Application for QIBA Project Funding

Title of Proposal: Investigation of Methods of Volume Correction for Lung Density CT		
QIBA Committee/Subgroup: Lung Density Biomarker Committee		
NIBIB Task Number(s) which this project addresses:		
PI (Project Coordinator or Lead Investigator Information)		
Last Name: Fain	First Name: Sean	Degree(s): PhD
e-mail:		Tel #:
Institution/Company: University of Wisconsin		
Total Amount Requested:		

Project Description

CT exams have shown utility in evaluating severity and progression of pulmonary emphysema in patients with chronic obstructive pulmonary disease (COPD). One of the major tasks in the profile drafting effort by the QIBA Lung Density Biomarker Committee is to assess the lung density bias and precision of repeat CT scans, using published longitudinal studies on non-diseased subjects. The repeatability coefficient determined from each study, a criterion for quantifying a real change in a lung density metric, has been shown to improve across all studies after volume adjustment to account for the change in the apparent lung density due to respiration. While there is consensus in the necessity of volume adjustment to achieve more accurate interpretation of densitometry CT measurements, there are competing methods and procedures among the published studies. Our attempts to evaluate the merit of a given method of volume adjustment were often hindered by the lack of details in the report. The prevailing models in use are of statistical in nature, making comparisons difficult without the raw data. Contacting authors of those studies had limited success. To understand the problem, we have performed some analysis with a set of the NLST data by applying statistical modeling at the sample level as most studies did which yielded similar improvement in the repeatability coefficient. However, the NLST data were taken one year apart, much longer the 3-month criterion for the studies included in the meta-analysis for the Profile document writing. A longer duration would likely produce real changes in the lung density due to natural progression. Moreover, they were taken on a 4-slice scanner which is outdated. We have further requested access to the COPDGene repeat-scan data sets with a range of intervals, which would allow us to create statistical and physiological models to make comprehensive evaluations of various methods of lung volume adjustment and its effect on the repeatability coefficient in particular and all sources of variances in general.

Primary goals and objectives

Lung density metrics such as RA950 and Perc15 varies linearly with the change in total lung volume as determined by CT volume histograms. By correlating the change of a metric to the change of volume at the sample level, a statistical model can be constructed to realign the respiration levels at the baseline and repeat scans. However, the underlying assumption of conservation of lung mass (sponge model) may not be valid due to the blood flow in the vessels during respiration. Dr Philip Judy has investigated the

hypothesis that the mass estimated from lung parenchyma partition of the does not vary during respiration and the histogram variation is associated the vessel-wall part of the histogram. By modeling the lung histograms the relationship between any given density metric and volume can be quantified with statistical parameters.