Conclusion
Tumor shape and position of esophageal cancer patients significantly vary on a daily basis. However, for the fast majority of fractions 5-mm PTV margins suffice when online MR guided setup correction are applied, enabling safe and efficient throughput MRI linac treatments for the majority of patients. Target coverage can be increased, but go along with an increased number of fractions that require online replanning. In both scenarios special attention should still be addressed to potential intrafraction tumor drifts.

OC-0084 Baseline shifts towards the heart after IGRT are linked to overall survival in lung SABR patients

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Purpose or Objective
A recent study showed that in a cohort of NSCLC patients treated with standard fractionation, small residual set-up errors that move the high dose region towards the heart following image-guidance have a significant effect on overall survival. As SABR patients are setup daily matching to the tumour itself, baseline shifts of the tumour may influence the unintended irradiation of the heart and mediastinum. This study investigates the association of baseline shifts with survival in a SABR cohort.

Material and Methods
136 NSCLC SABR patients treated with a daily soft tissue matching, 2mm action threshold, online CBCT IGRT protocol were studied. The mean shift of the high dose region in the direction of the heart due to baseline shifts was determined for each patient by performing a bony-anatomy match starting from the final soft tissue match position recorded during delivery for each fraction (taking bony anatomy as a surrogate for heart location), averaging this value over all fractions, and then projecting the resulting vector in the direction of the heart. This 'heart-baseline shift' was then used to categorise the patients into high and low risk groups based upon the median value. Correlations of this parameter with common clinical variables was tested. Kaplan-Meier survival curves were used to compare patients with baseline shifts towards/away from the heart, and the significance was determined through multivariable Cox regression, correcting for patient age, performance status, GTV volume and existing comorbidities.

Results
The heart-baseline shifts had a median value of -0.5mm (range -9.0 – 8.6mm) and were independent of all tested clinical variables. Yet this parameter was significantly associated with survival, with patients with baseline shifts towards the heart having significantly worse prognosis as compared to cases with shifts away (Figure 1). Multivariable analysis found a hazard ratio of 1.261 per mm (p = 0.002) for the baseline shift, when analysed as a continuous variable (Table 1).

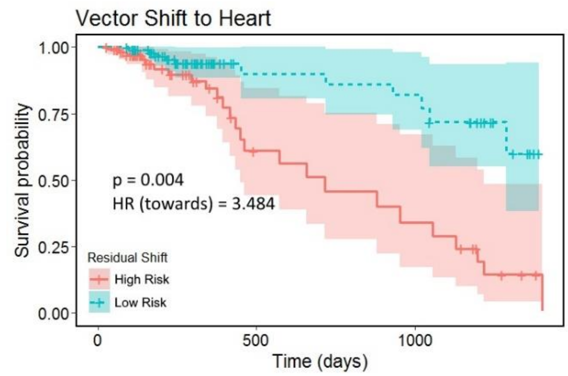

Figure 1: Multivariable Cox regression survival curves, stratified on the median baseline shift towards or away from the heart (-0.5mm) to ensure equal group sizes. High risk patients (those > -0.5mm, meaning that the majority of shifts will move the high dose region towards the heart) have worse overall survival (p=0.004). The HR gives the hazard of death for high risk patients as compared to low risk patients.

Variable	p-value	Hazard ratio (95% CI)
Vector shift to the heart (per mm)	0.002	1.261 (1.086 – 1.466)
ECOG-PS	0.322	3.367 (0.305 – 37.207)
Age	0.130	1.035 (0.989 – 1.083)
ln(GTV)	<0.001	2.139 (1.376 – 3.324)
Comorbidity score	0.306	3.261 (0.339 – 31.364)

Table 1: Multivariate Cox regression results with shift to the heart as a continuous variable.

Conclusion
Baseline shifts of the tumour towards the heart (thereby increasing the heart dose) during SABR significantly correlate with poorer overall survival in this cohort of early stage NSCLC patients. Such increase in dose to the heart appears to have an early effect on survival. These results provide evidence that stricter heart dose constraints are required when planning thoracic SABR. Furthermore, a PRV around the heart may be required to limit the effects of unavoidable baseline shifts.

OC-0085 Correcting CBCT images for dose calculation using a U-shaped deep convolutional neural network

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Purpose or Objective
Radiotherapy (RT) dose calculations on daily cone beam computed tomography (CBCT) images may eventually allow online-adaptive workflows with current state of the art linac technology. Image correction is crucial when using CBCT for dose calculation; and for online-adaptive RT the corrections should be fast in addition to providing accurate dose calculation. This study evaluated three different deep learning based correction strategies using a U-shaped convolutional neural network architecture (Unet) in terms of their photon and proton dose calculation accuracy.

Material and Methods
For training, CT to CBCT deformable image registration (DIR) was performed for 42 prostate cancer patients. This