Metabolomics in the world of infectious diseases

Rapidly emerging and re-emerging infectious diseases require rapidly developing tools. It is imperative that these tools not only detect exposure but also rapidly provide strategies for therapeutics to combat the spread of the disease. New and improved technologies have paved the way for predicting, understanding, diagnosing, monitoring and developing strategies to combat infectious disease at the systems level. Metabolomics is one such high throughput technology, which involves comprehensive profiling of small molecules such as amino acids, lipids, sugars and environmental chemicals within a cell, tissue, body fluids, or the whole infectious organism. Ultra-high resolution mass spectrometry combined with advanced bioinformatics analysis tools are used to detect and analyze these metabolites in biological samples. These metabolites could serve either as predictive biomarkers that define exposure, or therapeutic biomarkers that fight the disease. Current investigations at Emory include utilization of this powerful technology to provide perspective and outcome to these complex diseases including parasite (malaria), bacterial (tuberculosis) and viral associated infectious disease (HIV), with an intent to ultimately devise therapeutic strategies.

The Malaria-Host Pathogen Interaction Center (MaHPIC), led by Dr. Mary R. Galinski, in the Division of Infectious Diseases, hosts a global collaborative project, wherein Dr. Dean P. Jones and Dr. Shuzhao Li from the Department of Medicine spearhead the Emory metabolomics team. The goal is to use state-of-the-art metabolic profiling methods to provide detailed metabolomics data for plasma samples collected in the course of non-human primate infections and human plasma samples from malaria endemic areas around the world.[1] Detection, analysis and association between thousands of metabolites found in the blood of animals and humans infected with malaria will tremendously impact the understanding of the disease and improve global health for this *parasite associated infectious disease*.

The team that studies *bacterial associated infectious disease* like tuberculosis (TB) includes Dr. Jeffrey M. Collins, in the Division of Infectious Diseases along with Dr. Thomas Ziegler and Dr. Russel R. Kempker. The aim is to use plasma metabolomics in the diagnosis of active tuberculosis disease and identify biomarkers of the disease, treatment response and immunity.[2] The Centers for Disease Control and Prevention (CDC) estimates one fourth of the world's population is infected with TB. Utilization of this high throughput omics technology will provide insight and public health intervention strategies for one of the world's deadliest diseases.

Past studies on *viral associated infectious diseases* at Emory have shown that metabolomics tool is very effective in differentiating healthy HIV subjects from controls. A study published by Dr. Sushma Cribbs from the Department of Medicine showed that metabolic profiling of bronchoalveolar lavage fluid from otherwise healthy HIV infected human subjects was different from the HIV-free control group, thereby providing biomarkers to predict HIV infected individuals who may be at a high risk for lung infection.[3]

While understanding infectious diseases and their pathology is important, utilization of metabolomics tool to determine effectiveness of preventative measures against infectious diseases is equally important. The Emory Vaccine and Treatment Evaluation Unit (VTEU) is a collaborative project in the School of Medicine led by Dr. Mark J. Mulligan, from the Division of Infectious Diseases. This multimillion dollar project employs the utilization of metabolomics as one of its components to understand the immunologic responses to vaccines.[4]

Just like 23andme.com predicts a vast array of information based on genetic knowledge and is an easily available public avenue; metabolomics profiling to predict and prevent diseases may not be a far-fetched thought in the future. Precision medicine is making a way for improved strategies to combat and prevent diseases. The utilization of metabolomics, while still in its infancy, will soon be used to its full potential to impact individual and global health against infectious diseases.

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References

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