THE MICROBIOME IN HUMAN HEALTH
ABOUT CIFAR

CIFAR has been successfully taking on difficult challenges for more than three decades. Our global research programs connect many of the world’s best minds—across borders and between disciplines—to shape new perspectives and spark ground-breaking ideas. CIFAR offers its research fellows the rarest of commodities—the freedom to take the kinds of intellectual risks that are essential for creating truly transformative knowledge. CIFAR also helps to share knowledge—on everything from improving human health to advancing technology, from building strong societies to sustaining the Earth—with engaged stakeholders who are ready to put ideas into action.
ROUNDTABLE OBJECTIVES

By bringing together researchers across different areas of expertise, including microbiology and anthropology, CIFAR’s Humans & The Microbiome program is producing new insights regarding how the microbes living on and inside of us shape our lives. On May 30, 2017, CIFAR hosted a roundtable at Canada House in London, England to explore recent advances in understanding the microbiome’s role in human health, development, and evolution. The goal of the roundtable was to engage in a discussion with researchers and public health experts in the UK community to explore opportunities for collaboration and research impact.

The roundtable highlighted the program’s current understanding and gaps in knowledge about how microbes affect human health, development and cultural evolution, as well as their plans to drive further research progress in these areas. Discussions with participants explored where the program’s research intersects with core issues and areas of interest of participating organizations. This report summarizes the key discussion points from that roundtable.

The roundtable was held at the High Commission of Canada in London, England and featured opening remarks by Janice Charette, High Commissioner for Canada to the United Kingdom of Great Britain and Northern Ireland.

CIFAR HUMANS & THE MICROBIOME PROGRAM PANELISTS

Dr. Brett Finlay is a professor in the Departments of Biochemistry and Molecular Biology at the University of British Columbia. Dr. Finlay’s research explores how the microbiome of humans can affect conditions such as asthma, inflammatory bowel disease, food allergies, and cardiovascular disease. He is also interested in treatment and prevention of infections, such as by C. difficile bacteria, and was the leader of the successful initiative to develop a SARS vaccine in 2003. He is co-director of CIFAR's Humans & The Microbiome program and co-author of the book “Let Them Eat Dirt.”

Dr. Philippe Sansonetti is a professor and head of the Unité de Pathogénie Microbienne Moléculaire at the Pasteur Institute of Paris and chair of Microbiology and Infectious Diseases at the Collège de France. Dr. Sansonetti’s research investigates how bacteria influences gut homeostasis and pathology. His work investigates how unharmful bacteria affect the physiology of intestinal crypts, a critical area where stem cells achieve renewal of the epithelial tissue that lines the surfaces of blood vessels and organs. His research into pathogenic bacteria focuses on Shigella, a bacteria that causes dysentery, as a model.

OPENING REMARKS – BRETT FINLAY

• The CIFAR Humans & The Microbiome program was founded in 2014 and includes 19 fellows and advisors with specialties that include microbiology, developmental and stem cell biology, metabolism and human physiology, evolutionary biology, history and anthropology.

• The Humans & the Microbiome program is probing the role of the microbiota in areas of human development, evolution and society (e.g. socio-cultural relations and change). The integration of health and anthropology makes this program particularly unique amongst other major international microbiome-based initiatives, giving it the potential to be truly transformative as a result.

• Our bacteria, viruses and fungi are very numerous, so much so that microbes outnumber human cells by 10 times. Microbes play an important role in our health, social behaviour and evolution. For example, gut microbes help us digest food, educate our immune system, and influence the development and functioning of our nervous system. Much research has demonstrated that disturbing the microbiota through antibiotics and lifestyle changes can lead to poor health outcomes.

• Over the past 50 years, we have seen a dramatic drop in the rates of infectious diseases including measles, mumps, hepatitis A, rheumatic fever and tuberculosis. At the same time, we have seen surges in immune disorders such as Crohn’s disease, multiple sclerosis, asthma and type 1 diabetes. This
disappearing microbial diversity raises questions about whether we are living too cleanly and the need to better understand the role for microbes in human disease.

• To date, the microbiota has been associated with many conditions, including type I diabetes, autism, allergies, obesity, cancer, and asthma. The complex interactions between the microbiota and humans is being actively explored and striking correlations are being found for particular disease states. However, there is a need for research to move beyond correlative studies to ones that go to causality in order to understand the impact of the microbiome.

• Researchers are discovering that many previously unsuspected areas of human health, such as childhood development, are being influenced by the microbes living within us. For example, the maternal microbiome has been shown to have long-term consequences for children.

• This multidisciplinary nature of the program is allowing the program to explore the role of the microbiome beyond just human health and disease. Researchers are exploring the history of the human microbiome, how it changes across generations, geographies and ethnicities, how it co-evolved with humans to help us adjust to changing food supplies and new diseases, and its influence on human behaviour and cultural practices. This work also raises questions about the extent to which we should consider humans as ‘superorganisms’ or ‘holobionts,’ inseparable from our microbes and our environment, and even whether we need to refine our understanding of what it means to be human.

ROUNDTABLE DISCUSSION

The Microbiome – State of Science

• When conducting international comparisons of the microbiome in young children, birthing methods, cultural practices and environment must be considered. For example, C-section and vaginal delivery have significantly different effects.

• A complication of coordinated international studies is differing methodologies across laboratories. The same sample processed by two laboratories can yield different results.

• Many studies focus on 16S rRNA and there is a need to delve deeper into the ecology of the microbiota. A path forward is needed to advance the science, as well as management of the large datasets that would be generated by large-scale studies.

• Studies need to move beyond bacteria and also looks at eukaryotes/fungi/viruses.

• The science is starting to move beyond identifying which microbes are present, towards measuring metabolites and identifying function. The products are important, and measurement of subtle metabolite changes is a challenge.

• Fecal transplants are being investigated in many countries, with some success. When successful, it is unclear why certain fecal matter works and why other fecal matter doesn't. There is a need to better define what makes for a healthy microbiome, and define what makes a ‘superdonor.’ Diet is important, but it isn’t the only factor. Lifestyle also plays an important role.

• The collaboration between dieticians and microbiologists needs to be improved. Following fecal transplant, diet is an important variable that needs monitoring. The microbes will continue to need ‘the right substrate.’ Apps may improve data collection, but accuracy will continue to be a problem.

• The gut-brain connection is an emerging research area. For example, recent research has shown links between the microbiome and Parkinson’s and autism. However, we don’t yet have the ability to delineate between genetic, environmental and microbiome variables.

• Large-scale studies are lacking that collect microbiome samples and track health outcomes over time. Such studies over long terms can yield insights into mechanisms into rare diseases such as Parkinson’s and other autoimmune disorders. However, patient confidentiality can be a challenge, since you cannot go back and ask additional questions of the donor that could give more insights into diet and lifestyle. Most studies now are doing the investigation after onset so it is hard to identify the cause. Dental assessments could be incorporated into such studies, since dental health has been shown to have linkages to many diseases as well.
Where is the field going?

- Personalized medicine is one of the new frontiers. What are the links between diversity in the human genome and diversity in the microbiome? Is there a human gene influence on the microbiome?
- Can we foster big international studies between countries?
- How do we move towards intervention studies most efficiently and move towards mechanistic understanding? Do we become involved in existing studies? For example, in drug trials or genomic studies, do we include sampling of the microbiome?
- Can we mandate collection of microbiome data and standardize it?
- How do we engage public health agencies?

What other public health issues do we need to be considering?

- There is a need to better interface with public health and nutrition. Microbiome research interfaces with the rise in obesity, but exercise and time outdoors are also important for exposure to good bacteria.
- Microbiome research needs to intersect with studies about aging. Research studies are demonstrating a decrease in microbiota post 65 that is not well understood. There are changes in lifestyle (mobility, social context, environmental factors), as well as diet that need consideration. Microbiome research could interface with aging research focusing on inflammation.
- Oral hygiene and collaboration with the dental community is important. Dental care in seniors’ care homes is often substandard and it may be playing a significant role in health.
- Because of their effects on the microbiome, antibiotics are not the harmless drugs we used to think they were, and can be linked with depression and anxiety.
- Physicians may be convinced by microbiome science, but they lack effective interventions. How should practice change? (e.g. probiotics, vaginal seeding)

Learn More: You can learn more about CIFAR’s Humans & the Microbiome program at www.cifar.ca/research/humans-the-microbiome/

Participants

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