White Paper: 
A vision for a European Microbiome Initiative

APC Microbiome Institute

September 2016
1. EXECUTIVE SUMMARY

This White Paper: A vision for a European Microbiome Initiative, is an initiative led by the APC Microbiome Institute in conjunction with ISC Intelligence, and follows on from a workshop on Microbiome-based Foods for Health and Sustainability in Brussels in Spring 2016. This event brought together more than 100 experts from across the research community, academia, industry, and policy and decision makers, who presented and discussed microbiome research as a key to improving health, informing food production, and boosting innovation for societal and economic impact for Europe (event report is available at http://apc.ucc.ie/microbiome-research-a-key-to-improving-health-driving-food-production-and-boosting-eu-innovation-2/). The workshop addressed substantial challenges and opportunities for society, researchers and industry in the area of microbiome research. Those discussions form the basis for this White Paper. The approach is twofold: (i) an analysis of the challenges for microbiome research, and (ii) an outline rationale for a comprehensive microbiome policy in Europe, coupled with an examination of the fragmented existing legislation that pertains to, or significantly impacts upon, the research area. The latter part of the White Paper proposes a roadmap for the development of a European Microbiome Initiative to enhance Europe’s capacity to deliver improved societal health and wellbeing, drive sustainable food production, and boost EU innovation.

The APC Microbiome Institute (Appendix 1) is an academe-industry research collaboration at the forefront of elucidating the links between diet, microbiota function and health, to deliver tangible benefits for the economy and society. Our vision is to be an agent of change in microbiome research to protect, maintain and improve health and wellbeing. The Institute is driving innovation in the agri-food and pharma sectors to tackle some of society’s grand challenges, ultimately leading to a more sustainable and competitive Europe.

2. INTRODUCTION

There are approximately 100 trillion microorganisms in and on the human body - the human microbiota. It is a complex community with at least one thousand different species of bacteria in the intestines alone. The scale and scope of research on the microbiome (a term used to describe the genes and genomes of the microbiota) is of relevance to all branches of human medicine and veterinary science, is very important to the economic welfare of society and has become one of the hottest topics in biology. Microbiome research has made headlines across the world in the scientific press and international media, with the microbiome featured on recent covers of Science, Nature and The Economist.

Research into the human gut microbiome is creating a paradigm shift in nutrition and health, and has become a key factor to consider in nutritional recommendations, medical interventions, health monitoring, and influencing consumer choice. The microbiome is not only a target for the treatment and prevention of disease, but it is also a repository for functional food ingredients, new drugs, and a source of novel biomarkers of disease. It is an area of increasing interest to the food, pharma, diagnostics and veterinary sectors and of growing importance to society, from both an economic and welfare perspective.

Accelerating microbiome research and exploiting the resulting microbiome knowledge for the improvement of life conditions for European citizens will require input from multiple sectors of the ERA. Although much of the recent advance in the microbiome area has come from the study of the human microbiome, the techniques were originally developed by environmental microbiologists. However, because of the larger recent investment in human-focused microbiome projects, there is a deficit of knowledge for exploiting the enormous relevance for microbiome-based advances in plant sciences, soil science, agriculture including sustainable practises, forestry, marine research and biodiversity management, climate change management, waste treatment, and water quality management. The challenge will be to identify solutions to the multiple cross-cutting technical hurdles that currently impede progress in all of these microbiome-related areas.

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3. CHALLENGES AND OPPORTUNITIES FOR MICROBIOME RESEARCH

There are many challenges facing the world today, such as a change in population demographics and dietary habits, burgeoning levels of chronic disease and an ageing population. These are increasing pressure on an already stressed agri-food system, and are adding further burden to health systems. But with every challenge comes opportunity, and many of these challenges are being addressed by the community of microbiome researchers and industry partners.

3.1 Increasing Population: The planet is facing an unprecedented change in its demographics, such as an explosion in population, an increasingly ageing population and a significant rise in obesity. The world population is estimated at 7.4 billion (August 2016) (1). In 1970, there were only half as many people, and with the population growing at a rate of around 1.13% per year, the average population increase is approximately 80 million per year. The United Nations projects the population to reach 8.5 billion by 2030 and 10 billion in the year 2056 (2). This has led, and will continue to lead, to a dramatic increase in food requirements, with a myriad of associated environmental issues, as well as increasing levels of malnutrition and undernourishment.

3.2 Maternal & Infant Health: The microbiome is essential for complete post-natal maturation of several internal organ systems, including the immune system, the mucosal barrier and the brain-gut axis (3-5). In the absence of a microbiota, development of these organ systems is incomplete. Furthermore, disruption of the colonising microbiota in early neonatal life is a risk factor for later development of immune-allergic and metabolic disorders (6). Loss of microbiota diversity can be a risk factor for many common immune and metabolic disorders, the frequency of which increases as society undergoes modernisation and socio-economic development. The neonatal microbiota is acquired primarily by mother-to-infant transmission during the birth process, and subsequently is supplemented by horizontal acquisition of microbes from the environment and social contacts. Research attention is directed towards understanding the impact of delivery mode, early feeding practices (breast/formula/mixed feeding), antibiotic exposure and sanitation, as the key influencers in shaping the infant microbiota that is essential to promoting early-life health.

3.3 Chronic Disease: Non-communicable diseases (NCDs), which encompass cardiovascular diseases, cancers, chronic respiratory diseases and diabetes, are the largest cause of death, accounting for more than 68% of global deaths in 2012, with almost 40% considered premature deaths under age of 70 years (7). According to the World Health Organisation (WHO), 42 million children under the age of 5 were overweight or obese in 2013 (8). The Food and Agriculture Organization of the United Nations (FAO) estimated the cost of obesity and related NCDs to be in the region of 1.4 trillion USD in 2010. Conversely, under-nutrition and malnutrition also pose a serious problem, with a combined cost to the global economy of greater than $5.5 trillion annually. This results in increasing health expenditure and a loss in productivity, leading to a severely negative impact on economies and society in both developed and developing countries.

3.4 Ageing Population: According to the United Nations Department of Economic and Social Affairs Population Division, by 2050 some 21% of the population will be over 60 years of age, compared to 9.2% in 1990 and 11.7% in 2013 and older persons are projected to exceed the number of children for the first time in 2047 (9). Studies examining the relationship between diet, host health, environment and the gut microbiota in the elderly have demonstrated that decreased microbiota diversity correlates with increased frailty, decreased diet diversity and inferior health parameters, and with increased levels of inflammatory markers (10). Individuals living in a community had the most diverse microbiota and were healthier compared to those in residential care. This decline in gut microbiome diversity provides an opportunity to tackle nutritional recommendations for the elderly at a public health level, and design foods that will promote a greater diversity of the gut microbiome.

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3.5 Animal health & associated food/nutritional quality. Similar to humans, animals are disposed to infection and disease and their health is influenced by their diet, genetics and environment. Understanding the complex interactions between these factors is integral to the promotion of animal health. Production systems for human foodstuffs are faced with various challenges including high treatment costs for animal disease, and associated ‘hidden’ costs such as weight loss, reduced reproductive performance, low yields, and safety and quality of the produce. The microbiome is a central component that directly influences animal health, including metabolism, physiology and the immune response. Stakeholders ranging across the agri-food chain, including farmers, vets and industry, are directing increased attention to research in livestock such as chickens, pigs and ruminants due to the huge potential to reduce the burden of disease and antibiotic use, and to ultimately create more sustainable food production systems. Food consumption has a significant impact on human health and the environment, and the microbiome is intrinsically linked to all aspects of the food chain and food security (i.e. the supply of reliable, healthy and nutritious food and feed).

3.6 Soil, crop, marine and environmental health: One of the main aims of the Common Agricultural Policy is to increase productivity whilst protecting the environment through safeguarding biodiversity. Environmental biotechnology increases the knowledge-base of biodiversity by investigating microbial communities with the help of novel tools such as metagenomics, which is in line with the EU Biodiversity Strategy to 2020. For example, the preservation/improvement in soil function and quality is dependent on soil microorganisms, which are essential to rhizosphere quality, disease resistance and plant nutrition (e.g. nitrogen fixation). The microbial communities in soil offer huge potential for crop production and sustainability. We also depend on microorganisms to remediate toxins in the environment (e.g. oil and chemical spills). Microbiome research will advance our knowledge in these ecosystems, with the ultimate aim of improving crop production and disease management, targeting the soil microbiome for optimal plant growth and health as well as the identification of novel bioactive and biocontrol agents. The microbiome can act as an early warning of perturbation in the ecosystem and inform more sustainable management strategies that will have a reduced environmental impact. Such microbiome monitoring/manipulation is compatible with “digital farming”, the digitization, tracking and on-going modulation of environmental parameters and farming practices, enabled by the Internet of Things.

3.7 Antimicrobial resistance is an increasingly serious threat to global public health that requires action across all government sectors and society. In the EU, 25,000 people die each year from an infection due to antibiotic-resistant bacteria (data from 2007) and infections result in healthcare costs and loss of productivity of at least 1.5 billion EUR each year (11). The European Commission has already recognised the pressing need for a “comprehensive ‘One Health’ approach to antimicrobial resistance. That requires a holistic, multi-sectoral approach, involving many different sectors (public health, food safety, bio-safety, environment, research and innovation, international cooperation, animal health and welfare, regulations, and non-therapeutic use of antimicrobial substances) to effectively tackle this complex problem” (12). Understanding how the microbiota colonises and interacts with its host (human, livestock, companion animals) to elicit beneficial activities (e.g. anti-microbial activity) is important to help reduce the levels of anti-microbials needed, but also for the discovery of new anti-microbials.

3.8 Standardized cross-sectoral approaches: Microbiome research offers uniquely empowering insights into a broad range of economic sectors detailed above. However, development of microbiome capability has advanced unequally across these sectors, which is impeding progress and preventing the necessary ability to compare datasets. For example, the best curated databases of microbial barcodes (16S genes) and microbial gene catalogues (that allow prediction of the aggregate function of a given microbiome dataset) are from the human gut microbiome, whilst microbiome datasets and catalogues from soil, water, marine and the environment are dominated by poorly characterized and largely uncultured organisms. There has been intense research, especially for the human gut microbiome, on the effect of DNA extraction methodologies on

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apparent microbiome composition but this knowledge is unevenly spread across different research sectors/sample types. Analytical pipelines and reference gene catalogues vary in robustness and phylogenetic assignment efficiency across sectors. Relational databases that include carefully curated biochemical pathway call-outs are not equally powerful across sectors. Finally, all microbiome research in the ERA would benefit from a unified approach to move away from the only technique that is currently affordable for large-scale projects (16S amplicon sequencing) to an affordable platform for shotgun sequencing. Developing an alternative to the current leading technology will need to be accompanied by new data management and bioinformatics pipelines, standardized from their inception for application across all sectors of microbiome research.

3.9 Big Data management: The potential for microbiome research to tackle grand challenges for societal and economic benefit is enormous e.g. the current human microbiome gene catalogue has ~10 million microbial genes available for exploitation to improve health and develop novel therapeutics. Success in this field must be underpinned by robust informatics and computational capabilities to maximize Big Data and empower decision-making and product roadmaps. This will involve skilled informaticians, appropriate technology and analytics platforms to integrate, interrogate and interpret multiples data sources (e.g. clinical, biological/genetic, socio-economic/environmental). As the eHealth sector continues to grow, it increases the capacity for continuous health monitoring of individuals and advanced personalised nutrition/medicine to identify at- risk individuals, predict disease and tailor appropriate treatments/solutions. A key challenge is the ability to handle (receive, process and store) the volume of data generated and distinguish ‘signals’ from ‘noise’. Sustainable research and e-infrastructures will be essential to progress the microbiome sector, while the European Cloud Initiative and European Data Infrastructure will play major roles.

3.10 Regulation: Microbiome research topics and ensuing products are very varied and hence the EU legislation that impacts this field spans across sectors of food regulations, public health, medicinal products, food safety, data protection, ethics, animal husbandry and others. A review of the current regulatory environment to develop a comprehensive policy framework for microbiome research is required. A consultation process between key stakeholders (public/consumer, academia, industry, regulators and policy makers) on a global level is essential to i) improve understanding between the different sectors and ii) identify scientific and policy needs, integrating research and regulation to drive innovation in the microbiome arena. Where possible, harmonisation of regulation and policy, including EFSA, EMA, FDA, FAO, OECD and WHO, should be considered in a global context in order to maximise the potential and outputs of microbiome research.

Research over the last few years has identified the human microbiome as a new target in the treatment of a wide range of diseases, which has led to the recent emergence of a new class of drugs known as Live Biotherapeutics (LBPs). The FDA defines an LBP as a biological product that: i) contains live organisms, such as bacteria; ii) is applicable to the prevention, treatment, or cure of a disease or condition of human beings; and ii) is not a vaccine. The US agency has produced a guidance document (Early Clinical Trials With Live Biotherapeutic Products: Chemistry, Manufacturing, and Control Information; Guidance for Industry) to support development of this class of therapeutics and assist with new product approval. The regulation and policy surrounding the development and approval of LBPs in Europe needs to be addressed urgently by the key stakeholders. The research community and industry argue that in some cases there is a lack of regulation, and in other areas over regulation, and so there is significant room for streamlining of legislation in this area across the EU. Despite the many regulatory frameworks, occasionally, research on the resulting product falls outside the regulations. An example of this is Faecal Microbiota Transplantation (FMT), which has been demonstrated to be a very efficacious and safe treatment for patients suffering from recurrent Clostridium difficile infection (rCDI) and who have failed repeated courses of antibiotic treatment. For recurrent CDI FMT works in approx. 94% of cases, and has been recommended as standard of care by ESCMID, NICE, AGA, ACG, and other
agencies. However FMT falls outside current regulatory frameworks and in Europe different types of regulations are being introduced in a piecemeal fashion by different countries (e.g. licenced biologics, stool banks-like a blood bank) or simply not being addressed, hence leaving a patient population vulnerable. There is an opportunity for Europe to introduce regulation to optimise FMT treatment to best ensure patient safety (manage risk) and affordable access to treatment (if treated as a drug, this would facilitate a few companies developing a licenced medicinal product and reduce access to a material that each human produces daily. Sensible regulations are particularly important for a product where the potential for patients to carry out unsupervised self-treatment is high.

Another area of regulation of particular note for the food industry in Europe is the relatively new legislation on food products that purport to have a health benefit (Regulation (EC) No 1924/2006), requiring that claims on products are clear, accurate and based on scientific evidence, and that the claimed effects should be “defined, beneficial, and measurable”. This legislation, while welcomed because it protects the consumer, has placed a huge burden on a food industry that now finds itself needing to conduct large scale, expensive clinical trials to demonstrate health benefits in a healthy population. Many of the earliest applications in this arena have been rejected, especially in the area of probiotics. This huge new expense has significantly deterred many European food companies from investing in and carrying out research and innovation in Europe.

Medicinal products for human use may only be placed on the market after approval by the relevant authorities, either by the European Commission or at national level by Member States’ competent authorities. The body of legislation governing this field is large and complex, with products also undergoing continuous safety monitoring through the process of pharmacovigilance once approved for human use. The Clinical Trials Regulation Regulation No 536/2014, adopted on April 16th 2014, will apply from 28 May 2016, and aims to create an environment favourable for conducting clinical trials combined with the highest standards of patient safety.

Microbiome-targeted, evidence-based and cost-effective interventions offer the potential for significant economic benefit to healthcare systems. The identification of microbiome-based biomarkers of disease risk has the capacity to offer early intervention and treatment opportunities, improved patient outcomes and reduced healthcare costs. Furthermore, global medical device production is expected to reach a value of $315bn in 2016, with this sector demonstrating increased interest in the microbiome for the design and development of next generation devices. The influence of the microbiome on human health is also a consideration for functionality, biocompatibility and safety testing of new products, in particular with regard to regulatory approval. On May 25th 2016, the EU agreed new rules on medical devices and in vitro diagnostic medical devices in an effort to ensure maximum safety of medical devices and in vitro diagnostic medical devices, while also enabling patients to benefit from innovative health care solutions in a timely manner. It is anticipated that these documents will be approved in Autumn 2016.

In July 2016, the FDA released a draft guidance document (13) on the principles of drug and diagnostic co-development as a practical framework to those advancing a therapeutic in parallel with an in vitro companion diagnostic test and also to assist agency staff reviewing these products. According to the agency, the ideal Rx/Dx co-development situation arises when the need for a companion test is identified at the earliest phases of drug development and the two are progressed and launched on the market together. Although the processes for advancing a drug and diagnostic are significantly different, this framework will assist developers with aligning both programmes and inform them at what points they should seek input from the agency. This aim of the framework is to ‘facilitate innovations in precision medicine by providing sponsors with a set of principles that may be helpful for effective co-development and in fulfilling FDA’s applicable regulatory requirements’. As our understanding of the role and importance of the microbiome in health and disease improves, suitable guidance and regulation at a European level needs to be put in place.
The evolving data regulation landscape is also an important consideration that must be addressed. The General Data Protection Regulation due to come into force in May 2018 will have far-reaching implications on the conduct of science and the related collaborative research, in particular with regard to access to and use of personal data. This will require the establishment of the principles of the regulation and how researchers will comply with the likely interpretation of the regulation through their data strategy. Amongst other things, this will require a clear presentation of how data will be managed, in particular personal data. The operation of the data environment will be determined by the construction of the European Cloud Initiative and the related data infrastructure.

3.11 Global Harmonisation: To reach its full potential, microbiome research will need a co-ordinated effort across of the global community of researchers from diverse disciplines such as biology, medicine, chemistry, mathematics, computer science, along with industry, policy makers, and regulators and there have been many calls to unify and harmonise this research amongst the scientific community (14,15). It will be essential to develop policies to facilitate sharing of IP ownership, management and access policies and procedures, as well as guidelines for data sharing, and need for harmonised standards for data curation and analysis. Indeed, earlier this year the USA has taken a step in this direction with the National Microbiome Initiative, whereby numerous federal agencies (including the National Institutes of Health, the National Science Foundation, the National Aeronautics Association, and the Department of Energy), will contribute $121 million to the project over the next two years, along with €400 million committed by philanthropic organizations, universities, and industry. Harmonisation should happen at a multitude of levels, such as agreeing the priorities for a common research agenda; developing standards for collecting and analysing samples, sharing data, intellectual property rights; developing new tools and other ways to collect and analyse data such as involvement of citizen scientists.

The microbiome research field offers unprecedented potential to improve the lives of global citizens - through improved nutrition, a more efficient and ecological food chain, improved healthcare through new diagnostic tools, medical devices and food/medicinal products to tackle NCDs and infectious disease. This sector is further driven by increased interest among the population to stay fit, lead a healthy lifestyle and a greater desire for “natural” foods and therapeutics. There is a huge potential for the microbiome industry (consisting of probiotics, prebiotics, foods, medical foods, other supplements, devices, and drugs) to address many of these issues, and indeed the market is expected to reach 658 million USD by 2023 (7).


The preceding sections have outlined the opportunities and challenges that face microbiome research in Europe, which are summarised in the Strengths- Weaknesses- Opportunities and Threats (SWOT) analysis in Table 2. The next steps to advance a European Microbiome Initiative (EMI) will include consultation with leading academic experts, relevant industry stakeholders, national and international funding agencies, local authorities, advocacy groups, policy and decision makers and regulators from Europe and beyond. Given the impact (elaborated earlier in this document) of microbiome research on multiple sectors of the European economy, this initiative will require input from a number of European Commission offices to ensure consultation with and input from stakeholders in animal/veterinary, forestry, horticulture and agricultural sectors and the biobased economy; marine and aquatic sectors including biodiversity and climate change.

A multidimensional process is proposed as follows, which is also illustrated in Table 1 below:

- Direct engagement with DG CONNECT, DG SANTE and DG RTD to promote and gain traction for the proposal, coupled with an official launch of the White Paper: A vision for a European Microbiome Initiative in Brussels and week-long APC exhibition at the Commission.
- An **expression of interest** exercise to be conducted among key stakeholders to ascertain the level of support for an EMI. EU National Contact Points and National Delegates from each supporting country will be approached to secure support from national governments and agencies.
- A comprehensive **infrastructure mapping exercise** to identify current infrastructure and requirements to underpin an EMI will be conducted based on the support secured during the expression of interest exercise.
- A follow up **roadmap process questionnaire** will be issued to define the optimal process that will be used to establish an EMI.
- In parallel, an opportunity for all citizens and organisations to contribute to the process will be made available through an **online public consultation** facility, which will ask the user specific questions regarding their knowledge and understanding of the microbiome and acceptance of microbial-based products (e.g. foods, therapeutics and diagnostics).
- Following completion of the above steps and collation of the information, an **EMI Strategy and Implementation Workshop** involving a select audience of key academics, industry, policy makers and interested parties will be convened in Brussels to discuss the proposed research model and implementation strategy for an EMI.
- This will be followed up with a **high-level policy agenda setting meeting** by December 2016.

### Table 1. A Roadmap for a European Microbiome Initiative

<table>
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<tr>
<th>Objective</th>
<th>Stakeholders</th>
<th>Deliverable</th>
<th>Responsible</th>
<th>Time frame</th>
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<tbody>
<tr>
<td>O1.1 Engagement with Stakeholders to develop whitepaper on “A vision for a European Microbiome Initiative”</td>
<td>DG CONNECT, DG SANTE, DG RTD, researchers industry across Europe</td>
<td>D1.1 Whitepaper on “A vision for a European Microbiome Initiative”</td>
<td>APC/ISC Intelligence</td>
<td>By Sept 2016</td>
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<td>D1.3 European Commission policy agenda setting meeting</td>
<td>APC</td>
<td>Oct 2016</td>
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<td>O1.2 Launch of Whitepaper</td>
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<td>D2. EU-wide analysis of support/requirement for an EMI</td>
<td>APC</td>
<td>Nov 2016</td>
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<tr>
<td>O2. Expression of Interest exercise to determine level of support/requirement for a European Microbiome Initiative (EMI)</td>
<td>EU National Contact Points; National Delegates; Government agencies; National Funding agencies</td>
<td>D3. EU-wide analysis of existing infrastructure and infrastructure gaps relevant to the successful establishment of an EMI</td>
<td>APC, with EC</td>
<td>Nov 2016</td>
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<tr>
<td>O3. Comprehensive mapping to identify existing infrastructure supporting microbiome research across the EU infrastructure gaps to be addressed to underpin an EMI</td>
<td>EU National Contact Points; National Delegates; Universities; Research Institutes</td>
<td>D4.1 Draft strategy for the establishment of an EMI</td>
<td>EC/stakeholders, with input from APC</td>
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<td>D4.2 EU-wide public consultation document detailing public knowledge, understanding &amp; perception of the microbiome, and attitudes to microbial-based products</td>
<td>EC/CORDIS</td>
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<td>O4.1 Define the roadmap for establishment of an EMI</td>
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<td>O4.2 Online broad public consultation on the concept of an EMI</td>
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Table 2. Strengths and Opportunities for a European Microbiome Initiative

<table>
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<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>• Extensive European knowledge base on microbiome research across ecosystems (human, plant, animal etc.)</td>
<td>• Fragmentation in microbiome research across the ERA and an absence of a large-scale interdisciplinary platform to support microbiome research</td>
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<td>• Existing engagement of key stakeholders in the microbiome industry (probiotics, prebiotics, foods, medical foods, other supplements, devices, and drugs, including food, therapeutics and diagnostics) via private R&amp;D initiatives and public-private partnerships</td>
<td>• Knowledge gaps within microbial ecosystems and a lack of knowledge transfer across and between ecosystems</td>
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<td>• Existing collaborations with and access to large-scale microbiome consortia and initiatives, including the International Human Microbiome Consortium and the NIH Microbiome Project</td>
<td>• Fragmented supporting infrastructures</td>
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<td>• Capacity for the EU to be a leading innovator in microbiome research due to the existing knowledge base, stakeholder engagement and potential to leverage existing collaborations and engagements with initiatives outside of Europe</td>
<td>• Inadequate citizen-centred science approach: a lack of consultation with the public to educate them on microbiome research and on making informed choices regarding microbial-based products (foods, therapeutics and diagnostics)</td>
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<td>• Significant potential to address the health societal grand challenge for better public health and improved patient outcomes via microbiome-based interventions and treatments</td>
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<td>• Economic benefit to health care systems via cost-effective interventions to reduce and treat non-communicable diseases</td>
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<td>• Potential for job creation across public and private R&amp;D &amp; I landscapes</td>
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<td>• Harmonisation of regulation &amp; policy, including EFSA, EMA, FDA, FAO, OECD, WHO, to maximise the potential and outputs of microbiome research for societal &amp; economic benefit.</td>
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<tr>
<td>• Leverage international media coverage of microbiome research to date to engage and educate the public on microbiome research and on making informed choices regarding microbial-based products</td>
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5. PERSONS/ORGANISATIONS SUPPORTING THIS WHITE PAPER

APC Microbiome Institute
Science Foundation Ireland
Wellcome Trust Sanger Institute (Pathogen Genomics Group)
Caelus Health
Cremo

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6. REFERENCES


Appendix 1: APC Microbiome Institute - overview
The APC Microbiome Institute (http://apc.ucc.ie/) established in Cork, Ireland, in 2003 is one of Science Foundation Ireland’s national centres for research and represents a partnership between academic partners (University College Cork, Teagasc (the Irish Agriculture and Food Development Authority) and Cork Institute of Technology) and industry. The APC has been funded to the value of €100 million since its foundation through competitively won grants and industry collaborations and its 320+ strong research team focus on active international research collaborations across the boundaries of traditional research sectors, fostering a lively trans-disciplinary environment with clinicians, clinician-scientists and basic scientists from diverse backgrounds working in teams, sharing ideas and resources. The scale and scope of APC’s research on the microbiome is of relevance to all branches of human medicine and veterinary science, is very important to the economic welfare and health of society and is one of the hottest topics in biology. A particular strength of the APC is its significant intersectoral partnership. The institute has secured more than €40 million from industry collaborations since 2003 and currently has over 25 research collaborations with industry across the food, pharma, biotech, animal and diagnostics sectors. A key strength of the APC derives from a capacity to blend the activities of research in fundamental science and clinical practice and over the past decade APC scientists have related food and microbial diversity with health, have discovered new anti-microbials and anti-inflammatories and developed templates for future foods.