

Standardisation in digital records can enable enhanced analysis techniques

In the current digital age, data from measurements are collected routinely for a wide range of applications.

Standardised digital records can improve data access and quality, and is crucial for complex areas such as healthcare, particularly in areas related to clinical decision making, such as **radiotherapy**.

Curating data in structured tables can enable **meta-analysis** which may reveal previously unknown patterns, clusters or correlations improving our understanding of the data, measurements, and their application domains.

Data collected from hospital audits and meta-analysis performed

We use **retrospective data** curated from a range of advanced Stereotactic Body Radiotherapy (SBRT) **dosimetry audits** targeted at the lungs, conducted at hospitals across the UK to examine audit performance.

We compare the **dose predicted** by each hospital's treatment planning system (TPS) and the **measured dose** in dosimeters placed in a test object.

Data is categorised by the TPS used, allowing a **comparison** of audited TPS between systems and hospitals.

Comparison highlights hospitals needing further investigation

Figure 1 shows the difference in measured dose versus that predicted by the TPS for all hospital audits. This analysis provides hospitals with a **quantitative comparison** between sites using similar equipment and systems.

From these data:

- different treatment planning systems are **comparable**, showing similar variability across all systems.
- hospitals and auditors can highlight instances where audits have highly **repeatable measurements**; have highly **variable measurements** (black dashed box); or have **small differences** between measured and predicted values (orange solid box).

This information may inform areas of focus that are tailored to a given hospital, such as focusing on **accuracy** or **precision**, or both.

This can also enable auditors and regulators to provide additional services or recommendations, set suitable **tolerances** for future audits, and potentially identify **previously unknown patterns** in the data.

highly variable measurements

outside the 95% confidence interval

small differences between measured and predicted values

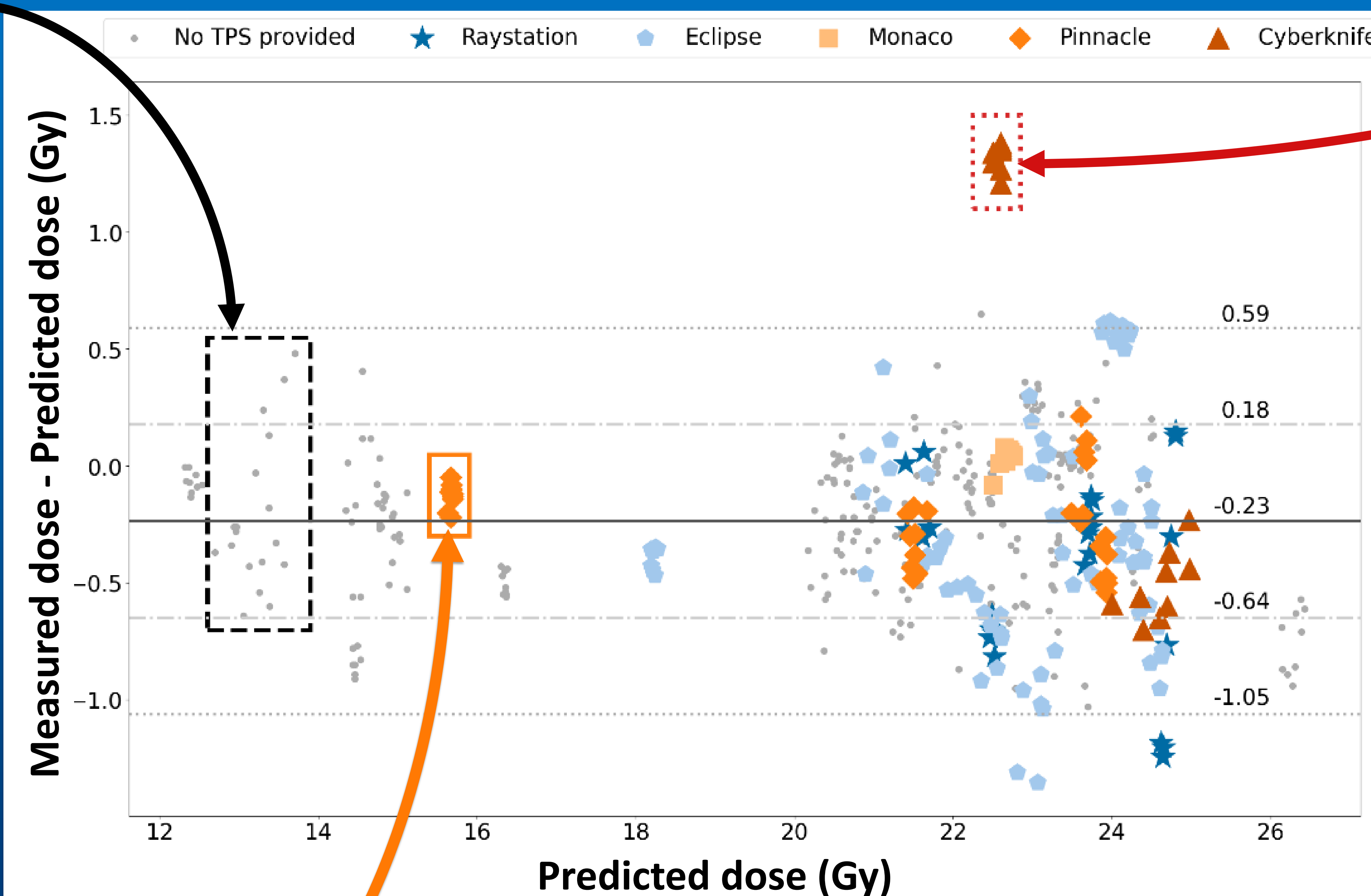


Figure 1: Comparison plot of the lung SBRT measured and predicted dose values. Each point is one of the measurements from an audit of a hospital (49 audits, 435 measurements).

The mean (solid black line), and one (dot-dashed grey lines) and two standard deviations (dotted grey lines) either side of the mean are shown, allowing the easy identification of outliers.

Coloured symbols highlight different TPS used, allowing comparison with similar set-ups.

Boxes highlight measurements from specific hospitals showing low precision (black dashed), low accuracy (red dotted) and high precision and accuracy (orange solid) measurements.

Statistical analysis reveals outliers and underlying distributions in the data

Audit measurements **outside the 95 % confidence interval** (red dotted box) may be easily flagged by an auditor and a follow-up audit scheduled. Where hospitals' measurements can be improved, auditors can assist with training in **good measurement technique**, as well as help develop new and improved **protocols**.

We also identify a large proportion of **missing TPS data** and the requirement for **standardised data collection**.