Purpose: In this work we study 1) the correlation between patient DVH deviations and 3D gamma passing rate of the whole patient volume, 2) the correlation between patient DVH deviations and gamma passing rates of each corresponding ROI, and 3) the capability of an software/algorithm that predicts patient DVH deviations based on planar QA result.

Methods: 96 unique "imperfect" step-and-shoot IMRT plans were generated by applying 4 different types of error–induced beam models on 24 clinical Head/Neck patients. The doses in each patient as well as QA phantom were then recalculated using an error-free beam model to simulate the real delivery. The degree of induced errors was tuned to result in planar QA results that are commonly achieved in clinics. Clinically relevant patient DVH deviations, as well as 3D Gamma passing rates for both the whole patient volume and each corresponding ROI were derived by comparing the "delivered" and planed patient dose. Predicted patient DVH deviations were generated by perturbing planned dose based on simulated results of per beam planar QA in a phantom, using a commercial software/algorithm.

Results: Weak to moderate correlation were found between clinically important patient DVH metrics (CTV-D95, parotid Dmean, spinal cord D1cc, and larynx Dmean) and 3D patient gamma passing rate (3%/3mm, 2%/2mm, 1%/1mm) for whole patient volume as well as for each corresponding ROI. Predicted DVH deviations were in good agreement with actual DVH deviations.

Conclusions: Gamma passing rate, even calculated in 3D for each specific ROI in real patient, has limited power in predicting clinical impact in terms of patient DVH deviations. The software/algorithm has potential to accurately predict these DVH deviations using the plan information and phantom planar QA results. Moving from Gamma based to patient DVH based IMRT QA appears to be both necessary and possible, and is therefore suggested.