

incontinence and mucus loss in the rectum mapping. For the IG-IMRT patients only mucus loss was significant in the anus mapping, while both mucus loss and proctitis were significant in the rectum mapping. Results for proctitis are illustrated for 3D-CRT (44% incidence) in the anus mapping (Fig. 1e,  $p=0.01$ ) and for IG-IMRT (27% incidence) in the rectum mapping (Fig. 1f,  $p<0.01$ ). Note that the largest dose differences are not necessarily most significant. In a region with large dose variations, random permutations can lead to large differences by chance. Figs. 1c and 1e indicate an effect of the extent of the intermediate dose region around the circumference of the anus. Figs. 1b and 1f show the effect of a longer intermediate dose region along the central axis.

**Conclusions:** Significant differences in the local dose to rectal and anal surfaces were found between patients with or without various GI toxicities. The locations of such differences provide clues about variables which are relevant to the clinical outcome, and which may serve as a basis for subsequent dose-effect modeling.

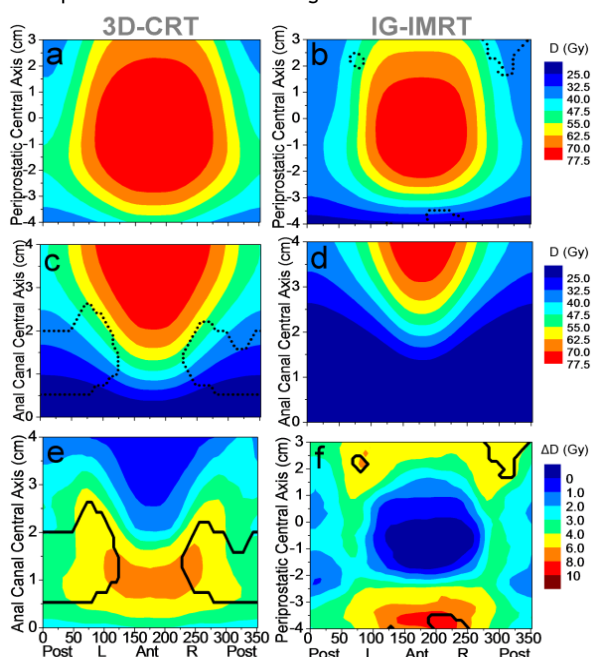


Fig. 1a,b) Mean rectum and c,d) anus dose maps: distance along central rectum axis (cm, vertical axis) vs. circumferential angle ( $^{\circ}$ , horizontal axis) e,f) Dose difference maps for proctitis. Contours indicate  $p=0.05$ .

#### OC-0257

##### NTCP models for acute dysphagia resulting from (chemo)radiotherapy for head and neck cancer

J.A. Dean<sup>1</sup>, K.H. Wong<sup>2</sup>, A.B. Jones<sup>2</sup>, K.J. Harrington<sup>2</sup>, C.M. Nutting<sup>2</sup>, S.L. Gulliford<sup>1</sup>

<sup>1</sup>The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, Joint Department of Physics, London, United Kingdom

<sup>2</sup>The Royal Marsden NHS Foundation Trust, Head and Neck Unit, London, United Kingdom

**Purpose/Objective:** Acute dysphagia is a common toxicity, associated with (chemo)radiotherapy for head and neck cancer, with substantial quality of life implications. 'Late' dysphagia is thought to result predominantly as a consequence of acute toxicity and associated interventions. There are currently limited dose-response data on radiation-induced acute dysphagia in the literature. The aim of this study was to train and validate NTCP models, providing

reliable tools to accurately predict the severity of acute dysphagia for individual patients.

**Materials and Methods:** Predictive models of moderate or worse (Common Terminology Criteria for Adverse Events grade 2 or 3) and severe (grade 3) acute dysphagia were trained using data from six clinical trials featuring a range of primary disease sites and treatment techniques. Toxicity outcome was defined as the peak grade of toxicity, which was scored weekly throughout radiotherapy and up to 4 weeks post-treatment and additionally at 8 weeks post-treatment. 266 patients were included in the analysis after excluding patients with two or more consecutive missing toxicity measurements. Pharyngeal mucosa dose-volume parameters, concomitant treatment and clinical factors were considered as model covariates. Logistic regression was used for classification. Lasso- and ridge-regularisation, class-weighting and cross-validated grid search were employed. The models were validated internally (with nested 5-fold stratified shuffle split cross-validation) and externally (on independent data) to measure their performance, using area under the receiver operating characteristic curve as the performance metric.

**Results:** Figure 1 summarises the dose-volume data.

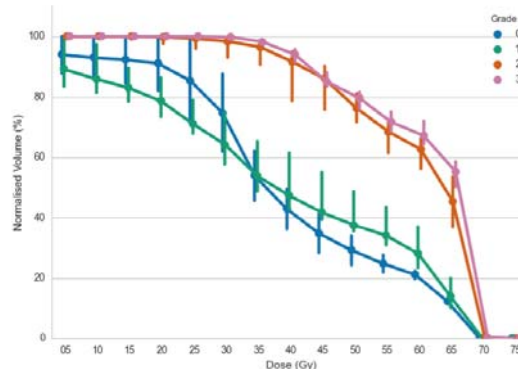


Figure 1: Summary of dose-volume histograms, grouped by peak dysphagia grade. The lines show the group medians and the error bars indicate the 95% confidence intervals.

Model diagnostics using learning curves showed that the severe dysphagia model was under-fitting the data. It was thought that this might be due to insufficient characterisation of concurrent chemotherapy. The model was retrained using 115 patients who did not receive concurrent chemotherapy. Table 1 shows the internal and external validation scores.

NTCP model	Internal validation (Mean $\pm$ standard deviation)	External validation
Moderate or worse dysphagia	0.89 $\pm$ 0.07	0.82
Severe dysphagia	0.63 $\pm$ 0.07	0.71
Severe dysphagia (Radiotherapy only patients)	0.67 $\pm$ 0.09	0.70

Table 1: Model performances.

The models contained a range of dosimetric and other variables, with V45 and concurrent chemotherapy having the highest regression coefficients for the moderate or worse and severe dysphagia models, respectively.

**Conclusions:** A high performance NTCP model, capable of accurately predicting moderate or worse acute dysphagia for individual patients, has been trained and validated. It can also be used for informed comparisons of dose distributions and treatment strategies. The performance of the severe dysphagia model did not improve when trained on radiotherapy only patients, suggesting that additional