The emergence of microbiome centres

As microbiome science expands, academic centres scramble to fill many needs, from service provider to industry liaison. A newly created network aims to share strategies and accelerate knowledge transfer, and invites others to join the efforts.

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Microbiomes — assemblages of interacting microorganisms, such as bacteria, archaea, fungi and viruses — are increasingly recognized as being crucial to the functioning of ecosystems, ranging from the deep sea to the human body. Understanding something as complex as a microbiome requires combining perspectives from many disciplines. Such transdisciplinary research is increasingly being organized, supported and facilitated in microbiome centres, which are academic hubs of microbiome-related research. In the US alone, more than 50 centres have been established at universities and national laboratories, most of them in the past three years. We argue that this rapid and recent growth signals that microbiome science is entering a new phase in its evolution, as the field is recognized as central to the life sciences and relevant to many other disciplines and industrial applications.

What is a microbiome centre, and what explains their extraordinary increase in numbers? While their missions and histories vary, microbiome centres across the US primarily exist to facilitate microbiome research, which is reflected in their shared core activities. The top three priorities of the centres are to accelerate new microbiome research by facilitating collaborations, support new projects and provide laboratory and analytical services. Furthermore, the centres serve not only research faculty, but also the wider campus and the local community. Most of them develop curriculum materials for graduate and undergraduate education, offer resources to the broader scientific community, communicate with the public about microbiome research and act as a liaison between researchers and industry.

There are several drivers for the emergence of microbiome centres. First and foremost, the growing interest among researchers to include microbiomes in their research has outstripped the capacity of microbiome experts to collaborate with newcomers to the field. While we have models for training graduate students in a new field, we do not have good models for training mid-career researchers or beyond who seek to add a new dimension to their work. The centres have tackled this challenge in different ways, from developing service facilities and providing seed funding, to training in microbiome experimental design and analysis as well as project consulting. A second driver of the emergence of microbiome centres is a desire for a more holistic approach to microbiome research; one that shares and builds on knowledge from across ecological systems and scientific disciplines. Microorganisms reside nearly everywhere on the planet and perform processes that are governed by similar evolutionary and ecological constraints, regardless of their habitat. Reflective of this, few of the current centres focus exclusively on one system, such as the human microbiome, and most encompass research on a variety of plant and animal hosts, environmental ecosystems and human-engineered systems. Microbiome centres thus bring together a diverse range of scholars from the sciences to humanities that naturally bridge across the traditional university structure. Finally, the rise of microbiome centres is a result of the funding landscape. Centres provide a mechanism for involving philanthropy in microbiome science with the particular benefit that this funding may not be restricted to a specific system.

Despite these commonalities among microbiome centres, there has been relatively little communication among them, but this is now changing. Last June, a Microbiome Centers Consortium (MCC; http://microbiomecenters.org/) was launched after representatives of 28 US microbiome centres gathered for a meeting at the University of California, Irvine. The aim of forming such a network of centres is to strengthen their ability to develop their mission, acting as an entry point for those new to the field and providing a cross-disciplinary bridge that paves the way for a more holistic study of microbiomes. The potential synergies of a consortium are numerous: the network can share best practices about their broad range of activities, help reduce redundancy in their workloads and become a communication hub to both advocate for the field and advise policymakers. The MCC can also contribute to the development, implementation and communication of methodological and data standards, as well as curricula and other materials. Finally, and perhaps most importantly, an integrated network can provide a platform for the major work ahead for the field. Regardless of the system (for example, host-associated or environmental), the big questions in microbiome science are similar: what role do microbiomes play in system health and resilience? Are the drivers of community structure conserved across different systems? Can we alter microbiomes to improve environmental and human health, and develop more sustainable biotechnology and resilient agriculture? To answer these questions, the field must uncover fundamental principles of microbiomes that will not be apparent by studying one system at a time. Addressing these challenges will require sharing knowledge, expertise and ideas widely among scientists and non-scientists alike, and across borders.

However, there is also a large structural barrier for microbiome science, which the MCC would aim to address. Over 85% of academic centres in the US are currently supported by short-term, internal funding and depend heavily on faculty members volunteering their time, motivated by a

desire to support their colleagues and grow microbiome science. This model is not sustainable and is insufficient to cover staffing needs and meet centres' long-term objectives. The reliance of the centres on transient funding is partly due to their newness, and they will soon require more stable support, like that of other research cores. However, this situation also stems from the centres' transdisciplinary nature, supporting both host-associated (for example, humans and plants) and non-host-associated (for example, soil, water and built environments) microbiome science. While the historical distinction between host and non-host microbiome science is no longer useful or accurate, it continues to influence research funding. For example, there are few funding sources in the US that support both medical research and environmental research when, in fact, microbiome science often crosscuts agency priorities[1,2]. This is a major impediment to the growth of microbiome science and a challenge that the MCC hopes to address. Some options available are broadening the scope of existing funding calls in recognition of the blurred lines of microbiome systems, developing philanthropic and industry partnerships and providing training opportunities for students and later-career researchers to help them leap between systems.

Research networks have been very useful for other transdisciplinary and rapidly growing fields of research, from environmental science (for example, the Ocean Carbon & Biogeochemistry Project (https://www.us-ocb.org/) and the Global Soil Biodiversity Initiative (https://www.globalsoilbiodiversity.org/)) to human health (for example, the US National Alzheimer's Coordinating Center (https://www.alz.washington.edu/)). These networks provide successful examples of the synergies described above, and we aim to learn from them as we grow the MCC. We invite any microbiome centres that are not yet part, or new ones that arise, to join in these efforts, as diverse and dense networks tend to be more robust. Advancing microbiome research so that it can fulfill its translational potential and be harnessed to improve ecosystem and human health will require the 'horizontal transfer' of knowledge, expertise and ideas widely among scientists across the globe[3]. Inspired by the rich biological networks of the microbiomes it studies, an MCC and its future connections with others around the globe will provide a means for this transfer and a voice for microbiome science. ❐

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Competing interests

The authors declare no competing interests.