Purpose: Delivered dose distributions for prostate seed implant treatments are often considerably different from the planned distribution. This makes accurate treatment plan evaluation important for future patient care decisions. Presently, treatment plan evaluation is based on several dosimetric quantifiers for the tumor and organs at risk. However, these do not account for effects of varying dose-rate, tumor repopulation and other biological effects. By including the biological response a more clinically relevant treatment plan evaluation may be obtained.

Methods: Eleven patients were evaluated. Each patient received a 145 Gy implant. Iodine-125 seeds were used and the treatment plans were created on the Prowess system. One month after the implant each patient received a CT scan. From these images the post-implant plan was created. In the post-plan, the primary tumor, urethra, bladder and rectum were contoured. The biologically effective dose (BED) was calculated for each voxel using the physical dose and the biological parameters of the appropriate organ. The BED was used to determine the tumor control probability and the normal tissue complication probabilities for the bladder, rectum and surrounding tissue.

Results: By incorporating radiobiological measures into the evaluation the predicted clinical outcome is concisely given by response probabilities of each organ. The average tumor control probability and complication probabilities for the urethra, bladder, rectum and surrounding tissue were 99%, 39%, 0.2%, 12% and 4% respectively. These measures provide a simpler means for evaluation and since they include radiobiological factors, the response probabilities provide a more reliable estimate of the treatment outcome.

Conclusions: The goal of this work was to create a more clinically relevant treatment evaluation by incorporating radiobiological measures that estimate the clinical results. This resulted in a simpler descriptor of treatment plan quality based on expected response probabilities rather than many endpoint doses for several organs.