fx) to the non-involved prostate. Planning constraints used were based on institutional procedures as well as from the FLAME trial, with small modifications in the boost plans. The dose distributions (with/without boost) were used to calculate the TCP and NTCP values for each patient. The TCP model used apparent diffusion coefficient maps to estimate cell densities while the NTCP models used were the conventional Lyman model for the rectum (late rectal bleeding grade $>= 2$; Rad. Onc., 73, 21-32, 2004) and the Poisson LQ model for the bladder (contracture; Ägren PhD thesis, 1995).

### Results:
The TCP increased from a median (range) of 0.45 (0.08-0.83) with the conventional approach to 1.0 (no range) with the focal boost. While there were only minor differences in the rectum NTCPs with vs. without the boost there were considerable differences in the NTCP for the bladder for two of the patients (more than a doubling of the NTCP with the boost; Table 1). These two patients had the index lesion that was closest to the bladder.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Rectum With boost</th>
<th>Rectum Without boost</th>
<th>Bladder With boost</th>
<th>Bladder Without boost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>1%</td>
<td>1%</td>
<td>12%</td>
<td>5%</td>
</tr>
<tr>
<td>Patient 2</td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>Patient 3</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Patient 4</td>
<td>1%</td>
<td>2%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Patient 5</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>Patient 6</td>
<td>2%</td>
<td>2%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>Patient 7</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

The DSS is comprised of two distinct models. The TCP model was found to be well calibrated with good discriminative ability. Training resulted in an adjusted weighted R2 value of 0.76, a weighted mean absolute residual (wMAR) of 4.7% and an area under the curve (AUC) of 0.67 [0.65, 0.69]. Validation resulted in an adjusted weighted R2 value of 0.51, a wMAR of 2.0% and an AUC of 0.57 [0.51, 0.63]. Contrastingly, the PML model was found to be poorly calibrated with good discriminative ability. Training resulted in an adjusted weighted R2 value of 0.76, a wMAR of 8.3% and an AUC of 0.66 [0.64, 0.68]. Validation resulted in an adjusted weighted R2 value of 0.27, a wMAR of 16.2% and an AUC of 0.66 [0.64, 0.72] with a wMAR of 1.0%.

**Conclusion:** A DSS developed with MAD has been validated in CCD extracted using RLHC infrastructure. The DSS uses standard clinical features to estimate with good accuracy the tumour control probability model (TCP) and a predictive machine learning model (PML): primary tumour stage (T), lymph node stage (N), metastasis stage (M), prostate specific antigen (PSA), Gleason score (GS), clinical-target-volume (CTV), total dose (D), and fractional dose (d). These features were selected as they are typically known within all clinics treating PCa patients, thus maximising the generalizability of the DSS.

**Purpose or Objective:** This study presents a universally applicable decision support system (DSS), with respect to the prediction of five-year biological no evidence of disease (SybNED) for localised prostate cancer (PCa) patients treated by external beam radiation therapy (EBRT).

**Material and Methods:** To develop a DSS this study utilised the traditional approach of model training based upon meta-analysis data (MAD; n=5218) from the literature with model validation based upon routine clinical care data (CCD; n=827) from clinics with a rapid learning healthcare (RLHC) environment. The following standard clinical features for PCa patients were investigated to train and validate a tumour control probability model (TCP) and a predictive machine learning model (PML): primary tumour stage (T), lymph node stage (N), metastasis stage (M), prostate specific antigen (PSA), Gleason score (GS), clinical-target-volume (CTV), total dose (D), and fractional dose (d). These features were selected as they are typically known within all clinics treating PCa patients, thus maximising the generalizability of the DSS.

**Results:** The DSS is comprised of two distinct models. The TCP model was found to be well calibrated with good discriminative ability. Training resulted in an adjusted weighted R2 value of 0.76, a weighted mean absolute residual (wMAR) of 4.7% and an area under the curve (AUC) of 0.67 [0.65, 0.69]. Validation resulted in an adjusted weighted R2 value of 0.51, a wMAR of 2.0% and an AUC of 0.57 [0.51, 0.63]. Contrastingly, the PML model was found to be poorly calibrated with good discriminative ability. Training resulted in an adjusted weighted R2 value of 0.76, a wMAR of 8.3% and an AUC of 0.66 [0.64, 0.68]. Validation resulted in an adjusted weighted R2 value of 0.27, a wMAR of 16.2% and an AUC of 0.66 [0.64, 0.72] with a wMAR of 1.0%.

**Conclusion:** A DSS developed with MAD has been validated in CCD extracted using RLHC infrastructure. The DSS uses standard clinical features to estimate with good accuracy (wMAR < 4.7%) and reasonable fidelity (AUC > 0.61) the SybNED rate and classification, respectively, of PCa patients. The performance of the DSS in the validation high-risk PCa cohort (wMAR = 1%) and patients (AUC = 0.66) for whom therapy could be potentially adapted or individualised based on the DSS has clinical relevance and should be prospectively validated.

**EP-1727**

**Dose individualisation through biologically-based treatment planning for prostate cancer patients**

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**Purpose or Objective:** The use of biological information on tumour control and normal-tissue complications for treatment plan optimisation can be used for individualising the dose prescription. For patients with prostate cancer, moreover, the tumour localisation by means of MR-images facilitates the use of such information for a simultaneous dose escalation in the so-called dominant intraprostatic lesions (DIL), thus further improving the treatment outcomes. However, a correct modelling of the tumour-control
probability depends on the accuracy of the alpha-beta ratio for prostate cancer, the value of which is still a matter of discussion in the scientific community. Therefore various scenarios should be investigated for understanding the limits of the biologically-based dose escalation to the tumour during prostate radiotherapy.

Material and Methods: This work investigates the potential and limits of biologically-based treatment planning for ten prostate-cancer patients with localised disease in the case of alpha-beta-ratios of 1.5 Gy, 3 Gy, and 4.5 Gy, respectively. The MR images of these patients were used for contouring the intraprostatic lesion as GTV and were matched with the CT images in EclipseTM. Biologically-based 7-fields IMRT plans were optimised by minimising the NTCP for rectal bleeding and bladder contracture and by maximising the TCP for the GTV. For all patients, the dose prescription for the PTV (whole prostate) was 72 Gy in 40 fractions.

Results: The results of this plan-comparison study show that the individual GTV dose coverage depends on the alpha-beta ratio for prostate cancer, while the calculated dose distribution (in particular the mean dose values and the D3%) for rectum and bladder are not influenced by this parameter. Also, the total dose to the GTV could be individually optimised and varied between 76 Gy and 87 Gy, depending on the position of the DIL within the prostate. Finally, the optimised total dose to the GTV increased when modelling the TCP with a lower alpha-beta ratio, with individual differences up to 3 Gy.

Conclusion: Biologically-based optimisation tools allow for individualised dose escalation in dominant intraprostatic lesions and, in principle, could be safely used for the treatment planning of prostate cancer. In fact, a variation of the alpha-beta ratio for prostate cancer between 1.5 Gy and 4.5 Gy causes a variation of the dose coverage of the GTV of up to about 3 Gy in total, thus showing an acceptable robustness of the TCP model with respect to this parameter. Biologically-based optimisation tools, finally, have the advantage of reducing optimisation time, contouring process, and dose hot spots. Studies are currently being carried out in order to further validate the TCP and NTCP models for prostate cancer treatment in the case of hypofractionated schedules.

Electronic Poster: Physics track: Intra-fraction motion management

EP-1729
The impact of CBCT-imaging and verification time on prostate motion using 4D TPUS Clarity system
P.P.E. Pang1, K. Knight1, M. Baird3, H.S.A. Boo1, M.Q.J. Loh1, W.S.J. Chan1, S.N. Aryan1, K.L.J. Tuan1
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Purpose or Objective: Accuracy of radiotherapy to the prostate is often challenged by geometrical uncertainties due to inherent organ motion attributed to daily variations of the bladder and rectal volumes and contents. This study aims to simulate the use of 4D Clarity ultrasound image guidance without CBCT imaging to analyse the magnitude and trend of prostate motion during treatment (74Gy given in 37 fractions). The impact of CBCT imaging and verification time on prostate motion will be analysed.

Results: Mean (median) imaging and overall treatment time was 4.6min (4.4 min) and 8.4min (8.3 min) respectively. Mean (median) prostate motion during overall treatment time was 0.72mm (0.6mm) Inf, 1.0mm (0.9mm) Post and 0.1mm (0.2mm) Lt respectively. Mean prostate motion without CBCT was 0.6mm (0.5mm) Inf, 0.9mm (0.8mm) Post and 0.1mm (0.1mm) Lt. Figure 1 demonstrates the observed prostate displacement over time in a single session from one of the patients. In general, the mean (median) maximum prostate drift during actual treatment alone tends to trend towards the following directions at 3.6mm (3.4mm) Inf, 7.4mm (5.2mm) Ant and 2.7mm (2.8mm) Lt. Magnitude of the median maximum prostate displacement increased relatively by 38.4%, 16.7% and 46.6% in the Inf, Ant and Lt directions respectively with added imaging time.

Conclusion: Prolonged overall treatment time due to CBCT imaging and verification time increases the intra-fraction prostate motion. We propose the use of 4D Clarity TPUS in place of TPUS with CBCT to reduce imaging time before radiotherapy to reduced total verification time leading to reduced prostate movement. Consequently, the magnitude of intra-fraction prostate motion could be reduced from reduced image acquisition and reconstruction time. This reduces the total in room time per patient and maximises patient throughput and treatment efficiency which is important in a busy radiotherapy centre.

EP-1730
Clinical evaluation of new approach for determining ITV target volume in NSCLC treated with 4D SABR
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3Xiaoshan Hospital of Zhejiang, Radiological Physics, Hangzhou, China
Purpose or Objective: To investigate the Geometric difference between six different ITVx delineation methods from 4D-CT for patients with Non Small Cell Lung Cancer (NSCLC) treated with Stereotactic Ablative Radiotherapy (SABR) technique.

Material and Methods: Between December 2013 and March 2014, 46 patients who underwent SABR were included in this retrospective study. All patients underwent imaging acquisition with 4D-CT scans, The tumour motion range, volume, marching index (MI) and encompassment index (EI) of ITV10, 11-