

An audit of adaptive radiotherapy in a large centre

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Purpose

All patients considered to exceed on-treatment imaging tolerances are referred to physics for assessment against the original plan objectives. If the original objectives are not met the patient is rescanned and replanned.

This audit was undertaken to assess the extent to which replans were necessary by tumour site. The intention is to inform and prioritise future adaptive workflows ensuring that resources and research is focussed on the tumour sites where it is most required.

Method

- A retrospective audit of all queries requiring physics input in 2016 were analysed.
- These were categorised according to the nature of the request with cone beam CT (CBCT) related queries further divided into 4 categories;
 - anatomical change,
 - moves/shifts
 - bolus position verification
 - other CBCT related queries.
- These were then split according to tumour site.
- A further retrospective analysis over 4 years of the Pinnacle 9.10 (Philips Radiation Oncology, Andover, USA) plan files was undertaken to investigate which sites required repeated planning.
- The data was analysed using an in-house python script to separate the plans by treatment site and whether they had been re-planned.

- For each site the percentage of replans is shown in Figure 2. This varies site by site with bladder patients most frequently requiring plan adaptation with 4.3% needing a replan, while 2.6% of lung patients require a replan.
- The proportion through treatment at which a replan was required is shown in Figure 3 and the reason is shown in Figure 4.

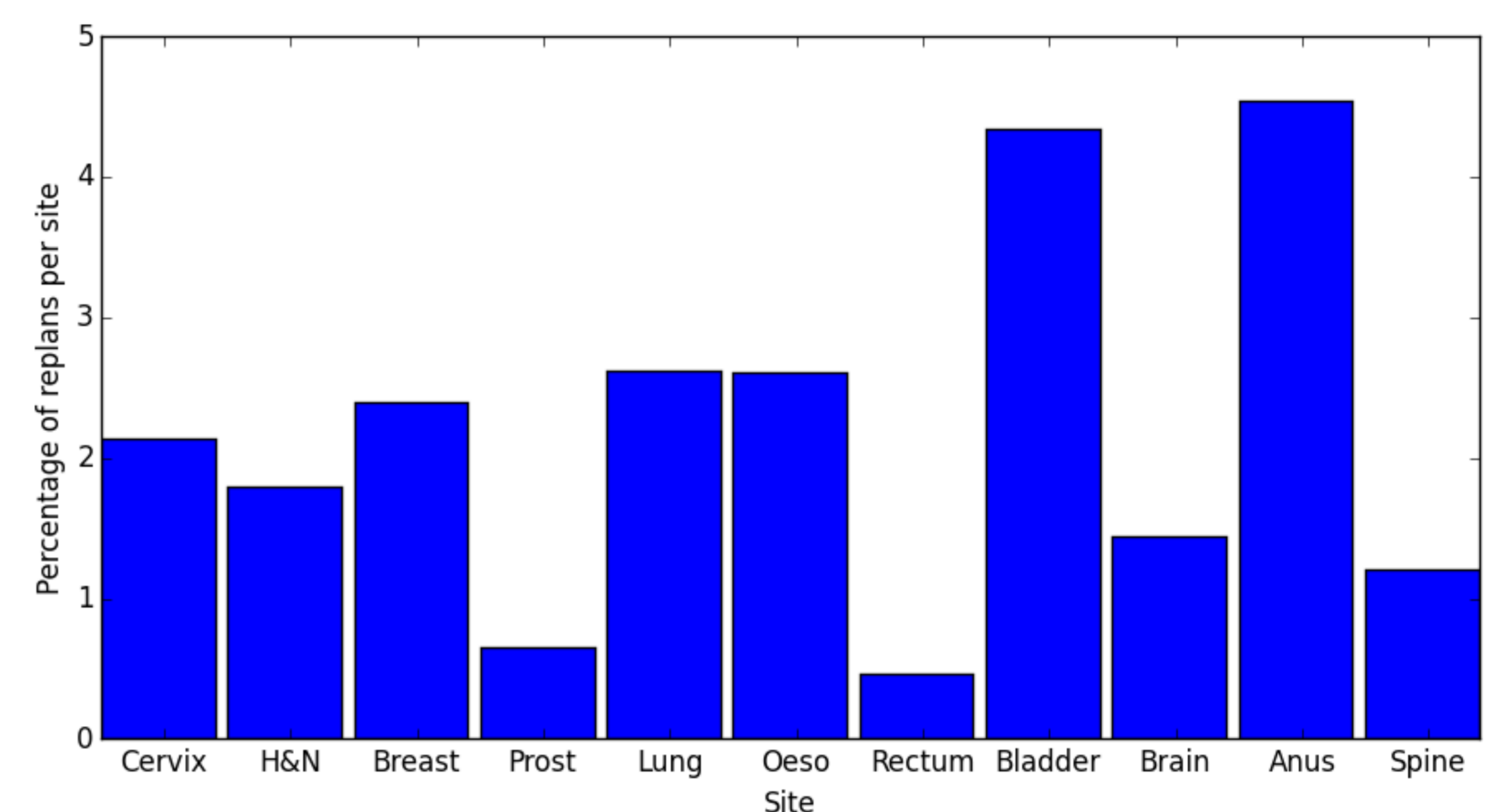


Figure 2: The percentage of initial plans that require a replan by site

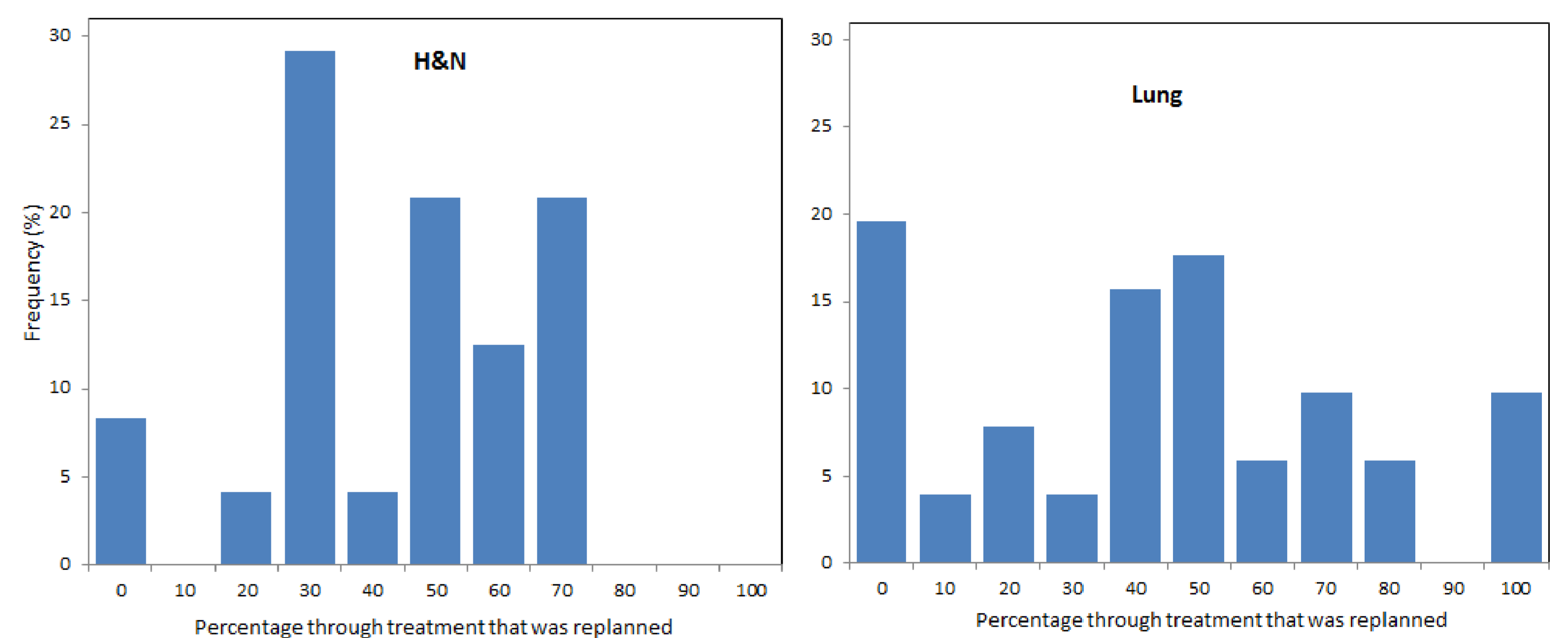


Figure 3: Histogram showing the percentage through the entire treatment that a replan was created.

Results

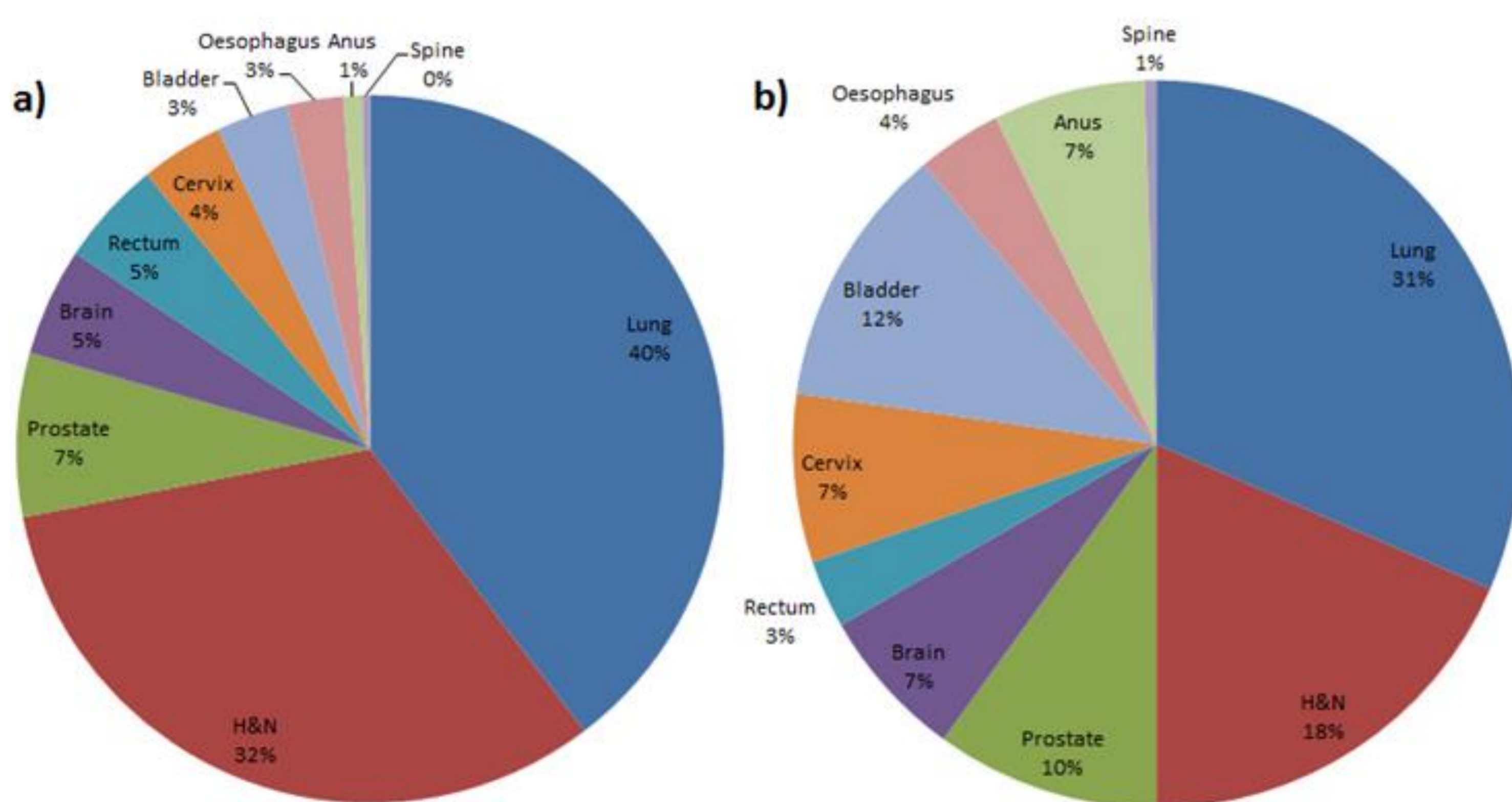


Figure 1: a) The percentage of patients requiring physics CBCT review by site and b) the percentage of patients that had a replan by site.

- In 2016 physics review was requested on 3,840 occasions out of ~110,000 fractions treated in that period.
- Of these requests 43.5% were for CBCT review. Within this group anatomical change was the main reason for the CBCT review (54.1%).
- Lung was the dominant tumour site requiring review: 39.2% of CBCT reviews overall and 41.5% of CBCT reviews related to anatomical change (see Figure 1 (a)). This was followed by head and neck tumours (31.9% and 31% respectively). In the majority of these a plan evaluation was done using the CBCT scan with HU overrides.
- The results of the 4 year analysis of Pinnacle plans (excluding breast) shows that overall 1.9% of all patients were replanned. The percentage of replans per site is shown in Figure 1 (b).

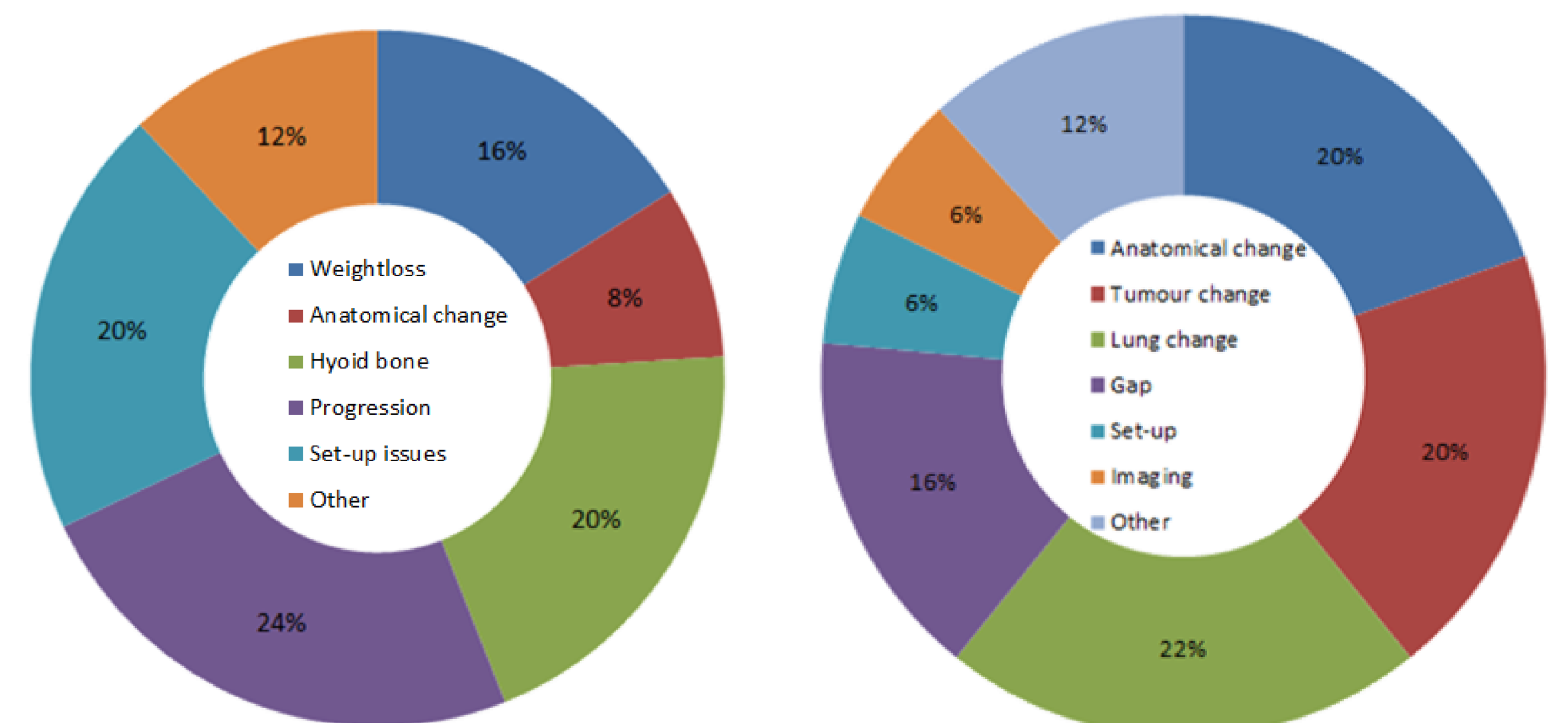


Figure 4: Reason for replanning for H&N (left) and Lung patients (right).

Conclusion

- This audit demonstrates that:
 - Lung patients require adaptive assessments on CBCTs in ~40% of cases due to tumour and anatomical changes. However only ~30% of all replans are lung patients.
 - Similarly H&N patients require CBCT adaptive assessments in 32% of cases but this only result in 18% of replans.
 - Our replan rate of 1.9% is in agreement with a previous study¹, showing that <5% of patients need a replan.
- This work will aid the development of improved IGRT protocols and the workflow design of new technology such as PBT and the MR-Linac.

Acknowledgements

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