**Abstract doctoral thesis – Eline Lauwers**

**Title: Novel outcome measures for cystic fibrosis in a changing world: functional respiratory imaging and computer aided lung sound analysis**

Cystic fibrosis is a life-threatening genetic disease, characterized by an early onset of progressive lung disease. Over the past decade CF care has evolved at a rapid pace having a great impact on the therapeutic approach and follow-up of patients. In this new world of advanced therapies and technological developments, the need for objective and sensitive methods to identify regional abnormalities in the lungs becomes increasingly important. The overall aim of this PhD project was to explore the role of two novel outcome measures in CF research: Functional Respiratory Imaging (FRI) and Computer Aided Lung Sound Analysis (CALSA).

FRI comprises quantitative CT analysis combined with computational fluid dynamics (CFD), which results in a set of structural and functional biomarkers on a lobar level. This technology has been studied in various pulmonary diseases, but research in the field of CF is scarce. Two studies were conducted to examine the added value of FRI in CF research. Results showed that FRI outcomes have the potential to complement findings derived from conventional outcome measures as an alternative to visual CT scores. Moreover, an interventional study suggested that multiple FRI outcomes are more sensitive than conventional outcomes to detect short-term therapeutic effects.

In the second part of this thesis, a novel approach for automated CALSA was evaluated in a real-world clinical setting. Our research focused on the development of automated algorithms that result in continuous output values, which can be used to indicate the severity level of a patient’s disease or to quantify treatment effects. The approach was proposed in collaboration with CoSys-Lab (Faculty of Applied Engineering, UAntwerp) and Sonavi Labs (Baltimore, USA). A cross-sectional study comparing digital lung sound characteristics to imaging outcomes offered a first clinical validation of the approach. A second interventional study demonstrated the responsiveness of sound characteristics to the short-term effects of airway clearance techniques.

Overall, both FRI and CALSA are suggested to be valuable outcome measures for CF. The added value of FRI focuses on the sensitivity of the technique and its potential to be used in clinical trials with a small number of patients and/or patients with mild lung disease. CALSA, on the other hand, has the advantage that it is suitable for frequent assessment in settings with minimal infrastructure. However, research regarding CALSA is still in an early stage and improvements to the methodology should be made before its implementation in clinical practice.