**Title:** How to make clinical predictions when we do not know everything?

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**Abstract:** In clinical practice, a plethora of examinations is conducted to assess the state of a certain pathology. These span from blood sample analysis, clinical imaging (e.g. CT, MRI) and biopsy sampling are among the most important diagnostic and prognostic tools. Such medical data correspond to snapshots in time of the patient’s state, since current standard of care (SoC) is not based on emergent technologies of real-time measurements, such as liquid biopsies or biosensors. Moreover, clinical data refer to different biological scales since imaging, such as MRI, typically provides an organ level picture of a disease (macroscopic), biopsies represent cellular patterns at a tissue (mesoscopic) level and -omics, FACS or molecular markers allow for sub-cellular insights. Finally, the biophysical mechanisms that regulate phenomena in all these scales are not completely known. Therefore, current clinical care faces the following challenges: (C1) data collection is sparse in time since it relies on patient’s clinical presentation, (C2) we lack the knowledge/uncertainty of the mechanisms involved in regulating these data variables across different scales (structural uncertainty), and (C3) medical data are multiscale. Therefore, integrating these data to predict the future of a disease and propose an appropriate treatment is a formidable task.

I propose to harness the ability of mechanistic models to integrating the existing biological knowledge and deal with the emerging dynamics. At the same time complete the missing knowledge by using data intensive techniques. Here I will present (i) a Bayesian regression framework of combining models and machine learning to predict tumor growth and (ii) model-driven classification method to assess the graft loss risk in kidney transplantation patients.

**Keywords**: Mechanism uncertainty, dynamic modelling, machine learning, clinical predictions

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