Title: Using Quality-of-Life Scores to Guide Prostate Radiation Therapy Dosing

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Abstract

Prostate cancer has one of the highest patient survival rates for cancer. The primary focus of treatment has moved to how to treat without decreasing the quality-of-life of patients. This project seeks to understand the surprisingly not-well-known connection between the radiation a patient receives and the symptoms a patient experiences. We use deep learning methods on small datasets as well as statistical analysis methods to evaluate organ sensitivity. In the biomedical field, data is expensive and not abundant, which leads to small datasets. Transfer learning is one method for handling small datasets, but with specialized networks we can lose its full advantages. We use image flipping and curvature-based interpolation methods to create more data in order to leverage transfer learning. Using interpolated and augmented data, we can train a convolutional autoencoder network to get near-optimal starting points for the weights in our convolutional neural network for analyzing the relationship between patient-reported quality-of-life and radiation. Furthermore, we use analysis of variance and logistic regression to analyze organ sensitivity to radiation and develop dosage thresholds for each organ region. We identify regions of both the bladder and rectum that are highly correlated with changes in individual symptoms. Finally, we estimate radiation therapy dosage thresholds to determine how high radiation therapy dosage needs to be in order to trigger collateral symptoms. Connecting deep learning methods and organ sensitivity provides a framework to inform patient care in the context of their quality-of-life.