AbstractID: 14105 Title: Monte Carlo modelling the effect of translational shifts and rotations on prostate dose-population histograms - what margins are required for IGRT?

Purpose: To investigate the effect of geometric uncertainties on prostate dose coverage based on population statistics and to determine the most appropriate margins for prostate IGRT. **Method and Materials:** Monte Carlo based software has been written using Matlab in order to implement Dose Volume Population Histograms (DVPH) for modeling geometric uncertainties. Whereas previously published work utilizing the DVPH concept has only accounted for translational uncertainties, this study has expanded this to include rotational uncertainties also. In this modeling, estimated values for systematic and random geometric uncertainties in 3-dimensions for both translational and rotational shifts are entered into the software. Presented in this study are the results of modeling prostate motion using translational uncertainties of $\Sigma = \sigma = 1.5$mm and $\Sigma = \sigma = 3$mm (representing IGRT and non-IGRT treatment), these are combined with rotational uncertainties of $\Sigma = \sigma = 1.5°$ and $\Sigma = \sigma = 3°$ for IGRT and non-IGRT. This modeling has been applied to six plans for a prostate treatment, based on margins around the prostate body of 0, 2, 4, 6, 8 and 10mm. **Results:** For the modeled non-IGRT treatment, results show that a full 10mm margin is required in order to achieve 95% prescribed dose coverage of the CTV to 90% of the population. For the IGRT treatment modeling, 95% prescribed dose coverage to >90% of the population was achieved by all plans – including that with 0mm margin. **Conclusion:** This work demonstrates the effect of geometric uncertainties (including rotations) and margin size on tumor coverage probability. Currently, these Monte Carlo calculations take several hours to complete on a desktop PC, work is in progress to use a distributed computing server in order to minimize the time taken for calculation.