Fighting infectious diseases in a complex world

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New advances in science and medicine help us gain ground against certain infectious diseases, yet new infections continue to emerge that spread rapidly into the population and may reach pandemic proportions. We face a perpetual challenge against the capacity of new pathogens to lead to emerging epidemics. And our global, mobile and interconnected world contributes with dangerous mechanisms that may potentially greatly magnify the global burden of diseases, causing significant human and economic costs – namely, the increasing complexity of our social relations, trade systems, and mobility patterns. The ICT and "Big Data" revolution enabled us to start quantifying this complexity and to envision modeling frameworks able to confront this epidemic reality. Computational models integrating mathematical epidemiology with complex systems and statistical physics approaches, data science and Geographic Information Systems offer new tools as important as medical, clinical, genetic or molecular diagnosis tools in the fight against infectious diseases. In the talk I will present my contribution to the field of computational epidemiology, through the development of data-driven multi-scale modeling applications to infectious disease spread, and I will address the effect of complexity inherent in the multiple facets of reality on the properties of epidemic propagation and on the efficacy of the intervention strategies that can be envisioned.