Background
Rapid dose fall-off in the normal tissues surrounding a lung SBRT target is critical to avoid significant toxicity. This study aims to explore the relationship between tumor dose prescription and steepness of dose gradient for lung SBRT plans.

Methods
This study is based on 20 4DCT simulation scans of patients with stage I non-small cell lung cancer, previously treated by SBRT to 60 Gy in 5 fractions. For each simulation CT, three plans, each consisting of 11 beams (9 equally-spaced beams with entry over the ipsilateral hemithorax + 2 non-coplanar beams), were generated for static-gantry IMRT delivery technique. The prescribed dose (PD) was consistent with the clinically delivered plan, with 95% of the PTV exposed to 60 Gy. We varied stipulations for dose heterogeneity within the target (homogenous plans - maximum dose approximating 120% of PD; moderately heterogeneous plans - maximum dose approximating 135% of PD, and extremely heterogeneous plans - maximum dose approximating 150% of PD). For each of the 60 plans, the mean distance per 10% change in isodose from the 100% to 50% isodose line was calculated.

Results
We found that increasing target dose heterogeneity related to steeper dose gradients. The mean maximum dose was:

- 121.5 6.5% of PD for the homogeneous plans
- 137.3 6.3% of PD for the moderately heterogeneous plans
- 156.4 5.9% of PD for the extremely heterogeneous plans

The mean distance per 10% change in isodose line was:

- 2.71 0.3 mm in homogeneous plans
- 2.64 0.3 mm in moderately heterogeneous plans
- 2.59 0.3 mm in extremely heterogeneous plans
- p < 0.001 for all comparisons

Figure 1. Representative examples comparing 50% and 100% isodose lines for a homogenous plan (purple volume, max dose of 115% of PD) and an extremely heterogenous plan (orange volume, max dose of 148% of PD) for the same patient. The ITV is contoured in red.

Conclusions
Heterogeneous dose prescription for lung SBRT achieved steeper dose gradients outside the target volume. This benefit may further improve the already low SBRT-related complication rates, and the inherent increase in Equivalent Uniform Dose (EUD) may yield advantages with respect to local tumor control.

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