

AGREEMENT OF AUTOMATED QUANTITATIVE CT ANALYSIS WITH MANUAL DENSITOMETRY AND RADIOLOGIST ASSESSMENT IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Relevance. Visual CT assessment of emphysema and airway changes in chronic obstructive pulmonary disease (COPD) depends on the reader, and manual densitometry is time-consuming. Before an automated system can support routine clinical decisions, its measurements must agree with established methods and reflect the functional severity of the disease.

Aim. To evaluate the agreement of an artificial intelligence (AI)-based CT analysis system with manual densitometry and radiologists' visual reports, and to identify independent quantitative predictors of COPD severity.

Materials and methods. The study included 117 subjects examined at the multidisciplinary clinic of Samarkand State Medical University in 2023–2025: 78 patients with spirometry-confirmed COPD (GOLD 1 – 10, GOLD 2 – 31, GOLD 3 – 26, GOLD 4 – 11), 24 at-risk individuals and 15 healthy controls. Inspiratory and expiratory scans were acquired on a 128-slice CT scanner. The automated system calculated the emphysema index (LAA-950), Perc15, the air trapping index, bronchial wall area percentage (WA%), Pi10 and the pulmonary artery to aorta (PA/A) ratio. Agreement was assessed with the Bland–Altman method, the intraclass correlation coefficient (ICC) and Cohen's kappa; associations with FEV1 were tested by Spearman correlation and multivariable ordinal logistic regression.

Results. Automated and manual LAA-950 measurements showed a negligible mean bias of +0.30 percentage points with ICC = 0.972, and repeated runs of the model gave practically identical values (ICC $\approx$ 1.00). Agreement with the radiologist was κ = 0.88 for the presence of emphysema and weighted κ = 0.86 for its grade, which matched the agreement between two independent radiologists (κ 0.74–0.86). All automated indices changed steadily with disease stage (p < 0.001): LAA-950 increased from $4.9 \pm 2.5\%$ in GOLD 1 to $39.5 \pm 8.7\%$ in GOLD 4, the air trapping index from $15.6 \pm 7.1\%$ to $53.7 \pm 10.6\%$, and Perc15 fell from –831 to –928 HU. Automated LAA-950 correlated with FEV1 more closely (ρ = –0.75) than manual densitometry (ρ = –0.72), visual semi-quantitative scoring (ρ = –0.67) and the radiographic score (ρ = –0.52). When all methods were entered into

one model, only the AI-derived indices remained independent predictors of a higher GOLD stage: LAA-950 (OR 2.61 per 1 SD; 95% CI 1.61–4.22), the air trapping index (OR 1.96; 1.25–3.07) and WA% (OR 1.58; 1.04–2.40). Visual CT and radiographic scores, age and smoking history lost significance; the model explained 64% of the variance (Nagelkerke $R^2 = 0.64$).

Conclusion. Automated quantitative CT analysis is interchangeable with manual densitometry, and its agreement with the radiologist lies within the range of agreement between two experts. Its quantitative indices capture the information contained in visual signs and predict disease severity independently, which supports using the system as a decision-support tool in routine practice.

Keywords: chronic obstructive pulmonary disease, quantitative computed tomography, artificial intelligence, densitometry, emphysema index, agreement.