AbstractID: 12756 Title: On the Dosimetric/DVH Impact of Variation in Organ Delineation: A Multi-Institutional Study and Proposed Quality System

Purpose: Anatomy contouring is an early and critical step in the workflow of per-patient customization of modern radiation therapy. Accurate and consistent delineation of regions of interest (ROIs) is vital, as inaccuracies will affect everything downstream in the workflow: the optimized dose, the DVH metrics, and in some instances the ROI-based guidance used in IGRT. However, despite the importance of ROI accuracy, there is, as yet, no industry-wide QA system for "anatomy engineering." This study examines this problem objectively.

Methods and Materials: Source data were generated by submitting a common head/neck CT dataset (with targets already defined) to over 100 institutions for them to contour and produce an IMRT Plan. The received data (Plans, Structures, Dose) were filtered by plan quality to pare down to a collection of the 32 best plans, each contoured and planned by a different dosimetrist. We quantify: 1) the ROI variation, and 2) the impact that the ROI variation has on important dosimetry/DVH endpoints. New technologies are employed, including a volumetric ROI comparison tool and a cross-platform 3D Dose/DVH tool allowing flexible association between DICOM RT structures and 3D dose grids.

Results: There is significant inter-dosimetrist variation in critical ROIs, with the degree of variation being organ-dependent. For the patient/plan we studied, there was a corresponding range of dose errors caused by the ROI variation (errors ranged from -289% to +56% for mean ROI dose; -22% to 35% for max dose). Based on our analysis, there appears to be an obvious ROI comparison metric cutoff beyond which the associated dose errors become minimal.

Conclusions: Given these results, we propose a practical "Quality System" that could quantify the performance of anatomy engineering systems (dosimetry staff, autosegmentation algorithms, physicians, etc.) and provide feedback for continual quality improvement.