

30 years of end-to-end dosimetry audits: The accuracy of advanced radiotherapy

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PURPOSE

The Radiation Quality Assurance Lab, including its IROC program in support of NCI clinical trials, monitor more than 2500 radiotherapy facilities worldwide. These programs exist to ensure accurate and consistent radiotherapy delivery, including supporting clinical practice as well as clinical trials. This study reviews the 30 year history of the anthropomorphic phantom program for advanced photon therapy.

METHODS

The RQALab offers anthropomorphic phantoms for institutions to perform end-to-end tests of the accuracy of their advanced radiotherapy. Phantoms are mailed to the institution where they are treated like a patient, including planning and delivery, and are returned to the RQALab for analysis. Several types of phantoms exist (Fig 1) that test SRS (a), IMRT (b,d), motion management (c), SBRT (e), multi-target delivery (f) and TBI (g). Institutions may perform this audit as an internal quality assurance test, or may be required to perform this test to participate in clinical trials (e.g., for IROC as part of NCI trials). Passing criteria typically require the dose to be within 5-7% and 3-4mm, and are established in collaboration with the NCI's clinical trial network.

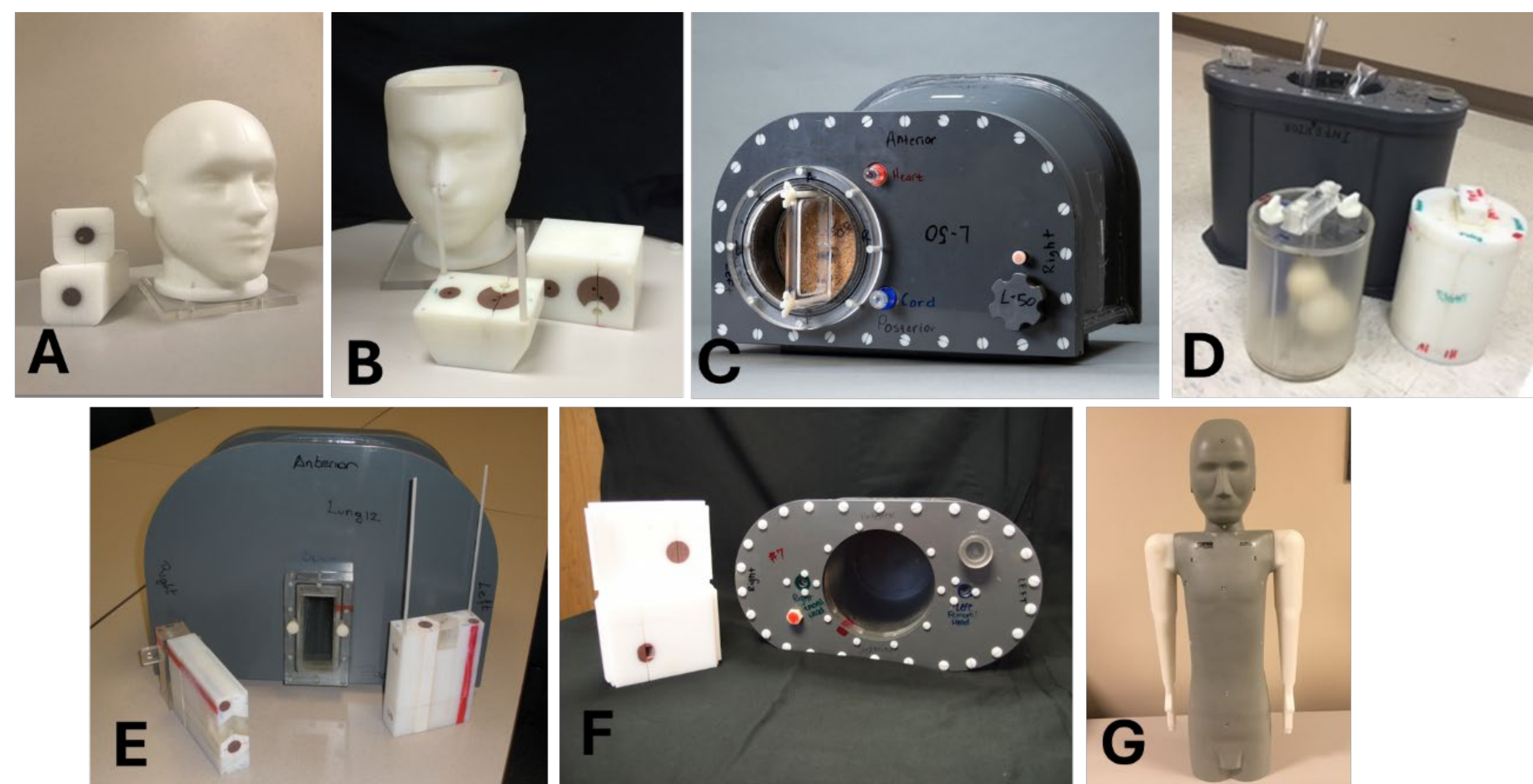


Fig1. Phantoms from the RQALab: (a) SRS, (b) IMRT H&N, (c) moving lung, (d) IMRT prostate, (e) SBRT spine, (f) liver, (g) pediatric TBI

RESULTS

A total of 9,774 photon phantoms have been irradiated since 1996, most frequently the IMRT H&N phantom (3,429), moving lung phantom (2,788), and SRS phantom (1,898). Overall, the average pass rate is 86.5%, with the highest pass rate seen for the IMRT H&N phantom (89%) and the lowest pass rate seen for the moving multi-target liver phantom (73%). Cumulative pass rates are shown in Figure 2. Overall, pass rates have significantly increased with time, which is particularly noteworthy because treatments have gotten more complex over this time period. TLD point dose agreement and gamma agreement ranges for each phantom type are shown in Figure 3. Differences are seen for different phantoms because of the different complexities inherent in the treatment delivery.

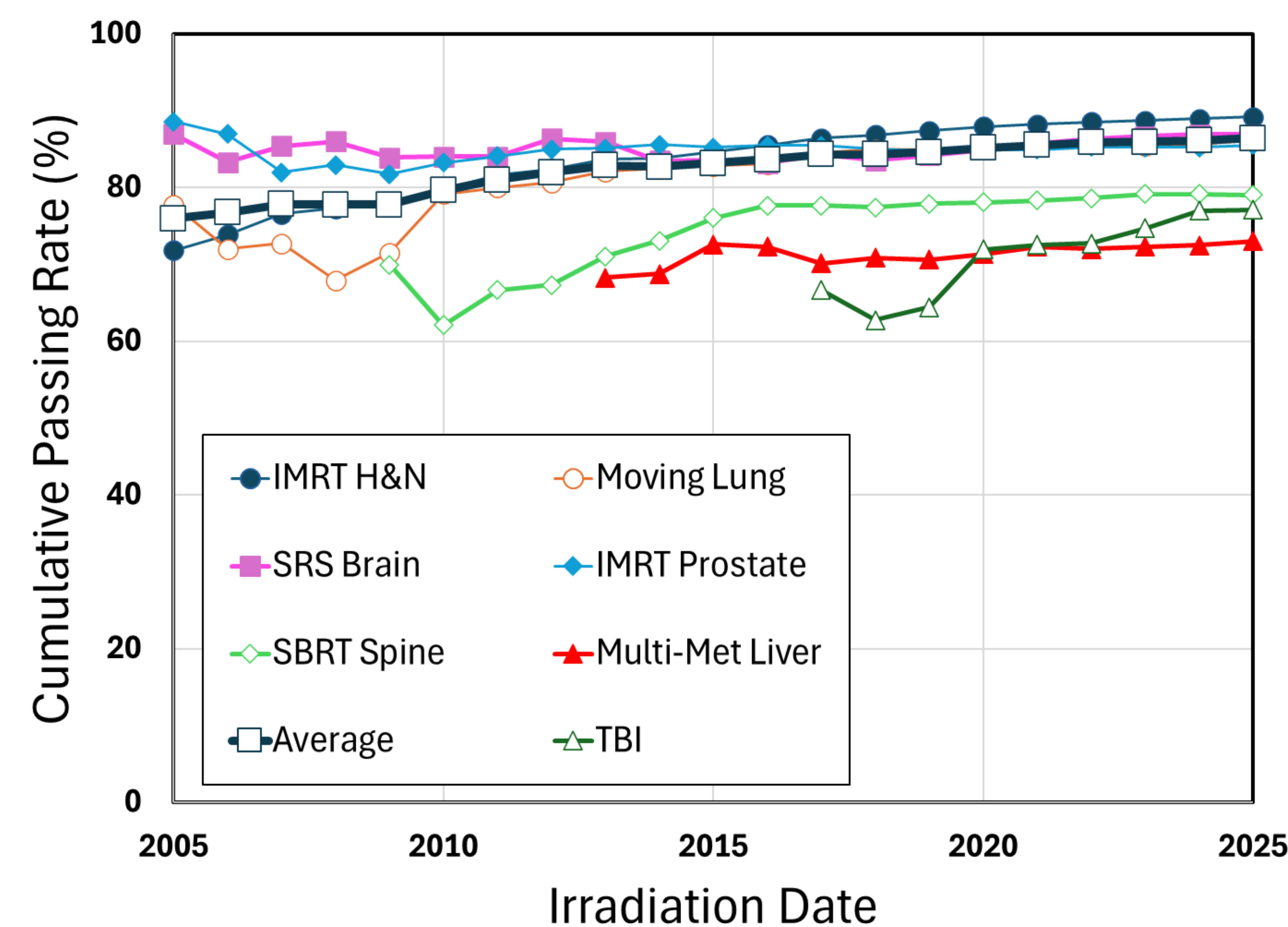


Fig2. Cumulative pass rate of the various RQALab phantoms

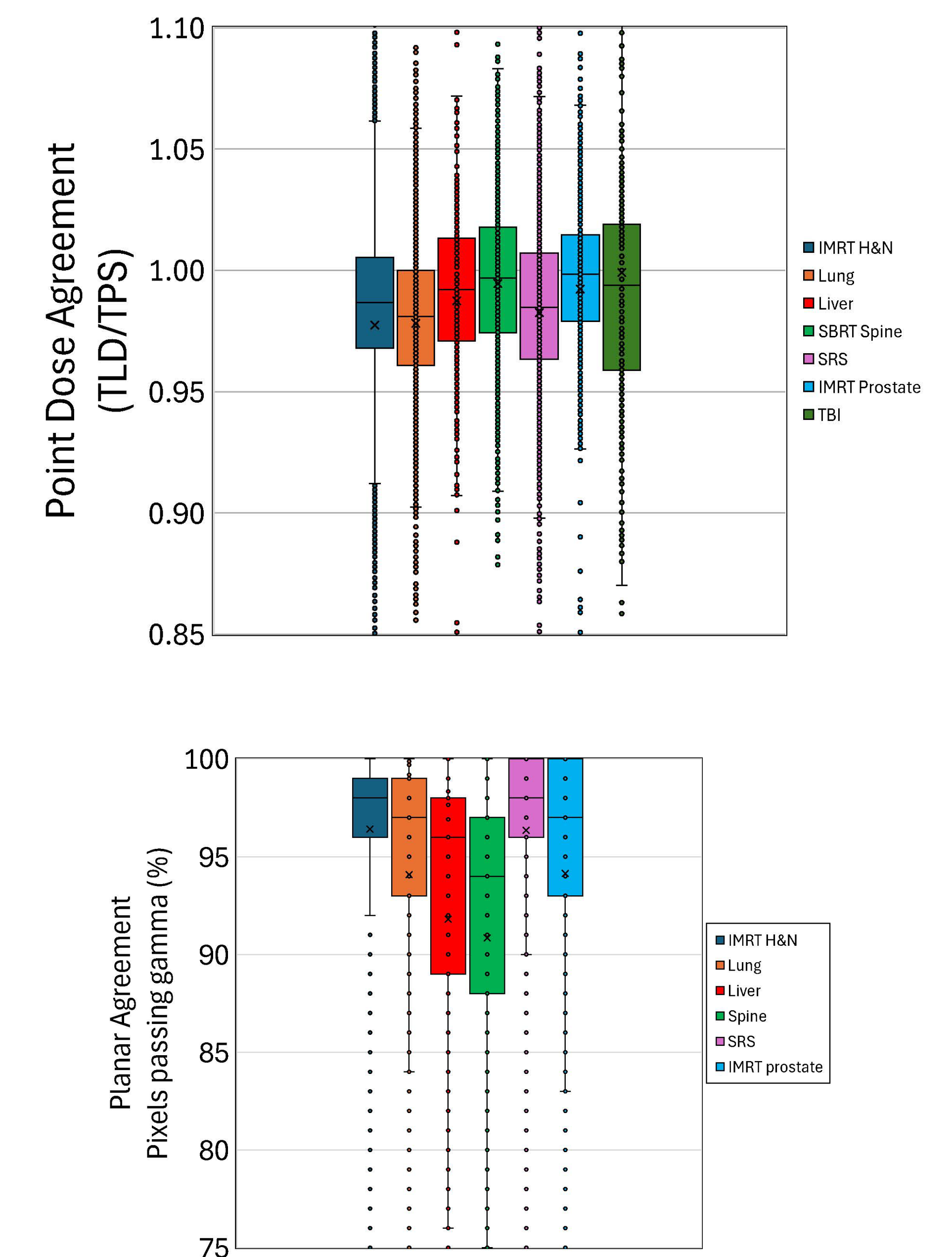


Fig 3. Total TLD point dose agreement (top) and gamma agreement (bottom) for each phantom type.

CONCLUSION

This broad evaluation of community practice highlights the progress being made in the face of increasingly complex radiotherapy. However, as the phantom program continues to highlight shortcomings, it also serves as a reminder that constant effort and attention are required to provide the high-level care required by radiotherapy patients.