UNIVERSITÄT BERN

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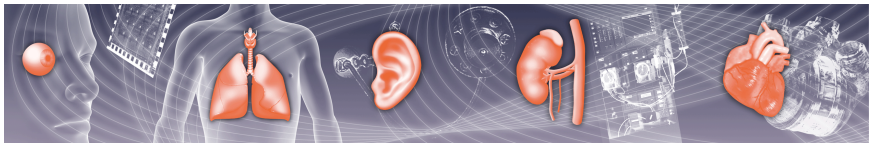
BIOMEDICAL ENGINEERING RESEARCH

Organs-on-Chip Technologies



November 20th, 2017, 2pm

Meeting Room F502, ARTORG Center, MU50 University of Bern

Organs-on-Chip Seminar

Prof. Paul Wilmes

Luxembourg Centre for Systems Biomedicine, University of Luxembourg

Title:
Function First: Systems Ecology of the Human Gut Microbiome

By Paul Wilmes,
Luxembourg Centre for Systems Biomedicine, University of Luxembourg, Esch-sur-Alzette, Luxembourg.

Changes in the human gut microbiome are associated with several chronic diseases. So far, the vast majority of studies have sought to identify community-wide compositional shifts and link these to disease etiology. Although the methods might be modern, these studies still abide by the principles of classical medical bacteriology for identifying single taxa and inferring causation. However, given the plasticity of microbial consortia, the traditional concepts that are applicable in infection biology might not directly apply in the context of chronic diseases. We have recently developed methods for integrated omic analyses (i.e. combined metagenomic, metatranscriptomic, metaproteomic and meta-metabolomic analyses) to resolve functional attributes of gastrointestinal microbiota. We have first applied our methodologies to samples collected over time from families with multiple cases of type 1 diabetes (T1DM). Despite the absence of consistent taxonomic differences across families, T1DM-specific effects in the microbiome were apparent at the functional level, reflecting for example a subtle increase in inflammation. Similar patterns are observed in the earliest colonization of the human gut where functional differences exist between infants born vaginally and those born by caesarian section. In this context, differences are also linked to differences in immune system

stimulation. Our results suggest that functional differences expressed by microbiomes may ultimately be key to our understanding of the role of the gut microbiome in chronic diseases. Furthermore, the results of the functional analyses allow formulation of clear hypotheses which posit how expressed functions may affect human physiology. To test such hypotheses we have recently developed a modular, microfluidics-based *in vitro* model (HuMiX, human-microbial cross-talk), which allows co-culture of human and microbial cells under conditions representative of the gastrointestinal human-microbe interface. HuMiX-based human cell cultures recapitulate *in vivo* transcriptional, metabolic and immunological responses in human intestinal epithelial cells following their co-culture with gut microbiota grown under anaerobic conditions. Thereby, HuMiX facilitates investigations of host-microbe molecular interactions and provides insights into a range of fundamental research questions linking the gastrointestinal microbiome to human health and disease. In my talk, I will explore and detail our newly developed approaches for investigating functional attributes of microbiomes, and describe how these methods may ultimately allow the unraveling of mechanisms linking the human microbiome to health and disease.

Biography

Paul Wilmes is Associate Professor of Systems Ecology at the Luxembourg Centre for Systems Biomedicine of the University of Luxembourg, where he heads the Eco-Systems Biology research group. Paul's main research focus is on using Systems Biology approaches to unravel fundamental ecological relationships within and between microbial populations *in situ*. His group has developed appropriate wet- and dry-lab methodologies for carrying out systematic molecular measurements of microbial consortia over space and time. This allows for example to define lifestyle strategies of distinct populations and link these to genetic and functional traits. The same approaches allow the study of microbiome-host molecular interactions. In this context, his group has also recently developed a microfluidics-based *in vitro* model of the human-microbial gastrointestinal interface called HuMiX.

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