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Editorial

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Understanding the bacterial approach to living in community

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Editorial

It is with pleasure that I submit this editorial and accept the opportunity to express some experiences in the field of Microbiology. This field has provided scientists with a host of interesting questions to approach and to answer from 'how can we harness their abilities' to 'how do we eliminate infections'. From a broad perspective, the science of microbiology is one of environment and the ability of microbes to thrive. Microbial "environments" exist in healthy situations and in unhealthy situations. They exist in microbial communities in the ocean, in the human mouth, in the human bowel, in extreme hot and cold temperatures, and in human disease. In community they may choose to thrive, survive, provide byproducts, cause illness or die. How do they make that choice? More to the point, why should we care?

Let us first examine the first question. How do microbes make the choice to thrive, survive, or die? The microbiome or community of microbes, in our bowel outnumbers the cells of our body. This body of microbes is acquired shortly after birth and reflects what is present in our intake of nutriment that in turn is reflective of our environment to some degree. Since it has been shown in mice that bowel flora, individual strains of bacteria, and/or ratios of bacterial species can actually affect our mood, could our basic bowel flora actually help mold personality from birth? More importantly, should this even be studied? A salientfeature of bowel flora research is its suggested connection to autism, which would itself be a reason to study the development and composition of bowel flora in the animal model from birth.

Bacteria, in conjunction with the immune system, have influenced the ability to breach the blood brain barrier, as evidenced by bacterial and viral meningitis. With studies supporting the influence of bowel flora, $1x10^{12}$ anaerobes and $1x10^{8}$ aerobes per gram of stool, on leaky bowel followed by anxiety and depression, certainly the possibilities of blood brain barrier penetration involving the immune system and/or byproducts of microbial metabolism exist. Bowel flora has also been shown to perhaps play a part in irritable bowel syndrome and obesity.

When we think of microbiomes in nature, how do they survive or thrive? In marine systems, bacteria can serve as nutrient sources for coral or algae. They can also live as biofilms on crustations and provide essential nutrients. This example of community in microbial survival is probably the most supported by overlapping natural systems.

When we look at the formation and sustenance of biofilms on the teeth, the conditions necessary for establishment include a surface attachment mechanism followed by one to two different genera of bacteria that supply dual metabolic needs. When these initial conditions are met, other bacteria are allowed into the biofilm depending on what advantage they supply. Anaerobes tend to live on lower layers of biofilms as their need for oxygen is less. Using quorum sensing, appropriate bacteria that contribute to biofilm formation are called to the area to contribute to the survival of the community. The community exists as a porous matt of bacteria through which liquid flows. Parts of the community are free to and do break off and flow away and others remain to sustain the community. Once this biofilm has established itself, it is difficult to eliminate.

In the disease state of cystic fibrosis, biofilms in the lung are part of the illness that has to be managed. The quantity of bacteria within these biofilms can be treated with a cocktail of antimicrobials to lower the count of microbes but the biofilm base remains. These communities protect themselves from the effects of antimicrobials by harnessing the communal defense systems. These defense systems again involve quorum sensing for the productions of toxins and/or enzymes that help protect the established community of microbes.

A biofilm is the smallest form of a microbiome and looking at biofilms may help us to understand larger systems. The tools are now available to harvest and sequence multiple organisms that reside in communities. We can also look at by-products of metabolism from certain microbial communities. We can look at and change bowel flora in animal models to help predict how such changes in the human may manifest.

We can design studies to help us understand which composition of bacterial community is the most healthful for us and which is the least healthful for us. We can use microbial communities to sustain health and know how important this is in light of the devastating illness caused by *Clostridium difficile*.

This is indeed an exciting time in the field of microbiology and the next generation of scientists will be tasked with how to live with the best and most natural selection of microbes in our bodies and in our natural environments. I have touched on just a few of the exciting projects waiting to be examined. Equally important to new studies is the ability of young investigators to publish novel ideas in unexplored territories. Today we are grateful for a new generation of avenues to publish valid and exciting new discoveries.

As we study the ability of microbes to live in community, we as humans make up our own microbiome. Our interactions influence the community at large and can make or break an investigation. As scientists we are tasked with the complex challenge of teasing the truth out of data and presenting it with the utmost clarity and objectivity.

As in the biofilm, we are a complex layer of contributors with truth in data as the first priority within the search for solutions.

Bacteria were on this earth billions of years before us and will remain long after we are gone. With respect for their abilities and the study of their communities, they continue to teach us how to survive and perhaps how to live in optimal health.

---Sheila Wood, PhD

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