AbstractID: 12582 Title: Volume variability in treatment planning systems

Purpose: Dose-volume histogram has become an important tool for evaluation of radiation outcome and is required in most clinical protocols. While accuracy of dosimetry in treatment planning system (TPS) is well quantified, the variability in volume estimation is uncertain which is investigated in this study.

Material & Methods: Structures varying from 0.6 cm^3 to 270 cm^3 were contoured on a CT of a patient with head and neck cancer. CT data with contoured structures were sent to 5 centers with different TPS for volume estimation. Additionally, a water phantom with accurately known volume objects was scanned with 1, 2, 3, 5, and 10 mm slice thickness. These CT data sets were also sent to various institutions for the estimation of the volume from their TPS. The data were analyzed and compared for error in each volume of structure.

Results: The variability of volumes among TPS may be significant (-20% to 300%), especially for small volume structures. The minimum and maximum errors is the range of -13% to 300%, -12%-183%, -24% to 92%, -20% to 30% for CMS-XiO, Pinnacle, Eclipse, and Oncentra, respectively. These differences become smaller for larger volumes with nearly a cutoff at about 20 cm^3. The calculated volume of the objects is a function of algorithm and slice thickness. For small objects like optic nerve, cochlea, lens etc, the estimation of the volume could have up to 300% error in some TPS. Based on this study, CMS-XiO has poor and Oncentra has superior contouring algorithm for volume estimates used in DVH.

Conclusions: Estimation of a volume is dependent on CT slice thickness and the quality of contouring algorithm in TPS. During commissioning of TPS and for all clinical protocols, evaluation of volume should be included to provide the limit of accuracy in DVH from TPS.