THE RESEARCH IMPACT ANTHOLOGY

RESEARCH FOR A HEALTHIER FUTURE



College of Medicine and Health

Improving the lives of people in Ireland and beyond

Our greatest resource in the College of Medicine and Health is Our people ??

An The



foreword

The ultimate aim of today's research is to ensure a healthier future - but it can take years to create an impact on people's lives.

Frequently, many individual pieces of research must be combined to effect change, like the cogs needed to make a wheel turn. Creating new knowledge in health research is just the first step in delivering health benefits; ensuring that that knowledge is translated and implemented is equally challenging.

The partnership among academia, the health and social care service, industry and policymakers is essential to promote, facilitate, translate and implement research advances in a timely manner. Better health and improved treatment outcomes for patients are the rewards for this effort. Much of the research described in this anthology is a testament to these strong partnerships.

Our greatest resource in the College of Medicine and Health is our people. We have a committed and dedicated staff who constantly innovate in both teaching and research. Staff develop new modules and programmes, seek to continually improve their teaching whilst growing and developing our research, and engage internally and externally in the process. It goes without saying that a research-rich environment is essential for high-quality student education. All our students are exposed to, and in many cases involved with, advances in healthcare knowledge and practice. They are assured that their education is delivered by a college at the cutting edge of research and innovation.

We are fortunate that the southern ecosystem offers fertile ground for growing and developing health research and innovation. This is owing to four interacting parts:

1. The unique and productive research hub at our university supported by a thriving Clinical Research Facility, a state-of-the-art simulation centre, modern labs and research infrastructure.

2. Our excellent interdisciplinary links, including the Tyndall National Institute; Health Innovation Hub Ireland; National Cancer Registry; Insight Centre for Data Analytics; National Perinatal Epidemiology Centre; and the National Suicide Research Centre to name but a few. **3.** Our proximity to our highly skilled healthcare workforce, their patients and the public through our partnership with the South/South West Hospital Group, and through our working relationship with Public Health and Primary Care.

4. Ireland is a home for 24 of the world's top biotechnology and pharmaceutical companies, many of which are based in Cork and have excellent working relationships with UCC.

Our future development plans for the College will build on this ecosystem and will strengthen the infrastructure so that all of us can reap its advantages for research and innovation for the ultimate benefit of patients and the public.

There are many and varied research stories to be told by the staff in our College. Each of the authors could have filled a book with their own research, not to mention those whose research is at an earlier stage and whose stories will be related in future anthologies.

For this anthology, researchers were asked to select just one piece of work which has had an impact on people's lives and which illustrates the nature of the work they do. We have categorised their stories into treatment, policy and social impacts.

As Head of the College of Medicine and Health, I am proud to present our inaugural research anthology which offers a window into the wonderful, lifechanging work that is being carried out here at University College Cork.

Finally, we would like to express our gratitude to our funders, donors and our supporters who help bring our work to fruition. Particular thanks are owed to our patients and the public, without whom much of this research could not have been realised.

Professor Helen Whelton

Head of College of Medicine and Health

OUR COLLEGE AT A GLANCE



Dental School and Hospital School of Clinical Therapies School of Medicine School of Nursing and Midwifery School of Pharmacy

School of Public Health

ACADEMIC PARTNER TO 9 HOSPITALS

UCC is the primary academic Partner to 9 hospitals in the HSE South/South West Hospital Group

Cork University Hospital/Cork University Maternity Hospital

University Hospital Waterford

University Hospital Kerry

Mercy University Hospital

South Tipperary General Hospital

South Infirmary Victoria University Hospital

Bantry General Hospital

Mallow General Hospital

Lourdes Orthopaedic Hospital Kilcreene



The College of Medicine & Health is proud to contribute to the University's position in the top 50 in Europe for teaching and learning as ranked by the Times Higher Education in 2018.

NATIONAL & GLOBAL NETWORK

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The College of Medicine & Health has a national and global network of collaborations through research and education.

APC MICROBIOME INSTITUTE

Is ranked Number 1 for research in Antimicrobials and in Probiotics (cwts bibliometric, leiden).

INFANT CENTRE

INFANT is Ireland's first and only perinatal research centre

> €28.5m RESEARCH INCOME IN 2017

STAFF & STUDENT NUMBERS

School	Undergraduate	Taught Postgraduate	
Clinical Therapies	237	69	
Dentistry	322		
Medicine	1035	130	
Nursing & Midwifery	794	235	
Pharmacy	243	76	
Public Health	106	137	
PhD Students	100		
International Students	521	79	
Area	Staff Num	Staff Numbers (fte)	
Academic	19	198	
Research	29	297	
Support Staff	20	204	
Total	69	699	

500+ AFFILIATED HOSPITAL CONSULTANT STAFF

RESEARCH PARTNERS AND FUNDERS

We would like to acknowledge and thank our funders, without whom the research described in this anthology would not be possible. Although some of our private donors wish to remain anonymous, the impact of their contribution cannot be over stated and we are very grateful for their support.



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THE RESEARCH IMPACT ANTHOLOGY / COLLEGE OF MEDICINE AND HEALTH

01

The APC: How we became one of the top five centres in the world

Highlights

Ambitious team has helped drive global research agenda in gut microbiota

APC ranked in world's top five microbiota research centres Research efforts have made tangible differences to the lives, careers and wellbeing of patients, academics and the public It has made a global impact on issues related to gut microbiota, but APC (Alimentary Pharmabiotic Centre) Microbiome Ireland, one of our star research centres at the College of Medicine and Health, was first sparked into existence by the meeting of enthusiastic and original thinkers 25 years ago.

Its director, Fergus Shanahan, Professor and Chair at the Department of Medicine, recalls clearly the occasion when one of his first collaborators, the late great surgeon and UCC professor, Gerry O'Sullivan, roared down the phone to him, back then: "Worldclass research in Cork? Can it be done? Of course it can be done."

In dismissal of the nihilists and naysayers, he added for emphasis: "It can be done because it is being done." And thus began the shared "hours upon hours every night" between the two men, discussing research questions.

"Our problem was too many ideas and not enough time," says Fergus. "Surrounded by unanswered questions about common clinical problems, we set ourselves to address them. Working together was the first turning point. We knew that if you want to go fast, go alone, but if you want to go far, go together."

They established collaborations with like-minded clinicians and scientists, such as Kevin Collins, Joe O'Connell, Ger Fitzgerald, Charlie Daly, Barry Kiely, and Eamonn Quigley, with others such as Michael Maher joining later.

"Every week, in the evening, after our day jobs, we would huddle into room 329 in the food science block of UCC and drive the research agenda," remembers Fergus.

They were already making their mark: "Examples of research completed included the discovery of a mechanism by which certain cancers evade immune surveillance (The Fas Counterattack, which became a citation classic); the demonstration of micrometastases in bone marrow as a prognostic biomarker for patients with gastrointestinal cancers; the use of modern software to refine CT scanning, to minimise diagnostic radiation exposure and to make CT safer; and the development of therapeutic manipulation of the gut microbiota for infectious and irritable bowel syndromes," he cites.

Such advances led to a series of high-profile papers in top peer-reviewed journals, and over time the group - known as The Cork Group - became internationally recognised for gut health research and rapidly rose in international rankings of publication citations. That progress was accompanied by several successes in competitions for international grants from the EU and elsewhere.

Of course that successful trajectory hadn't travelled far from its ambitious roots, the original state of intent verbalised by Gerry in that phone conversation. "It wasn't enough for us," admits Fergus. "We had ambitions to become world leaders and to get Irish ideas onto a global stage and into a world marketplace."

To achieve this, they worked closely with industry and in 1999 set up their own campus company, Alimentary Health Ltd (AH). This was the second turning point, because Alimentary Health enabled them to work with the global giant Procter & Gamble and their scientists.

"Soon, our combined efforts led to the launch of what has become the number one probiotic prescribed by gastroenterologists in North America (Align[™] in the USA and Alflorex[™] in Europe).

"Later, the Wall Street Journal would write that this was the one probiotic organism with 'solid science behind it'," says Fergus. "And the story of the Cork probiotic was written up as an example of disruptive technology for patients with irritable bowel syndrome in Forbes magazine."

The next turning point was the foundation of the Science Foundation Ireland (SFI)-funded Alimentary Pharmabiotic Centre (APC) in 2003, which is now known as APC Microbiome Ireland, with Alimentary Health Ltd, along with its affiliates, as the anchor commercial partners.

Industry partnerships increased and flourished. Today, APC is ranked amongst the top five such centres in the world. In addition to having a positive influence on patients' lives, APC research has contributed to the local economy by anchoring existing manufacturing jobs, by the creation of hundreds of new high-tech jobs and by attracting foreign direct investment.

"There are now nine companies working in Cork that would not otherwise have a footprint here, were it not for the APC," says Fergus.

"For the Irish taxpayer, APC researchers have successfully leveraged every euro of SFI investment by recouping an additional euro from foreign direct investment."

This level of delivery - from a centre which has also prided itself in promoting a collaborative environment, conducive to learning and innovation - is unparalleled by any other sector of the public service. In Cork and at UCC, our APC research has made a real difference for patients, professors and for the public. "Who said it couldn't be done?!" quips its passionate director.

02 /

Not just a gut feeling: what we eat and other factors affect our microbes and our mood



Highlights

APC Microbiome research shows that certain prebiotics could modulate anxiety and other stress-related behaviours Discoveries have opened up new field of 'psychobiotics', the study of bacteria or biochemicals that support the brain

Over the past decade it has become increasingly clear that the microbiome - the trillions of microbes, mainly bacteria, within our gastrointestinal tract plays a crucial role in human health and wellbeing, especially in regulating the gut-brain axis.

Our researchers at the APC Microbiome Ireland have been playing a crucial role in highlighting how those gut bacteria influence our brain function and behaviour, under normal and stressful conditions.

APC Microbiome Ireland scientists John Cryan, Chair of the Department of Anatomy and Neuroscience, and Ted Dinan, Professor of Psychiatry and Neurobehavioural Science, who have spent the past 14 years exploring the gut-brain connection, have put the spotlight on how food and other factors impact our psychological wellbeing.

Their research has shown that people who are clinically depressed have less diversity in the microbiota in their gut and that we need to eat a diet rich in fibre, fish, fruit and vegetables in order to create and maintain that healthy diversity.

They have studied prebiotics, which are nondigestible food ingredients that promote the growth of beneficial microorganisms in the intestines, and have found that a combination of two of them, the soluble fibres fructo- (FOS) and galactooligosaccharides (GOS), which are similar to those naturally found in breast milk and some vegetables, could modulate anxiety, cognition and stress-related behaviours in healthy mice. Their research also shows that these prebiotics modified specific gene expression in key brain regions, reducing chronic stress-induced elevations in stress hormones and immune factors, in addition to stress-induced depressive-like and anxiety-like behaviour.

Taken together, these data strongly suggest a beneficial role of prebiotic treatment for stressrelated behaviours, which strengthens the evidence base supporting therapeutic targeting of the gut microbiota for brain-gut axis disorders and in that context, offers new avenues in the field of nutritional psychiatry.

Their discoveries have led to them coining the term "psychobiotics", which are any bacteria, or support for bacteria, that benefit the brain. They include the prebiotics, which are often dietary fibres, and probiotics, which are live microorganisms that have a beneficial effect on the prevention and treatment of diseases, as well as any intervention that targets the microbiome to support brain health.

Psychobiotics are an exciting new development that could play an important supportive role in the prevention and treatment of mental health conditions in the future.

Their book, **The Psychobiotic Revolution: Mood, Food, and the New Science of the Gut-Brain Connection**, released last year, has been a bestseller within the scientific community and beyond.

People who are clinically depressed have less diversity in the microbiota in their gut...and we need to eat a diet rich in fibre, fish, fruit and vegetables, in order to create and maintain that healthy diversity.

03 /

Such phenomenal growth in such a short time from our INFANT

*

Highlights

Irish Centre for Fetal and Neonatal Translational Research exploring new frontiers in pre-eclampsia, infant nutrition, and newborn brain injury

For every euro received in State funding, INFANT research has generated five euros in new revenue When babies are born it is usually a joyous occasion. In most cases it goes well, but some babies are born either too soon or very sick. They may not have grown well enough in the womb or may have suffered an injury during labour.

When you consider that there are 65,000 babies born annually in Ireland - the highest birth rate in Europe - then it is not surprising that we need a research centre to explore how we can make pregnancy and birth safer for our mums and babies, and improve outcomes.

Our dedicated perinatal translational research centre reaches out from the bench to the cotside - often little incubators - in a very real way, so that our innovations are put into clinical practice. Our centre is the first of its kind in the country.

INFANT, the Irish Centre for Fetal and Neonatal Translational Research, was established in September 2013 by Prof. Geraldine Boylan and Prof. Louise Kenny, two innovative academics in perinatal research at our college. They secured a starting grant from Science Foundation Ireland (SFI) to develop a dedicated research centre in UCC.

Geraldine's speciality was in the neurophysiology of the baby brain and Louise's expertise was in preeclampsia and obstetrics. They had each built their own individual talented research teams for several years, and in INFANT, they pooled their resources and built multi-disciplinary programmes.

Geraldine, INFANT director, says: "We combined our efforts. We said mothers and babies should be together, so the research should be together!

"We had an excellent research team and a bedrock of good work going on; we were all in the right place at the right time. And what we have in Cork, also, is a great synergy between the university and the hospitals (Cork University Maternity Hospital and Cork University Hospital); it has been perfect for working well in the perinatal space.

"If our INFANT centre, just barely five years old now, could be judged from a child developmental perspective, it has hit all its milestones and would be in the 99th percentile - maybe even off the charts!", says Geraldine.

"We received €5.9M from SFI to set up the centre in 2013, which enabled us to build the core infrastructure of the centre, and now we have a funding portfolio of €30M. We have outperformed all of our key performance targets and now have 100 staff working in INFANT. We have won funding from the EU, the Wellcome Trust and from industry and received donations through philanthropy. For every one euro of funding we have received from the state, we have been awarded another five euros on top of that, from non-Exchequer sources," she says proudly. "Working closely with industry enables our team to get their technologies or new devices or drugs realised, as speedily as possible. This is so important for these vulnerable populations."

Research at INFANT, of course, touches all humanity. Our dedicated researchers are on call 24/7 since a lot of their work explores problematic situations that happen at birth and afterwards, and how these can be prevented down the road for other mums and babies.

None of this could be done, of course, without the families who engage in our research with our multidisciplinary team of doctors, nurses, scientists, engineers, postgraduate students and research support staff.

"We need to study mothers and we need to study the babies to find out why problems happen, and we can only do that because of the parents and families who engage with our research. They really understand why we are doing it," says Geraldine. "I am constantly overwhelmed by their altruism and their generosity. It doesn't matter what funding in the world we get - without them, this research wouldn't happen."

It's hard to believe that not too long ago it was seen as unethical to do research with children. "Actually it's unethical not to do it," says Geraldine. "For a long time children did not participate in research, and as a result, most of the medical devices and many of the drugs we use have never been properly tested for infants or children - even though their development and physiology are completely different to adults. The evidence base isn't there, so we are working to make sure that medical devices and treatments for children are tested and developed to the best possible standards."

INFANT is changing that landscape nationally and internationally. Our research is known all over the world; we have delivered over 300 highly cited academic publications in the last four years alone. We are known throughout the world in relation to pre-eclampsia, newborn brain injury, maternal and infant nutrition, and infant allergy. We have lots of high impact papers published in those areas and more in the pipeline.

For the director, she is fully confident that there is no stopping their phenomenal pace of growth: "We have only just scratched the surface of what we need to do for mothers and babies," she says. "There's so much more yet to be done and we won't stop!"

04 /

The licensing of our newborn baby algorithm is a dream come true

Highlights

INFANT centre research has developed seizuremonitoring algorithm that works 24/7 The algorithm is the first ever developed for babies to be clinically trialled

While most babies are born healthy, one in every 500 are at risk of developing seizures after birth. These babies need urgent care but there may be no visible signs of what is happening in the brain, making those seizures very difficult to both detect and treat.

Seizures can be detected by measuring the electrical patterns of the baby's brain with an EEG monitor, using small sensors applied to the scalp. These patterns are difficult to interpret and an EEG expert needs to be available in the hospital on a 24-hour basis, which is rarely the case. As a result, infants with seizures may go undiagnosed and untreated.

Our researchers at the INFANT centre have changed all that, however. They have developed a groundbreaking computer algorithm that provides monitoring around the clock.

This groundbreaking development - the first algorithm ever developed for babies that has been clinically trialled - was made possible due to the commitment of INFANT researchers, who are on call 24/7, and the families of the babies monitored throughout the research process.

"When a baby is in distress our researchers are there

very quickly to start monitoring so that we can get the information that will not only help that particular baby but also babies in the future," says INFANT director Geraldine Boylan. "That's how we developed our current technology for monitoring seizures - with the help of families who have participated in our research studies since 2003. This work allowed us to gather all the information and data we needed to train computer algorithms, which has given us an automatic device to interrogate the brainwave patterns of babies, which helps clinicians make decisions.

"My dream of getting this from the bench to the cotside is now a reality, as a large multinational patient monitoring company has recently licensed our technology and are integrating it into their machines for neonatal intensive care units," says Geraldine.

The company's products are used all over the world. INFANT has truly made its stamp in helping to improve the outcomes for babies far beyond the reach of its Cork-based research centre.

"When a baby is in distress our researchers are there very quickly to start monitoring so that we can get the information that will not only help that particular baby but also babies in the future."

05

Making history: our research has influenced the nation's oral health as well as further afield

Highlights

OHSRC has been instrumental in recommending new regulations for community water fluoridation OHSRC's collaborative research grant, FACCT, is helping to reduce the incidence of tooth decay and fluorosis in Irish children

While the arrival of that first tooth, and then all the others pushing through afterwards, may generate lots of excitement for baby's loved ones, underneath the surface there is a lot more going on in the bone than meets the eye.

The permanent teeth, which usually don't become visible until between six and seven years afterwards, are being formed deep in the bone before the age of three; that is when the enamel, the hardest structure in the human body, is being laid down.

In Ireland back in the '50s and early '60s, tooth decay levels in children were so overwhelming that community water fluoridation (CWF) was introduced as a public health measure. Since then, CWF - and from the '70s the introduction of fluoride toothpaste - have been the cornerstone of tooth decay prevention.

"With a public health fluoridation policy, however, comes a responsibility to monitor and adapt as needed. Our Oral Health Services Research Centre (OHSRC), established 35 years ago, the only one in the country, has been extensively involved in the monitoring process," says its deputy director, Mairead Harding.

"Having been designated a World Health Organisation (WHO) collaboration centre back in 1988, we are nationally and internationally renowned for our expertise in a wide area of oral health strategies," she says. "And currently with the Health Service Executive (HSE), we are working on a €1.2 million, six-year Health Research Board (HRB)funded collaborative applied research grant, called FACCT - Fluoride and Caring for Children's Teeth."

Previous research conducted in 1984 and in 2001-2002 indicated significantly lower levels of dental decay among children surveyed in CWF areas in comparison to those without. But it was noticed that this reduction was accompanied by an increase in white patches and fine lines on the enamel of the teeth (dental fluorosis), which are associated with fluoride intake during tooth development and evident in the children's teeth as they grew older.

"Since from the time of birth, a baby's second round of teeth start forming. Growing away in the jawbone, it follows that the amount of fluoride ingested by its little body will influence the extent to which it might get these white marks," says Mairead.

As a result, the government implemented new regulations in 2007 reducing the levels of fluoride from 0.8 to one part per million (ppm), to 0.6 to 0.8ppm, with a target value of 0.7ppm.

They couldn't control the amount of toothpaste people were using, but they could control the amount of fluoride in the water.

Parents were also advised not to use toothpaste when brushing their children's teeth before the

age of two, unless otherwise advised, and to supervise them up to the age of seven, ensuring that toothpaste is not swallowed and only a small peasized amount is used.

The impact of these policy changes on children's oral health, and in particular on the appearance of those white marks, are being evaluated in the FACCT research project. This work has international significance in particular for North America and Canada, and other countries worldwide, which have also reduced their fluoride to similar levels but have not measured the impact on the population.

"A lot of our work in the study has been about developing insight into fluorosis; this included leading a European Union project looking at fluoride ingestion of toothpaste - to see what was happening in other countries in Europe as well as our own," says Mairead. "We looked at a way of recording this fluorosis because it's very subjective, depending on varying conditions, so we developed a photographic method to take pictures of it."

At our OHSRC in general, most of the research is about the prevention of oral disease and providing the scientific evidence to ensure that people are confident about using water fluoridation and of course the fluorosis issue is entrenched in that.

"Our research is all about maximising the benefits and minimising the risks, so it's important to us to get the message out there to use fluoride toothpaste responsibly, while appreciating the scientifically proven preventive success story that the CWF scheme has been for us as a country," says Mairead.

The most common chronic disease of childhood is dental decay. In a WHO global burden of disease study, untreated decay in the permanent teeth was number one out of 291 diseases studied. It outlined that some of the significant impact of tooth decay on children's quality of life, included pain, discomfort, disfigurement, acute and chronic infections, eating and sleep disruption, as well as higher risk of hospitalisation.

"At the other end of the age spectrum, back in 1989, six years after our OHSRC was formed, 41% of adults over 65 in Ireland didn't have one of their own natural teeth left." says Mairead.

"That has changed dramatically, with an increasing number of older people now keeping their own teeth into older age.

"As can be seen, our oral health research follows human life and its environment from the beginning to the end, with its rewarding impact shared on the world stage as well as at home," adds its deputy director. 06/

Our less invasive cancer treatment improves patients' quality of life

Highlights

UCC College of Medicine and Health has become global leader in new field of 'electrochemotherapy' Electrochemotherapy is less invasive than similar cancer treatments, with trials indicating that it leaves surrounding cells unaffected

Living with cancer is incredibly difficult. Having cancer on the skin is a constant visible reminder of that disease. It can cause not only deterioration in people's mental quality of life, but also in their physical quality of life, because if left unchecked, these areas can continue to grow and to ulcerate and bleed.

In some cases, patients have been told there is nothing else that can be done, but in recent years an alternative minimally invasive treatment, developed by our researchers, has changed all that, both at home and on the world stage.

Scientists have found that you can shock cancer cells by delivering very short electrical pulses to the tumour - a technology called 'electroporation' which allows those cells to become more porous and better able to absorb a drug.

Our multidisciplinary team, working in translational cancer research within our College of Medicine and Health, has become a global leader in this technology, using electroporation with chemotherapy, called 'electrochemotherapy'.

The major benefit of the technology is that by directly targeting just the membrane of the cells, it causes the tumour to regress while leaving the surrounding nerve endings, vascular cells and the muscle structure unaffected.

While the development of electrochemotherapy was a multi-national collaborative effort across multiple sites in Europe, the major role we played was in the clinical translation and validation of its use for skin cancer patients and getting that success story on to the world stage. Although the clinical trials began in 2004, the treatment of patients on a regular basis started six years ago, with an average of 20-30 patients in Cork, per year, benefitting since then.

"Now we have moved to the point where there are actually hospitals all over Europe who are using this technology for cancer patients, so that is a fantastic plus to us. We were involved in the development of the technology, in the translational piece, in clinically validating it, doing the studies, getting it published, presenting it to the world and seeing other centres start to take it on,"

says Declan Soden, principal investigator.

The group has recently achieved another major first, completing the first randomised control trial using electrochemotherapy.

For the clinician at the coalface, so to speak, it is extremely rewarding to see that groundbreaking research touch the real lives of patients:

"Electrochemotherapy can be used on those who have been unsuitable for other forms of treatment, so quite often I see patients who would have been turned down by everyone else, and who really feel as if they are at the end of the road," says consultant plastic surgeon Jim Clover, who is also clinical senior lecturer in plastic surgery at UCC.

"Skin cancer in particular is a very visible and very emotive disease. They are a lovely group of patients to look after, and this treatment can make a great difference to their quality of life. They often come back re-energised and reinvigorated by the treatment and able to carry on and enjoy themselves a little bit more."

Because Cork is the only location in the country where this alternative minimally invasive day-case treatment is being offered, people are travelling from all corners of Ireland, as well as from overseas.

Electrochemotherapy is such a quick procedure in contrast to other conventional cancer treatments, which can be more invasive and labour intensive, causing more disruption of a patient's time and quality of life.

But while Jim is the one who witnesses the joy that quality of life brings to patients, he is ever mindful of the collaborative effort that enables that outcome. "Everything we do is part of the team - and we all have different roles in it. I'm the one who presses the button at the end of it, but I'm under no illusion at the number of people who each play a pivotal role in allowing for treatment," he says.

While our team has trials published - and at various other stages - they are constantly evaluating how they can make better treatment, more useful for the patient.

Following further research, they have now developed specific electrodes that can attach to the head of an endoscope, to be used internally, so that patients for instance who have some forms of bowel cancer or oesophogeal cancer, are now being treated endoscopically with electrochemotherapy - with the same benefits being observed as with skin cancer patients.

In addition, they are researching interactions with the immune system, treating patients with melanoma receiving immunotherapy (using their immune system to fight cancers) with electroporation.

"We are continually trying to challenge current methods, saying 'can we do this better?'," says Declan. "We can reduce the impact on the patient and we can reduce costs - I think they are two of our guiding principles."

07 /

Our discovery prevents postsurgical pain



Highlights

UCC School of Medicine research shows that use of the drug pregabalin can reduce pain symptoms and improve functionality in patients for up to three months following lumbar discectomy

Since the work was published, it has been cited more than 125 times in peer review literature Chronic back pain is hugely debilitating, severely hampering people's ability to get on with their everyday lives on a social and occupational level. And apart from the misery it causes to each individual sufferer, there is an economic fallout for society also.

About 20 years ago, a group of Scottish pain doctors reported the surprising fact that 22% of all patients who attended their clinic attributed their chronic pain to having undergone surgery in the past, often the distant past.

William Macrae, one of those doctors, defined this as a new syndrome, calling it Chronic Post-Surgical Pain (CPSP), now sometimes called Persistent Post-Surgical Pain (PPSP).

It applied to patients who had undergone uneventful and successful surgery, but who continued to experience pain as a result, for months or years afterwards, long after they had otherwise healed.

Underlying CPSP are neuroplastic changes, including "windup" and central sensitisation, which result from either direct injury to nerves, or high-frequency pain signals delivered via sensory nerves. Ultimately it leaves patients suffering.

Surgery for lower back pain posed a particular problem because although the mechanical issue - a disc protruding onto a nerve root - could be corrected, patients were still left at high risk afterwards of suffering from CPSP and all its life-sapping effects.

Eight years ago, our investigators at the School of Medicine at UCC undertook impactful research which has since prevented development of CPSP in many patients undergoing lumbar discectomy, the surgical removal of abnormal disc material pressing on a nerve root or the spinal cord.

Dr. Siun Burke, then an MD student, and now an anaesthetist at the Mercy Hospital in Cork, and George Shorten, Professor of Anaesthesia and Intensive Care Medicine at UCC and consultant anaesthetist at Cork University Hospital, demonstrated that pregabalin, a drug licensed for treatment of epilepsy, neuropathic pain and anxiety, substantially improved patients' function and pain symptoms for up to three months after lumbar discectomy.

In other words, they found that when pregabalin was administered during the 24 hours around the time of surgery, it diminished the degree of persistent pain which followed. The regimen they chose was three doses of pregabalin: one just before the operation and then two more small amounts within the following 24 hours. The profile of patients their research focussed on were adults with lower back pain which radiated down one or other leg as a result of a disc bulging and protruding or pressing on one of the spinal nerves.

Three months after surgery, compared with those who had received standard analgesia, those who had received pregabalin had less than half of the degree of disability and one third less pain. And this had been achieved without incurring any significant adverse effects.

Since the work was published, it has been cited more than 125 times in the peer review literature.

Administration of pregabablin perioperatively for patients undergoing lumbar discectomy (and many other procedures) is now widely practised around the world.

"Apart from lessening pain and pain persistence after the surgery, it also means that patients' function has improved substantially in what they can do up to three months and longer after the operation," says George. "Standard measures of day-to-day function were substantially better for patients who received pregabalin."

Much of the follow-on work has focused on adjustment of the regimen - the dose and timing of pregabalin for these patients, and further characterisation of the magnitude of its benefits.

"It has certainly resulted in some changes of practice for the better, and it's also pointed the researchers towards a line of investigation that has developed enormously as time goes on."

says George.

Radicular low back pain, which is pain that radiates into the lower extremity of the body directly along the course of a spinal nerve root, is a leading cause of disability globally and lumbar discectomy is one of its standard therapies.

On a practical level their research has reached so many people: "Its most important impact is the benefit to patients who would otherwise have gone on to experience longstanding pain and disability after surgery," says George



TREATMENT IMPACTS



College of Medicine and Health

THE RESEARCH IMPACT ANTHOLOGY / COLLEGE OF MEDICINE AND HEALTH 23

01 /

STOPP/START: screening tools to reduce risk of adverse drug reactions and events among older people

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Highlights

UCC School of Medicine has developed new prescription criteria for older patients with multiple conditions, STOPP/START As a result of the success of the programme, the European Commission has funded two major UCC research projects into multi-morbidity and polypharmacy in the elderly

STOPP/START: screening tools to reduce risk of adverse drug reactions and events among older people

As our population ages, so too do the risks attached to multimorbidity and polypharmacy - older people who are suffering from more than one chronic disease taking several medicines at the one time.

Inappropriate prescribing and polypharmacy are highly prevalent problems globally - particularly among the older population - and are associated with increased incidence of adverse drug reactions (ADRs) and adverse drug events (ADEs).

As a result, we know that medication-relation iatrogenic morbidity and mortality (that is, caused by medical examination or treatment) is increasing steadily.

Medicine prescription for the older population is clearly a complex issue, but we in the School of Medicine have developed internationally recognised and widely cited screening tools called the STOPP/START prescription criteria.

STOPP/START is the only set of IP criteria devised for older people that has been shown by randomised controlled trials (RCTs) to improve tangible patient outcomes - that is, with better medication appropriateness, reduced adverse drug reactions, reduced medication cost and fewer falls.

STOPP (Screening Tool of Older Persons' Prescriptions) is a systembased list of potentially inappropriate medications (PIMs) where the potential risk probably outweighs the potential benefit.

START (Screening Tool to Alert to Right Treatment) is a complementary list of potential prescribing omissions (PPOs) which could be detrimental to the patient.

As a result of the international recognition we have received for STOPP/START, we have been funded in recent years for two major research projects by the European Commission called SENATOR and OPERAM, with pivotal UCC involvement.

Both involve large-scale RCTs to examine the efficacy of software engines that deploy STOPP/START criteria to minimise PIMs and PPOs in older people with multi-morbidity and polypharmacy.

01

Lead researchers:

Professor Denis O'Mahony School of Medicine

Selected references to the research:

Gallagher P, O'Connor MN, O'Mahony D. Prevention of potentially inappropriate prescribing for elderly patients: a randomized controlled trial using STOPP/ START criteria. Clin Pharmacol Ther. 2011 Jun;89(6):845-54. doi: 10.1038/clpt.2011.44. Epub 2011 Apr 20. PubMed PMID: 21508941.

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02 /

Our ImmuPatch is challenging traditional vaccine and drug delivery

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Highlights

ImmuPatch delivers vaccine through skin patches, removing logistical problems associated with needle and syringe vaccinations

ImmuPatch team working with Médicins Sans Frontières and WHO to license technology to commercial partners

Our ImmuPatch is challenging traditional vaccine and drug delivery

Although we cannot take the discovery of vaccines for granted in the 21st century, immunisation has helped us become resistant to some of the deadliest diseases in the world and raised our life expectancy as a result.

However, vaccines, most of which are administered using conventional needles and syringes, are very sensitive to degradation and must be distributed using highly organised cold-chain systems, transporting and storing them at appropriate temperatures, from the point of manufacture to the point of use, all of which is a costly and complex procedure.

We at the School of Pharmacy and Department of Pharmacology are challenging those methods with our ImmuPatch, a vaccine stabilisation and delivery technology based on dissolvable microarray skin patches. Through this method, the vaccine or drug is released directly into the body through the skin.

We are already making a big impact; we know that vaccines ranging from influenza and polio to candidate malaria and Ebola are stabilised and function in ImmuPatches.

Since ImmuPatch eliminates the requirement for needles and syringes, it also permits increased ease of self-administration and may improve patient compliance to drug therapies. Our novel methods and formulations to incorporate the vaccine or drug into the patch enables it to be stable outside of refrigerated or frozen storage-as opposed to conventional methods - and the vaccine potency or drug bioavailability can be enhanced. This significantly prolongs the shelflife of the drug or vaccine and permits vaccine stockpiling which will impact on pandemic preparedness and routine immunisation programmes.

We are building on a patent and publication portfolio, with ImmuPatch being developed with commercial drug and vaccine manufacturers, for example with an SME (small or medium-style enterprise), and EU Horizon H2020 research and innovation consortium, 'SAPHIR', for veterinary vaccine purposes.

In addition to dissemination and researcher training, we are also providing knowledge to the international humanitarian medical NGO, Médecins Sans Frontières (MSF), and to the World Health Organisation (WHO), on patch-based vaccine delivery, to assist in policy and practice development and also in licensing the technology to commercial partners.

02

Lead researchers:

Dr. Anne Moore School of Pharmacy

Selected references to the research:

Acceptability of microneedle-patch vaccines: A qualitative analysis of the opinions of parents Marshall S, Fleming A, Moore AC, Sahm LJ. (2017) Vaccine. Aug 2. pii: S0264-410X(17)31009-5. doi: 10.1016/j.vaccine.2017.07.083. Examines the public's acceptance of new vaccine delivery technologies.

Induction of Broad Immunity by Thermostabilised Vaccines Incorporated in Dissolvable Microneedles Using Novel Fabrication Methods. Vrdoljak A., Allen E.A., Ferrara F., Temperton N.J. Crean A.M., Moore A.C., (2016). J Control Release. 2016 Mar 10;225:192-204. doi: 10.1016/j.jconrel.2016.01.019 Describes the development of dissolvable patches and the significant improvement in vaccine stability and immune responses.

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03

Developing 'smart antibiotics' for hospital-acquired infections



APC Microbiome and School of Microbiology have discovered new 'narrow-spectrum' antibiotic, thuricin CD New spun-out company, Artugen Therapeutics, will explore potential role of thuricin CD and other 'smart antibiotics' in the treatment of hospital-acquired infections

Developing 'smart antibiotics' for hospital-acquired infections

What would we do without antibiotics? They have saved millions of lives by helping clinicians to treat previously fatal infections. However, the drive to develop new antibiotics has usually been directed at identifying molecules with a broad spectrum of activity - so that the infection could be treated, even in the absence of knowing the identity of the infectious bacterium.

This approach has brought its own problems which we are tackling at the APC Microbiome Institute and the School of Microbiology.

Unfortunately, broad spectrum antibiotics can cause significant damage to the human microbiome, the collection of microbes that live in and on the human body and play an important role in human health. They also put every microbe under pressure to develop antibiotic resistance, which can then spread between bacteria.

Our research team has been searching for narrow-spectrum antibiotics, which would target problematic bacteria, without causing this collateral damage to the microbiome and which would not promote resistance development.

Our target organism is Clostridium difficile, a hospital-acquired, often lethal bacterium which normally causes infections following antibioticinduced damage to the microbiome.

We screened over 30,000 individual bacteria before we discovered thuricin CD, which is an exquisitely active narrow-spectrum type of natural antibiotic produced by bacteria to help them compete in the crowded bacterial environments of the gut.

Moving from discovery to bedside is an arduous process, but we have spun out a small company, Artugen Therapeutics, to help drive forward thuricin CD and other potential treatments. Initial results are really encouraging and we hope to develop what will be one of many narrow-spectrum 'smart antibiotics' over the coming years.

03

Lead researchers:

Professor Colin Hill and Professor Paul Ross APC Microbiome Institute and the School of Microbiology

Selected references to the research:

Rea MC, Sit CS, Clayton E, O'Connor PM, Whittal RM, Zheng J, Vederas JC, Ross RP, Hill C. 2010. Thuricin CD, a posttranslationally modified bacteriocin with a narrow spectrum of activity against Clostridium difficile. Proceedings of the National Academy of Sciences of the United States of America 107:9352-9357.

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04

Using low dose insulin-like growth factor for cardiac repair post heart attack



Highlights

Department of Medicine research group investigating stem cell approaches to cardiac repair in ST elevation myocardial infarcts (STEMIs) Research showed that 15ng of Insulin-like Growth Factor 1 can improve outcomes for heart attack patients compared to those on lower doses or placebo

Using low dose insulin-like growth factor for cardiac repair post heart attack

Myocardial infarction - commonly known as heart attack - remains the major cause of cardiovascular mortality in the developed world, accounting for over 6 million events worldwide per annum.

Despite significant advances in acute revascularisation (restoring blood flow to the heart), in an era of thrombolysis and percutaneous coronary intervention (PCI), a significant number (20% of patients) with ST elevation myocardial infarcts (STEMIs), develop long-term heart failure and remain at risk of sudden cardiac death.

For over a decade our research group in the Department of Medicine and other investigators have evaluated stem cell approaches to cardiac repair in STEMI. We initially performed a number of large animal preclinical studies that identified Insulin-like Growth Factor 1 (IGF-1) as a key paracrine factor secreted from stem cells that orchestrates cardiac repair in this clinical context.

We subsequently sought regulatory approval for a Phase 1 safety and efficacy trial to evaluate low dose IGF-1 in patients with STEMIs who were at risk of sudden cardiac death and development of heart failure.

With UCC as sponsor and funding from a HRB-SFI translational award, we completed at Cork University Hospital a first-in-man double blind randomised-controlled clinical trial, involving 47 subjects, comparing two low doses of IGF-1 (1.5 and 15 ng) in patients who were undergoing primary PCI for STEMI and who had moderate left ventricular systolic dysfunction.

This RESUS-AMI trial showed that low dose IGF 1 was safe. Moreover, 15 ng IGF-1 showed significantly improved cardiac end-diastolic volume, stroke volume and cardiac mass, two months after myocardial infarction, when compared to 1.5 ng IGF-1 or placebo control.

We are currently preparing a regulatory package to submit to the European Medicines Agency (EMA) and to the United States Food and Drug Administration (FDA) for approval of low dose IGF-1 as an orphan drug designated therapy for high-risk patients post myocardial infarction.

This preliminary work will form the prelude to future industry engagement for funding of a pivotal multicentre Phase IIB efficacy trial in these patients.

04

Lead researchers:

Professor Noel Caplice School of Medicine

Selected references to the research: (*senior author)

O'Sullivan JF, Leblond AL, Kelly G, Kumar AH, Metharom P, Buneker CK, Alizadeh-Vikali N, Hristova I, Hynes BG, O'Connor R, Caplice NM*. Potent long-term cardioprotective effects of single lowdose insulin-like growth factor-1 treatment post myocardial infarction **Circulation Cardiovasc Interv** 2011:4;327-335.

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05 /

Working towards providing gene editing for rare diseases

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Highlights

UCC School of Medicine's Department of Physiology developing gene editing treatment for three rare cystic fibrosis mutations Team working towards an efficient gene editing strategy that could correct virtually all known (300+) cystic fibrosis-causing mutations

Working towards providing gene editing for rare diseases

While drugs are now available for approximately 50% of people living with cystic fibrosis (CF), a relatively common genetic disorder which affects up to 100,000 people worldwide, we at the Department of Physiology in the School of Medicine are focusing on those patients who suffer from rare forms of the disease for which no drugs are available.

Our research has involved gene editing, a new technique which can repair disease-causing mutations in the DNA sequence in both living cells in the laboratory, and in preclinical model systems.

On the world stage, in November 2017, Californian man Brian Madeux became the first patient to receive gene editing medicine as part of a controlled clinical trial for a rare liver disease.

Last year, through our gene editing research, we developed a method for high efficiency repair for three rare CF mutations in cell models.

Our current approach, funded by the CF Trust (UK) and the CF Foundation (USA), is to develop an efficient gene editing strategy which could correct virtually all of the 300+ known CF-causing mutations.

The next step is to work with partners in the UK, Europe and the US to translate these lab experiments to preclinical models and determine if gene editing might be a viable therapeutic option for patients in the future.

There are at least 7,000 rare diseases which collectively affect about 7% of the world's population. Whilst the symptoms, age of onset, and life expectancy vary widely between these diseases, the two common features which unite them are that, firstly, in the vast majority of cases, the genetic mutation which causes them is known, and secondly, an effective therapy is extremely unlikely to exist. Only 3% of rare diseases have a drug which treats the cause.

It is within that context that our work is based. There is still a lot of research before CF gene editing is ready for clinical evaluation, but this is the goal we are working towards.

05

Lead researchers:

Dr. Patrick Harrison School of Medicine

Selected references to the research:

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06 /

Exploring how mental and physical health is interlinked in the care of patients with cystic fibrosis

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Highlights

Collaborative team of UCC researchers discovered that symptoms of anxiety and depression increase with age in cystic fibrosis patients, negatively impacting lung function

Research has shown the feasibility of conducting online screening for depression and anxiety in cystic fibrosis patients

Exploring how mental and physical health is interlinked in the care of patients with cystic fibrosis

Cystic fibrosis (CF) is a chronic life-shortening illness, although increased survival into adulthood is now expected because of treatment advances.

To date, most research has focussed on the most promising treatments to improve the physical aspects of the disease, such as lung function and dietary management, but there has been less research on the psychological impact of having CF.

Our researchers at the School of Nursing and Midwifery, the School of Public Health, and the Department of Paediatrics and Childcare found that symptoms of anxiety and depression increase with age, after conducting a national study funded by the Health Research Board and Cystic Fibrosis Ireland.

Called 'CF-DAP Prevalence of Depression and Anxiety in patients with CF and impact on Physical Health and Quality of Life', our study, in collaboration with the University of Leeds and John Hopkins University, also revealed that depression and anxiety were found to negatively impact on lung function in adult patients and on quality of life in both adult and adolescent patients.

We also found that patients who had depression or anxiety experienced more hospitalisations over a 12-month period than those who didn't, and that of those who did experience mental health problems, only two thirds seek help.

Similar studies to ours have been conducted in over 20 countries across Europe and in the USA as part of an international collaboration, all of which have undoubtedly shown that mental and physical health among CF patients are interlinked, and that mental health assessment and screening needs to become routine practice incorporated into their care programmes.

However, we are the only country to demonstrate the impact of the feasibility of online screening of adult CF patients for depression and anxiety, which we found produced a higher response rate than face-to-face screening in clinics.

Online screening therefore has potential for early detection and intervention for mental health problems, which in turn will contribute to better physical health and quality of life.

06

Lead researchers:

Professor Eileen Savage School of Nursing & Midwifery

Selected references to the research:

Cronly J, Duff AJ, Riekert KA, Perry IJ, Fitzgerald AP, Horgan A, Lehane E, Howe B, Ni Chroinin M, Savage E. (2018) Online versus paper-based screening for depression and anxiety in adults with cystic fibrosis in Ireland: a cross-sectional exploratory study. BMJ Open (in press)

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07 10

The National Self-Harm Registry Ireland has had local, national and global impact

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Highlights

Registry instrumental in development of national suicide programmes, and has supported academic work on causes and development of selfharm and suicide

National Suicide Research Foundation has helped countries in Europe, Africa and Asia develop their own surveillance systems for self-harm and suicide
The National Self-Harm Registry Ireland has had local, national and global impact

The National Self-Harm Registry Ireland was developed by the National Suicide Research Foundation (NSRF) in collaboration with members of our School of Public Health. The Registry has grown from a national surveillance system for self-harm to impacting how other countries set guidelines for how they monitor this issue.

The National Self-Harm Registry Ireland has provided data for the national suicide prevention programmes, Reach Out (2004-2014) and Connecting for Life (2015-2020), on an ongoing basis, and it has supported academic work on the causes and prevention of self-harm and suicide.

In 2015 and 2016, the NSRF worked with the World Health Organisation (WHO) on a 'Practice Manual for Establishing Surveillance Systems for Suicide Attempts and Self-Harm', based on the registry template. This led to a collaborative publication with WHO. Following the publication of the WHO Practice Manual in 2016, the NSRF has fulfilled an increasing number of requests to guide countries in developing regional or national surveillance systems for self-harm in European, Eastern Mediterranean, African and Asian countries.

This development contributed to a successful application by the NSRF to become recognised as a WHO Collaborating Centre for Surveillance and Research in Suicide Prevention.

The NSRF's expertise goes back to its origins in 1995, two years after the decriminalisation of suicide in Ireland, when it first established a monitoring system for self-harm presentations to hospital emergency departments in the former Southern and Mid-Western Health Boards, in conjunction with a European research consortium.

At the request of the Department of Health and Children in 2000, the registry was established as a national surveillance system for self-harm and since 2002, annual reports of the registry have been published and disseminated among key stakeholders.

In 2007, the Public Health Agency in Northern Ireland supported the establishment of a Self-Harm Registry in the Western Health and Social Care Trust based on the template of the Irish Registry, which was expanded to all 12 acute hospitals in Northern Ireland in 2012.

07

Lead researchers:

Ella Arensman, Eileen Williamson, Paul Corcoran, Eve Griffin, Christina Dillon, Niall McTernan, Ivan Perry. School of Public Health

Selected references to the research:

Corcoran P, Griffin E, Arensman E, Fitzgerald AP, Perry JJ. Impact of the economic recession and subsequent austerity on suicide and self-harm in Ireland: An interrupted time series analysis. International Journal of Epidemiology. 2015 Jun; 44(3):969-77.

Arensman E, Griffin E, Daly C, Corcoran P, Cassidy E, Perry IJ. Recommended next care following hospital treated self-harm: Patterns and trends over time. PLoS One. 2018 Mar 1;13(3): e0193587.

Griffin E, McMahon E, McNicholas F, Corcoran P, Perry IJ, Arensman E. Increasing rates of self-harm among children, adolescents and young adults: a 10-year national registry study 2007-2016. Social Psychiatry and Psychiatric Epidemiology. 2018, May 2. https://doi. org/10.1007/s00127-0181522-1.

08

We aim to promote cancer awareness and support those on their survivorship journey

Highlights

School of Nursing and Midwifery formed new group to highlight the unique experiences and life-altering symptoms of cancer patients Two targeted interventions developed as result, with educational and tech focus for gynaecological and testicular cancers

We aim to promote cancer awareness and support those on their survivorship journey

One in two people will develop cancer at some point in their lives and just under half of these cancers are preventable. Detecting cancer early can effectively reduce the mortality associated with the disease; two out of three persons survive for five years or longer after diagnosis.

The goal of educators and researchers at our School of Nursing and Midwifery is to advance our understanding of cancer awareness and cancer survivorship and thereby improve healthcare providers' practice - and ultimately, individuals' experience of cancer survivorship.

Our main research focus is therefore on the promotion of cancer awareness and on the support of individuals on the cancer survivorship journey.

Our Enhancing Cancer Awareness and Survivorship Programmes (ECASP) group, through the conduction of over 15 studies, has highlighted the life-altering symptoms experienced by individuals undergoing cancer treatment and has developed two targeted interventions. They are: educational intervention focused on sexuality in women with gynaecological cancer, and virtual reality intervention for testicular cancer awareness.

We have worked with the Irish Cancer Society to better understand the impact of health literacy on men's access to cancer prevention information, and we are currently working with the Irish National Cancer Control Programme to scope and map National Cancer Survivorship Services.

Nine doctorate students associated with ECASP have graduated, thus building research capacity. An MSc/Postgraduate Diploma in Nursing (Oncology) was launched in 2015 which facilitates the education of nurses in the specialist area of oncology.

80

Lead researchers:

Professor Josephine Hegarty School of Nursing and Midwifery

Selected references to the research:

O'Mahony, M., Comber, H., Fitzgerald, T., Corrigan, M. A., Fitzgerald, E., Grunfeld, E. A., Flynn, M. G. and Hegarty, J. (2017) 'Interventions for raising breast cancer awareness in women', Cochrane Database of Systematic Reviews, (2). doi:10.1002/14651858.CD011396.pub2

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09/

The role of our technology in the challenging but rewarding future of gene therapy



Highlights

UCC School of Pharmacy has developed and patented new nanodelivery systems for use in gene therapy Proof of concept published in several animal models of disease, including Huntington's disease and prostate cancer

The role of our technology in the challenging but rewarding future of gene therapy

Knowledge regarding the genetic basis of diseases, including cancer and neurodegenerative disease, has grown rapidly in recent years. In some cases, disease is related to a 'defective' gene and in others, a 'rogue' gene.

Gene therapy provides the opportunity to replace the defective gene or alternatively to silence the rogue gene.

Although gene therapy is exciting and has vast potential, one of the major challenges that has to be faced before safe and effective medicines for patients can be routinely prescribed is the availability of a delivery system for the genetic material that ensures arrival at the diseased site in sufficient quantities to elicit the response required.

We at the School of Pharmacy in the College of Medicine and Health are overcoming this hurdle, having developed and patented novel nano-delivery systems using materials known as cyclodextrins (CDs).

This technology has produced modified CDs capable of packaging the genetic material into nanoparticles (extremely fine particles) which are non-toxic, protect the genetic material from degradation in the body, and also ensure delivery into diseased cells.

The major impact of this technology is that it offers a flexibility to the patient. A library of functionalised CDs have been synthesised which can be co-formulated to produce bespoke nanoparticles suitable for the treatment of a wide range of genetically based diseases.

Proof of concept has been published in several animal models of disease including Huntington's disease, prostate cancer and AML.

The next phase for us is to progress this technology into early-stage clinical trial and ideally this will be achieved in partnership with a commercial entity.

09

Lead researchers:

Professor Caitriona O'Driscoll School of Pharmacy

Selected references to the research:

Guo J., Eileen EG., Darcy R., Cotter TG., McKenna SL., Cahill MR., O'Driscoll CM. (2017). Antibody-targeted cyclodextrinbased nanoparticles for siRNA delivery in the treatment of acute myeloid leukaemia - physicochemical characteristics, in vitro mechanistic studies and ex vivo patient derived therapeutic efficacy. Molecular Pharmaceutics, 14:940-952. DOI:10.1021/acs. molpharmaceut.6b01150.

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How our digestive tract can influence a key area for emotion in the brain

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Highlights

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UCC researchers demonstrated that major disturbances in communication between the gut, microbiota and the brain underlie fear memory recall

Study suggests therapeutic targeting of gut microbiota may help to treat anxiety

How our digestive tract can influence a key area for emotion in the brain

Anxiety disorders represent a major proportion of mental health issues in Western societies, with approximately one in four individuals affected.

However, the neurobiology of anxiety disorders are not well understood and advances are urgently required to develop safer, more effective treatment strategies, with a reduced side-effect profile and a rapid onset of action.

Our researchers at the Department of Psychiatry and Neurobehavioural Science and the Department of Anatomy and Neuroscience have recently led a study, funded by the Brain and Behaviour Research Foundation, to investigate the hypothesis that microbial regulation of fear and anxiety is integrated at the level of the amygdala, the brain's emotional processor, which is a key region implicated in anxiety disorders.

Our study demonstrated that major disturbances in communication between the gut microbiota - that is, the complex community of microorganisms within the digestive tract - and the brain underlie fear memory recall, in particular at a molecular level in the amygdala.

The main impact of this study is that it reveals novel molecular mechanisms in specific gut-brain axis pathways that are important for the expression of fear and anxiety, and that are linked to key brain regions.

Therapeutic targeting of the gut microbiota is an appealing prospect, and these findings may expedite the promise in this approach for the treatment of anxiety.

10

Lead researchers:

Dr. Gerard Clarke School of Medicine

Selected references to the research:

Hoban AE, Stilling RM, M Moloney G, Moloney RD, Shanahan F, Dinan TG, Cryan JF, Clarke G. Microbial regulation of microRNA expression in the amygdala and prefrontal cortex Microbiome 2017 Aug 25;5(1):102. doi: 10.1186/s40168-017-0321-3.

Hoban AE, Stilling RM, Moloney G, Shanahan F, Dinan TG, Clarke G, Cryan JF The microbiome regulates amygdaladependent fear recall. Molecular Psychiatry 2017 May 16. doi: 10.1038/mp.2017.100

PEARRL research is exploring earlier access to new medicines and breakthrough therapies for patients

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Highlights

PEARRL network improving drug delivery technology and screening models across Europe Research objectives will help to improve efficiency and costcompetitiveness of pharma R&D, leading to faster market readiness and patient access to breakthrough drugs

PEARRL research is exploring earlier access to new medicines and breakthrough therapies for patients

While we are very aware of the commercial success of the global pharmaceutical market, it is less well known that behind the scenes there is a very high failure rate associated with developing new medicines, which is a costly, lengthy and risky process.

In fact, since the 1950s the number of medicines approved for patient use has decreased by 50% every decade. This reflects a clear need for the development of innovative technology to ensure that new drugs are developed into medicines as efficiently and cost effectively as possible so that patients can benefit earlier.

We at the School of Pharmacy are co-ordinating the PEARRL (Pharmaceutical Education and Research with Regulatory Links) European Training Network (ETN) research so that we can develop novel drug delivery technology, new screening methods, and innovative models to forecast drug levels in humans.

These research objectives will collectively streamline the development of new oral medicines by improving the efficiency and costcompetitiveness of pharmaceutical research and development (R&D). This means that since medicines will be brought to the market faster and at reduced cost, patients will get earlier access to breakthrough therapies.

PEARRL is funded under the European Union's Horizon 2020 research and innovation programme and we have joined forces with the pharma industry, through our partners Janssen, Merck, Pharmathen, Sirius and Biorelevant.com, in addition to collaborating with regulatory organisations EMA, HRPA, BfArM and MHRA.

PEARRL strengthens Europe's scientific excellence in academia through our partner universities, Johann Wolfgang Goethe University (Frankfurt), National Kapodistrian University of Athens, University of Applied Sciences & Arts Northwestern Switzerland, and the University of Bath.

/ 11

Lead researchers:

Dr. Brendan Griffin School of Pharmacy

Selected references to the research:

Mesoporous silica-based dosage forms improve bioavailability of poorly soluble drugs in pigs: case example fenofibrate, O'Shea, et. al (2017) J. Pharm. Pharmacol, 69 (10), pp. 1284-1292. Research showing benefits of bioenabling formulations

Comparison of in vitro tests at various levels of complexity for the prediction of in vivo performance of lipid-based formulations: Case studies with fenofibrate, Griffin et al (2014) E. J. Pharm. Biopharm. 86 (3), pp. 427-437. Research showing merits of more predictable in vitro testing to predict in vivo drug levels.

Biopharmaceutical modeling of drug supersaturation during lipid-based formulation digestion considering an Absorption sink, Stillhart et al. (2014) Pharm. Res., 31 (12), pp. 3426-3444. Research showing merits of in silico modelling in drug development.

12 /

Making Connections: protecting and repairing the brain in neurodegenerative disease



Highlights

Department of Anatomy and Neuroscience and Cork Neuroscience Centre research project, 'Making Connections', developing new interventions for neuron protection Objective of project is to understand lifestyle factors, such as sleep and diet, and their connections to neurodegenerative disorders like Parkinson's disease

Making Connections: protecting and repairing the brain in neurodegenerative disease

As we celebrate our increasing longevity - an achievement which the United Nations calls "one of the most significant social transformations of the 21st century" - we are also faced with the challenge posed by neurodegenerative disorders, a group of disorders which lead to brain degeneration as we age.

For instance, despite decades of investigation, a disease-modifying therapy for two of the most common of these disorders, Alzheimer's disease and Parkinson's disease, has not yet been found.

We at the Department of Anatomy and Neuroscience and Cork Neuroscience Centre (CNC) in the School of Medicine are involved in a research project called 'Making Connections', which aims to develop new interventions to protect neurons and their connections in the ageing brain, and as a result improve societal health and wellbeing.

The objectives of this research programme - funded by Science Foundation Ireland (SFI) and the Irish Research Council (IRC) - are to understand the impact of lifestyle factors such as sleep, nutrition, stress and other events that lead to the death of neurons and their connections in neurodegenerative diseases, such as Parkinson's disease.

We hope to better understand how and why these diseases occur so that we can develop new ways to protect and repair the brain. In order to do this, we use an integrated approach that combines the study of individual neurons, all the way through to studies involving people with Parkinson's disease.

With our ageing demographic there is a critical need for such therapy, as the incidence and the socioeconomic impact of these diseases continues to rise.

We are working in collaboration with four other universities: Trinity College Dublin, Cardiff University and Lincoln University in the UK, and the University of Ferrara in Italy.

12

Lead researchers:

Dr. Gerard O'Keeffe and Professor Aideen Sullivan School of Medicine

Selected references to the research:

Zeb2 is a negative regulator of midbrain dopaminergic axon growth and target innervation. Hegarty SV, Wyatt SL, Howard L, Stappers E, Huylebroeck D, Sullivan AM, O'Keeffe GW. Sci Rep. 2017 Aug 17;7(1):8568. doi: 10.1038/s41598-017-08900-3.

Effects of intracerebral neurotrophic factor application on motor symptoms in Parkinson's disease: A systematic review and meta-analysis. Hegarty SV, Lee DJ, O'Keeffe GW, Sullivan AM. Parkinsonism Relat Disord. 2017 May;38:19-25. doi: 10.1016/j.parkreldis.2017.02.011.

Nociceptin/Orphanin FQ Inhibits the Survival and Axon Growth of Midbrain Dopaminergic Neurons Through a p38-MAPK Dependent Mechanism. Collins LM, Dal Bo G, Calcagno M, Monzón-Sandoval J, Sullivan AM, Gutierrez H, Morari M, O'Keeffe GW. Mol Neurobiol. 2016 Dec;53(10):7284-7297.

13 /

Discovering the potential link between malaria protection and hypertension

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Highlights

Department of Pharmacology and Therapeutics research suggests that higher incidence for hypertension in Africans is result of angiotensin II-induced malaria protection

Paper, published in Circulation Research, points to new protection strategies against severe malaria

Discovering the potential link between malaria protection and hypertension

Research from our Department of Pharmacology and Therapeutics, in collaboration with New York University School of Medicine, USA, has shown a credible link between the high rate of hypertension, stroke and myocardial infarction among Africans and Afro-Americans and a genetic defence mechanism to protect against malaria.

Across the world, black people display a rate of hypertension, stroke, and myocardial infarction that is significantly higher than other ethnic groups. Our study, which has been published in the peer-reviewed medical journal, Circulation Research, sought to understand a possible alternative cause for hypertension in populations that have been under the selective pressure of malaria.

Our research links the well-known fact that angiotensin II, a hormone that is involved in the regulation of the plasma sodium concentration and arterial blood pressure, is a major driver of hypertension, with the finding that polymorphisms in genes (the genetic variation within a population) that result in higher levels of angiotensin II are associated with protection against severe malaria.

Our work proposes that the higher incidence for hypertension in populations of African and South Asian origin is the protection against severe malaria provided by elevated levels of angiotensin II. This possibility now allows us to suggest superior treatment plans to combat hypertension in patients with malaria.

But the importance of the research paper is much broader, as the proposed mechanism of protection against severe malaria also points to new and unique pharmacological strategies for the treatment of the disease.

13

Lead researchers:

Professor Thomas Walther Department of Pharmacology and Therapeutics

Dr. Ana Rodriguez Associate Professor in New York University School of Medicine

Selected references to the research:

Gallego-Delgado J, Walther T*, Rodriguez A. The High Blood Pressure-Malaria Protection Hypothesis. Circulation Research. 2016. 119:1071-75. * Corresponding and equally contributing last author TREATMENT IMPACTS

14 /

Better outcomes for hepatitis C infected patients

Highlights

UCC research group is spearheading the treatment of hepatitis C patients Research group, working with clinicians, was the first to identify fingerprints of immune escape in hepatitis C

Better outcomes for hepatitis C infected patients

The World Health Organisation has listed hepatitis C infection amongst the top elimination targets by 2030. Estimates put the epidemic as infecting approximately 20,000 persons in Ireland and 70M worldwide. The genesis of hepatitis C research in Ireland had its origins in the iatrogenic infection in 1977, in a series of events that would change the Irish health system and spearhead the development of a world-leading example of health care integrated with translational research, with UCC at the forefront.

In collaboration with colleagues, a research group in University College Cork was established in the late 1990s with the goal of improving the care of patients with hepatitis C through research.

This contributed to the identification of genetic patterns associated with persistence and clearance of hepatitis C viral infection. Using this and other information we implemented a testing programme with Cork University Hospital that optimise the use of immune modulating therapy in individuals infected with the hepatitis C virus.

The shared platform of research in tandem with clinical care was the first to identify fingerprints of immune escape in Hepatitis C. These and other data have revealed more optimal approaches to the design of vaccines for particular classes of viruses.

We participate in the national Irish Hepatitis C Outcomes Research Network with the mission of contributing to the health and well-being of hepatitis C patients by informing policy through outcomes based on research. The shared vision is that everyone in Ireland will have access to care and receive curative treatment by 2030. We are continually endeavouring to challenge our understanding of viral infections and to reduce the impact of this disease on society.

/ 14

Lead researchers:

Dr. Liam Fanning School of Medicine

Selected references to the research:

Naik AS, Owsianka A, Palmer BA, O'Halloran CJ, Walsh N, Crosbie O, Kenny-WalshE, Patel AH, **Fanning** LJ. Reverse epitope mapping of the E2 glycoprotein inantibody associated hepatitis C virus. PLoS One. 2017 May 30;12(5):e0175349. doi:10.1371/journal.pone.0175349. eCollection 2017. PubMed PMID: 28558001; PubMedCentral PMCID: PMC5448734.

Palmer BA, Schmidt-Martin D, Dimitrova Z, Skums P, Crosbie O, Kenny-Walsh E, **Fanning** LJ. Network Analysis of the Chronic Hepatitis C Virome DefinesHypervariable Region 1 Evolutionary Phenotypes in the Context of Humoral ImmuneResponses. J Virol. 2015 Dec 30;90(7):3318-29. doi: 10.1128/JVI.02995-15. PubMed PMID: 26719263; PubMed Central PMCID: PMC4794698.

Gray E, O'Leary A, Stewart S, Bergin C, Cannon M, Courtney G, Crosbie O, De Gascun CF, Feeney E, Houlihan DD, Kelleher B, Lambert JS, Lee J, Mallon P, McConkey S, McCormick A, McKiernan S, McNally C, Murray F, Sheehan G, Norris S, **Fanning** LJ;Irish Hepatitis C Outcomes and Research Network (ICORN). High mortality during direct acting antiviral therapy for hepatitis C patients with Child's C cirrhosis: Results of the Irish Early Access Programme. J Hepatol. 2016 Aug;65(2):446-8

15

Seeking new therapeutic targets for pregnancy complications



Highlights

Department of Pharmacology and Therapeutics is identifying disruptive signalling pathways causing pre-eclampsia and gestational diabetes

Data from research show that mitochondrial dysfunction has links with both conditions

Seeking new therapeutic targets for pregnancy complications

Pre-eclampsia (PE) is a serious condition of late pregnancy causing high blood pressure and increased protein in the urine. Gestational diabetes (GDM) develops because the mother's body is unable to produce extra insulin needed throughout the pregnancy.

The ultimate goal of our research at the Department of Pharmacology and Therapeutics, in collaboration with the obstetric research team in INFANT, is to identify the disruptive signalling pathways causing PE and GDM and to develop an effective therapy for these complications in order to improve the long-term outcome of pregnancy for both mothers and babies.

Women with GDM have an increased risk of developing PE. These pregnancy complications affect 15% of first-time mothers. Preterm delivery is a serious complication of PE and GDM, and even marginal improvements in gestational age can confer substantial fetal survival rates.

There is significant evidence that failure to respond properly to insulin (insulin resistance) is a central cause of both complications. Although PE and GDM recede after birth, both mother and child have an increased risk of developing heart disease and type II diabetes later in life.

Mitochondria provide us with energy released from our dietary intake; they are abundant in the placenta to cope with the increased energy demands during pregnancy. However, this energy process is complex and if it fails, by-products of the energy-generating mitochondrial network can be stressful to our bodies.

Obesity can also disrupt the mitochondrial network causing inflammation in our adipose tissue, making it difficult for our bodies to use insulin properly. Our work, which is ongoing, has generated data that links mitochondrial dysfunction with pre-eclampsia and GDM.

15

Lead researchers:

Dr. Cathal McCarthy Department of Pharmacology and Therapeutics

Selected references to the research: (*senior author)

Williamson RD, McCarthy FP, Khashan AS, Totorika A, Kenny LC, McCarthy C. Exploring the role of mitochondrial dysfunction in the pathophysiology of pre-eclampsia. Pregnancy Hypertension 2018 Jul;13:248-253. This work provided evidence that mitochondrial function was altered in patients with pre-eclampsia.

McCarthy C, Kenny LC. Therapeutically targeting mitochondrial redox signalling alleviates endothelial dysfunction in preeclampsia. Sci Rep. 2016 Sep 8;6:32683-94. The first evidence that plasma mediators in pre-eclampsia disrupt mitochondrial function.

Di Francesco L, Dovizio M, Trenti A, Marcantoni E, Moore A, O'Gara P, McCarthy C, Tacconelli S, Bruno A, Alberti S, Gizzo S, Nardelli GB, Orso G, Belton O, Trevisi L, Dixon DA, Patrignani P. Dysregulated post-transcriptional control of COX-2 gene expression in gestational diabetic endothelial cells. Br J Pharmacol. 2015;172(18):4575-4587. This work described the damaging effect of oxidative stress and inflammation in the development of gestational diabetes mellitus.







College of Medicine and Health

THE RESEARCH IMPACT ANTHOLOGY / COLLEGE OF MEDICINE AND HEALTH 55

Focusing on dietary patterns for health and environmental sustainability

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Highlights

Centre for Health and Diet Research has demonstrated the benefits of the DASH diet pattern, which includes high intake of vegetables and whole grains, and limited intake of salt and saturated fat

The DASH diet has helped to lower blood pressure. When DASH-compliant food is served at multinational companies, it is associated with weight loss and reduced absenteeism

Focusing on dietary patterns for health and environmental sustainability

We hear so much about the importance of having a healthy lifestyle nowadays, and at our Centre for Health and Diet Research (CHDR), in the School of Public Health, we are passionate about promoting that message.

As leaders in transdisciplinary research in diet, physical activity and nutrition across the life-course, our constant goal is to drive its translation into policies and practices that improve the health and wellbeing of our populations at home and internationally.

For instance, in a series of interlinked studies, we have shown the benefits of a specific dietary pattern - the DASH diet pattern - which consists of a high intake of fruit and vegetables, whole grains and lowfat dairy products, with limited saturated fat and salt.

Our research has shown it is associated with substantially lower blood pressure in middle-aged men and women in Ireland, with effects equivalent to blood pressure lowering therapy; and that much of the fall in blood pressure observed in the Irish population over recent decades can be explained by a population level shift towards a more DASH-compliant dietary pattern.

We have also shown, in a study involving major multi-national companies based in Cork, that implementation of the DASH diet pattern in workplace restaurants and canteens is associated with weight loss and reduced absenteeism among workers.

This research has led to the development of a successful commercial spin-out company in UCC called Food Choice at Work Ltd, which is focused on the promotion of a healthy and environmentally sustainable diet in the workplace setting.

The company has now been trading successfully for two years and is providing an evidence-based public health nutrition consultancy service to major public sector agencies and multinational companies in Ireland.

Our centre, which was established a decade ago, has produced a substantial body of original research, and has been described by an international review panel as "flourishing", with a "unique mix of people, backgrounds and skills, to be a real strength and perhaps unique in Europe".

01

Lead researchers:

Professor Ivan Perry School of Public Health

Selected references to the research:

Harrington, J. M., A. P. Fitzgerald, P. M. Kearney, V. J. McCarthy, J. Madden, G. Browne, E. Dolan and I. J. Perry (2013). "DASH diet score and distribution of blood pressure in middle-aged men and women." Am J Hypertens 26(11): 1311-1320.

Kabir Z, Harrington JM, Browne G, Kearney PM, Perry IJ. Changing dietary patterns and associated risk factors on trends in blood pressure levels in middle-aged Irish adults: a population-based study. J Hum Hypertens. 2016 Feb;30(2):147-8

Geaney F, Kelly C, Di Marrazzo JS, Harrington JM, Fitzgerald AP, Greiner BA, Perry IJ. The effect of complex workplace dietary interventions on employees 'dietary intakes, nutrition knowledge and health status: a cluster controlled trial. Prev Med. 2016;89:76-83.

02 /

Better primary care for patients with diabetes

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Highlights

UCC School of Medicine's Department of General Practice has established research group examining primary care services for diabetes patients Studies have led to development of local retinopathy screening programme and expansion of community podiatry services

Better primary care for patients with diabetes

Ireland is on the verge of a diabetes crisis with its incidence here expected to rise by 30% by 2020.

The care of patients with diabetes has traditionally been provided by hospital specialists. However, as the prevalence of diabetes increased and it was recognised that most patients could be looked after by a competent general practitioner, a new approach to treatment was advocated.

We at the Department of General Practice, in collaboration with local general practitioners, established a group, with the goal to improve the care for patients with diabetes in a community setting.

We began as an educational peer support group focused on quality improvement for patients with diabetes. A register of patients was established in participating general practices which now holds key information on the care of nearly 6,000 patients with the disease.

This resource has facilitated multiple studies of the primary care of patients in Ireland with diabetes funded by a number of sources including the HSE, the Health Research Board, the Irish College of General Practitioners and a medical charity established by the group. These studies have had a significant influence on the development of diabetes care in Ireland.

For example, a study of screening of patients with diabetes in general practice for eye disease (retinopathy) informed the development of a local retinopathy screening programme which is now running nationwide.

A study of lower limb amputations in patients with diabetes has encouraged the expansion of podiatry services in the community, for foot care in patients with diabetes.

An evaluation of the role of a community-based diabetes specialist nurse has informed the development and expansion of this service by the HSE.

These and other studies - as well creating a continuing flow of quality improvement information from our cohort of patients with diabetes - has demonstrated the capability of general practice to provide high-quality care in the community.

Hence, national policy for the care of patients with diabetes has now shifted towards a model of integrated care between hospitals and general practice, and there is now a 'cycle of care' for patients with diabetes available through general practice.

02

Lead researchers:

Professor Colin Bradley School of Medicine

Project nurse facilitator:

Ms Katie Murphy

Selected references to the research:

Informing the development of a national diabetes register in Ireland: a literature review of the impact of patient registration on diabetes care. O'Mullane et. al.(2010) Informatics in Primary Care. Review of previous research to encourage the creation of a diabetes register.

Quality-assured screening for diabetic retinopathy delivered in primary care in Ireland: an observational study McHugh S et.al. (2013), British Journal of General Practice. Research showing the feasibility and acceptability of a community-based retinopathy screening service.

Trends in the incidence of lower extremity amputations in people with and without diabetes over a five-year period in the Republic of Ireland. Buckley CM et.al (2012) PLoS One. Research highlighting the need for improved foot care for patients with diabetes.



Contributing towards national policy on safe staffing

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Highlights

UCC School of Nursing and Midwifery has played an integral role in co-creating new national policy document on safe staffing in surgical and medical wards

Next phase of research will assess safe nurse staffing levels in hospital emergency departments

Contributing towards national policy on safe staffing

The nursing workforce in Ireland is under pressure in relation to recruitment and retention. Our research team in the School of Nursing and Midwifery has played a major role in working with the Department of Health to create a national policy document on safe staffing in surgical and medical wards, which was rolled out earlier this year.

It is the first time that research has been undertaken to this level in Ireland to inform safe nurse staffing and skill-mix, and our recommendations in the national policy document, entitled 'Framework for Safe Nurse Staffing and Skill-Mix in General and Specialist Medical and Surgical Care Settings in Ireland', will be implemented to ensure improved standards across the public health sector.

We knew from a research perspective that there was a relationship between nurse staffing and issues such as mortality rates, adverse events, missed care, staff job satisfaction and turnover rates, as well as how satisfied patients are with their care.

We used a specific scientific approach, which involved pilot projects in three national hospitals, to measure the impact of the changes to nurse staffing on such outcomes to form our recommendations.

Essentially, our recommendations will now be ensuring that the right nurses are in the right place at the right time. The next phase of our research is looking at safe nurse staffing in emergency departments.

Our research team (Professor Jonathan Drennan (PI), Professor John Browne, Dr. Aileen Murphy, Dr. Noeleen Brady, Dr. Darren Dahly, Professor Eileen Savage and Professor Josephine Hegarty) worked on this Health Research Board and Department of Health-funded programme, in association with the University of Southampton (Professor Peter Griffiths), the University of Technology Sydney (Professor Christine Duffield) and National University of Ireland Galway (Professor Anne Scott).

03

Lead researchers:

Professor Jonathan Drennan School of Nursing and Midwifery

Selected references to the research:

Department of Health (2016) Interim Report and Recommendations by the Taskforce on Staffing and Skill Mix for Nursing on a Framework for Safe Nurse Staffing and Skill Mix in General and Specialist Medical and Surgical Care Settings in Adult Hospitals in Ireland. Department of Health, Dublin.

Griffiths P, Ball J, Drennan J, Dall'Ora C, Jones J, Maruotti A, Pope C, Recio Saucedo A, Simon. (2016) Nurse staffing and patient outcomes: Strengths and limitations of the evidence to inform policy and practice. A review and discussion paper based on evidence reviewed for the National Institute for Health and Care Excellence Safe Staffing guideline development. International Journal of Nursing Studies. http://dx.doi.org/10.1016/j. ijnurstu.2016.03.012

Recio-Saucedo A, Pope C, Dall'Ora C, Griffiths P, Jones J, Crouch R, Drennan J. (2015) Safe staffing for nursing in emergency departments: evidence review. Emergency Medical Journal. 32:888-894.

Putting the spotlight on how older patients' medicine needs to be understood



Highlights

Older patients often have specific medication needs but tend to be excluded from medical trials UCC School of Pharmacy research has found a distinct lack of accessible information on medicine modification for nursing home patients

Putting the spotlight on how older patients' medicine needs to be understood

We are all living longer, with the population in Ireland aged 65 years or older set to double to 1.4 million by 2046. Medication is one of the most important therapeutic interventions we have to prevent, treat and cure disease.

It's no surprise, then, that older people are the highest consumers of prescription medication; it clearly plays a crucial role in decreasing their morbidity and mortality and improving their quality of life.

However, older adults tend to be excluded from clinical trials and therefore their needs are often not appreciated until the medication is in routine use.

Our research in the School of Pharmacy is highlighting to healthcare professionals, the pharmaceutical industry and regulatory agencies how medicines are being used in daily practice, and it should support the consideration of the needs of the older population in the drug development process.

We are investigating medicine optimisation for older patients. While we know they prefer tablets and capsules, these often need to be modified. For example, tablets may need to be split or crushed, or capsules opened, due to swallowing difficulties or due to the need to administer lower doses. These modifications may compromise the effectiveness of the medication.

Our research so far has found that over one-third of nursing home residents require a medication to be modified to meet their needs, but almost half of all modifications were not supported by easily accessible information on the effect of modification.

04

Lead researchers:

Dr. Laura Sahm, Dr. Abina Crean and Ms Aoife Mc Gillicuddy School of Pharmacy

Selected references to the research:

Central Statistics Office. Population and Labour Force Projections 2016-2046. Dublin: Government of Ireland 2013.

Mc Gillicuddy A, Crean AM, Sahm LJ. Older adults with difficulty swallowing oral medicines: a systematic review of the literature. Eur J Clin Pharmacol. 2016;72(2):141-51. doi:10.1007/s00228-015-1979-8.

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Mc Gillicuddy A, Kelly M, Sweeney C, Carmichael A, Crean AM, Sahm LJ. Modification of oral dosage forms for the older adult: An Irish prevalence study. Int J Pharm. 2016;510(1):386-93. doi:http://dx.doi. org/10.1016/j.ijpharm.2016.06.056.



Improving the care of people with dementia in hospital



Highlights

UCC Centre for Gerontology and Rehabilitation collected first ever multi-hospital dementia prevalence data in Europe Results of and recommendations from study have informed National Dementia Strategy and have been cited by OECD in its own dementia report

Improving the care of people with dementia in hospital

The realisation that hospital staff had little training or confidence in the care for the many older people in hospital who are confused was one of the driving forces behind our groundbreaking research at the Centre for Gerontology and Rehabilitation in the School of Medicine.

We set about changing this with an ambitious research programme in 2010, which revealed that the hospital nurses surveyed described their experience of caring for people with dementia as 'stressful' and 'challenging'.

We collected the first ever multi-hospital dementia prevalence data in Europe, showing that nearly 30% of older people admitted to hospital had dementia (the Cork Dementia Study). We co-led a national audit of all 35 acute hospitals in Ireland (INAD), demonstrating that staff training and practice in dementia care needed improvement.

At the same time, we co-led a series of studies showing that delirium, a life-threatening acute confusion in hospital, is much more common than was thought (the Cork Delirium Studies).

The results of this research programme have been cited in the recent OECD report on the quality of dementia care across all OECD countries, and were also quoted directly in the Irish National Dementia Strategy (2014), forming the basis of several key priority actions.

One of these actions was that 'national delirium pathways' - that is, roadways for organising care - would be developed, and this was achieved last year.

Another key action was that the HSE would develop a national hospital dementia pathway and in this context three hospital pilots are almost completed, with a national pathway template beginning.

Also among those key priority actions were our recommendations that there be a national research programme in progress with plans to re-audit hospitals in 2019; that at least 25% of acute hospitals would employ dementia nurse specialists by 2019; and that hospital environments would become more "dementia friendly" with the provision of, for instance, quiet spaces, better signage and lighting.

It's great to have been part of this improvement in care and to show that CoMH-led research can really make a difference.

05

Lead researchers:

Dr. Suzanne Timmons School of Medicine

Selected references to the research:

D O'Sullivan, M Mannix, S Timmons. "Integrated Care Pathways and Care Bundles for Dementia in Acute Care: Concept Versus Evidence." American Journal of Alzheimer's Disease & Other Dementias (2017): 1533317517698791.

O'Regan N. A., Maughan K., Liddy N., Fitzgerald J., Adamis D., Molloy D. W., Meagher D., and Timmons S. (2016) Five short screening tests in the detection of prevalent delirium: diagnostic accuracy and performance in different neurocognitive subgroups, Int J Geriatr Psychiatry, 2017; doi: 10.1002/gps.4633.

Briggs R; O'Shea E; de Siún A; O'Neill D; Gallagher P; Timmons S; Kennelly S; (2016) 'Does admission to a specialist geriatric medicine ward lead to improvements in aspects of acute medical care for older patients with dementia?'. International Journal Of Geriatric Psychiatry.

Seeking to expand our role as pharmacists for chronic disease management



UCC School of Pharmacy is demonstrating that an appropriately trained and educated pharmacist can and should be able to independently prescribe drugs for chronic disease management School of Pharmacy studies have shown that clinical pharmacists play major role in reducing adverse drug events, with potential savings of €800 per patient

Seeking to expand our role as pharmacists for chronic disease management

The role of the pharmacist has expanded internationally over the last 20 years from a medicines-focused to a more patient-focused profession. One of the primary roles of the pharmacist now is to manage patients' chronic ailments, including supporting and helping them get the best possible outcomes from their medication.

Recently here in Ireland, the role of the pharmacist has expanded, with the provision of vaccination services in 2011, the supply of emergency hormonal contraception also that year, and the supply of emergency medicines legislation in 2015.

However, while pharmacists in other jurisdictions within the EU and North American are now conferred with independent prescribing rights - with a particular focus on chronic disease management the same range of role expansion has not yet occurred in Ireland.

We at the School of Pharmacy are challenging that restriction, with our research demonstrating that an appropriately trained and educated clinical pharmacist can play a significant role in reducing adverse drug events (ADRs)—having identified that the number needed to treat (NNT) to prevent one patient having one ADR is 15—and in reducing potential inappropriate prescribing of medicines amongst our elderly patients.

Our studies have demonstrated that the number of ADRs occurring amongst elderly patients decline after a medicines review conducted by a pharmacist, and also that this is a cost-reducing initiative with potential savings of \in 800 per patient.

With increasing pressures becoming more apparent in our healthcare services, in both primary and secondary care, the opportunity exists for the Department of Health and Health Services Executive to look at expanding the role of the pharmacist in these areas so that we can work in collaboration with medical colleagues to optimise and enhance the management of patients' chronic diseases.

06

Lead researchers:

Prof. Stephen Byrne School of Pharmacy

Selected references to the research:

Cullinan S, Fleming A, O'Mahony D, Ryan C, O'Sullivan D, Gallagher P, Byrne S., Doctors' perspectives on the barriers to appropriate prescribing in older hospitalized patients: a qualitative study. Br J Clin Pharmacol. 2015 May; 79(5):860-9. doi: 10.1111/bcp.12555.

Gallagher J, O'Sullivan D, McCarthy S, Gillespie P, Woods N, O'Mahony D, Byrne S., Structured Pharmacist Review of Medication in Older Hospitalised Patients: A Cost-Effectiveness Analysis. Drugs Aging. 2016 Apr;33(4):285-94. doi: 10.1007/ s40266-016-0348-3.

O'Sullivan D, O'Mahony D, O'Connor MN, Gallagher P, Gallagher J, Cullinan S, O'Sullivan R, Eustace J, Byrne S., Prevention of Adverse Drug Reactions in Hospitalised Older Patients Using a Software-Supported Structured Pharmacist Intervention: A Cluster Randomised Controlled Trial. Drugs Aging. 2016 Jan;33(1):63-73. doi: 10.1007/ s40266-015-0329-y.

07

Influencing Ireland's community nursing and midwifery policy



Highlights

UCC-led investigation into a proactive community nursing and midwifery model for Ireland is now informing national policy Evidence review showed a need for generalist nursing in conjunction with specialist nursing and midwifery, with particular regard for Ireland's changing demographic profiles

Influencing Ireland's community nursing and midwifery policy

We are all as a population heavily reliant on our vital primary and community healthcare services, but a vision to re-organise the existing nursing and midwifery workforce in the community, to provide a proactive rather than reactive model of care, has been identified by our researchers.

The Department of Health-backed project, which led to our evidencebased review, is now guiding and informing national policy for nursing and midwifery in the community in Ireland. The process, which commenced with a national public consultation programme in 2017, is ongoing.

A draft policy has been developed in which the model of care is one that offers the individual, family and community a range of choices, which includes the vision to re-organise the existing nursing and midwifery workforce in the community.

Primary and community health services are the universal points of access for all members of the population. It is acknowledged that there is an increasing need to match health workforce supply to the changing demographic and epidemiological profiles. Successful models of nursing and midwifery in the community - delivering healthcare throughout the lifespan and across a health and illness continuum and sectors - are limited.

Our project involved a team of researchers from our School of Nursing and Midwifery and our Department of General Practice, together with National University of Ireland, Galway (NUIG) and University College Dublin (UCD) and with an input from community health, academic and clinical expertise.

This evidence review found no single overarching model of nursing and midwifery practice in the community; key components were identified, however. These include: the need for the right nurse or midwife providing the right care to the right people in the right setting. A model of generalist nursing supported by specialist nursing and midwifery providing client care at all levels will result in better health outcomes. This approach will ensure that clinical outcomes are meaningful, lasting, and more sustainable. Putting such a model for nursing and midwifery in the community into operation demands a need for strong leadership and effective clinical governance.

07

Lead researchers:

Dr. Patricia Leahy-Warren and Dr. Helen Mulcahy School of Nursing & Midwifery

Selected references to the research:

Leahy-Warren, P. Mulcahy, H. Benefield, L., Bradley, C., Coffey, A., Donohoe, A., Fitzgerald, S., Frawley, T., Healy, E., Healy, M.' Kelly, M., McCarthy, B., McLoughlin, K., Meagher, C., O'Connell, R., O'Mahony, A., Paul, G., Phelan, A., Stokes, D., Walsh, J., Savage, E (2017) 'Conceptualising a model to guide nursing and midwifery in the community guided by an evidence review'. BMC Nursing, 16 https://bmcnurs. biomedcentral.com/articles/10.1186/s12912-017-0225-3

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Examining the impact of closing small emergency departments

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Highlights

School of Public Health's 'SIREN' study identified and investigated geographical networks of emergency care in Ireland SIREN is analysing the performance of the Emergency and Urgent Care Systems in Ireland and providing a framework for their future evaluation

Examining the impact of closing small emergency departments

There has been an increasing tendency to reconfigure acute hospital care in Ireland towards a more centralised and specialised model, particularly for complex care conditions. Although centralisation is presented as 'evidence-based', it often faces public opposition, arising from concerns about future access to services. Plans to downgrade or close emergency departments have been particularly controversial.

We at the School of Public Health have recently completed a mixedmethods study called SIREN (Study of the Impact of Reconfiguration on Urgent and Emergency Care Networks) following on from which we will be making recommendations to the Department of Health to open up for public debate, re-consideration of its approach to closure of smaller emergency departments, and the impact of reconfiguration policies (that is, centralising acute care into large hospitals in cities) on older patients living in rural communities.

The main research objectives of SIREN were to identify geographical networks of emergency and urgent care in Ireland, and describe the model of Emergency and Urgent Care Systems (EUCS) configuration planned/implemented in each region; to analyse the process by which plans for EUCS reconfiguration were developed; to analyse the relationship between different models of governance and provision, and system-level indicators of activity, process and clinical outcome; and to develop, implement and test a comprehensive evaluation framework for EUCS.

From this research we are delivering an analysis of the performance of EUCS in each region and a framework for the future evaluation of EUCS in Ireland.

SIREN (Study of the Impact of Reconfiguration on Urgent and Emergency Care Networks) was Health Research Board (HRB) funded (€1 million) under the Collaborative Applied Research Grants (CARG) awards.

Our researchers were joined in SIREN by a consortium from Trinity College Dublin (TCD) and the Royal College of Surgeons in Ireland (RCSI), as well as a number of national and international collaborators, including from the School of Health and Related Research (ScHARR) at the University of Sheffield; the College of Medicine and Health and the Health Information Systems Research Centre (HISRC) here in UCC; and the National Directorate for Quality and Patient Safety in the HSE.

60

Lead researchers:

Professor John Browne School of Public Health

Selected references to the research:

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Foley, Conor et al. Understanding perspectives on major system change: A comparative case study of public engagement and the implementation of urgent and emergency care system reconfiguration. Health Policy, Volume 121, Issue 7, 800 – 808

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09

Reducing the economic and societal burden of preventable disease

Highlights

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ESPRIT research group has provided reliable estimates on prevalence of diabetes and diabetes complications, essential to health policy formation

ESPRIT has also investigated subclinical hypothyroidism, specifically the effects of substituting hormone replacement therapy with a placebo
Reducing the economic and societal burden of preventable disease

Our research group at the School of Public Health, ESPRIT (Evidence to Support Prevention, Implementation and Translation), has a vision: to reduce the economic and societal burden of preventable disease and to generate the best evidence to guide research into practice.

As a result, we have an impact on national policy, on practice, and on health outcomes. Our work is currently informing national health policy on diabetes a growing health problem in Ireland.

With support from a Health Research Board (HRB) Research Leader Award and in partnership with the National Clinical Programme in Diabetes (NCPD), we are for example, taking a population approach to prevention and control of diabetes. We have provided valid and reliable estimates of the incidence and prevalence of diabetes and diabetes complications, essential in informing national health policy.

We are also evaluating the NCPD, identifying which aspects of the programme are working, for whom, and in what circumstances. We are using national surveys of diabetes nurse specialists, podiatrists and practice nurses to inform implementation of the national model of integrated care, the long-term programme of change, and improvement for the country's health and social care services.

Another important component of our work with the NCPD is exploring the economic burden of diabetes in Ireland. We have provided robust, informative and policy-relevant estimates of the excess health service use and costs attributable to diabetes. We highlight areas for potential cost-savings in the context of finite healthcare resources, such as a shift in routine management to primary care and improved access to effective ancillary services, such as foot care services and dietetic interventions.

In addition, we are exploring trends in pharmaceutical expenditure on diabetes in Ireland. Our findings highlight the need for innovative policies to ensure quality diabetes care can be provided at an equitable, affordable and sustainable rate.

09

Lead researchers:

Professor Patricia Kearney School of Public Health

Selected references to the research:

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10 /

Measuring the quality of clinical learning environments for doctors-in-training



Highlights

Medical Education Unit research shows that medical training environments often fall short of Irish doctors' expectations Medical Council adopted Medical Education Unit's survey into its own annual National Survey of Trainee Experience

Measuring the quality of clinical learning environments for doctors-in-training

After graduation from medical school, doctors continue to train under supervision for several years until they are ready to practice independently. These doctors-in-training learn while they work, providing care to patients. Their working environments, therefore, need to support learning.

Problems with the retention of Irish medical school graduates in the Irish healthcare system have made the quality improvement of clinical learning environments an important focus nationally.

Research we carried out at the Medical Education Unit (MEU) in the School of Medicine made key contributions to this goal and was afterwards published as part of the first 'Your Training Counts' report. The Medical Council now uses this survey annually to measure and improve the experience of doctors-in-training.

Our initial study in this area was funded by the Royal College of Physicians of Ireland (RCPI) in 2012 to investigate the quality of clinical learning environments in its training programmes. Using an instrument originally developed in the Netherlands, our work demonstrated that doctors' experiences of training environments often fell short of expectations. Undertaken in partnership with RCPI, our work supported quality improvement of training, particularly for the most junior doctors-in-training.

Following on from this, in 2014, the Medical Council adopted the survey as part of its National Survey of Trainee Experience – Your Training Counts. Our researchers at MEU and the School of Applied Psychology were commissioned to evaluate the reliability and validity of the instrument to ensure that the findings were credible.

10

Lead researchers:

Dr. Deirdre Bennett School of Medicine

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Medical Council: Your Training Counts. Dublin, Ireland; 2014.

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Bridging the gap between ideal and real-world health services

Highlights

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School of Public Health research investigating the factors influencing implementation success of falls prevention services Research team has collaborated with managers and health professionals locally and nationally

Bridging the gap between ideal and real-world health services

We know from clinical trials that there are numerous things that can be done to improve a person's health, their quality of life and their experience of health services. Yet a gap persists between what should happen and what actually happens in healthcare.

Our research at the School of Public Health seeks to answer questions about how we can implement evidence-based practices and policies in a way that is effective, but also acceptable and sustainable.

One objective of our research is to evaluate the implementation of a multifactorial risk assessment clinic in primary care to reduce falls among older people.

Using mixed methods, we are examining the strategies used to support the introduction of the falls service and identifying the factors that help and hinder implementation success.

We have provided feedback to managers and health professionals locally and nationally about how to expand falls prevention services and how to improve the uptake and experience of older people using these services.

We will also generate evidence about how implementation strategies can be used to support health services in other settings.

This research is supported by a Fellowship in Ageing Research, funded by the Centre for Ageing Research and Development in Ireland (CARDI). We collaborate with the School of Medicine's Centre for Gerontology and Rehabilitation, as well as with the Health Service Executive (HSE) and with health professionals in hospitals and primary care centres across Cork city and county, in addition to receiving an expert input from implementation experts at the Gillings School of Public Health, University of North Carolina.

/ 11

Lead researchers:

Dr. Sheena McHugh School of Public Health

Selected references to the research:

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McHugh S, Wall O, Sinnott C, Byrne M, Timmons S, Kearney PM. Characterising an implementation intervention to support the introduction of community-based falls risk assessment clinics. Age and ageing. 2016;45(suppl 2):ii13-ii56.

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12

Exploring how well-planned outdoor playspaces can benefit children of diverse abilities

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Highlights

Department of Occupational Science and Occupational Therapy study identified 'Universal Design' concept as a way to make community playspaces more inclusive

Study showed that across 18 European countries, there is an overall lack of play policy, and where there is policy, UD concept is under-represented

Exploring how well-planned outdoor playspaces can benefit children of diverse abilities

Children love to play outdoors. Community playspaces provide an important opportunity for social inclusion, as well as for engaging with nature, which is known to reduce stress and support positive health and wellbeing.

However, playspaces such as playgrounds often do not meet the needs of many children, including those with disabilities, which results in them being socially excluded from local community settings.

We at the Department of Occupational Science and Occupational Therapy carried out a nationally funded study, using the concept of Universal Design (UD) - which is the design and composition of an environment so that it can be used by all, regardless of their disability - as one way for promoting inclusion. As a result, we identified a need to synthesise good practice in UD in inclusive policies and guidelines for outdoor playground design and provision, to plan for inclusion more effectively.

It is anticipated that the results of this study will inform the future development of national guidelines for inclusivity and will also identify ways of tailoring UD principles to play provision.

Working in collaboration with the Centre for Excellence in Universal Design, we conducted intergenerational research on outdoor play in community parks and playgrounds. We carried out a review of policy and guidelines, as well as playground observations and interviews with park playground providers, and with children and adults of varying ages, abilities and play preferences in a city council area.

Findings from the review of play policy in 18 European countries identified an overall lack of play policy internationally, and when policy is available, UD was under-represented. Few guidelines were found that considered the play needs of children with different abilities and their families. Insufficient development of policy and legislation results in insufficient funds, limited knowledge, and diminished responsibility among playground planners, designers, and providers. From a rights-based perspective, a lack of national and regional policy on inclusive outdoor play compounds the exclusion of children with disabilities from playgrounds.

12

Lead researchers:

Dr. Helen Lynch School of Clinical Therapies

Selected references to the research:

Lynch, H., Moore, A., Edwards, C., & Horgan, L. (in press). Community Parks and Playgrounds: Intergenerational Participation through Universal Design. Dublin: Centre for Excellence in Universal Design at the National Disability Authority of Ireland.

Lynch, H., Moore, A., & Prellwitz, M. (2018). From policy to play provision: Universal design and the challenges of inclusive play. Children, Youth and Environments, 28(2), xx-xx. Retrieved from http://www.jstor.org/action/ showPublication?journalCode=chilyoutenvi

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SOCIAL IMPACTS



College of Medicine and Health

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01 /

Our patient-held USB medication record aims to eliminate risk of errors

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Highlights

UCC Department of General Practice has developed a patient-held USB medication record which could help to eliminate medication errors at the interface of primary and secondary care

Preliminary findings suggest feasibility of introduction and a demonstrable reduction in medication error

Our patient-held USB medication record aims to eliminate risk of errors

Medication errors (any error in the prescribing, dispensing or administration of a drug), whether there are adverse consequences or not, are the single most preventable cause of patient injury.

Yet they are particularly prevalent at the interface of primary and secondary care, as patients transition between hospital and the community. Communication of medication information at times of hospital admission and discharge is currently suboptimal.

We at the Department of General Practice in the School of Medicine have developed a patient-held electronic medication record in the form of a USB device which may offer a solution to eliminating medication errors, which are also associated with significant healthcare costs.

Medication reconciliation is the formal process for identifying and correcting unintentional medication discrepancies during transitional care and is promoted as a method to improve patient safety internationally. There is currently a dearth of novel interventions to improve medication reconciliation at the interface of primary and secondary care.

Based on the premise that the patient is the one constant during transitional care, and that information technology has the potential to facilitate integration of medication information, our patient-held electronic medication record may provide a solution.

The device, which resembles a key and utilises USB technology, has been developed in association with a commercial provider of general practice (GP) software, Si Key Ltd.

Once activated, it provides a link to the patient's medication list in their GP record and facilitates transfer of medication information between primary and secondary care.

The PHARMS (Patient Held Active Record of Medication Status) feasibility study is examining the introduction of this intervention in primary and secondary care. Preliminary findings suggest acceptability to key stakeholders, feasibility of introduction of the intervention in primary and secondary care, and a reduction in medication error. With this device, there is potential for positive impact on patient safety and on healthcare costs.

/ 01

Lead researchers:

Dr. Elaine Walsh School of Medicine

Selected references to the research:

Walsh EK, Hansen CR, Sahm L, Kearney P, Doherty E, Bradley C. The Economic Impact of Medication Error: A Systematic Review. Pharmacoeipdemiology and Drug Safety 2017 25(2)3-23 DOI: 10.1002/ pds.409

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02 /

Being PREPARED: promoting collaborative multidisciplinary dementia care in the community

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Highlights

PREPARED project has explored the understanding and management of behavioural and psychological symptoms of dementia in primary care PREPARED team have rolled out practicebased workshops for GPs, launched a university-accredited dementia learning course, and developed an online resource

Being PREPARED: promoting collaborative multidisciplinary dementia care in the community

The number of people in Ireland aged 65 and over is increasing at a faster rate than other EU countries. A century ago life expectancy here was about 50; today it is almost 77 for men and 82 for women. Although our ageing population is to be celebrated, it does bring healthcare challenges.

How well are we equipped, for instance, to deal with the rising incidence of dementia, estimated to at least double over the next 30 years, given its close association with an ageing demographic?

We at the Department of General Practice have been identifying the dementia-specific educational needs of primary healthcare professionals from the perspective of clinicians, patients and family carers as the focus moves more towards those who work in health and social care services in the community, outside of hospital.

Called the PREPARED (Primary Care Education, Pathways and Research of Dementia) project, our national primary care dementia educational and research initiative launched in 2015 has already made an impact in contributing to our understanding of the management of behavioural and psychological symptoms of dementia in primary care.

We have rolled out practice-based workshops for GPs and primary care teams, launched a university-accredited 12-week dementia blended learning course, produced guidance materials for healthcare professionals nationally, and developed an online clinical resource, www.dementiapathways.ie.

We at PREPARED, together with our partners at the Irish College of General Practitioners and the School of Nursing, Dublin City University, have worked closely with The Alzheimer Society of Ireland, with people with dementia, and with family carers in a bid to achieve our overall aim of supporting healthcare professionals to give optimal dementia care in the community.

02

Lead researchers:

Dr. Tony Foley School of Medicine

Selected references to the research:

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Foley T, Jennings A, Boyle S, Smithson WH. The development and evaluation of peerfacilitated dementia workshops in general practice. Educ Prim Care. 2017 Oct 20:1-8

Foley T, Boyle S, Jennings A, Smithson WH. "We're certainly not in our comfort zone": a qualitative study of GPs' dementia-care educational needs. BMC Fam Pract. 2017 May 22;18(1):66

03 /

Harnessing new brain cells is our focus



Highlights

Department of Anatomy and Neuroscience focused on negative lifestyle factors contributing to neurodegeneration and psychiatric disorders

Research shows positive effects of exercise and nutraceuticals on brain health, as well as gut microbiota

Harnessing new brain cells is our focus

The role that a negative lifestyle plays in contributing to psychiatric disorders and the degeneration of neurons in the brain, which affect our memory and mood, has been the focus of our research.

Neurodegenerative and psychiatric disorders, affecting memory and mood, are leading causes of disease burden in society, due to the poor efficacy of current treatments combined with negative lifestyle factors.

Neurogenesis, that is the impairment in the production of new neurons in the hippocampus, a brain region critical for memory and mood, underpins certain symptoms of these disorders.

The challenge of our research at the Department of Anatomy and Neuroscience, is to understand the impact of the lifestyle factors - stress, inflammation, exercise and diet - on neurogenesis-related memory and mood, and to determine how lifestyle interventions may interact to improve and prolong brain health.

We have shown that inflammation and stress have detrimental effects on neurogenesis, and that exercise can have a memory-enhancing effect.

We demonstrated that dietary supplementation with a seaweedderived nutraceutical from a local enterprise reversed age-related cognitive deficits. It also increased the diversity of gut microbiota, the complex community of microorganisms within the digestive tract which is increasingly being viewed as a significant regulator of behaviour.

Our research has impacted upon the scientific community and developed Ireland's international reputation through our publications, conference presentations and awards.

In the longer term, our research is providing knowledge on brain function which is essential for development of therapeutics for brain disorders, which place a heavy global burden on healthcare systems.

In an educational capacity, we have delivered a series of workshops and talks to primary and secondary school children, teachers, parents, sports clubs, and retirement groups to promote the importance of brain health to prevent cognitive and mental health issues in later life.

03

Lead researchers:

Dr. Yvonne Nolan School of Medicine

Selected references to the research:

Hueston CM, Cryan JF, Nolan YM. (2017) Stress and adolescent hippocampal neurogenesis: diet and exercise as cognitive modulators. Transl Psychiatry. doi: 10.1038/tp.2017.48.

Ryan SM, Nolan YM (2016) Neuroinflammation negatively affects adult hippocampal neurogenesis and cognition: can exercise compensate? Neurosci Biobehav Rev 61:121-131

Nolan YM, Sullivan AM, Toulouse A. (2013) Parkinson's Disease in the Nuclear Age of Neuroinflammation. Trend Mol Med 19:187-196

04,

Investigating prosodic skills for speech in children with spina bifida



Highlights

UCC School of Clinical Therapies researching the connection between spina bifida and atypical speech prosody in children The research objective is to inform support systems for children with spina bifida, allowing them to fully integrate into education, the world of work, and society

Investigating prosodic skills for speech in children with spina bifida

Spina bifida (SB) is a congenital condition characterised by malformation of the spinal cord and some parts of the brain, affecting 1 per 2000 births, with Ireland having one of the highest incidences in the world.

Due to the structural defect, individuals with SB often have lifelong problems in sensory and motor functions and cognitive abilities, as well as speech and language skills required for everyday communication, which could have a serious impact in terms of independence, education, employment and social integration.

Our research in the School of Clinical Therapies - which will be of relevance to policymakers responsible for providing effective services for children during the school years - aims to raise awareness of prosodic difficulties and their impact on communication in children with SB, and to shed light on the best practice for assessing and managing these problems.

Children with SB generally show adequate vocabulary and grammar in spoken language, but they are not good at making inferences, as well as integrating words, knowledge of the world and context, during conversations.

Atypical features in speech prosody - the "melody of speech" - have been noted, but the ability to both understand and produce speech prosody, and how this skill is related to language development in these children, is unknown.

With funding from the Health Research Board, we are undertaking a research project called 'Profiling Receptive and Expressive Prosodic Skills in Children with Spina Bifida and Hydrocephalus', in order to answer these questions.

A pilot study by our research team and the preliminary data of this project showed that children with SB did not do as well as their age and language skill-matched typical peers in a number of speech prosody tasks, for example in using intonation to indicate 'like' and 'dislike'.

It is hoped that the findings of our research will inform future suitable support systems for children with SB to ensure that they can reach their full social and educational potential, so that when they become young adults they will have better opportunities for education, employment and socialisation.

04

Lead researchers:

Dr. Alice Lee School of Clinical Therapies

Selected references to the research:

Lee, A., Hayes, O., Ní Mhurchú, D., & Gibbon, F. E. (2016). A preliminary study of prosody skills in children with spina bifida. In H.-O. Enger, M. I. N. Knoph, K. E. Kristoffersen, & M. Lind (Eds.), Helt fabelaktig! Festskrift til Hanne Gram Simonsen på 70-årsdagen [Absolutely fabulous! Festschrift to Hanne Gram Simonsen on the 70th birthday] (pp. 111-125). Oslo: Novus Forlag.

05 /

New proven ways to build health, wellbeing and resilience for work and for life



Highlights

UCC School of Medicine clinicians and researchers have developed a range of stress management and resilience training programmes for business, educational and clinical settings

'LifeMatters SMART programme' has been applied to child safety programmes in the USA and addiction treatment in Canada

New proven ways to build health, wellbeing and resilience for work and for life

We all need stress in our lives - it's a natural motivator. But when it spirals out of control, interfering with our jobs, family life and relationships, affecting our general health and wellbeing, then it can be insidiously destructive.

Our clinicians and researchers at the School of Medicine have developed a range of evidence-based stress management and resilience training programmes. These are now adopted nationally and internationally as a best practice framework for reducing stress and improving health, wellbeing and performance in educational, business and clinical settings.

Having received philanthropic funding, we carried out extensive research on the programmes, together with colleagues at the School of Applied Psychology and Student Health Services. With over 1,000 participants completing the programmes between 2009 and 2012, our findings were clear: the LifeMatters model, tools and techniques are measurable, teachable and sustainable, and they help people reduce stress and anxiety while building health, wellbeing and performance for work and for life.

SAFEMED and SAFEMED SMART (Stress Management and Resilience Training) are bespoke wellbeing and performance coaching programmes focused on clinician health and patient safety. SAFEMED has been accredited by the Medical Council in Ireland. Our SAFEVET programme has been adopted nationally by the Veterinary Council of Ireland into their new vet and veterinary student nurse training. Our NurseWell programme is delivered to final year nursing students.

The LifeMatters SMART programme also uses cognitive behavioural techniques and life skills tools in educational, business and clinical therapeutic settings. It has been applied in child safety programmes in the USA, in treatment services for addictions in Canada, and with clinician and bench scientist training in the NHS in the UK and at Harvard University in the US.

Earlier this year, LifeMatters was also adopted by our INFANT centre (Irish Centre for Fetal and Neonatal Translational Research) at UCC, in programme and handbook form, written and designed by our lead clinician and researcher of the programme Dr. Margaret O'Rourke, LifeMatters forms part of the centre's B-BEST START programme, which empowers parents to build their own health, wellbeing and resilience so that they can be active, informed and emotionally engaged with their newborn babies, infants and children.

05

Lead researchers:

Dr. Margaret O'Rourke School of Medicine

Selected references to the research:

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O'Rourke M (2016) New Vet Handbook with SAFEVET : A practical guide to building self-care, wellbeing and resilience in practice. Published by the Veterinary Council of Ireland – Practical Application of our research on stress profiling.

O'Rourke M(2018) B-BEST START : LifeMatters for Mums, Dads and New Born Babies: A practical and complete guide to health, wellbeing and resilience in Infant and early life. Published by EU and SFI 2014-2020 Structural and Investment / INFANT funding



Our Let Me Decide advance care directive is self-empowering



Highlights

UCC Centre for Gerontology and Rehabilitation has developed 'Let Me Decide', a healthcare directive that allows people to state their wishes for future health and personal care while still of sound mind

Let Me Decide, a power of attorney directive, has sold more than 1 million copies and is available in seven languages

Our Let Me Decide advance care directive is self-empowering

Over the past 50 years medicine has advanced at an amazing rate. What was once considered miraculous is now considered routine. We have developed an ability to resist and postpone death in many new and complicated ways.

Our ability to make these end-of-life decisions is hugely important because it gives us control and autonomy over what happens to our bodies.

What happens, for instance, if injury or disease leads to our inability to communicate fully with those around us? And if we can't communicate our desires then are we unable to choose?

It is for circumstances like these that we at the Centre for Gerontology and Rehabilitation, after many years of research and consultation, have created an advance healthcare directive called Let Me Decide, which allows people to state their wishes for health and personal care while they are competent for a time in the future.

It is a power of attorney, which allows us to nominate a designated healthcare representative who can act on our behalf, just like we already commonly do with legal wills.

Our advance care directive is the world's most popular living will, has sold more than 1 million copies, and is available in seven languages.

On a national level, it is being used in community hospitals and in homecare settings: people share their written self-empowering choices with those close to them and with healthcare professionals, and in that process relieve them of responsibility about those decisions around the person's quality of life care.

Let Me Decide is a clear example of research from our college, linking up to the heart of society's organised efforts to protect and promote the rights of every individual, to decide their healthcare options for themselves.

In book and video form, it is now also part of a comprehensive educational programme that includes workshops, publication and training guides.

06

Lead researchers:

Professor Willie Molloy School of Medicine

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Providing an end-of-life ethics education within the healthcare system



Highlights

UCC School of Nursing and Midwifery coordinated a project to develop an ethical framework for end-of-life care The 'Ethical Framework' is a comprehensive set of online educational modules that introduce and discuss ethical issues that arise during end-of-life care

Providing an end-of-life ethics education within the healthcare system

Having an ethical framework within the healthcare system for dealing with end-of-life care, such as breaking bad news, maintaining patients' autonomy, ensuring the role of rights, and the withholding or withdrawing of treatment, benefits us all.

Currently, legislative and regulatory bodies in Ireland are driving reform in relation to end-of-life care provision. However, if the reforms envisaged in documents such as the HSE National Consent Policy (2013) and the Assisted Decision Making (Capacity) Act 2015, are to come about in the fullest sense, then end-of-life ethics education and information dissemination need to be embedded and sustained in healthcare organisations.

We at the School of Nursing and Midwifery co-ordinated a project involving a consortium of ethical, legal, sociological and clinical experts from UCC, together with the Royal College of Surgeons in Ireland and the Irish Hospice Foundation, funded by the Hospice Friendly Hospitals/Atlantic Philanthropies Programme from 2007-2012.

The project engaged in ethical, legal and empirical research with Irish health professionals and the general public in order to inform the development of an ethical framework for end-of-life care.

It has also led to the design and implementation of the world's first MSc in End-of-Life Healthcare Ethics here at the School of Nursing and Midwifery. Two cohorts of students have graduated to date.

The 'Ethical Framework' is a comprehensive set of online educational modules that introduce and discuss ethical issues that arise for health and allied professionals, patients and families in the course of end-oflife treatment and care.

Two studies undertaken in 2013 and 2015 demonstrate that these resources are a very effective means of building ethics capacity in healthcare organisations.

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Lead researchers:

Dr. Joan McCarthy School of Nursing and Midwifery

Selected references to the research:

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End-of-Life Care in Ireland: Ethical Challenges and Solutions. McCarthy J (2014) In Houses of the Oireachtas Joint Committee on Health and Children Report on End of Life and Palliative Care in Ireland, Volume 1. (http://www.oireachtas. ie/parliament/media/committees/ healthandchildren/health2014/End-of-Life-Vol-1.pdf) SOCIAL IMPACTS



Our cognitive screening test, The Quick Guide, has been adopted worldwide



Highlights

UCC Centre for Gerontology and Rehabilitation's 'Quick Guide', a cognitive screening test, has been translated into 15 languages The guide can differentiate between normal cognitive function, subjective cognitive disorders, MCI and early dementia, and measure changes over time

Our cognitive screening test, The Quick Guide, has been adopted worldwide

Our latest publication from the Centre for Gerontology and Rehabilitation, called 'The Quick Guide', contains the scoring and administration instructions for our Qmci (Quick Mild Cognitive Impairment) screening instrument, consisting of a list of questions carried out in less than five minutes.

Our Qmci has been translated into 15 different languages across the world and it can be used reliably - with the instructions now contained in this short booklet - by doctors, nurses, allied health professionals and anyone who has been trained to use it.

The challenge with most cognitive screening instruments is that they take time to administer; this is impractical, especially in clinical settings. Because our Qmci screen is a brief and reliable method, it has been used in clinics, hospitals, long-term care settings, family doctors' offices, and in the community since its validation six years ago.

It is designed to differentiate between normal cognitive function, subjective cognitive disorders, mild cognitive impairment (MCI), and early dementia, and to measure changes over time.

It is a suitable tool in any setting. For example, it was even used at an Everest base camp to measure cognitive changes at altitude, believed to contribute towards acute mountain sickness (AMS) at a time when trekkers need to rely so much on their own cognitive performance and judgment.

Its scores can be adjusted for age and educational level. The scoring system out of 100 is ideal for tracking subtle changes which affect functional performance. It has also been used in randomised clinical trials, case studies, and observational cohort studies.

This short and easy-to-use booklet is another perfect example of research translated into clinical practice - offering the opportunity to prevent disease, protect and promote health and wellbeing in society and reaching out to a variety of settings on a practical level in the process.

Lead researchers:

Professor Willie Molloy School of Medicine

Selected references to the research:

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