

AbstractID: 13667 Title: A framework to determine the risk of developing pneumonitis in lung cancer patients undergoing radiotherapy

Purpose: To determine which dose and non-dose features of patients undergoing thoracic radiotherapy best predict the incidence of possible lung pneumonitis and to estimate the corresponding risk of developing pneumonitis.

Method and Materials: The study employed a database of 235 patients, out of which 34 were diagnosed with Grade 2+ pneumonitis. A total of 94 dose and non-dose features of each patient were analyzed. To determine the most significant features likely to affect patient outcome, a two-fold optimization approach was developed. First, the feature values were evaluated by four machine learning models for accurate prediction. The model accuracy was measured in terms of tenfold cross-validation-based area under ROC curve (AUC). Next, the ROCs of the four models were combined. Towards that end, a Bayesian decision fusion methodology was developed. Finally, based on the combined ROC, the fusion model isolated the set of most significant features and also computed patient-specific risk of injury.

Results: Out of 94 original features, 27 were selected by the four models. AUC values corresponding to the four models were 0.75, 0.70, 0.79, and 0.73, respectively. Most notably, when the four models were combined, the AUC improved to 0.85. Furthermore, the fusion model identified only six features as most significant. They consisted of two dose features: EUD ($a=2$) and V_{30} ; and four non-dose features: gender, tumor location, histology type, and chemotherapy schedule. The corresponding probabilities for injured patients were found to be significantly higher than those for non-injured patients, demonstrating robustness of the over all predictive model.

Conclusion: A framework was developed to predict the incidence of pneumonitis in lung cancer patients undergoing radiotherapy. The predicted probabilities of injury were found to correspond well with the known injury status of the patients. The framework may potentially be used in the clinic to improve the treatment decision-making process.