Purpose: This study focuses on the possible clinical impacts and the trustworthy of calculated dose distributions evaluated by measured gamma criteria and potential use of plan-specific gamma value.

Method and materials: A MATLAB-based program was developed to calculate the upper- and lower-bounds of dose distributions measured by certain gamma value (e.g. 3%-3mm) on a voxel-by-voxel basis. Calculated data were imported to CERR for analyses. 15 IMRT plans for prostate, lung, and head-and-neck tumors (5 for each site) were analyzed using (3%-3mm) (the standard adopted by the authors’ institute). The mean dose to PTV, bladder, rectum, and parotid; maximum dose to cord, and V20 of lung are compared. Additional gamma values (2%-3mm and 4%-4mm) were utilized to compare the dosimetric impacts of different gamma criteria.

Results: The upper- and lower- bounds vary in a wide range. For a standard gamma (3%-3mm), the lower-bounds of PTV-mean are 3.01%-4.34%, 3.06%-15.6%, and 4.22%-8.28% lower than planned value for prostate, lung, and head-and-neck plans, respectively. The upper-bounds increased by 2.74-7.86 Gy and 3.49-5.65 Gy for bladder-mean and rectum-mean doses, respectively. The cord-max increased by 0.2-9.2 Gy and 0.74-3.02 Gy for lung and head-and-neck plans. The upper-bounds of lung V20 increasing varies between 2.5% (from 4.8% to 7.3%) and 4.8% (from 62.7% to 67.6%). The upper-bounds for parotid-mean increased by 0.9-9.07 Gy for head-and-neck plans. For various gamma applied to a lung plan, the upper-bounds range from 39.91%-43.70% for left-lung V20 and 27.10%-31.10% for right-lung V20. Gamma variation for other two sites was also analyzed.

Conclusion: This study provides a fast evaluation of dosimetric impact of gamma criteria to a treatment plan. The results reveal that the same gamma value can cause different dosimetric consequences for individual plan. This method can also be used to select appropriate gamma value based on the robustness of the plan.