Feasibility of using brain MRI quantitative analyses for evaluating scanner quality in a multi-site institution

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PURPOSE

- The ACR MRI Accreditation program mandates phantom tests to ensure baseline image quality
- However, real-world scans may uncover clinical quality issues not detectable by phantom testing.
- We investigate the feasibility of a complementary method using real world brain MRI scans to compare scanner performance in a multi-scanner, multi-site institution.

METHODS

- Quality assessment software, quality**metrix**, was developed to evaluate slice thickness, slice gap, in-plane resolution, field-of-view, brain coverage, scan angle, and relevant contrast-to-noise ratios (CNR) against a reference dataset of 20,000 scans acquired from a variety of magnets globally.
- CNR between white matter and gray matter was independently assessed for T1-w and T2-FLAIR images, and between FLAIR white matter hyperintensities and white matter for T2-FLAIR images.
- A single CNR was computed for each sequence, and normalized from 0-1 based on the range of values in the reference dataset.
- The figures to the right display the highest and lowest average total CNR scores for FLAIR and T1 sequences from independent scanners.

DATA

4682 scans including T1-w and T2-FLAIR were collected between 2022 and 2024

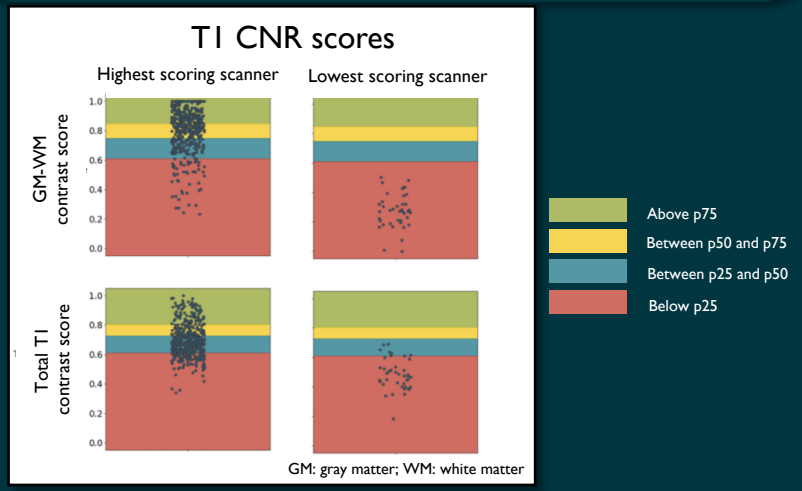
15 magnets from 10 sites across a large geographical area were included

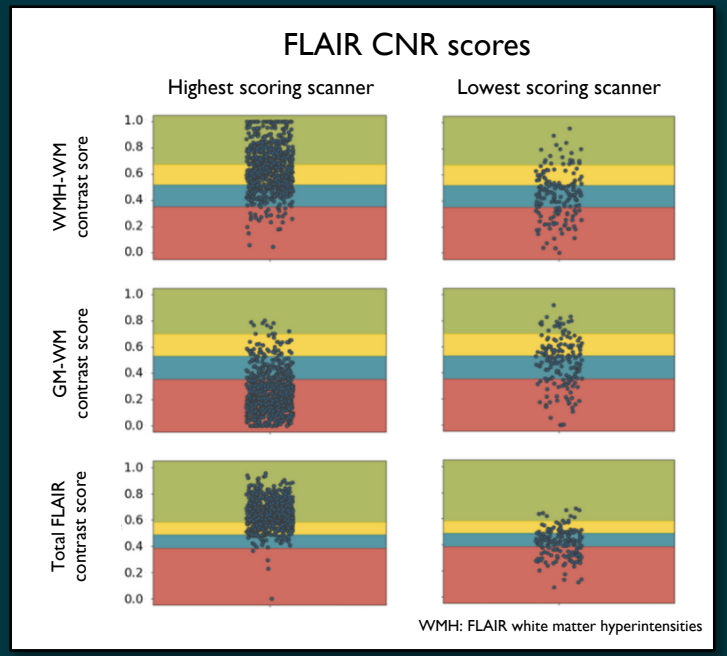
1.5 T and 3.0 T scanners from three major MRI manufacturers were included

RESULTS

IQR: inter-quartile range; p25 = 25th percentile; p75: 75th percentile

	CNR average image quality range	CNR IQR relative to reference data
T2-FLAIR	0.41 to 0.66	p25 = 0.38, p75 = 0.58
T1-w	0.48 to 0.70	p25 = 0.61, p75 = 0.80





CONCLUSIONS

- This real-world approach complements phantom tests by revealing inter-scanner variability under routine clinical operation.
- Benchmarking against a global reference dataset enables cross-site comparisons and targeted interventions ensuring reliable quantitative volumetry in routine imaging.
- Scanners with consistently low scores are earmarked for QA / protocol review with corrective maintenance and targeted protocol improvements underway for each.