Metabolomics-2013
OMICS Group Conferences
Accelerating Scientific Discovery
2nd International Conference and Exhibition on
Metabolomics & Systems Biology
April 8-10, 2013 Hilton Chicago/Northbrook, USA

Systems medicine and metabolic profiling of diseases

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Abstract

The metabolite profile of a subject constitutes the interaction of the genotype with the environment and therefore is the molecular reflection of the (clinical) phenotype. Metabolic profiling of body fluids such as blood plasma, urine and cerebral spinal fluid, but also tissues becomes increasingly feasible, utilizing technological advances such as in (in vivo) NMR spectroscopy and Mass Spectrometry. Metabolomics is becoming increasingly important in clinical diagnostics. To integrate all these data and gain mechanistic insights, a 'systems medicine' solution is required. Systems medicine is the application of systems biology approaches in medical concepts, research and practice.

We propose pathway-based analyses to link the metabolic profile of a patient to changes in the underlying metabolic network of cells and tissues affected by a disease. The approach uses mathematical models to integrate the vast amount of knowledge that is available about metabolic networks. The models provide structured information about how metabolites and reactions are interconnected and organized into pathways. High-throughput data can be utilized to reconstruct so-called Genome-Scale Metabolic Models. These models can be used to study the function of specific enzymes and pathways (fluxes) in the context of the complete metabolic network. The approach enables the integration of patient-specific metabolomic data with information on the genome (such as SNPs, epigenetic information) and transcriptome (gene expression, mRNA) if such data is available. Pathway-based analysis of metabolomic data is expected to contribute towards the development of personalized healthcare (including personalized medicine).

Biography

Natal van Riel has completed his Ph.D at the age of 26 years from Utrecht University in the Netherlands. He is Ass Prof. in the Dept. of Biomedical Engineering at Eindhoven University of Technology and principal investigator of the Systems Biology and Metabolic Diseases research program. His group focuses on modeling of metabolic systems to understand disease mechanisms and interpret experimental data, with applications in Systems Medicine. He is (co)author of over 50 scientific publications in leading, peer reviewed journals.