



### Mission:

Linking Irish science with industry and society through excellence in research, education and outreach in gastrointestinal health.



<http://apc.ucc.ie>  
<http://microbemagic.ucc.ie>



[www.youtube.com/pharmabiotic](http://www.youtube.com/pharmabiotic)



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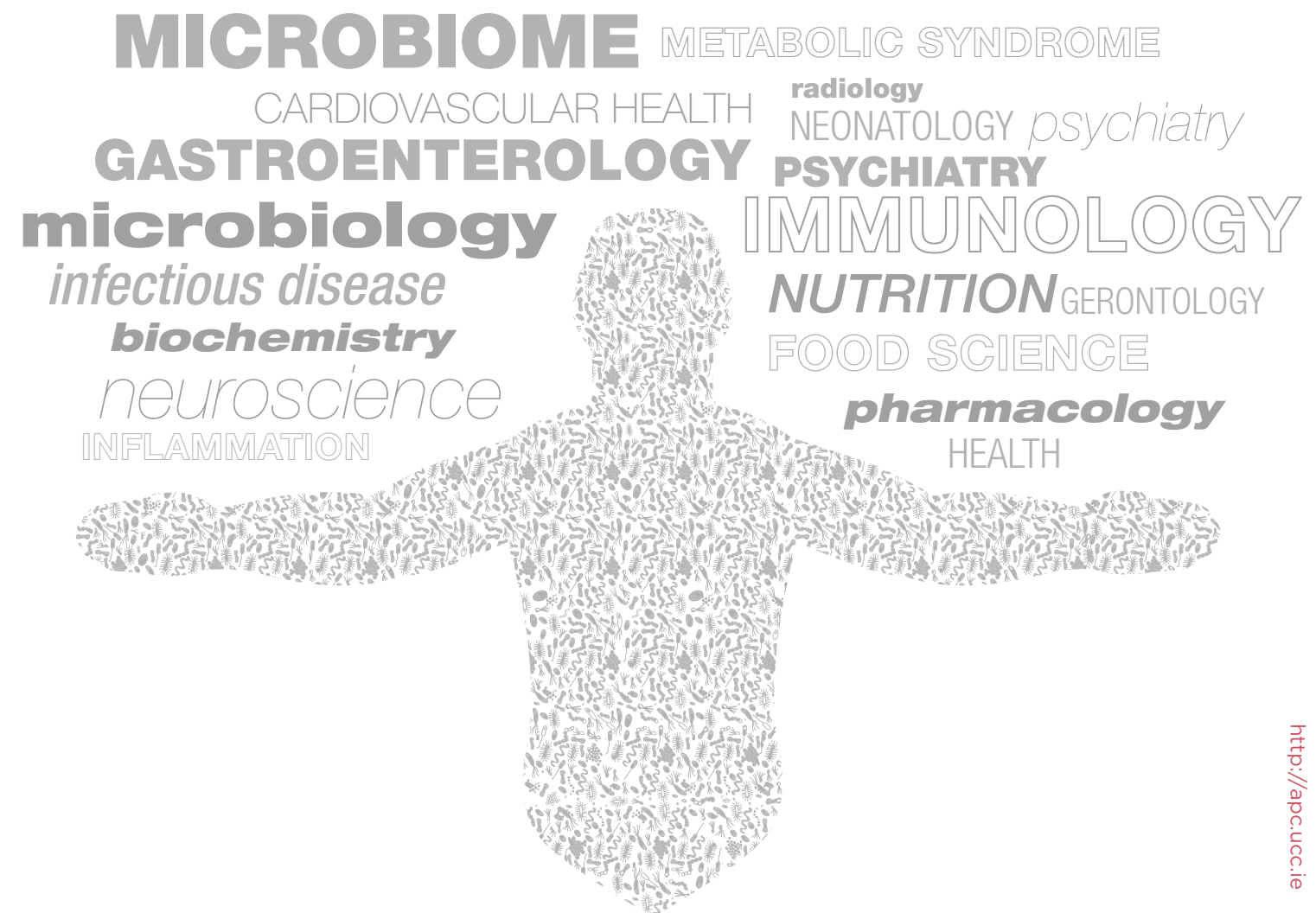
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Now in its second decade, the APC is about people working together across the boundaries of traditional research sectors. The APC has created a lively trans-disciplinary environment with clinicians, clinician-scientists and basic scientists from diverse backgrounds working in teams, sharing ideas and resources. Although focused upon the magic and mysteries of the gastrointestinal bacterial community, (the microbiota), the scale and scope of the work has become one of the fastest moving areas of biology, of relevance to all branches of medicine and veterinary science, and is of growing importance to the economic welfare of society.

The microbiota is not only a target for treatment and prevention of disease, it is a repository for functional food ingredients and even new drugs and is a source of novel biomarkers of disease risk. APC researchers welcome collaborators from industry, large and small enterprises, indigenous and multi-national, and have extensive experience with the food, agriculture, pharmaceutical, biotechnology and diagnostic sectors. The scientific organisation of the APC consists of a matrix of vertical pillars or themes of intellectual pursuit which are supported by multiple horizontal or shared technology platforms. This ensures freshness of ideas and support for intellectual curiosity while serving as a magnet to attract and drive industry-focused research.

**Fergus Shanahan**  
APC Director  
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SUCCESSES - THE FIRST 12 YEARS

Discovery

- > Novel anti-microbials & anti-inflammatories
- > Relating food & microbial diversity with health
- > Templates for future foods

Impact

- > Training next generation of risk-takers
- > Exceeding norms for commercial metrics
- > 100 publications / year since 2003

Magnet

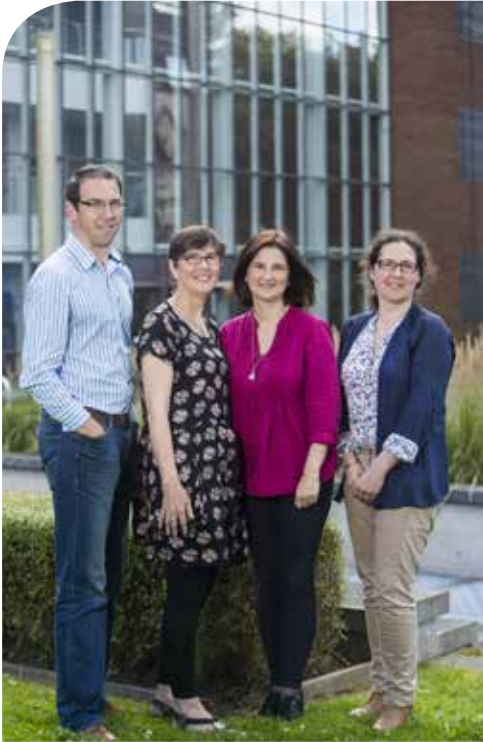
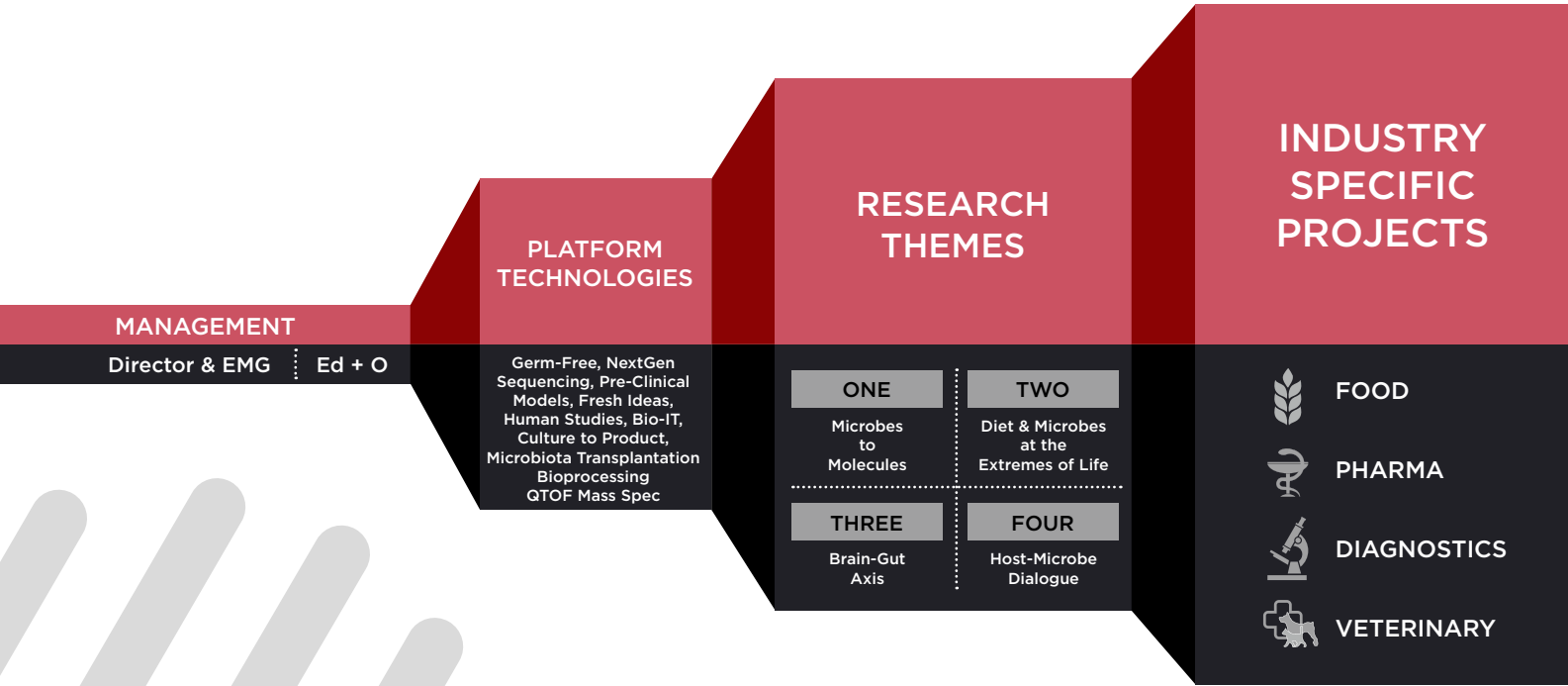
- > Attracting industry
- > Foreign direct investment

Education & Outreach

- > Bringing science to society
- > Crossing boundaries

Agent of Change

- > Leadership
- > Environment suited to innovation
- > Challenging outdated policies
- > Removing obstacles



People working together

Picture Left:

**L to R:**  
Fergus Shanahan  
Director

Sally Cudmore PhD  
General Manager

Gerald Fitzgerald  
Deputy Director

Picture Above:

**L to R:**  
Brendan Curran  
Intellectual Property Manager

Catherine Buckley PhD  
Communications and Outreach Manager

Susan Rafferty-McArdle  
Operations Manager

Eileen Herlihy  
EU Grants Manager



One of the key philosophies of the APC Microbiome Institute is ensuring that the research is commercialised in order to benefit consumers, patients and the Irish economy. Industry partnerships are vital in enabling the APC to fulfil this goal, by providing possible commercial routes for the outputs of APC research, and in ensuring that the APC remains relevant to industry. The research activities of the APC are applicable to many different industry sectors – food, pharma, biotechnology, infant nutrition, medical foods, diagnostics, sports nutrition, and animal health – and the APC has a range of industry partners spanning these sectors. In each case APC researchers work on specific projects with these partners, in order to further the company's own R&D agenda. The scope and scale of industry projects vary considerably, depending on the needs of the company.

The APC has over a decade of experience in collaborating with industry and companies value the expertise of APC faculty across a range of disciplines and their experience in working with industry-specific projects and delivering commercially relevant outputs. The APC welcomes new industry partners from Ireland and globally, through a variety of flexible modalities. We work closely with the relevant state agencies and can facilitate companies in accessing state funding mechanisms. The benefits of APC partnership include the ability to undertake collaborative research, access to APC Technology Platforms, extensive APC databases and bio-banks, and the reservoir of knowledge and know-how held by the APC investigators (subject to confidentiality and intellectual property agreements). In addition, there is the reputational benefit accruing from interacting with one of the leading global centres of excellence in gut microbiome science in the world.

Those interested in collaborating with the APC please contact:

**Sally Cudmore**  
APC General Manager  
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# Industry Partnerships



Current Partners Include:



Partnership with industry



The translation of APC research into commercial outputs is of primary importance to the APC and we are well practised in capturing and managing intellectual property. We also work closely with the Technology Transfer Offices in UCC and Teagasc in order to commercialise the outputs of APC research. All APC inventions are captured and evaluated for patentability and commercial potential before proceeding with patent applications and mapping out appropriate routes for commercialisation, from licensing to spinouts. In addition, all industry projects are governed by individual collaboration agreements that set out the principles and procedures for managing and exploiting IP.

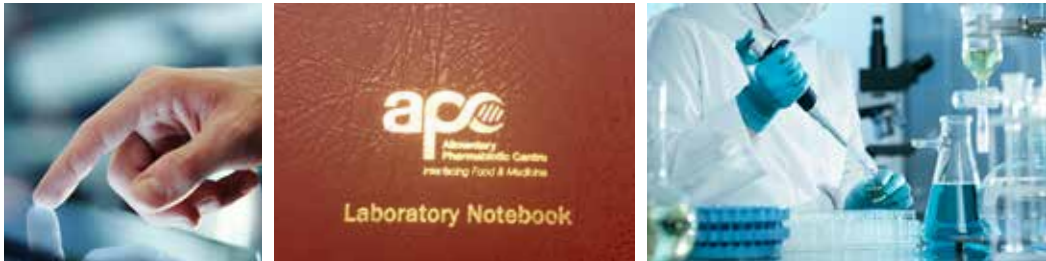
A significant benefit of being an APC industry partner is that any IP created in APC academic projects is offered to industry partners for licensing (unless a start-up company opportunity exists). A key tenet for APC is that we reserve the right to use licensed IP for research and teaching purposes, and also maintain freedom to operate around the use of platform tools and technologies for training, research and education purposes.

Those interested in learning more about APC's technology transfer policies and potential licensing opportunities please contact:

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APC Intellectual Property Manager  
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# Technology Transfer

Bench to bedside to marketplace





The term 'Pharmabiotics' refers to any biological entity 'mined' from the gastrointestinal microbiota, including probiotics, prebiotics, bacteriocins, bacteriophages and other bioactive molecules. The discovery of valuable pharmabiotics is at the heart of the "Microbes to Molecules" theme. We believe that novel pharmabiotics can have a significant impact on the pharmaceutical, medical food and functional food sectors. For example, the current threat posed by multi-drug resistant bacteria is a major challenge, so the APC is searching for new treatment modalities. Our researchers have discovered a narrow spectrum antimicrobial peptide highly active against *Clostridium difficile*, while bacteriophages active against *Pseudomonas aeruginosa* have also been identified.

Outputs from this theme include new anti-inflammatory and anti-infective therapeutics. We will also develop functional ingredients and probiotic strains for the food sector and will assist food companies to provide sufficient scientific and clinical validation to assist in meeting the health claim requirements of regulatory bodies.

#### Leaders:

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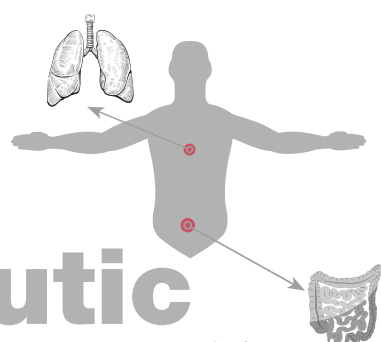
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## Microbes to Molecules

### RESEARCH THEME 1

therapeutic  
PROBIOTIC *bifidobacteria* production food host  
carbohydrate anti-biotic human MICROBIOTA  
bacteriocins PREBIOTIC phages  
pharmabiotic mechanisms  
anti-inflammatory



Mining microbes  
for mankind



**L to R:**  
Roy Sleator  
Douwe van Sinderen  
Paul Ross  
Paul Cotter  
Mary Rea  
Colin Hill



The interaction between diet, the microbiota and health at the extremes of life - infants and older people - is the main topic of this research theme, with a unifying emphasis on the role of the microbiota in modifying the effects of nutrition on major systems including cognition and inflammatory disease. In infants and older people, the gut microbiota is in a state of flux, so these are particularly relevant life-stages in which to modulate the microbiota in a health-promoting direction. We also explore the microbiota at other extremes, such as in elite athletes and in people with chronic GI conditions. Outputs include new identifying food ingredients for infant formula and for the elderly, in addition to determining dietary recommendations for infants, athletes, patients and the elderly to address issues and conditions that are typically associated with these extremes of life. We are also identifying biomarkers of microbiota alteration and metabolite depletion, both of which can be monitored to track the risk for reduced health status that can profoundly influence how individuals are medically treated and managed.

#### Leaders:

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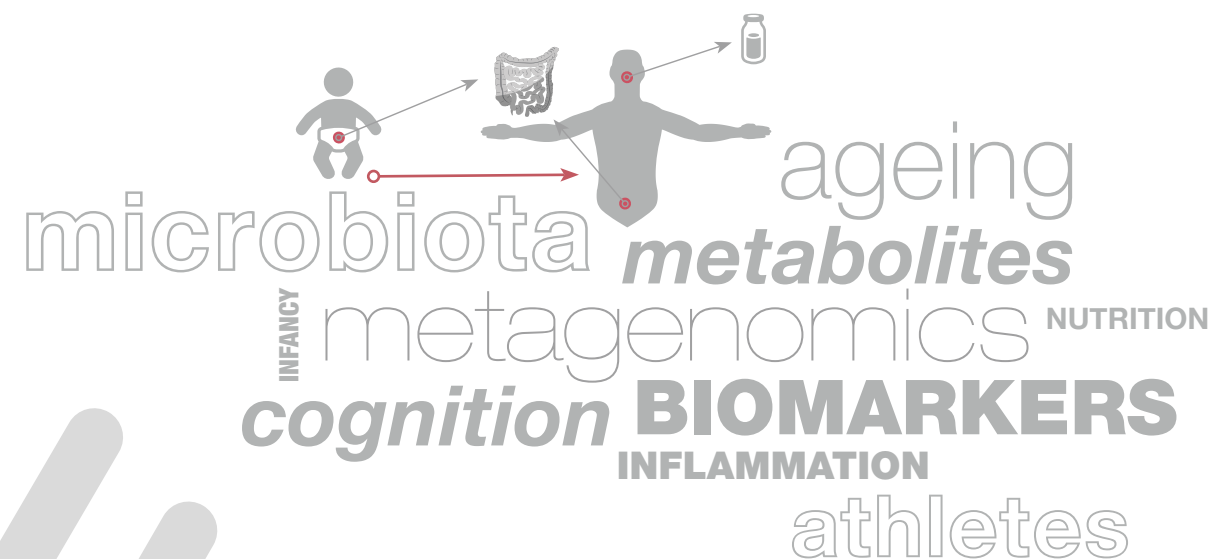
**Tony Ryan**

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## Diet and Microbes at the Extremes of Life

### RESEARCH THEME 2

Promoting microbiota diversity; promoting health



**L to R:**  
Catherine Stanton  
Tony Ryan  
Paul O'Toole



This APC theme addresses the communication between the brain and the gut and how it can be influenced by the gastrointestinal microbiota. This is an area of significance in infancy, where important links between diet, microbes and cognition are established. The influence of the microbiota on obesity and metabolic syndrome are also increasingly recognised. The APC has made significant contributions in this area, which represents a real opportunity for foods designed for cognition, infant brain development, functional gastrointestinal disorders and for healthy ageing, which are significant growth areas for healthcare and food companies. Microorganisms, or microbial components, have a role in either causing or preventing many of these conditions. A better understanding of the role of this axis in the stress response, and its links with other debilitating conditions, such as anxiety, depression, autism, and IBS, will provide new treatment and management strategies – these will represent opportunities for both the food ingredients and the pharmaceutical sectors.

Leaders:

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# Brain-Gut-Microbiota Axis

RESEARCH THEME 3



NEUROSCIENCE anxiety

PUBLIC HEALTH

stress

Microbiota

mental health

probiotics IBS

COGNITION

VISCERAL PAIN metabolic disease

depression AUTISM

psychobiotics



L to R:  
John Cryan  
Ted Dinan

Microbes maketh man



“Host-Microbe Dialogue” explores the network of signalling interactions among the microbiota, host immune-inflammatory responses and metabolism and the impact of diet on each component of this triad. The gut microbiota influences human health and susceptibility to most common diseases, including immune-allergic, colon cancer and various metabolic diseases, such as obesity-related disorders, diabetes and cardiovascular disease. Each of these chronic disorders has an immune or inflammatory component, and, indeed, the ageing process itself is associated with increases in low-grade inflammation (inflammageing). This low-grade inflammation, and the diseases associated with it, is a significant healthcare burden in developed countries, and represents a multi-billion Euro opportunity for companies in the food, pharmaceutical and diagnostic sectors. The APC has built a global reputation in inflammatory diseases, particularly in functional gastrointestinal conditions, inflammatory bowel disease (IBD) and in inflammation of the elderly. The challenge now is to develop new and robust microbial and other biomarkers of disease risk and to manipulate disease risk by targeting the microbiota using designer foods and/or pharmabiotics. This is a strategically important area both in the context of the ageing population and evolving economic and public health policies.

#### Leaders:

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##### Cormac Gahan

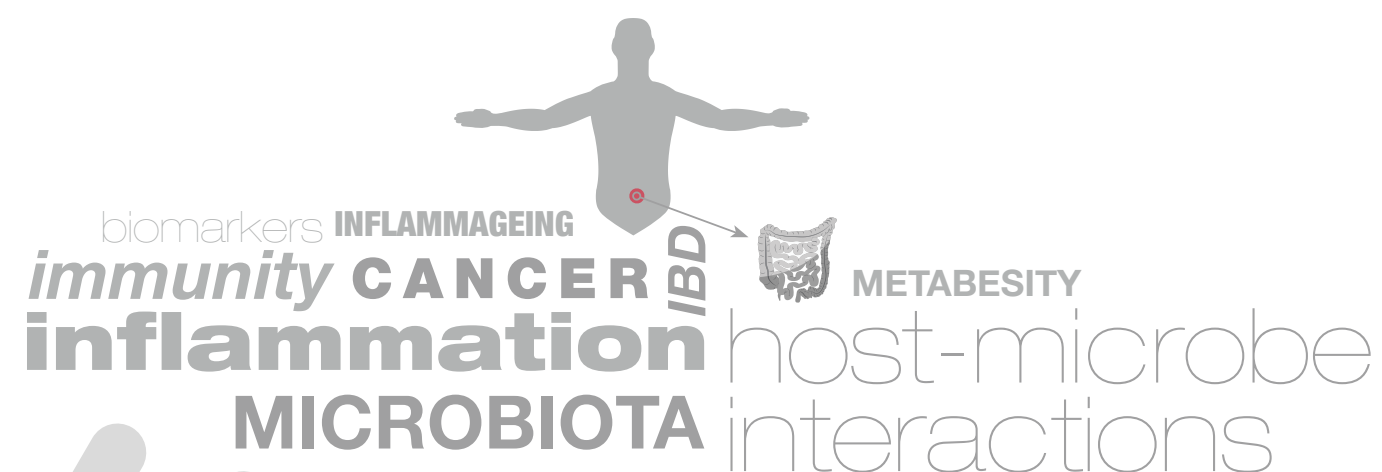
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## Host-Microbe Dialogue

### RESEARCH THEME 4



#### L to R:

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Ken Nally  
Silvia Melgar  
Marcus Claesson  
Fergus Shanahan  
David Clarke  
Cormac Gahan



Shared minds



### Isolating, identifying and producing gut bacteria and metabolites

The APC studies the most complex ecosystem in nature – the human microbiota. The APC's **Culture to Product Platform** deals with thousands of bacterial strains, which are stored in a well catalogued collection. This APC culture collection is an invaluable resource to an Institute which is based on over a decade of 'mining microbes for mankind', and is available for screening to APC industry partners. Our **Next Generation Sequencing Platform** uses the most up to date sequencing technologies to identify and characterise complex bacterial communities. The analysis of these complex datasets requires sophisticated bioinformatics programmes and expertise (**Bi-oIT Platform**). Pilot-scale production of bacterial strains can be carried out in our **Bioprocessing Platform**. The **QTOF Mass Spec Platform** allows us to discover and identify likely functional proteins/peptides and metabolites.

### Establishing the mechanism of action of new pharmabiotics

To establish how individual pharmabiotics influence health is one of the central goals of the APC. In our pre-clinical unit (**Pre-Clinical Models Platform**) we have built up significant expertise in *in vitro*, *ex vivo* and *in vivo* models of many acute and chronic diseases. One of the most sophisticated models is the use of gnotobiotic or germ-free animal models – a highly technical facility available to very few centres worldwide (**Germ-Free Platform**).

### Efficacy in humans

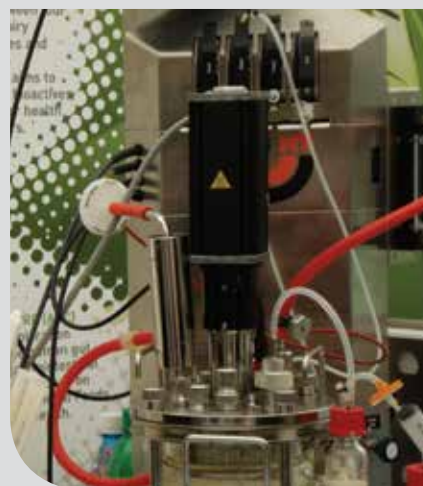
The objective of the APC is to work from bench to bedside, which re-

quires access to patient groups and healthy populations. This expertise is provided by APC clinician scientists (**Human Studies Platform**). Another significant resource in this context is our ability to select and identify a minimal microbiota and to perform complete microbiota transplants, a new programme for the APC (**Microbiota Transplantation Platform**). The APC also has sophisticated imaging capabilities, which facilitate the deciphering of mechanisms of action of bacterial strains, as well as the host immune response.

### Freshness, agility

Our final platform has been designed to assist the APC to quickly respond to changes in rapidly moving scientific fields (**Fresh Ideas Platform**). This platform provides a mechanism for APC Faculty to engage in exciting fundamental and applied research projects through postgraduate-led research.

## Building on Platform Research



**apc**  
Microbiome  
Institute  
Interfacing Food & Medicine

A unique  
resource globally





The APC recognises that scientific advances can only be implemented with the support of an informed society. All APC staff play an active role in sharing our excitement about our science, in informing and updating patient groups and consumers of our progress, and in engaging with young people to encourage future generations with an understanding of the science issues that affect them and society.

#### Informing society

The APC works with the medical community, patient groups and general society by hosting public fora, open days in association with the World Gastroenterology Organisation and the Irish Society for Colitis & Crohn's Disease, amongst others and by contributing media articles.

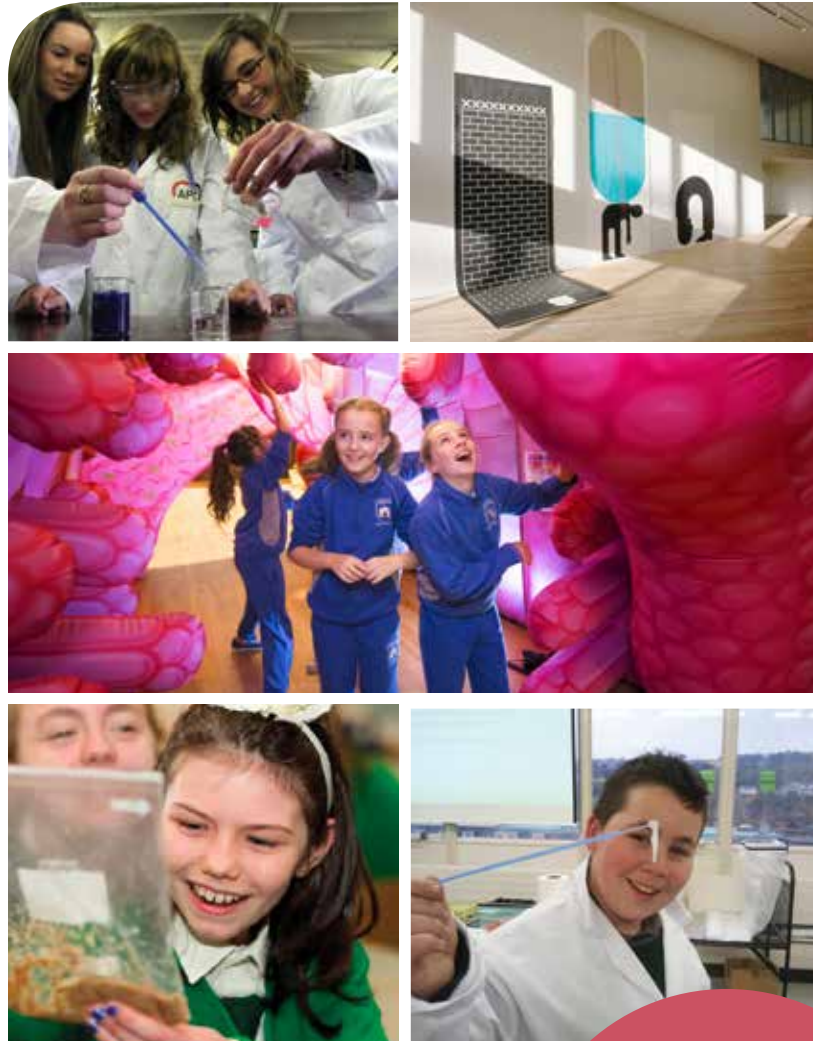
#### Engaging with industry

The APC's main *raison d'être* is to create economic and societal impact, and collaborations with innovative industry partners is a key to this success. We design industry workshops to cater for the ongoing training requirements of the food, pharma and diagnostic sectors and with a view to attracting new partners to the Centre.

#### Inspiring future scientists

Science literacy is an essential tool for life in the 21st century. APC's MicrobeMagic@school and Budding Biologists programmes for primary and secondary schools are designed to enthuse students about science through Inquiry Based Science Education and by providing opportunities for hands-on laboratory experience.

## Education and Outreach



#### Contact:

**Catherine Buckley**

APC Communications and Outreach Manager  
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<http://apc.ucc.ie>  
<http://microbemagic.ucc.ie>

Create a curious public

*"The workshops are an excellent innovation. They give the students an opportunity to visit and work inside a 'real' top quality laboratory. It also gives teachers the ability to make science exciting."* **Cormac De Fein, teacher, Pobalscoile na Trionoide, Youghal**

Since its establishment over a decade ago the APC Microbiome Institute has had an active history in EU framework programmes, both as a project leader and partner, from Marie Curie fellowships and Training Networks to large collaborative projects. We are interested in pursuing opportunities with individual researchers, research organisations, SMEs and industry across the three main pillars of the programme: Excellent Science, Societal Challenges (in particular Health and Food) and Industrial Leadership.

#### Contact:

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#### Excellent Science

- Basic to applied research
- Blue Skies Research
- Bottom Up to Top Down Approach
- Training & Knowledge Transfer

#### Industrial Leadership

- Bioactives & Biomakers
- Competitiveness
- Data & Diagnostics
- Functional Foods
- Innovation
- Medicines/Therapies
- MNCs & SMEs

#### Societal Challenges

- Ageing
- Diet/Nutrition
- Society & Economy
- Food Production
- Human & Animal
- Policy & Population Health
- Ecosystems

# HORIZON 2020



# APC Faculty



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Psychiatry, stress, anxiety, depression, IBS, psychobiotics

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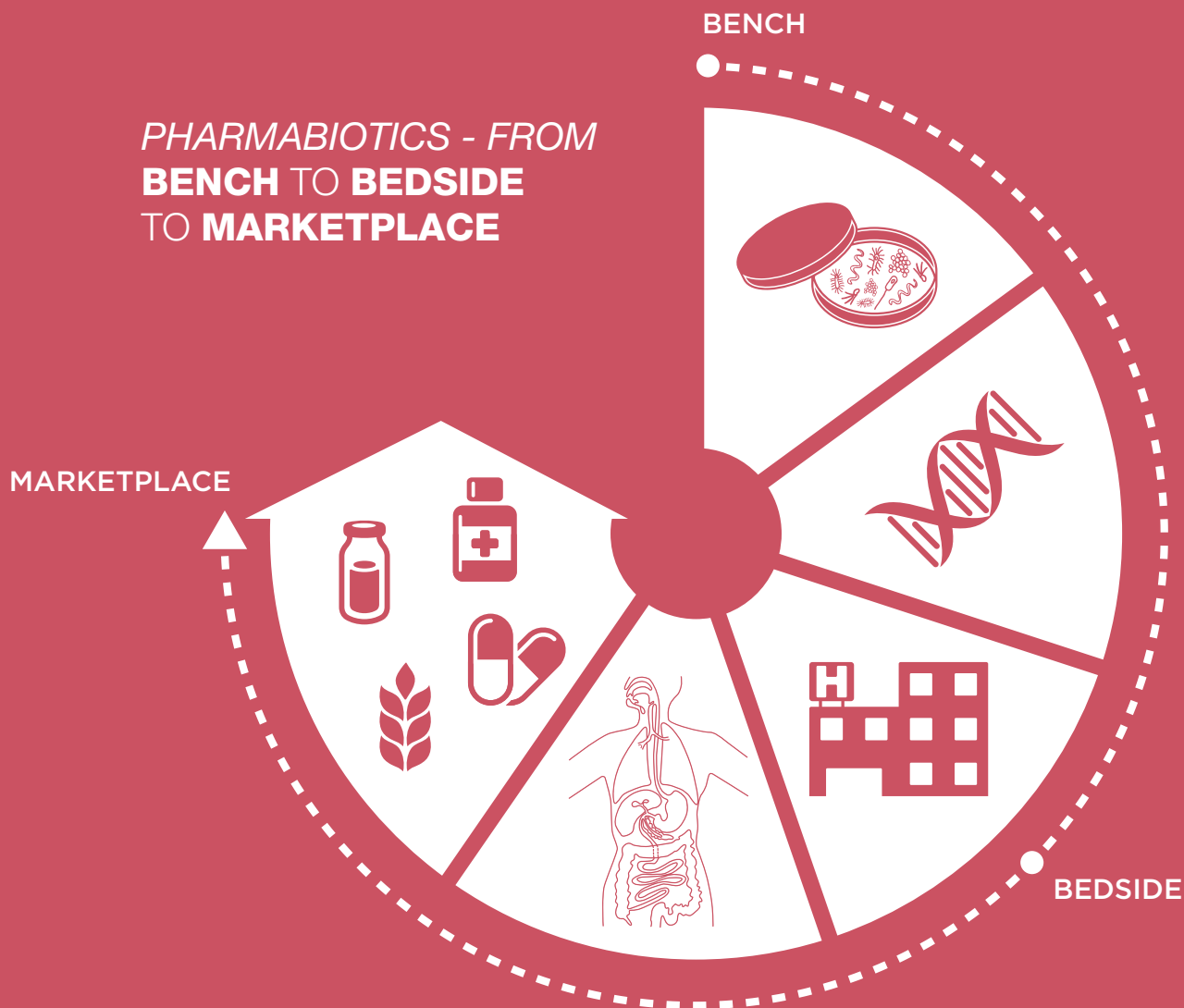
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*PHARMABIOTICS - FROM  
**BENCH TO BEDSIDE  
TO MARKETPLACE***



**Passion** AMBITION  
confidence *Enthusiasm*  
**BELIEF**