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Evaluating the utility of microbiome dynamics for predictive modeling: pathway to microbiome-mediated healthcare

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Keywords

Human gut microbiome, temporal dynamics, perturbations, chronic inflammation.

Abstract

Recently, longitudinal changes in human gut microbiome composition have been proposed to be more robust markers of host health than cross-sectional variation. However, it is unclear how gut microbiome dynamics are influenced by chronic inflammatory conditions, such as inflammatory bowel disease (IBD), cancer, and obesity. Microbiome features, including species diversity and taxonomic composition, could be evaluated to assess the system's capacity to resist (degree of change from baseline: resistance) and recover (ability to return to baseline: resilience) following a perturbation. By applying a perturbation to the gut environment, we can observe microbiome features at baseline and post-perturbation to assess both resistance and resilience. Although challenging to measure, resistance and resilience may be related to the health of the host. Given this, we aim to understand the utility of resistance and resilience as potential biomarkers of host health and treatment response in patients with chronic inflammation.

To calculate resistance and resilience metrics, we have identified data sets where participants have been subjected to some kind of intervention or perturbation (e.g., antibiotic or drug treatment). We will explore whether dynamics following these perturbations are informative of follow-up health status. This will guide predictive modeling of treatment outcomes in multiple chronic inflammatory conditions, based on microbiome features. A key outcome of this work is to better understand features of the microbiome that are more informative of gut microbiome response to perturbation. We hypothesize that a subset of baseline microbiome features will be indicative of post-perturbation gut microbiome changes and can be predictive of host treatment response in multiple chronic inflammatory conditions. The long-term goal of this work is to develop therapeutics that increase gut microbiome resistance and resilience. If successful, this would contribute to the emerging field of microbiome-mediated healthcare.