

Radiation Treatment Uncertainties: Issues and Controversies

The radiation treatment process consists of multiple steps, with each step containing inherent uncertainties and assumptions. Our research program involves the evaluation of these uncertainties and the development of models to predict the corresponding clinical outcome using this information. This analysis has highlighted the following issues. **1. Target volume definition:** (a) Physicians have a large variability in target volume definition. (b) ICRU definitions of target volume are ambiguous. **2. Dose-volume histograms (DVH):** (a) Uncertainties in dose, especially if no inhomogeneity corrections are made. (b) Substantial uncertainty in volume determination dependent on the calculation used in treatment planning systems. (c) DVH reduction schemes make assumptions about biological response, which are invalid for some organs. **3. Optimization concerns:** Different treatment techniques will be chosen on the basis of the optimization routine, dependent on whether or not uncertainties are included. **4. Biological modeling:** The calculation of TCP and NTCP makes major assumptions about (a) availability of reasonable response data, and (b) accuracy of models used to predict TCP and NTCP for different dose-volume-fractionation schemes. In this overview, one example will be shown of each issue/controversy and specific conclusions will be highlighted.