

AbstractID: 11426 Title: Estimate of the uncertainty in relative secondary cancer risk calculations following proton therapy and intensity modulated x-ray therapy

Purpose: To determine the uncertainty in calculations of the ratio of relative risk (*RRR*) of developing a secondary malignant neoplasm (SMN) from proton therapy compared to that of IMXT for prostate cancer by examining the sensitivity to key input parameters.

Methods and Materials: The *RRR* and associated uncertainties were examined for a typical patient treated for early-stage prostate cancer. Proton therapy and IMXT plans were developed using clinical protocols. Baseline risk of SMN was estimated using primary doses from treatment planning calculations, stray doses from Monte Carlo simulations and available data, radiation weighting factors (w_R) values from ICRP Publication 92, and the linear no-threshold model for SMN risk. The sensitivity of *RRR* to w_R was estimated by re-computing the *RRR* using various scaled w_R values. The influence of uncertainties in the dose-response model was estimated by re-computing the *RRR* with various available models. The influence of inter-patient variation in primary dose was determined using the standard deviation of mean dose in organs at risk over a patient population, while variation in stray dose was determined with Monte Carlo simulations.

Results: The baseline *RRR* for the selected patient was 0.66, suggesting that proton therapy can reduce the calculated incidence of SMN by 34% compared with IMXT. Changes in w_R and the shape of the dose-response model introduced uncertainties of $\pm 10\%$, and $\pm 7\%$, respectively. Inter-patient variations in primary and stray dose produced *RRR* values that deviated greatly from the baseline value; however, a strong positive correlation coefficient was observed, resulting in a net uncertainty in the baseline *RRR* of $\pm 30\%$. Thus, the total uncertainty in the baseline *RRR* was 0.22 ($2\text{-}\sigma$).

Conclusion: Proton therapy can reduce the incidence of SMN compared with IMXT for a population of prostate patients, independent of uncertainties in w_R and the shape of the dose response model.