Center For Advanced Mathematical Sciences | CAMS

NETWORK MEDICINE

THE HEALTHCARE SYSTEM AS A COMPLEX SYSTEM

The SARS-CoV-2 pandemic has dramatically demonstrated how mathematical models can inform and thereby optimize public health interventions.

In this talk we review recent contributions from our group aiming to better understand how to curb the spread of SARS-CoV-2 both on population scales and in specific settings by means of pharmaceutical and non-pharmaceutical interventions. However, despite the fact that they represent an enormous disease burden, the literature is much sparser when it comes to the use of epidemiological models to better understand the progression of non-communicable, chronic diseases in the population, such as diabetes, cardiovascular diseases, or mental diseases.

In the second part of the talk we will utilize the fact that those diseases spread on so-called disease networks -- namely on networks that connect diseases that often co-occur in patients due to shared genetic or environmental risk factors. Using a unique dataset comprising pseudonymised claims data for all Austrians receiving out- or inpatient care over several years, we develop a quantitative, network-based framework to test for all possible comorbidity relations between each pair of human diseases.

We show that this network undergoes dramatic structural changes across the lifetime of patients as a function of their sex. Furthermore, we give examples for how this comorbidity framework can be used to accurately predict future disease risks in the population, to model drug-disease interactions, to identify medical precursors for events such as serious suicide attempts, as well as to disentangle how much genetic or environmental risk factors contribute to the pathogenesis of individual diseases.

Monday, July 18, 2022 • 3:00 pm
College Hall, Auditorium B1 and **Online**

Peter Klimek
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Peter Klimek is Associate Professor at the Medical University of Vienna and faculty member of the Complexity Science Hub Vienna. Drawing from his expertise in complexity science, data science, statistics and physics, his research aims to improve our understanding and ability to predict complex socio-economic systems, ranging from human disease over healthcare systems to economic and financial systems. Peter and his research team developed prediction and stress-test models for how people acquire more and more chronic disorders as they age, how healthcare systems cope with changes in their workforce, and how shocks disrupt economic and financial markets.

He invented a novel statistical test to detect signs of electoral fraud and was the first to mathematically prove that governments are bound to become ineffective over time. He authored a textbook an the Theory of Complex Systems (together with S. Thurner and R. Hanel) and operated a model used by the Austrian government to forecast the COVID-19 epidemics in Austria. Peter was awarded a PhD in physics in 2010 and a Venia Docendi (habilitation) in computational science in 2018. He is author or co-author of more than 90 publications, presented at more than 60 conferences or invited lectures. In 2021, he received the Paul Watzlawick Ring of Honor (together with Stefan Thurner). In 2022, he was elected Austrian Scientist of the Year 2021.

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