Purpose: The Gaussian error function (GEF) model was used to fit into the dose-volume histograms (DVHs) of prostate IMRT and calculate the prostate equivalent uniform dose (EUD) associated with interfraction organ motion.

Methods: Three patients with small (39 cc), medium (60 cc) and large (87 cc) prostate volume were selected from a group of twenty in this study. Cumulative DVHs for the prostate that were shifted in the anterior–posterior directions based on a 7-beam IMRT plan were calculated and modeled using the Pinnacle3 treatment planning system (TPS) and GEF. To simulate the interfraction prostate motion, the prostate was shifted 1 cm in the anterior and posterior directions in 2 mm steps, using the dose distribution based on the IMRT plan without actual prostate motion. The prostate cumulative DVHs were converted to corresponding differential DVHs to calculate the prostate EUDs in each interfraction motion using MATLAB.

Results: Prostate EUD was computed to per fraction in order to measure the equivalent dose at each movement step. Prostate EUDs were found to decrease as the prostate shifted to both the anterior and posterior directions. The prostate EUD was also expected to have the maximum value at the isocentre, since the target received the best dose coverage when the prostate displacement remains zero. Our result showed that patient with the smallest prostate volume (39 cc) in the group has the smallest prostate EUD, when the prostate was shifted 1 cm anteriorly and posteriorly. Since the percentage difference of the prostate EUD calculated by the TPS and GEF is significantly less than 0.5%, we consider the GEF model a good potential alternative to determine the prostate EUD.

Conclusions: We validated our GEF model which can predict the prostate EUD with accuracy less than 0.5% compared to the results from the TPS.