RESEARCH TOPIC DASME13
Data science for knowledge integration to enhance clinical prediction and clinical trial design: applications in sepsis prediction and prevention

Curriculum DASME standard

Research Area
Immuno

Laboratory name and address
Clinical Epidemiology and Research Centre (CERC)

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Abstract
This PhD project will involve two studies: 1) the development of a model using electronic medical records and machine learning for sepsis prediction and early detection; and 2) the design and conduct of an adaptive clinical trial platform for the comparison of different interventions in patients with bloodstream infection. Starting from the clinical need of improving the outcomes of patients with severe infections, and grounded on fundamentals of clinical epidemiology, this project will train the PhD candidate in advanced data science approaches for information or knowledge integration to increase the precision and efficiency of predictions. While study 1 embodies the most typical application of these approaches (prediction based on 'Big Data'), the analytical framework of knowledge integration is shared with Bayesian adaptive methods, which typically allow prior knowledge (and knowledge that is acquired over time) to dynamically inform and change our predictions and study design.

Main technical approaches
Technical approaches employed in the project will include state-of-the-art supervised and unsupervised machine learning techniques, and simulation and decision modeling techniques. These techniques will be learned and applied stimulating their understanding in the context of the clinical research questions and following methodological standards for prognosis research and randomized controlled trials.

Scientific references
1. Singer M, Deutschman CS, Seymour C, et al. The third international consensus definitions for sepsis and septic shock (sepsis-3). JAMA. 2016; 315(8):801–10

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3. Mišić VV, Rajaram K, Gabel E. A simulation-based evaluation of machine learning models for clinical decision support: application and analysis using hospital readmission. NPJ Digit Med. 2021 Jun 14;4(1):98.
4. Bhatt DL, Mehta C. Adaptive designs for clinical trials. N Engl J Med. 2016;375(1):65-74.
5. Wason JM, Trippa L. A comparison of Bayesian adaptive randomization and multi-stage designs for multi-arm clinical trials. Stat Med. 2014 Jun 15;33(13):2206-21.

Type of contract

Scholarship of € 25.000 gross per year awarded by Istituto Clinico Humanitas. This sum is subject to IRPEF income tax and exempt from social security contributions.

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