INSPIRE: Personalized computational models of COPD progression for patient phenotyping

Description

Chronic Obstructive Pulmonary Disease (COPD) is an highly disabling airways pathology, with a high prevalence and a significanteconomic and social cost. It is caused by a complex variety of interactions between genes and the environment that give rise to severalclinical phenotypes. New therapeutic targets have recently been found, giving hope for improving the living conditions of affected patientsand reducing the costs associated with hospitalizations. However, the efficacy of new therapies under development will depend heavily onthe identification of the correct phenotype and risk profile of the patient. There is an extensive literature on integrated multi-scale modelsthat could be used to perform such phenotyping and risk stratification of patients, but little has be translated to clinic practice. The main motivation of this project is focused in the prediction of the therapeutic responses thanks to computational models of pulmonary inflammation and their integration into clinical practice. Due to the extreme complexity of these models, the use of large-scale computational resources together with efficient simulation codes, is mandatory. The achievement of this objective requires the design of:

- a model of lung inflammation development due to particle deposition
- a model of mechanical rupture of the lung due to the internalstresses caused by breathing
- a model of the biological interactions networks that underlines the different phenotypes of COPD
- a model for the prediction of phenotype of the patient and of the risk of exacerbations
- correlations with clinical parameters.The team involved in the project has extensive experience in the areas involved by the objectives of the project.

On the one hand, the UPF group is an expert in the application of engineering methods, augmented reality and simulation systems applied to clinicalproblems, allowing them to interpret mathematical models for describing the mechanisms of tissue regulation behaviour. On the other hand, the BSC team has extensive knowledge of high performance simulations, particularly for biomedical research at organand tissue levels, and has been developing a complete fluid dynamics model of respiration along with the transport of particles.

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