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Introduction

Prostate cancer is the most common cancer in UK males and CHHiP technique continues to be a standard of care. GenesisCare uses a scripted CHHiP class solution for treatment planning with VMAT. The script produces acceptable doses for targets and organs-at-risk. However, wider quality aspects as Conformity index (CI) and gradient index (GI), varied most among planners and lacked an objective measure within the TPS.

This project describes the development and implementation of a quality improvement model in two steps:

1. Create an objective scoring tool to benchmark plan quality.
2. Use top plans to create a new class solution to improve plan quality and reduce planner variability.

Methods

50 randomly selected CHHiP plans were picked to form the quality review set. A further 40 patient plans were then selected, post release of the tools, to validate the model. All plans were created within Pinnacle (v14.0, Philips Medical Systems) with plan scoring, DVH parameters collected and analysed in MS. Excel.

For every parameter evaluated, an ideal value and associated weight were defined. The parameter score is higher if DVH value approaches the ideal value, then the score is linearly lower as the value deviates.

The spreadsheet calculates an overall score that consists of the summation of a PTV score (based on PTV coverage and dose spillage) with an OAR score (based on OAR sparing).

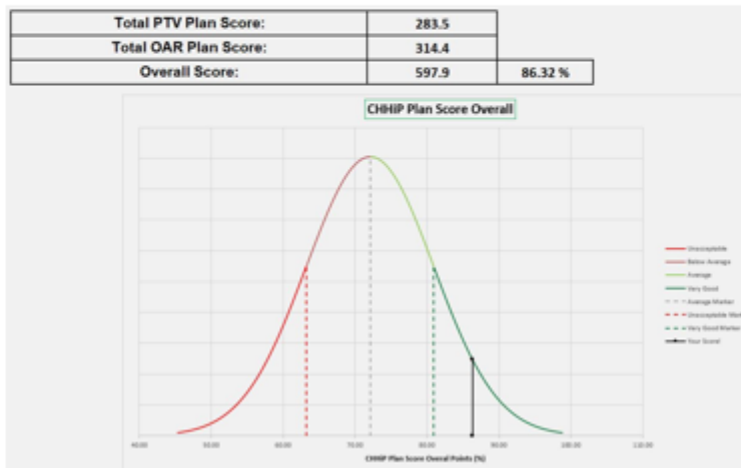


Figure 1. Example of overall plan score display

To determine the ideal scores for OAR, we used a predictive model that takes into account the overlap between OARs and the PTV, as well as achieved doses on the review set, to predict achievable OAR dose sparing that can be updated for the anatomy of any future case.

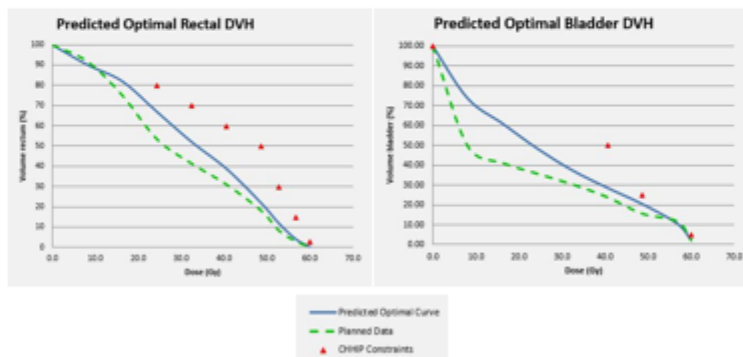


Figure 2. Example of rectal and bladder dose

After scoring the review set, the top 15 performers were then selected to update the Scripted class solution and, along with the scoring tool, released for clinical use. Close monitoring of post release plans ensued, with plan score results recorded in the validation set in comparison to the review set.

Results

The results of this study are presented in the table below:

	Scores (median \pm SD)	
	Prior release	Post release
overall	72.5 \pm 8.4	78.21 \pm 5.8
PTVs	59.8 \pm 9.8	63.44 \pm 6.91
OAR	85.1 \pm 11.1	92.99 \pm 8.03

Conclusion

The introduction of the updated class solution and plan score tool showed improved plan quality and decreased plan variability (standard deviation reduced by \approx 3%).

The scoring tools uses data derived from DVH to objectively quantify the quality of dose distribution decreasing the subjectivity associated with plan evaluation.

The tools proved successful in increasing normal tissue sparing, providing effective quality control of the VMAT plan for Prostate cancer patients.

References

V. Hernandez, C.R. Hansen, L. Widesott, A. Bäck, R. Canters, M. Fusella, *et al.* What is plan quality in radiotherapy? The importance of evaluating dose metrics, complexity, and robustness of treatment plans *Radiother Oncol*, 153 (2020), pp. 26-33