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Comprehensive Analysis of Single Institution, Patient-Specific IMPT QA Data Across 18 Disease Sites

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INTRODUCTION

- Patient-specific quality assurance (PSQA) is an essential part of radiation therapy, ensuring that planned treatments are delivered with utmost accuracy
- A periodic review of PSQA data allows the clinic to assess treatment planning and QA practices
- This review can then inform changes in clinical procedures to improve practice and clinical efficacy

AIM

To perform a two-year review of PSQA across 18 disease sites treated with intensity modulated proton therapy (IMPT)

METHODS

- A two-year retrospective analysis of 776 patients and 5,919 PSQA measurements across 18 disease sites was performed with data spanning from January 2024 to December 2025
- PSQA is collected using a Matrixx 2D ion chamber array in water or solid water with 1 or more measurements per treatment field.
- PSQA data is analyzed via myQA software for reporting
- Gamma index (3%/3mm criterion) was retrieved and analyzed for all PSQA measurements
- The gamma minimum, gamma mean, interquartile range (IQR), and site count were computed for each treatment site
- The gantry in which PSQA was completed was also recorded and analyzed from August to December 2025
- Depth of measurement was also collected and analyzed, but is not presented due to low/no association with gamma pass rate

RESULTS

- The distribution statistics support high PSQA accuracy, with the Gamma IQR and overall mean exceeding 98.4% (Table 1)
- The P(Bed)+LN, H&N, and Brain disease sites are responsible for ~51% of all PSQA measurements (Fig 1)
- Greatest increase in mean gamma between years for a disease site was ~0.9% improvement for anal (Fig 2)
- Maximum variation in mean gamma between treatment rooms per disease site was ~2.5% for liver (Fig 3)

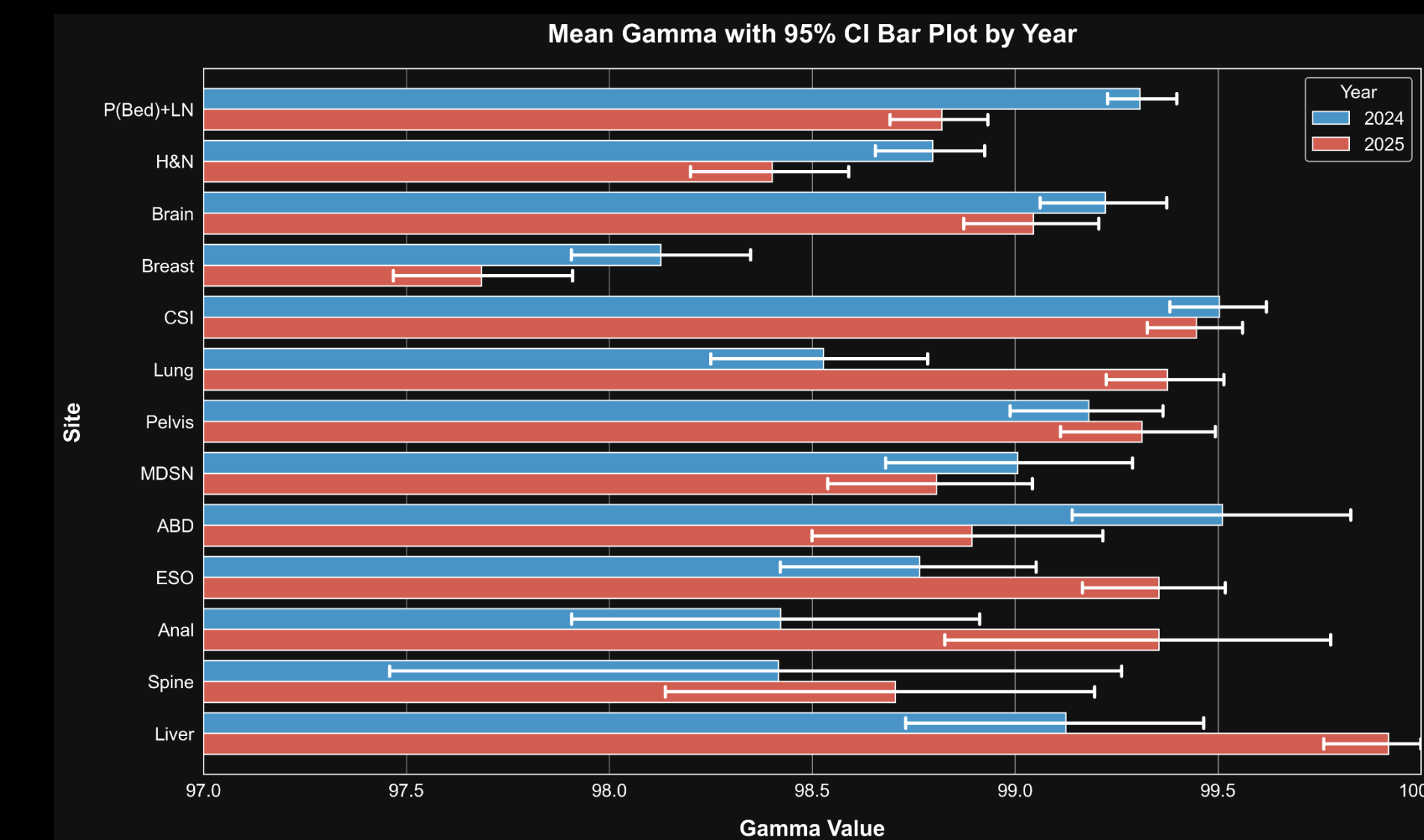


Figure 2: Bar plot displaying the mean gamma recorded per site per year under a 95% confidence interval (CI) with a 0.05 p-value for high Volume sites

Metric	Values
Total Patients	776
Total Measurements	5,919
Minimum Gamma	>90.3% (100%)
Mean Gamma	98.9%
Gamma Range (IQR)	98.4%-100.0%

Table 1: Overall summary of two-year PSQA gamma data

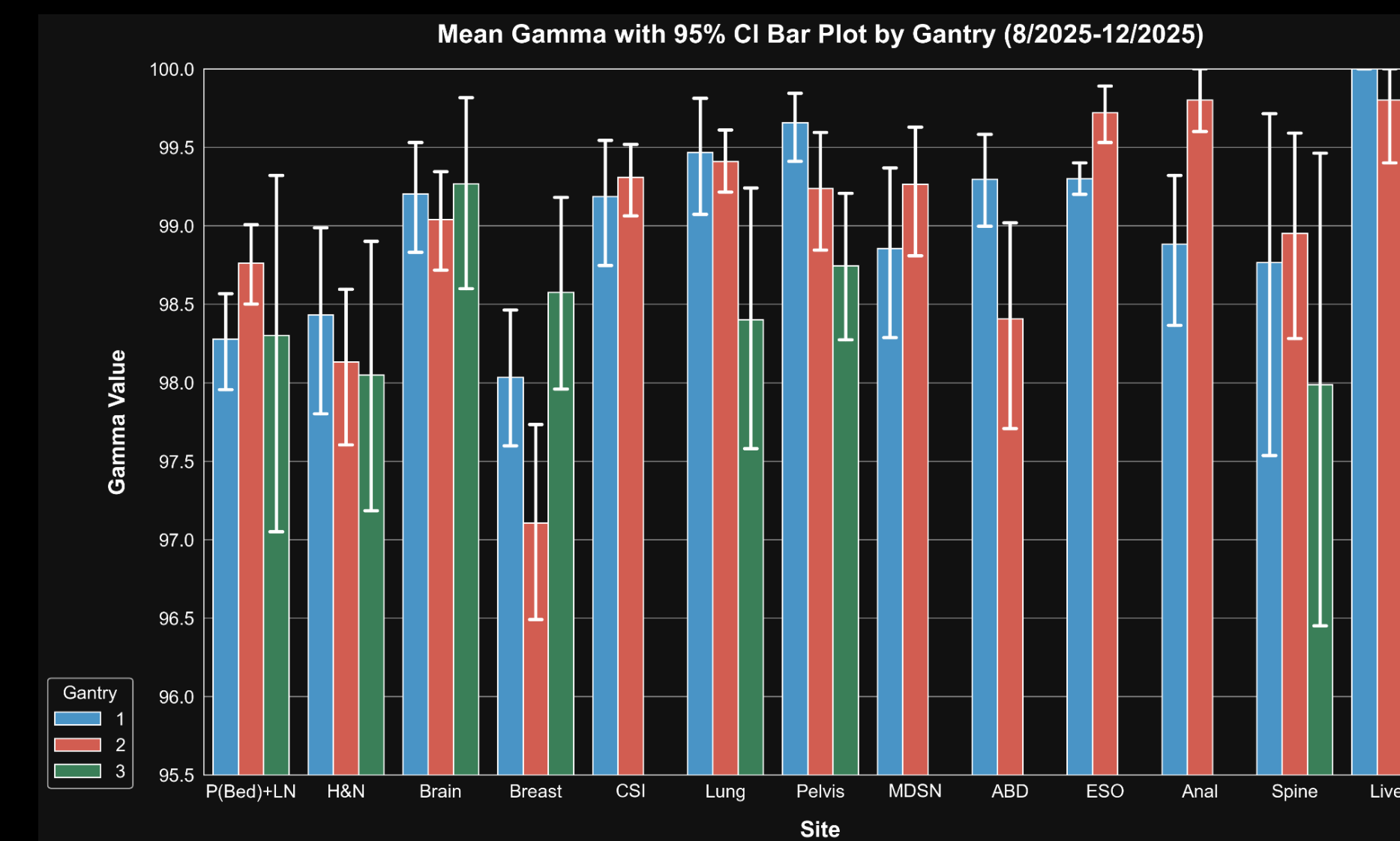


Figure 3: Bar plot displaying the mean gamma recorded per site per measurement gantry under a 95% CI with a 0.05 p-value for high Volume sites

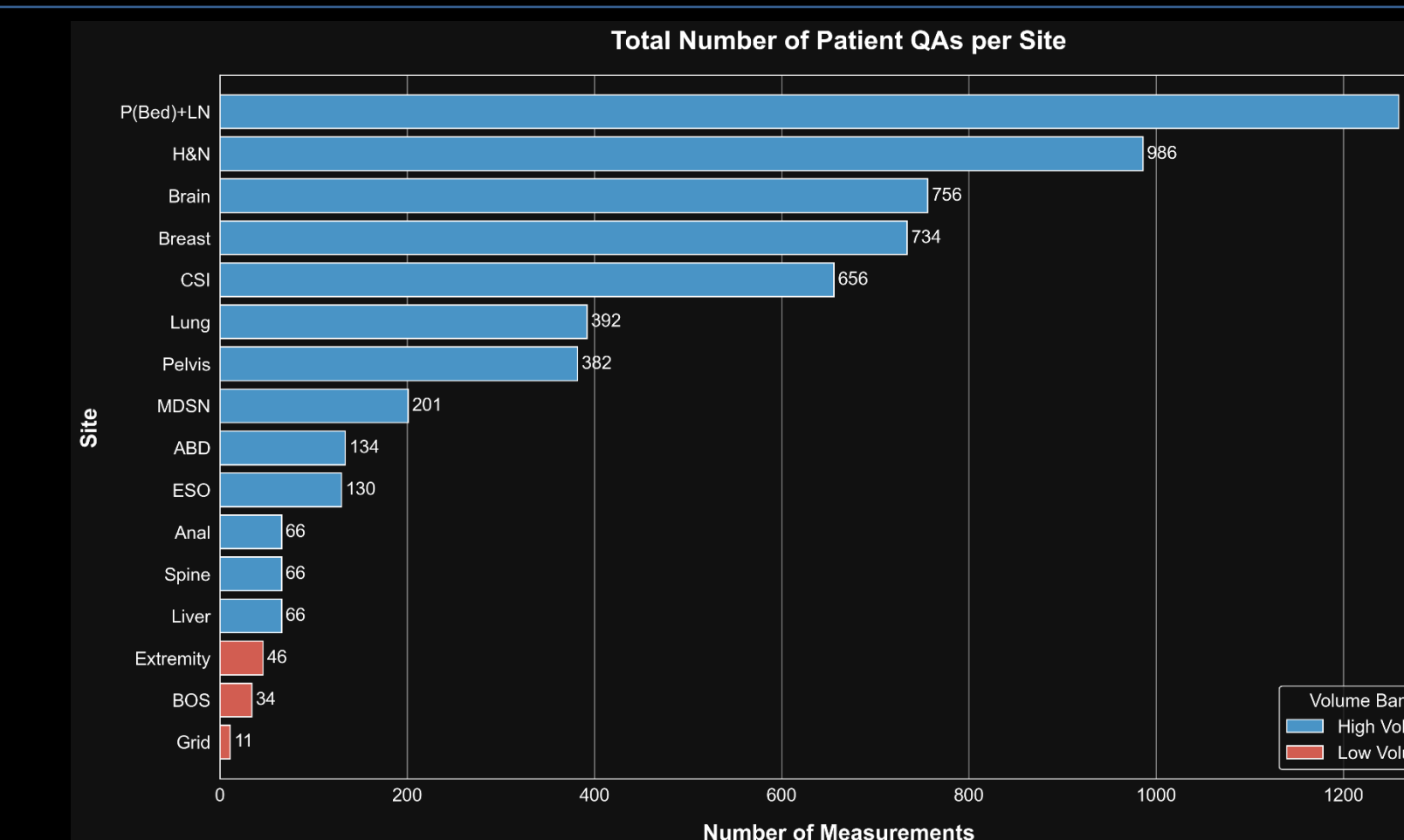


Figure 1: Distribution of PSQA measurements by disease site

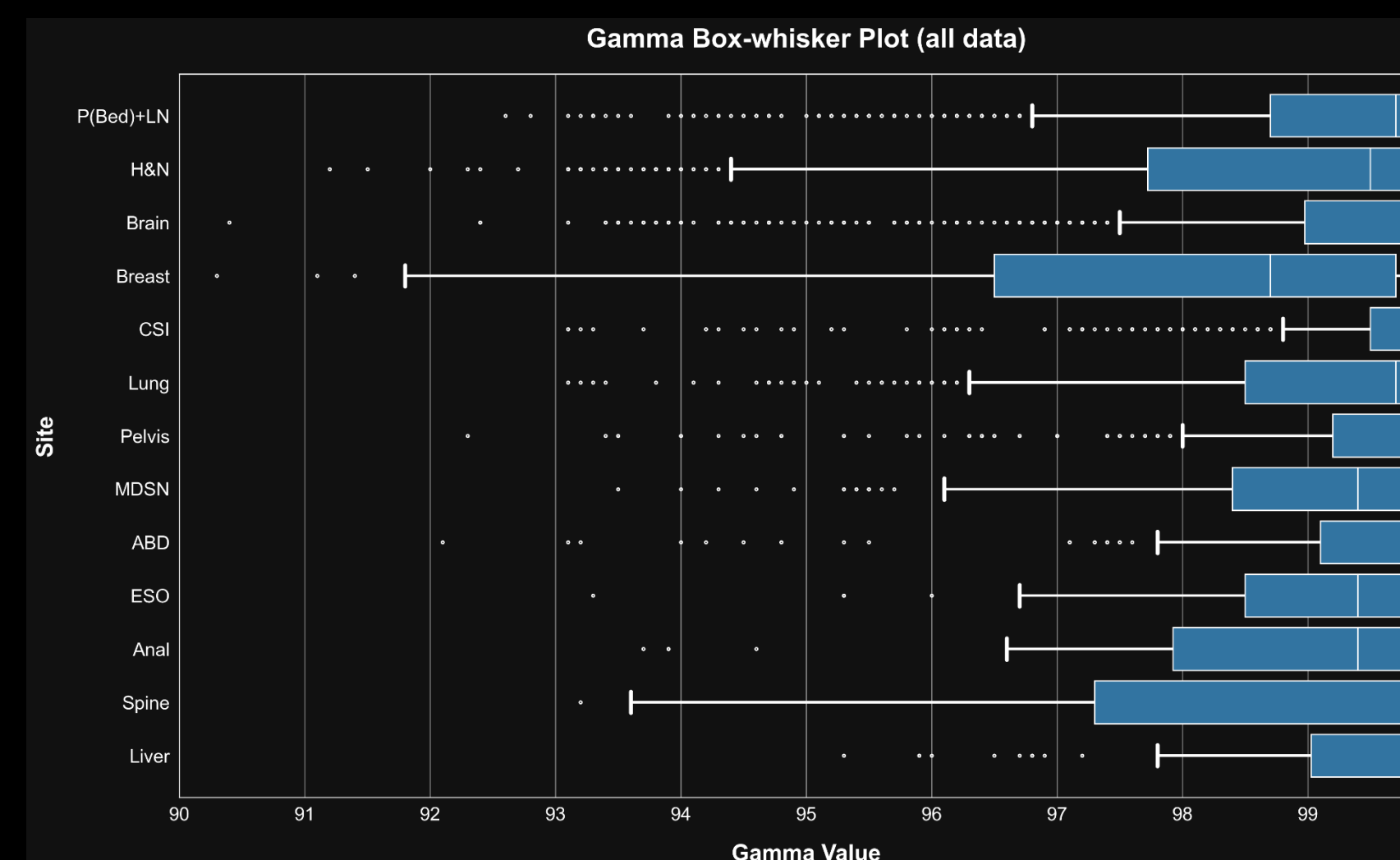


Figure 4: PSQA data displaying IQR and outliers for each site for high Volume sites

CONCLUSIONS

- This two-year retrospective PSQA analysis demonstrates consistent PSQA performance across 18 distinct treatment sites
- The mean of Gamma (3%/3mm) of 98.9% over the two-year period exceeds AAPM TG-224's recommendations
- Few than 0.42% PSQA below 93% highlights the importance of strong treatment planning standards and machine QA program (Fig 4)
- These findings provide benchmarking data for multi-site proton therapy programs and new centers join in proton therapy
- The Gamma IQR of 98.4-100% supports integration of log based QA and streamlining of PSQA practices

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