Why Quantitative Imaging is Important to CT & How QIBA is Addressing This Need in 2019:2

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Quantitative Imaging Biomarkers Alliance RSNA

Quantitative Plaque Morphology by CTA

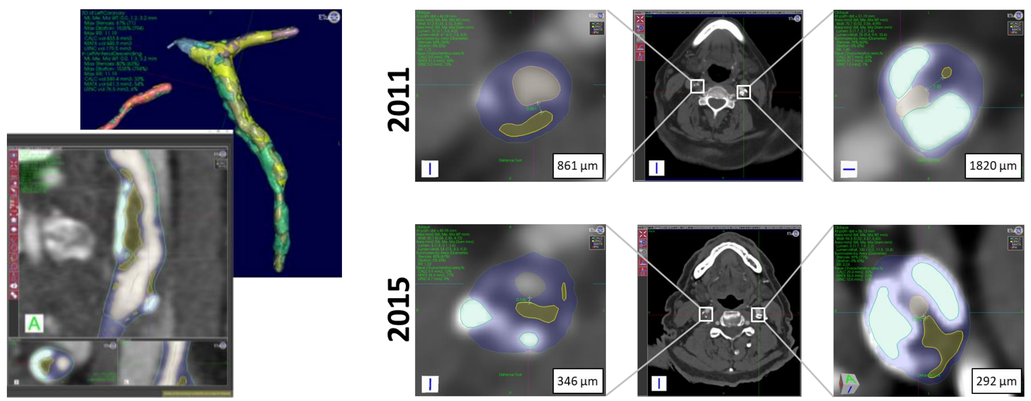
Atherosclerosis is a major health concern for our aging population. But there is a critical gap in the biomarker qualification, needed to optimize treatment. **Feasibility of plaque characterization with CTA in coronary and carotid has been demonstrated.**

However, lack of standardization is significantly decreasing the clinical implementation because of the methodological heterogeneity. First steps are to standardize protocols for each arterial bed, select optimal parameters and provide objective performance assessment techniques with standardized metrology metrics and nomenclature for software analysis by developing calibration phantoms and specific technical guidelines for structural measures, and use of histological ground truth for tissue characteristics.

To establish these biomarkers, standardization of quantitative imaging across different protocols, anatomical locations and different manufacturers with cross-calibration is required. Reliable quantitation using more sophisticated techniques than simple HU thresholding without specific mitigation of known limitations where ground truth of tissue is objectively determined is new but energizing.

QIBA is uniquely positioned to effectively meet this need and has produced a Profile which has been publicly reviewed and is in late stages of producing the first substantial consensus in this critical field.

Illustrative example of histologically validated plaque morphology across time:



CT Lung Density

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the world. CT remains the gold standard for imaging-based phenotyping of COPD. Compared to visual interpretation, **quantitative imaging biomarkers of COPD are objective and can be made reproducible.**

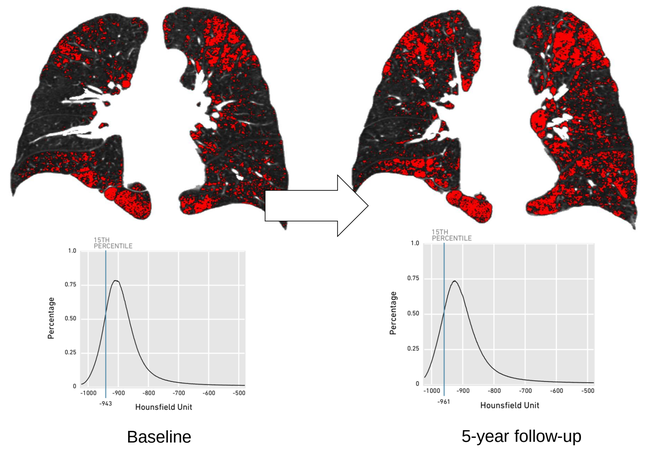
The QIBA Lung Density committee has recently released a Profile document for public comment that outlines standard CT protocol requirements and establishes the following longitudinal claims:

- Claim 1: An increase in LAA-950 HU of at least 3.7% is required for detection of an increase in the extent of emphysema, with 95% confidence.
- Claim 2: **Without volume adjustment,** a decrease in Perc15 of at least 18 HU, is required for detection of an increase in the extent of emphysema, with 95% confidence.
- Claim 3: **With volume adjustment**, a decrease in Perc15 of at least 11 HU, is required for detection of an increase in the extent of emphysema, with 95% probability.

The lung density committee has also completed the following groundwork projects related to improving and understanding reproducibility of lung density metrics:

- Validation and development of a phantom-based method for increasing the reproducibility of HU values across different scanner makes and models and reconstruction protocols. Results are published* and currently being validated in the NIH sponsored COPDGene study.

- An inter-software repeatability study involving nine commercial and academic software packages. Results indicate that the inter-software reproducibility coefficients are 1.2% for LAA-950 and 1.7 HU for Perc15. It is recommended that longitudinal studies use the same lung density analysis software for the entire study when possible.



Baseline (left) and 5-year follow-up (right) CT scans from a COPD patient. Regions of the lung less than -950 HU are highlighted in red, and HU histograms are displayed below the scan images. Perc15 (without volume adjustment) decreased 18 HU over 5 years, and LAA-950 decreased 10%, indicating a true progression in the extent of emphysema according to claims 1 and 2.

Baseline

5-year follow-up

* Chen-Mayer, HH, et al. "Standardizing CT lung density measure across scanner manufacturers." Medical physics 44.3 (2017): 974-985.