“Delay Treatment or Switch to Different Machines? Dosimetric effect v.s. Tumor Control Probability”

Innovation/Impact
Dose delivery differences resulted from machine model designs are evident; however, it might be small comparing having a compromised TCP with delayed radiation treatment. This study evaluates the balance between dosimetric differences during delivery and compromised TCPs.

Introduction
When a linear accelerator is unavailable for treatment, a clinical decision has to be made as to whether patients can be treated on a Linear Accelerator different from the one the patient was planned for or the treatment be postponed until the original Linac becomes available again. This work investigates the feasibility of switching patients between different accelerators for intensity modulation radiation therapy (IMRT).

Method and Materials
We have performed Monte Carlo simulations of photon beams from different Linac models and vendors. Prostate and head and neck treatment plans for Siemens Primus, Primart, Artiste and Varian-21Ex/IX accelerators are studied in this work. Dose distributions for given plans are recalculated using different beam data with the same nominal energy from different Linacs. We have compared DVHs, the maximum, the minimum and the mean dose to the target and critical structures due to switching accelerators. In the process of switching a treatment plan to a different accelerator, there are issues, such as optimum penumbra compensation, dose distribution at the boundary of target and critical structures and multileaf collimator (MLC) leaf width effects, needed to be considered and verified with measurements. In making the final decision whether to switch machines, the tumor control probability (TCP) based on a LQ model with time delayed is compared.

Results and Discussion
Figure 1 and 2 are two DVHs of two plans from Varian and Siemens models and delivered with different machines marked at the legends. Slight dose coverage differences have been observed. Figure 3 shows the TCP estimation with both delayed and without delayed treatments. Undesired drop of TCPs is observed in the figure with treatment gap.

Conclusion
Based on the analyses done in this work, it is therapeutically more beneficial to switch a patient to a different machine than to postpone a treatment until the original machine is available, especially for fast growing tumors such as head and neck cancers.