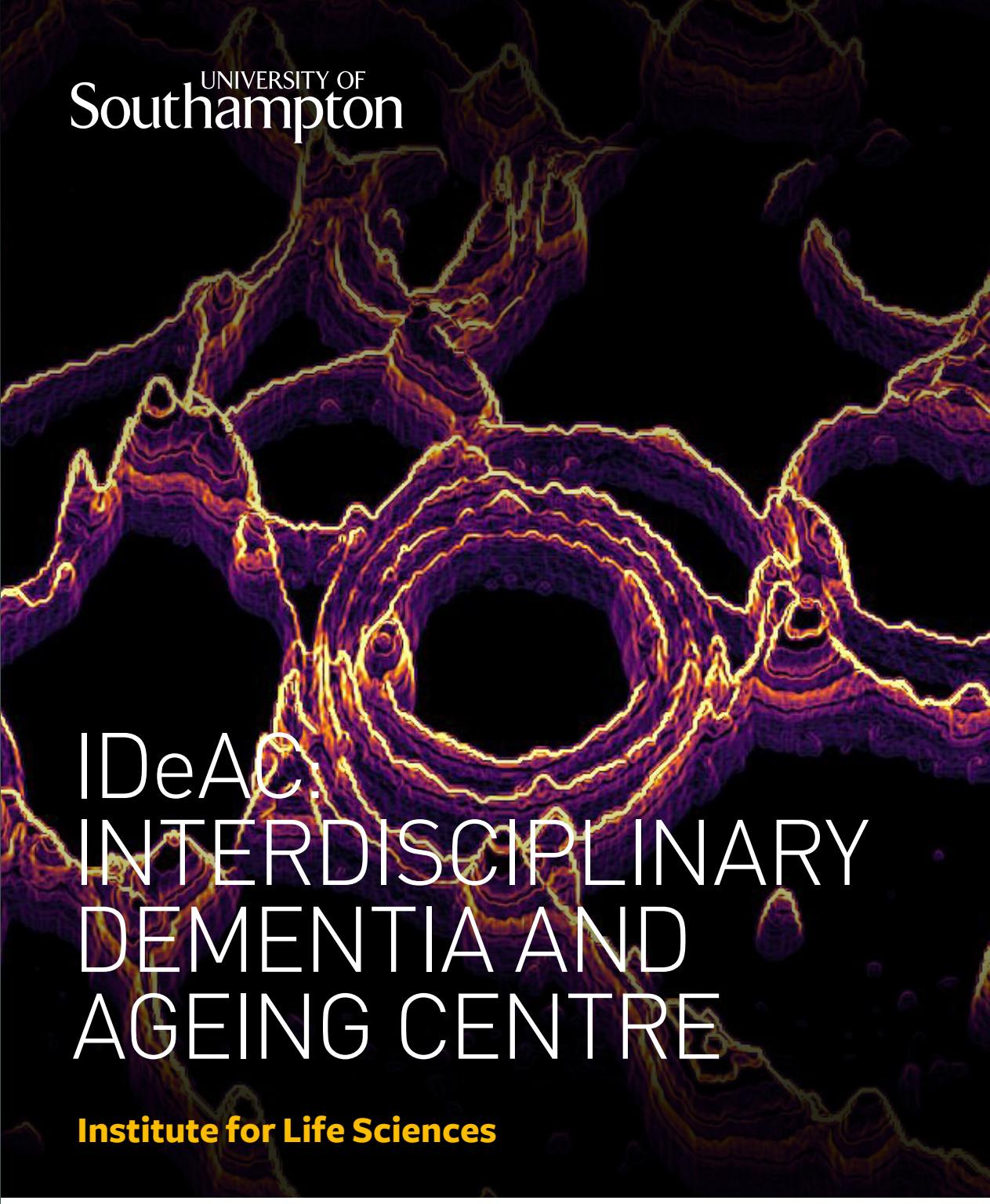


UNIVERSITY OF Southampton

IDeAC: INTERDISCIPLINARY DEMENTIA AND AGEING CENTRE

Institute for Life Sciences

iDeAC
Interdisciplinary Dementia and Ageing Centre
Southampton

NHS
University Hospital Southampton
NHS Foundation Trust

INTRODUCTION

The challenge

The South Coast is a region with an ageing population. Demographic pressures over the next 20 years will increase pressure on clinical services. Research into brain ageing and dementia is crucial, but needs to integrate advances across disciplines and be focused along the entire length of the clinical pathway: from biology through clinical and social care to system management at scale. New insights will come from the interface between disciplines thinking differently about dementia and brain ageing. In Southampton, all the elements are already in place.

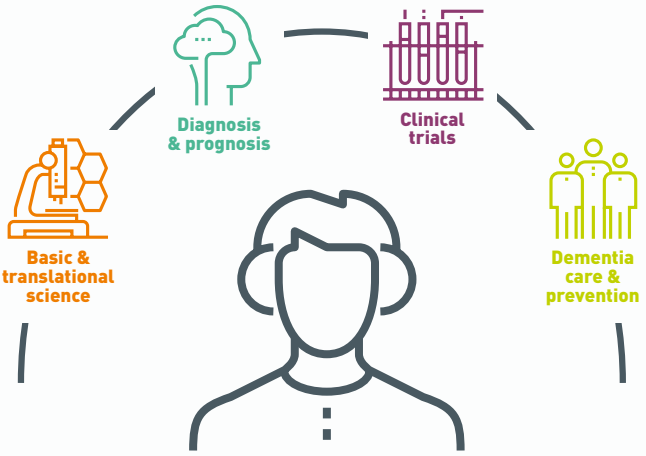
IDeAC Vision

IDeAC, the Interdisciplinary Dementia and Ageing Centre aims to focus and energise these efforts by supporting researchers and clinicians and making interdisciplinary collaboration easy, capable and effective.

By thinking differently and transforming healthcare through collaborative interdisciplinary research into the problems of brain ageing and dementia; from molecules to models of care.

IDeAC network

Led by Consultant Neurologist and Professor of Clinical Neurology and Dementia, Christopher Kipps and Professor of Clinical Neuroanatomy, Roxana Carare, the IDeAC network started in 2019 as a local network of researchers and clinicians at the University of Southampton and University Hospital Southampton NHS Foundation Trust. The network provides opportunities to engage with the IDeAC community and grow research collaborations.



IDeAC Themes

IDeAC members' expertise sits within four themes that link research and clinical activity from basic and translational science, through to community care and system design. Individuals affected by disease due to brain ageing neurodegeneration and dementia are at the centre of our research.

Front cover image of aggregated "Tau Protein" which forms in the human brain in Alzheimer's disease. Image courtesy of Dr George Devitt, Dr Iris Nandhakumar, Prof Amrit Mudher, Prof Sumeet Mahajan, University of Southampton.

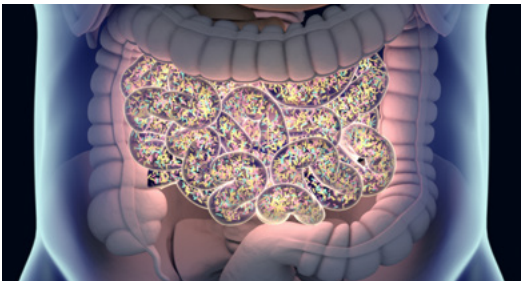
BASIC & TRANSLATIONAL SCIENCE

Basic & translational science expertise sits within cell biology, vascular pathophysiology and neuroinflammation.

Case Study 1 Basic & Translational Science: Microbiome

EUREKA project: gut microbiomes predictive of healthy ageing phenotypes.

The bacteria in our gut are important for our general health and changes to these bacteria are linked to a number of diseases, including dementia. Researchers will investigate the relationship between the bacteria in the gut and our immune system with the aim to identify 'signatures' that can help to identify who may be at risk of developing disease. Researchers apply cutting edge measurement of bacteria in stool and skin swabs and analyse the blood for changes to the immune system in people aged 50 - 80 with and without inflammatory bowel disease or people with Alzheimer's or Parkinson's Disease. Doctors and scientists are working with companies TopMD and BioArte who use computer models and artificial intelligence to identify typical patterns for a healthy gut and immune system. The combined information from the gut and the blood may lead to the development of a diagnostic test to predict risk of inflammatory bowel disease and dementia.



Case Study 2 Basic & Translational Science: Inflammation

BRAIN: Biomarker Research Assessing Inflammation in Neurodegeneration.

Researchers from the University and Hospital study the link between inflammatory markers in the cerebrospinal fluid with brain function in patients with dementia. The knowledge exchange from this collaborative activity has led to better integration of clinical studies and basic neuroinflammation research alongside early career researcher development. The aim is to translate research into better patient care with potential to pave the way towards new preventative treatment techniques to treat inflammation in order to prevent or delay the onset of dementia.

BRAIN AI: Biomarker Research to Assess Inflammation in Neurodegeneration using Artificial Intelligence.

Over 850,000 people currently live with dementia in the UK. Dementia diagnosis is a complex process that takes on average 2 years from the start of symptoms. Brain imaging can help detect early signs of dementia. Infection and inflammation are seen as drivers that accelerate dementia progression.

An interdisciplinary group of researchers and clinicians working in the fields of imaging, inflammation, neurology and data science have joined forces to create a Diagnosis Support Tool. They are using Artificial Intelligence methods to combine brain imaging with measures of inflammation from body fluids. This tool will support clinicians in early diagnosis and evaluation of dementia progression.

Case Study 3 Basic & Translational Science: Vascular

Harnessing the heart-lung-brain interactions in the search for vascular biomarkers for neurological dysfunction.

The interdisciplinary team from University Hospital Southampton & University of Southampton includes specialists in cardiothoracic surgery, ophthalmology, cardiac perfusion, imaging, mathematics, and neuroanatomy. The team are in the optimal position to conduct a study to investigate the heart-lung-brain interactions and their effect on the variability of cerebral blood flow in anaesthetised patients undergoing cardiothoracic surgery with cardiopulmonary bypass and different levels of hypothermia.

By systematically and methodically being able to control elements of the cardiovascular and respiratory systems function we can isolate the different signals transmitted from the brain blood flow and prove that spontaneous cerebral vasomotion as a key force for the clearance of fluid from the brain is present and began in the wall of the cerebral arteries. This research will establish a highly sensitive early marker for the early detection of dementia, before the onset of clinical symptoms. It will also inform new targeted therapies for dementia.

DIAGNOSIS AND PROGNOSIS

This theme links basic science to clinical services for evaluation of dementia diagnosis and provision of care. It includes dementia diagnostic imaging, with expertise in structural and functional imaging, modelling and scientific computing.

Case Study 4 Diagnosis & Prognosis: Imaging

Perfusion to Diagnosis.

Dementia comes in different types, such as Alzheimer's disease, vascular dementia, frontotemporal dementia , and dementia with Lewy bodies. These types have different mechanisms of action and can progress in different ways but they can be very difficult to tell apart. Identifying the type of dementia helps better manage patients' symptoms and plan supportive care.

A brain imaging technique called Single Photon Emission Computed Tomography can help identify changes in brain perfusion. A reduction in brain perfusion is an early sign of dementia. Scientists from University Hospital Southampton developed a software tool called Perfusion to Diagnosis (p2d) which quantifies the patient's brain images and compares to those of healthy individuals. p2d highlights regions and patterns of reduced perfusion within the brain, which are helping clinicians, identify different types of dementia.

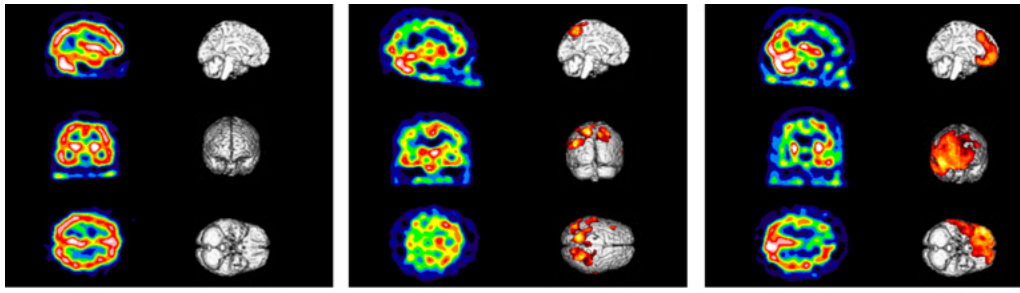


Image courtesy of Dr Sofia Michopoulou, University Hospital Southampton NHS Foundation Trust

Example of perfusion patterns produced by p2d for a healthy individual, a patient with Alzheimer's disease and a patient with frontotemporal dementia are shown.

Case Study 5 Diagnosis & Prognosis: Imaging

Stratification of tauopathy patients using vibrational and optical spectroscopy.

Researchers are developing techniques with clinicians to identify tauopathy patients at early stages of disease to offer an accurate prognosis. The team have demonstrated that spectral biomarkers generated using label-free techniques including Raman spectroscopy can be used to identify and stratify tauopathy patients. The clinical translation of this methodology has the potential to improve the speed and accuracy of dementia diagnosis in the future.

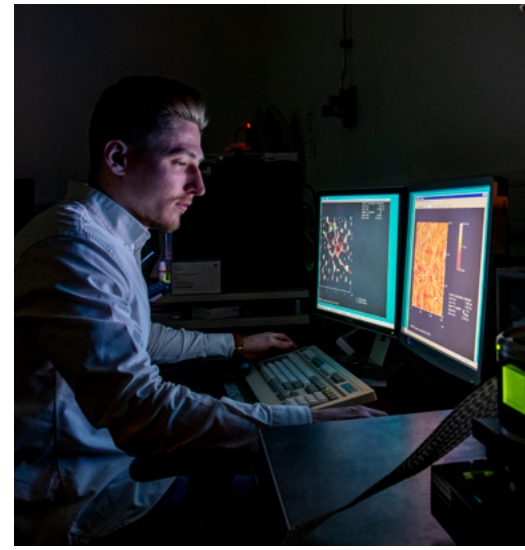


Image courtesy of Dr George Devitt, Biological Sciences, University of Southampton

CLINICAL TRIALS

There is a long history of dementia, brain ageing and neurodegenerative disease trials in Southampton.

Case Study 6 Clinical Trials

Combining Memantine and Cholinesterase inhibitors in Lewy body dementia treatment trial (COBALT).

Lewy body dementia (LBD), which includes both Dementia with Lewy bodies and Parkinson's disease dementia, is a neurodegenerative disease that causes a troublesome range of cognitive and neuropsychiatric symptoms. Patients with LBD are usually offered treatment with cholinesterase inhibitor drugs, which can help these symptoms in most people. Southampton researchers are part of an NIHR Health Technology Assessment funded international multi-centre trial, led by Newcastle University, examining whether the addition of Memantine may help people with LBD. The Southampton site for this trial is the Memory Assessment and Research Centre, Moorgreen Hospital. More information about this study is available on the **NIHR website**.

Case Study 7 Clinical Trials

Permeability of the blood-brain barrier in Alzheimer's disease (PEBBAL) measured using dynamic contrast-enhanced MRI: a pilot study.

Inflammation is the body's normal response to injury and infection. It can be healthy or harmful depending on the situation. We know that when people with dementia get infections their cognitive symptoms can get worse. Blood vessels normally block the entry of bacteria and chemicals into the brain, which if allowed to enter would cause damage to neurons. This defence is called the blood-brain barrier (BBB). Research studies have measured how much of a chemical contrast moves from the blood into the brain using dynamic contrast-enhanced MRI and suggested that the BBB may become more permeable in dementia. Researchers have developed a more accurate method to measure BBB permeability, using these brain scans.

The team are interested in how the BBB, inflammation and dementia are linked. The team believe that with an improved method of measuring BBB permeability, this study could lead to new information about the causes of dementia and help to predict those people with Alzheimer's disease who may deteriorate more quickly.

Case Study 8 Clinical Trials

Enroll-HD

Enroll-HD is a worldwide observational study for Huntington's disease (HD) families. It monitors how the disease appears and changes over time in different people, and is open to people who either have HD or are at-risk. It aims to better understand Huntington's disease to give better insights into developing new drugs, improve the design of clinical trials to find treatments that work faster, and to improve clinical care for people with HD by identifying best clinical practices and working to ensure that all families get that standard of care.

Enroll-HD is a platform to support other HD research and runs through the Wessex Neurological Centre regional HD service at University Hospital Southampton.

DEMENTIA CARE AND PREVENTION

Dementia care and prevention focuses on the individual, with a strong research base in user-centred and care-delivery design and the dementia workforce.

Case Study 9 Dementia Care & Prevention: Community care and senses

Material Citizenship Framework project.

Moving into a care home is a significant and often life changing transition. Everyday objects can make this easier. Whilst it is widely believed that care homes encourage new residents to bring personal possessions with them, a recent study found this not to be the case. Only certain objects are encouraged in care homes and people with a dementia are often excluded from deciding which objects they take with them. Material citizenship is a conceptual framework that focuses on the interactions people have with objects, for example, access to a preferred coffee cup or being able to use a hairdryer or a pair of hair straighteners. Material citizenship emphasises the use of objects as way of enabling staff to support residents live a meaningful life. We have developed a material citizenship training package which we have piloted with staff in care homes for older people.

More information is available on the **NIHR ARC Wessex website**.

Case Study 10 Dementia Care & Prevention: Community Care

Creating Learning Environments for Compassionate Care (CLECC) in mental health settings: an implementation study.

A programme called Creating Learning Environments for Compassionate Care (CLECC) is being adapted for use in mental health settings. In CLECC, all registered nurses and health care assistants from participating wards attend a study day, with a focus on team building and understanding patient experiences. A nurse educator supports the team to try new ways of working on the ward, including regular supportive discussions on improving care. Ward managers attend learning groups to develop their leadership role. Volunteer team members receive training in observations of care and feed back information to colleagues. Researchers found that the CLECC programme can be made to work with nursing teams on NHS general hospital wards and that staff felt it improved their capacity to be compassionate. We are now evaluating the best way to use CLECC in mental health settings.

Our Purpose:

IDeAC seeks to focus, energise and support interdisciplinary research and clinical translation in dementia and brain ageing in Southampton throughout the health and social care pathway (from molecules to models of care.)

IDeAC aims to generate new insights into the problems of dementia and brain ageing by challenging existing thinking and developing innovative solutions through interdisciplinary collaboration.

IDeAC aims to build on existing strengths to catalyse collaborative interdisciplinary research partnerships across academic, clinical, social care and industry sectors in Southampton and beyond

IDeAC Activities:

We host a programme of events and seminars to catalyse collaborative interdisciplinary research to address challenges in dementia and ageing. We actively pursue opportunities to support network activities and research across the themes.

How to get involved:

Researchers, clinicians and healthcare practitioners in the Wessex region who are interested in joining the network and mailing list should contact **IfLSAdmin@soton.ac.uk**.

"The strength in IDeAC is the close collaboration between academics (who are testing ideas), NHS staff (who are involved in day to day diagnosis and care), engineers (for technological development and modelling), mathematicians (for modelling processes that cannot be seen with any current method) and industry (who develop new treatments)"

Professor Chris Kipps, University Hospital Southampton NHS Foundation Trust and Professor Roxana Carare, University of Southampton
Co-leads, Interdisciplinary Dementia and Ageing Centre (IDeAC)

Find out more:

www.ideac.org
www.southampton.ac.uk/life-sciences

IfLSAdmin@soton.ac.uk