AbstractID: 8888 Title: Novel decision aid for IMRT treatment plans generated using multiobjective optimization

Purpose:

To develop the decision making component of a multiobjective IMRT optimization procedure for prostate cancer that incorporates disparate sources of information used in clinical decision making, the uncertain outcomes inherent in radiation therapy and the preferences of the patient.

Materials and Methods:

Currently, many IMRT plans are developed for each patient without indication of which plan provides the optimal balance between tumor control and complication probability. Coupled with the typical number of objectives, plan selection is difficult. We chose a Bayesian Network (BN) coupled with a Markov Model (MM) and utility theory to calculate Quality Adjusted Life Expectancy (QALE) for IMRT treatment of prostate cancer. The BN was constructed with the advice of experts; conditional probabilities were obtained from research and clinical trial publications and expert opinion. Local, regional, and distant control were included as were complications to bladder and rectum. The MM relied on transition probabilities derived from the BN, published clinical trials and life expectancy tables. Utilities were obtained from the literature. Plan ranking was based on QALE or any of the components, e.g. local control or complications.

Results:

Probabilities of local and distant control as a function of disease state matched published values well, as did life expectancies. Sensitivity analyses highlighted the critical nodes in the network. Analysis of outcomes versus probability of lymph node involvement provided a basis for decisions regarding pelvic irradiation. A BN is well-suited to handle rigorously conditional probabilities and the disparate nature of clinical variables. QALE provides a method for ranking plans based on clinically relevant criteria that incorporates the probabilistic nature of the outcome.

Conclusion:

A decision aid was constructed using a Bayesian Network coupled to a Markov Model. This resulted in the ability to rank competing plans based either on QALE or specific outcomes.