

## Microbial Diversity in the Genomic Era: Functional Diversity and Community Analysis

Functional applications of human microbiome diversity studies

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### **Abstract**

The human microbiome refers to the collection of symbiotic, pathogenic, and commensal microorganisms that co-inhabit discrete sites across the human body and play a crucial role in human physiology, health, and disease. The average human body houses more bacterial cells than it does human ones, and this has led to the human microbiome being referred to as the second genome of its host. Perturbation of the natural balance of microbes within the human body, referred to as dysbiosis, has been associated with human pathologies including neurodegenerative diseases, tuberculosis, fatty liver disease, obesity, cancer, and human immunodeficiency virus. The pervasive impact of the microbiome on various aspects of human physiology is also becoming increasingly appreciated as understanding around the various gut–organ axes (e.g., gut–brain, gut–liver) continue to emerge and evolve. Importantly, the microbiome is readily influenced and shaped by environmental factors including lifestyle, diet, and environmental exposures. This dynamic nature of the microbiome enables the detection of changes in microbiome profiles, which are indicative of potential disease risk before the onset of more permanent health effects. The human microbiome is also readily malleable to noninvasive interventions like prebiotics, postbiotics, and lifestyle changes. This further posits the microbiome as attractive target for therapeutic interventions and as the next frontier for health innovation. Several international research efforts, catalyzed by the human microbiome project, have thus sought to propel the clinical relevance of microbiome research, through the accurate identification of outlier signatures indicative of disease onset and risk. In this chapter, we discuss the human microbiome, its role in human health, the factors that regulate it, and the functional applications of microbiome research.