respiratory illness such as COVID-19: A rapid systematic review: https://www.medrxiv.org/content/10.1101/2020.04.01.20049528v1

Impact of non-pharmaceutical interventions against COVID-19 in Europe: a quasi-experimental study: https://www.medrxiv.org/content/10.1101/2020.05.01.20088260v2

Introduction to and spread of COVID-19 in care homes in Norfolk, UK: https://www.medrxiv.org/content/10.1101/2020.06.17.20133629v1

Page 12 – Smell loss confirmed as key symptom

Global Consortium for Chemosensory Research: https://gcchemosensr.org/projects/

Comparison of COVID-19 and common cold chemosensory dysfunction: https://www.rhinologyjournal.com/Rhinology_issues/manuscript_2564.pdf

Management of new onset anosmia during the COVID pandemic – BRS consensus guidelines: https://www.authorea.com/users/325144/articles/453171-management-of-new-onset-anosmia-during-the-covid-pandemic-brs-consensus-guidelines

Page 13 – Coordinating the county's care

Health Economics Consulting: https://sites.uea.ac.uk/health-economics-consulting

DEVELOPING TESTING

Page 19 – Pilot proves community testing potential

Norwich Testing Initiative: https://www.earlham.ac.uk/norwich-testing-initiative

Page 20 – Anitgen produced to aid research

Leaf Expression Systems: https://www.leafexpressionsystems.com/covid-19/

Page 20 – Funding for rapid diagnostic test

Iceni Diagnostics: https://www.icenidiagnostics.com/

Page 20 – Analysis reveals atypical symptoms in care home cases

Testing for SARS-CoV-2 in care home staff and residents in English care homes: A service evaluation: https://www.medrxiv.org/content/10.1101/2020.08.04.20165928v2

Page 21 – Innovative testing of pneumonia patients

UEA Research – Molecular diagnostics: https://www.uea.ac.uk/research/explore/molecular-diagnostics

Page 21 – Modelling contact tracing

Combining fine-scale social contact data with epidemic modelling reveals interactions between contact tracing, quarantine, testing and physical distancing for controlling COVID-19: https://cmmid.github.io/topics/covid19/tracing-network-local.html

LIFE UNDER LOCKDOWN

Page 22 – Crisis causes crash in carbon emissions

Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement: https://www.nature.com/articles/s41558-020-0797-x.epdf

UEA Research – 360 degree view of CO_2: https://www.uea.ac.uk/research/explore/360-degree-view-of-co2

Page 23 – Tracking our health and wellbeing

COVID-19 wellbeing tracker study: https://www.uea.ac.uk/web/groups-and-centres/addiction-research-group/c19-wellbeing-study

Page 23 – Revealing relationships and routines

Lockdown Networks: Researching the impact of coronavirus lockdown on social relationships: https://lockdownnetworks.wordpress.com/

Page 24 – Caring for young carers

Understanding the needs of young carers in the context of the COVID-19 pandemic: https://www.uea.ac.uk/documents/96135/2234204/CRCF+RB+-+Understanding+the+needs+of+young+carers+in+the+context+of+the+covid-19+pandemic.pdf

Page 24 – Keeping children in care connected

Contact during lockdown: How are children and their birth families keeping in touch?: https://www.nuffieldfjo.org.uk/app/nuffield/files-module/local/documents/nfjo_contact_lockdown_rapid_research_main_report_20200521.pdf

Page 25 – Guidance to help informal carers

Supporting informal carers during the COVID-19 pandemic: https://www.brit-thoracic.org.uk/document-library/quality-improvement/covid-19/informal-carers-and-covid-19/

Page 25 – Identifying most at risk globally

Bearing the brunt of COVID-19: older people in low and middle income countries: https://www.bmj.com/content/368/bmj.m1052

Page 25 – Success of working from home

An affordance perspective of team collaboration and enforced working from home during COVID-19: https://www.tandfonline.com/doi/full/10.1080/0960085X.2020.1800417

WORK WITH US

Earlham Institute

Decoding Living Systems

Earlham Institute's research combines genomics, bioinformatics and molecular biology. We use data driven approaches to answer complex biological questions. From idea to innovation, we are committed to working with industry partners to translate research into outcomes that can deliver solutions to industrial challenges and realise impact. To work with us, contact **business.development@earlham.ac.uk**

www.earlham.ac.uk/engaging-us

John Innes Centre

Unlocking Nature's Diversity

The John Innes Centre is an independent, international centre of excellence in plant science, genetics and microbiology. Our work has significant economic impact – strengthening businesses, creating jobs and training the next generation of scientists. To access cutting-edge technologies, partner with our experts or develop innovative scientific solutions, contact the Knowledge Exchange and Commercialisation team: **kec@jic.ac.uk**

www.jic.ac.uk/working-with-industry

NHS

Norfolk and Norwich University Hospitals

NHS Foundation Trust

Norfolk and Norwich University Hospitals NHS Foundation Trust undertake high-quality, high value research that's important to healthcare worldwide. We align our research with our vision for patient care, including caring for older people, people living with cancer, young babies and children and public health. To find out more, contact **commercial.research@nnuh.nhs.uk**

www.nnuh.nhs.uk/research-and-innovation

Quadram Institute

Science Health Food Innovation

The mission of Quadram Institute is to deliver healthier lives through innovation in gut health, microbiology and food. Through Quadram Institute industry partnerships we work collaboratively to translate our science to benefit patients, consumers and society.

quadram.ac.uk/industry

The Sainsbury Laboratory

TSL

The Sainsbury Laboratory is a world-leading research institute working on the science of plant-microbe interactions. The Laboratory has state-of-the-art technologies and support services and is renowned for the quality of its fundamental scientific research in plant health.

www.tsl.ac.uk

UEA

University of East Anglia

Research at UEA focuses on some of the most important global challenges facing society. We work with policymakers and industry leaders, delivering new ideas, knowledge and solutions that have a far-reaching impact. Get in touch with **business@uea.ac.uk** to explore how we can work together to meet your challenges.

www.uea.ac.uk/business

norwich research park

Norwich Research Park is a community of world-leading research organisations and ground-breaking businesses, working together to create solutions to global challenges in food and health. Our vision is to change lives and rethink society.

www.norwichresearchpark.com

WORLD LAND TRUST™

www.carbonbalancedprinter.com

Healeys Print Group - Reg. 2108

By using Carbon Balanced Paper this publication has, through the World Land Trust, balanced the equivalent of 163kg of carbon dioxide. This support will enable World Land Trust to protect 114m^2 of critically threatened tropical forest.

Published: October 2020 (revised)

norwich
research
park

WWW.NORWICHRESEARCHPARK.COM